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ANESTHESIA & ANALGESIA IN NONHUMAN PRIMATES: A RESOURCE GUIDE

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Compiled by Elizabeth Tobey (Librarian), 2022**

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Cover photo: Coppery Titi Monkey with baby. Courtesy Adobe Stock Photos.

Introduction

Description: *Anesthesia and Analgesia in Nonhuman Primates: A Resource Guide* is a bibliography of biomedical and veterinary literature on the use of anesthesia and analgesia in primate species commonly used in laboratory research published between 2000 to 2021. It contains 570 citations. This bibliography updates *A reference source for analgesia & analgesics in animals* compiled by Dr. Richard L. Crawford (AWIC Series 2000-02) published in December 2000 and archived in the National Agricultural Library Digital Collections.

Dr. Crawford subdivided the previous bibliography into twenty sections organized by individual species or species groups. The bibliography covered most vertebrate and some invertebrate animals, including commonly-used laboratory species such as mice, rats, rabbits and other rodents, and primates. One section of the bibliography covered nonhuman primates. In the twenty years since Dr. Crawford published this bibliography, the number of publications on veterinary anesthesia and analgesia has increased greatly. Because of the large amount of literature, AWIC staff members decided to compile a series of bibliographies, each one covering a particular group of animals.

Scope: This guide covers peer-reviewed literature (articles in peer-reviewed journals, books, book chapters, and conference proceedings) on anesthesia and analgesia use in nonhuman primates published between 2000 and 2021. The following databases were searched:

- PubMed
- Web of Science (All Databases: Web of Science Core Collection as well as Biological Abstracts, BIOSIS Citation Index, Current Contents Connect, KCI-Korean Journal Database, Russian Science Citation Index, SciELO Citation Index, and Zoological Record)
- Scopus
- EBSCO platform databases (Agricola, CAB Abstracts, eBook Collection (EBSCOhost), Global Health, Zoological Record, Biological Abstracts, MEDLINE)

How to Use This Resource Guide

The sections within the bibliography are organized using two levels of headings: first by species/genera or group, and then by topic. You can navigate directly to a section using the hyperlinks in the Table of Contents.

Species Subheadings:

- **General Nonhuman Primates:** This section contains citations on anesthesia and analgesia in nonhuman primates. These citations address nonhuman primates in general or focus upon two or more species.
- **Baboons:** These citations concern nonhuman primates of the genus *Papio*.
- **Great Apes and Gibbons:** This section contains citations on anesthesia and analgesia for great apes in a laboratory, zoo, or wild setting. Species covered include chimpanzees

(*Pan troglodytes*) and bonobos (*Pan paniscus*). Gibbons (of the genus *Hylobates*) are also included, even though they are classified as lesser apes.

- **Macaques:** Macaques are used extensively as animal models in biomedical research in the United States and abroad.
- **Callitrichids:** Callitrichids are "New World" monkeys native to Central and South America belonging to the subfamily Callitrichinae. These include marmosets and tamarins.
- **Other Nonhuman Primates:** This section contains citations on anesthesia and analgesia for other nonhuman primates including capuchin monkeys, prosimians, African Green monkeys, squirrel monkeys, and Titi monkeys.

Citation Order: Citations are arranged in ascending order by the last name of the first author within each section of the bibliography.

Keywords: Each citation is followed by a series of selected 'Keywords' derived from the citation records of the database searched. This bibliography derives from multiple databases, so Keywords may vary in form since databases may use different controlled vocabularies and different indexing terms.

Finding Full-Text of Articles

You may check the National Agricultural Library's (NAL) online catalog, [AGRICOLA](#), to see which books and periodicals that the library has in its holdings. Some online periodicals in NAL's holdings are only available to USDA employees through the [Digitop](#) portal. Other articles are open access and may be downloaded for free. If you are not a USDA employee, check with your local or institutional library to see whether your library subscribes to these periodicals or can order them on interlibrary loan.

Information on how to request materials that are included in the National Agricultural Library (NAL)'s collections can be found on the [Request Library Materials](#) page. USDA employees can request books and articles through Document Delivery. All patrons are encouraged to explore local library resources first before contacting the National Agricultural Library. If you are not a USDA employee, you may visit the library during its hours of operation to request items from our circulation desk or read electronic articles on-site. You may also request items on interlibrary loan through your home library (check with your institutional, university, or public library's loan office for further information).

For more information: Contact the Animal Welfare Information Center at awic@usda.gov or visit our website at <https://www.nal.usda.gov/programs/awic>.

Acknowledgments:

AWIC would like to thank the following individuals for their help in completing this bibliography:

- Dr. Aisha Ellis (former Technical Information Specialist, AWIC) and Dr. Gwendalyn Maginnis (Nonhuman Primate Specialist Veterinary Medical Officer, Animal and Plant Health Inspection Service) for reviewing citations and answering technical questions about the bibliography.
- Daniel Klein, a graduate student in Animal Sciences at the University of Florida who regularized citation Keywords and made style and formatting corrections to the bibliography.

Disclaimer: *This research guide is for informational purposes only. If you are a researcher planning to use any of the anesthesia/analgesia drugs or methods mentioned in these citations on amphibians and reptiles, you should always consult a veterinarian.*

General Nonhuman Primates

This section contains citations on anesthesia and analgesia in nonhuman primates in general or focusing upon more than one species.

Anesthesia

Description: This section includes anesthesia protocols and citations on monitoring of vital signs during surgery for nonhuman primates, including general information applicable to all nonhuman primate species or to multiple species. It also includes citations that describe anesthesia protocols for a specific type of surgery (such as neurosurgery), for sedation/chemical restraint, or for diagnostic imaging (such as MRIs).

Results (26):

Alstrup, A. K. O., & Smith, D. F. (2013). Anaesthesia for positron emission tomography scanning of animal brains. *Laboratory Animals*, 47(1), 12–18.
<https://doi.org/10.1258/la.2012.011173>

Keywords: Anesthesia/methods/*veterinary; Anesthetics/*pharmacology; Blood Volume; Brain/blood supply/metabolism/*pathology; Laboratory Animal Science/methods; Neuroimaging/methods/veterinary; Positron-Emission Tomography/methods/*veterinary; Regional Blood Flow/drug effects; Synaptic Transmission/drug effects

Bee, W. H. (2001). Standardized electroretinography in primates: A non-invasive preclinical tool for predicting ocular side effects in humans. *Current Opinion in Drug Discovery and Development*, 4(1), 81–91. Scopus.

Keywords: anesthesia; animal experiment; animal model; controlled study; dark adaptation; Drug Evaluation, Preclinical; drug research; drug safety; electroretinogram; Electroretinography; Eye; eye toxicity; good laboratory practice; Haplorhini; ketamine; monkey; neurotoxicity; Non-

human primate; nonhuman; pentobarbital; prediction; Predictive Value of Tests; retina; review; Species Specificity; Standard for clinical electroretinography; Standard for non-clinical electroretinography

Bennett, A. J. (2003). Ketamine: The good, the bad, and the alternatives for physiological and behavioral data collection in nonhuman primates. *American Journal of Primatology*, 60(Supplement 1), 89–89.

Keywords: Anesthesia; ketamine

Bertrand, H. G. M. J., Sandersen, C., & Flecknell, P. A. (2018). Reported analgesic and anaesthetic administration to non-human primates undergoing experimental surgical procedure: 2010-2015. *Journal of Medical Primatology*, 47(4), 217–225. Scopus. <https://doi.org/10.1111/jmp.12346>

Keywords: althesin; analgesia; analgesic agent; anesthesia; anesthesiological procedure; anesthetic agent; Animal Surgery and Non-drug Therapy; Animal Welfare; Article; benzodiazepine; buprenorphine; carprofen; corticosteroid; dipyrone; disease classification; disease severity; experimental surgery; fentanyl; general anesthesia; inhalation anesthetic agent; intravenous anesthetic agent; isoflurane; ketamine; Laboratory Animal Science; Laws and Regulations; local anesthetic agent; macaque; midazolam; nonhuman; nonsteroidal inflammatory agent; opiate derivative; paracetamol; perioperative period; phenobarbital; practice guideline; priority journal; propofol; remifentanyl; steroid; surgery; surgical technique; systematic review; thiopental; tiletamine plus zolazepam; Veterinary Pharmacology and Anaesthesiology

Brash, M. G. I. (2008). Wild animal anaesthesia. (V. Roberts, Ed.). *British Veterinary Zoological Society. Proceedings of the Satellite Meeting 2008, 2nd April, 2008, ICC, Birmingham. How to cope with more odd species: fish, primates, macropods, wildlife case studies and wildlife capture and anaesthesia. ZOOREC:ZOOR14501008094; p. 32).*

Keywords: Anesthesia; wild animals.

Cital, S. J. (2013). Non-human primate anesthesia: A general overview. *NAVTA Journal*, August/September, 26–31. CAB Abstracts.

Keywords: adverse reactions; anesthesia; anesthetics; drug action; mechanism of drug action; primates; Veterinary Pharmacology and Anaesthesiology; Zoo Animals

De Benedictis, G. M., Fante, F., Bellini, L., Bortolami, E., Pilla, T., Dedja, A., Ravarotto, L., Ancona, E., Cozzi, E., & Busetto, R. (2007). Refinement strategies in the anaesthetic management of nonhuman primate xenotransplantation. *Xenotransplantation*, 14(5), 466–466.

Keywords: Anesthesia; nonhuman primates; xenotransplantation

Fahlman, A., Bosi, E. J., & Nyman, G. (2006). Reversible anesthesia of Southeast Asian primates with medetomidine, zolazepam, and tiletamine. *Journal of Zoo and Wildlife Medicine*, 37(4), 558–561. Zoological Record.

Keywords: Adrenergic alpha-Agonists/administration & dosage; Adrenergic alpha-Antagonists/administration & dosage; Anesthesia Recovery Period; Anesthetics, Combined/*administration & dosage/adverse effects; Animal Physiology and Biochemistry (Excluding Nutrition); APEC countries; ASEAN Countries; Asia; Cercopithecidae; Commonwealth of Nations; Developing Countries; Heart Rate/drug effects; Hylobates; Hylobates lar; Hylobates/*physiology; Hylobatidae; Imidazoles/administration & dosage; Macaca; Macaca fascicularis; Macaca fascicularis/*physiology; Macaca nemestrina; Macaca nemestrina/*physiology; Medetomidine/administration & dosage; Pongidae; Pongo; Pongo pygmaeus; Pongo pygmaeus/*physiology; Respiration/drug effects; South East Asia; Species Specificity; Threshold Countries; Tiletamine/administration & dosage; Time Factors; Veterinary Pharmacology and Anaesthesiology; Zolazepam/administration & dosage; Zoo Animals

Fish, R. E., Popilskis, S., Lee, D., & Elmore, D. (2008). Chapter 12—Anesthesia and Analgesia in Nonhuman Primates. In *Anesthesia and Analgesia in Laboratory Animals* (2nd ed, pp. 335–363). Elsevier/Academic Press.

Keywords: Analgesia; anesthesia; experimental surgery; postoperative care

Goldstein, P. A. (2018). Nonhuman primates in anesthesia research: Have we reached the end of the road? *Anesthesia and Analgesia*, 126(6), 2129–2134. Scopus. <https://doi.org/10.1213/ANE.0000000000002655>

Keywords: abnormal behavior; acquired immune deficiency syndrome; adverse outcome; anesthesia induction; anesthetic agent; Article; baboon; behavior; behavioral research; biomaterial; chimpanzee; cognition; comparative study; consciousness; distress syndrome; drug exposure; emotion; evidence based practice; genomics; gorilla; human development; in vitro study; inflammation; isoflurane; Lemuridae; long term care; Lorisidae; Macaca; medical ethics; medical research; mental health; monoclonal antibody; moral status; motor development; nerve cell differentiation; nervous system inflammation; neurobiology; neurotoxicity; orangutan; pain severity; pediatric anesthesia; postnatal care; primary prevention; priority journal; prosimian; prospective study; psychological well-being; rhesus monkey; sacrum; skin; social competence; social status; species differentiation; spinal anesthesia; systematic review (topic); tarsier

Hethcox, L. A., Calvert, C., Girkin, C. A., & Downs, J. C. C. (2014). The Effects of General Anesthesia on IOP in Nonhuman Primates (NHP). *Investigative Ophthalmology & Visual Science*, 55(13).

Keywords: Anesthesia; intraocular pressure

Horne, W. A. (2001). Primate anesthesia. *The Veterinary Clinics of North America. Exotic Animal Practice*, 4(1), 239–266, viii–ix. Scopus. [https://doi.org/10.1016/S1094-9194\(17\)30059-2](https://doi.org/10.1016/S1094-9194(17)30059-2)

Keywords: *Anesthetics; Anesthesia; Anesthesia/*veterinary; anesthetic agent; animal disease; Animals, Domestic; Animals, Domestic/*physiology; domestic animal; monitoring; Monitoring, Physiologic; Monitoring, Physiologic/veterinary; physiology; Preanesthetic Medication; Preanesthetic Medication/veterinary; premedication; Preoperative Care; Preoperative Care/veterinary; Primates/*physiology; review

Ishizawa, Y., Patel, S., Ahmed, O. J., Sierra-Mercado, D., & Brown, E. N. (2014). Differential neuronal dynamics in somatosensory versus higher-order cortices during recovery from propofol anesthesia in primates. *Anesthesia and Analgesia*, 118, S179–S179.

Keywords: Anesthesia; propofol

Jasien, J. V., Hethcox, L., Turner, D., Girkin, C. A., & Downs, J. C. C. (2016). Comparison of the Effects of Injectable and Inhalant Anesthesia on IOP in Nonhuman Primates as Measured with Continuous IOP Telemetry. *Investigative Ophthalmology & Visual Science*, 57(12).

Keywords: Anesthesia, injectable and inhalant; intraocular pressure; monitoring

Kelz, M. B., & Mashour, G. A. (2019). The Biology of General Anesthesia from Paramecium to Primate. *Current Biology*, 29(22), R1199–R1210. Scopus. <https://doi.org/10.1016/j.cub.2019.09.071>

Keywords: Anesthesia

Laboratory Animal Anaesthesia: Non-human Primates 1 / [compiled by Paul Flecknell]. (2003, January 1). [CD Rom]. University of Newcastle Upon Tyne (UK); Agricola. <https://search.ebscohost.com/login.aspx?direct=true&db=agr&AN=CAT31029284&site=ehost-live>

Keywords: Animal anesthesia -- Technique.; Primates as laboratory animals

Masters, N. (2008). Primate medicine & surgery in general practice. *British Veterinary Zoological Society. Proceedings of the Satellite Meeting 2008, 2nd April, 2008, ICC, Birmingham. How to cope with more odd species: fish, primates, macropods, wildlife case studies and wildlife capture and anaesthesia.* (V. Roberts, Ed.; ZOOREC:ZOOR14501008043; p. 20).

Keywords: Anesthesia; chemical restraint; wild animals

Mosley, C. A. (2017). Anesthesia Equipment. In *Veterinary Anesthesia and Analgesia: The Fifth Edition of Lumb and Jones* (pp. 23–85). Wiley; Scopus. <https://doi.org/10.1002/9781119421375.ch3>

Keywords: Anesthesia equipment; Endotracheal tube; Laryngeal mask airways; Nasotracheal intubation; Orotracheal intubation; Retrograde intubation; Supraglottic airway devices; Tracheostomy; Wire- or tube-guided techniques

Murphy, K. L., Baxter, M. G., & Flecknell, P. A. (2012). Chapter 17—Anesthesia and Analgesia in Nonhuman Primates. In C. R. Abee, K. Mansfield, S. Tardif, & T. Morris (Eds.), *Nonhuman Primates in Biomedical Research (Second Edition)* (pp. 403–435). American College of Laboratory Animal Medicine. Academic Press.
<https://doi.org/10.1016/B978-0-12-381365-7.00017-0>

Keywords: Anesthesia; anesthetic depth; analgesia; body temperature; cardiac arrest; deep sedation; endotracheal intubation; fluid administration; general anesthesia; hemorrhage; hypotension; imaging; immobilization; injectable anesthesia; intraoperative monitoring; intravenous cannula placement; Ketamine; neuromuscular blocking agents; neurosurgery; obstetric anesthesia; oxygenation; pain assessment; pediatric anesthesia; preanesthetic drugs; postanesthetic care; respiratory depression and arrest; suggested anesthetic protocols; ventilation; volatile liquid and gas anesthetics.

Olberg, R.-A. (2007). Monkeys and Gibbons. In *Zoo Animal and Wildlife Immobilization and Anesthesia* (G. West, D. Heard, & N. Caulkett, Eds.; BCI:BCI201300567135; p. 386).

Keywords: Anesthesia; chemical restraint; gibbons; immobilization; monkeys; zoo animals

Olberg, R.-A., & Sinclair, M. (2014). Monkeys and Gibbons. In *Zoo Animal and Wildlife Immobilization and Anesthesia* (G. West, D. Heard, & N. Caulkett, Eds.; BCI:BCI201500234348; p. 571).

Keywords: Anesthesia; chemical restraint; gibbons; immobilization; monkeys; wild animals; zoo animals

Roe, A. W. (2007). Long-term optical imaging of intrinsic signals in anesthetized and awake monkeys. *Applied Optics*, 46(10), 1872–1880. <https://doi.org/10.1364/AO.46.001872>

Keywords: Anesthesia; behavioral studies; intrinsic signal imaging; neurological studies; optical imaging

Sloan, T., & Rogers, J. (2009). Dose and timing effect of etomidate on motor evoked potentials elicited by transcranial electric or magnetic stimulation in the monkey and baboon. *Journal of Clinical Monitoring and Computing*, 23(4), 253–261. Scopus.
<https://doi.org/10.1007/s10877-009-9190-z>

Keywords: Action Potentials; Amines; Amplification; amplitude modulation; Anesthesia; anesthesia induction; Anesthesiology; Anesthetics; Anesthetics, Intravenous; animal experiment; article; atropine; Baboon; Bioelectric potentials; Compound action potentials; controlled study; cortical electric motor evoked potential; cortical magnetic motor evoked potential; Cortical stimulation; Diffusers (optical); dose response; Dose-Response Relationship; Drug; drug

megadose; Electric Stimulation; Electrophysiology; Etomidate; evoked muscle response; Evoked Potentials, Motor; evoked somatosensory response; experimental monkey; Female; Haplorhini; Intravenous injections; isoflurane; Isoflurane; Ketamine; latent period; low drug dose; Magnetic stimulation; Magnetics; Monkey; Motor evoked potentials; Motors; muscle action potential; Muscle response; Muscles; nonhuman; Papio; priority journal; single drug dose; Somatosensory evoked potentials; Spinal cords; synaptic potential; Time Factors; Transcranial; transcranial magnetic stimulation

Unwin, S. (2005). Anaesthesia. *The Laboratory Primate*. [Handbook of Experimental Animals.]. (S. Wolfe-Coote, Ed.; ZOOREC:ZOOR14206039385; p. 292). <https://doi.org/10.1016/B978-012080261-6/50018-0>

Keywords: Anesthesia; laboratory animals

Ver Hoeve, J. N., Glatting, B., McIntyre, K. B., Christian, B. J., Nork, T. M., & Kim, C. B. Y. (2014). Gender Differences in Anesthetized Primate ERG and Full-field Flash VEP. *Investigative Ophthalmology & Visual Science*, 55(13).

Keywords: Anesthesia; gender differences; ophthalmology

Weston-Murphy, H. (2001). Primate handling and anesthesia. *Proceedings of the North American Veterinary Conference*, 15, 925–927. Agricola.

Keywords: Anesthesia; Primates; restraint of animals

Analgesia

Description: This section includes citations on the use of analgesic drugs in nonhuman primates to treat postoperative or other pain.

Results (10):

Coulter, C. A., Flecknell, P. A., & Richardson, C. A. (2009). Reported analgesic administration to rabbits, pigs, sheep, dogs and non-human primates undergoing experimental surgical procedures. *Laboratory Animals*, 43(3), 232–238. Scopus. <https://doi.org/10.1258/la.2008.008021>

Keywords: *Analgesics; *Animal Welfare; Analgesia; Analgesia/statistics & numerical data/*veterinary; analgesic agent; anesthetic agent; animal use refinement; Animal Welfare; animal well-being; Laboratory; Animals, Laboratory/*surgery; article; Canis familiaris; combination drug therapy; Dogs; drug therapy; experimental animal; frequency; general anesthetics; laboratory animals; local anesthetics; nerve block; nonhuman; Oryctolagus cuniculus; Ovis aries; Pain; Pain, Postoperative; Pain, Postoperative/prevention & control/*veterinary; Rabbits; Refinement; research programs; research projects; Rodentia; Sheep;

skin incision; Species comparison; species differences; Species Specificity; Suidae; Surgery; Surgery, Veterinary; Surgery, Veterinary/*methods; surgical technique; Swine; veterinary drugs

Ding, H., Cami-Kobeci, G., Husbands, S., & Ko, M. (2015). Bifunctional MOP/NOP receptor agonist, BU10038, as a strong and safe analgesic in monkeys. *Journal of Pain*, 16(4), S59–S59. <https://doi.org/10.1016/j.jpain.2015.01.250>

Keywords: Analgesics

Ding, H., Hayashida, K., Suto, T., Sukhtankar, D. D., Kimura, M., Mendenhall, V., & Ko, M. C. (2015). Supraspinal actions of nociceptin/orphanin FQ, morphine and substance P in regulating pain and itch in non-human primates. *British Journal of Pharmacology*, 172(13), 3302–3312. <https://doi.org/10.1111/bph.13124>

Keywords: Analgesia; intrathecal administration; morphine; nociception/orphanin FQ peptide receptor agonists; pain management; pruritis

DiVincenti, L. J. (2013). Analgesic use in nonhuman primates undergoing neurosurgical procedures. *Journal of the American Association for Laboratory Animal Science : JAALAS*, 52(1), 10–16.

Keywords: Analgesia/methods/*veterinary; Analgesics/administration & dosage; Animal Welfare; Neurosurgical Procedures/*veterinary; Pain Management/veterinary; Pain, Postoperative/drug therapy/prevention & control/*veterinary; Primates/*surgery

Dykstra, L. (2007). Opioid analgesics: Mentors, monkeys and mice. *Drug and Alcohol Dependence*, 87(2–3), 316–320. <https://doi.org/10.1016/j.drugalcdep.2006.11.004>

Keywords: Alcohol abuse; analgesics; drug abuse; opioid analgesics; substance abuse

Murphy, H. W. (2008). Get a hand on your patient: Primate restraint and analgesia. In *Small animal and exotics. Proceedings of the North American Veterinary Conference, Volume 22, Orlando, Florida, USA, 2008*, pp. 1917–1919. CAB Abstracts. <https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20093019031&site=ehost-live>

Keywords: Anesthesia; anesthetics; exotic organisms; exotic species; introduced organisms; non-indigenous organisms; non-indigenous species; non-native organisms; non-native species; nonindigenous species; pain killers; vertebrates; Veterinary Pharmacology and Anaesthesiology; Zoo Animals

Paul-Murphy, J. (2001). Primate analgesia. *Proceedings of the North American Veterinary Conference*, 15, 913. Agricola.

Keywords: Analgesics

Vierboom, M. P. M., Breedveld, E., Keehnen, M., Klomp, R., & Bakker, J. (2017). Pain Relief in Nonhuman Primate Models of Arthritis. In B. Clausen & J. Laman (Eds.),

***Inflammation: Methods and Protocols* (BCI:BCI201700808735; Vol. 1559, pp. 411–417). https://doi.org/10.1007/978-1-4939-6786-5_28**

Keywords: Analgesia; analgesics; arthritis; collagen-induced arthritis; common marmosets; inflammation; pain relief; rhesus macaques; translational medicine

Wladischkin, K. A., Dysko, R. C., Collins, G. T., Ko, Y.-A., Winger, G., & Ko, M.-C. (2012). Pharmacological characterization of NOP receptor agonists as abuse-free and constipation-free analgesics in monkeys. *FASEB Journal*, 26.

Keywords: Analgesics; NOP receptor agonists; pharmacology

Adverse Effects

Description: The following citations address adverse effects of anesthetic or analgesic drugs on nonhuman primates. Most of these citations address effects of these drugs on neonatal nonhuman primates.

Results (18):

[Anonymous]. (2005). Comparison of the apoptotic effects of the anesthetic, ketamine, in developing rat and monkey forebrain cultures. *Birth Defects Research Part A-Clinical and Molecular Teratology*, 73(5), 302–302.

Keywords: Anesthetics; apoptosis; brain development; ketamine; neurotoxicity

Hansen, T. G., & Henneberg, S. W. (2010). Neurotoxicity of anesthetic agents and the developing brain in rodents and primates: The time has come to focus on human beings. *Anesthesiology*, 113(5), 1244–1245. Scopus. <https://doi.org/10.1097/ALN.0b013e3181f71092>

Keywords: Humans; Time Factors; time; nonhuman; priority journal; human; Species Specificity; growth, development and aging; drug effects; species difference; brain; rodent; experimental animal; neurotoxicity; toxicity; nerve degeneration; apoptosis; Anesthetics; Rodentia; Brain; letter; cognition; anesthetic agent; nerve cell plasticity; rhesus monkey; nerve cell; Neurotoxicity Syndromes; n methyl dextro aspartic acid receptor blocking agent; brain development; cell population; 4 aminobutyric acid receptor blocking agent

Ko, M.-C., & Husbands, S. (2008). Effects of a novel kappa opioid receptor agonist, TRK-820, on intrathecal morphine-induced itch and analgesia in monkeys. *FASEB Journal*, 22.

Keywords: Analgesia; kappa opioid receptor agonist; morphine; pruritis

Koo, E., & Oshodi, T. (2012). Comparative neurotoxic effects of dexmedetomidine and ketamine in prenatal monkey brains. *Anesthesia and Analgesia*, 114.

Keywords: Anesthetics; brain development; dexmedetomidine; ketamine; neurotoxicity

Maloney, S. E., Creeley, C. E., Hartman, R. E., Yuede, C. M., Zorumski, C. F., Jevtovic-Todorovic, V., Dikranian, K., Noguchi, K. K., Farber, N. B., & Wozniak, D. F. (2019).

Using animal models to evaluate the functional consequences of anesthesia during early neurodevelopment. *Neurobiology of Learning and Memory*, 165, 106834.

<https://doi.org/10.1016/j.nlm.2018.03.014>

Keywords: Disease Models, Animal; *Behavior; Apoptosis/drug effects; *Apoptosis; *Non-human primate; Anesthesia/*adverse effects; *Rodent; *Anesthetic; *Sedative agents; Anesthetics/adverse effects; Neurodevelopmental Disorders/*chemically induced

McGowan Jr., F. X., & Davis, P. J. (2008). Anesthetic-related neurotoxicity in the developing infant: Of mice, rats, monkeys and, possibly, humans. *Anesthesia and Analgesia*, 106(6), 1599–1602. Scopus. <https://doi.org/10.1213/ane.0b013e31817330cf>

Keywords: Humans; Rats; Disease Models, Animal; nonhuman; priority journal; rat; surgical technique; human; pathology; disease model; risk factor; Risk Factors; Risk Assessment; Age Factors; age; growth, development and aging; drug effect; Mice; mouse; chemically induced disorder; risk assessment; neurotoxicity; nerve degeneration; nervous system; editorial; experimental model; Haplorhini; Anesthetics, Inhalation; Anesthetics, Intravenous; inhalation anesthetic agent; intravenous anesthetic agent; drug exposure; developmental stage; Neurotoxicity Syndromes; toxicity and intoxication; Nervous System; brain development; anesthesia complication; Nerve Degeneration

Neudecker, V., Perez-Zoghbi, J. F., Grafe, M., & Brambrink, A. (2019). GFAP expression in the visual cortex is increased in juvenile non-human primates that were exposed to anesthesia during infancy. *Anesthesia and Analgesia*, 128, 380–380.

Keywords: Anesthesia; brain development; visual cortex

Paule, M. (2011). Preclinical Neurotoxicity Assessments of Pediatric Anesthetics: Translational Approaches Using a Nonhuman Primate Model. *Neurotoxicology and Teratology*, 33(4), 506–507. <https://doi.org/10.1016/j.ntt.2011.05.054>

Keywords: Anesthetics; neurotoxicity; pediatrics; translational model

Raper, J., Simon, H. K., & Kamat, P. P. (2021). Long-term evidence of neonatal anaesthesia neurotoxicity linked to behavioural phenotypes in monkeys: Where do we go from here? *British Journal of Anaesthesia*, 127(3), 343–345. Scopus. <https://doi.org/10.1016/j.bja.2021.06.005>

Keywords: nonhuman; behaviour; oxidative stress; phenotype; microglia; Phenotype; neurotoxicity; Anesthetics; Editorial; Haplorhini; behavior disorder; anesthetic agent; Anesthesia; drug exposure; Neurotoxicity Syndromes; toxicity and intoxication; nerve cell differentiation; brain development; glial fibrillary acidic protein; astrocytosis; *non-human primate; *Anesthesia; *behaviour; *anaesthetic neurotoxicity; *Anesthetics; *astrogliosis; *glial fibrillary acidic protein; *neurodevelopment; *Neurotoxicity Syndromes/etiology; *paediatric anaesthesia; astrogliosis; anaesthetic neurotoxicity; neurodevelopment; paediatric anaesthesia; pediatric anesthesia; perirhinal cortex

Rosado-Mendez, I. M., Noguchi, K. K., Castañeda-Martinez, L., Kirvassilis, G., Wang, S. H., Manzella, F., Swiney, B. S., Masuoka, K., Capuano, S. I., Brunner, K. G., Crosno, K., Guerrero, Q. W., Whitson, H., Brambrink, A., Simmons, H. S., Mejia, A. F., Zagzebski, J. A., Hall, T. J., & Ikonomidou, C. (2019). Quantitative ultrasound and apoptotic death in the neonatal primate brain. *Neurobiology of Disease*, 127, 554–562.

<https://doi.org/10.1016/j.nbd.2019.03.032>

Keywords: Animals, Newborn; Ultrasonography; Macaca mulatta; *Apoptosis; *Imaging; *Primate; *Development; Sevoflurane/*pharmacology; *Sevoflurane; *Quantitative ultrasound; *Thalamus; *Brain injury; *Neonatal; Apoptosis/drug effects/*physiology; Brain/*diagnostic imaging/drug effects; Neurons/drug effects; Oligodendroglia/drug effects

Schenning, K. J., Miranda-Dominguez, O., Martin, L. D., Coleman, K., Neudecker, V., Perez-Zoghbi, J. F., Fair, D., & Brambrink, A. (2020). Changes in Brain Functional Connectivity After Infant Anesthesia Exposure Are Associated With Alterations in Social Behaviors in Juvenile Non-Human Primates. *Anesthesia and Analgesia*, 130, 501–501.

Keywords: Anesthesia; brain function; neurodevelopment; pediatrics; social behaviors

Slikker, W., Han, X., Liu, F., Zhang, X., Gu, Q., Liu, S., Paterson, T. A., Paule, M. G., Hanig, J. P., & Wang, C. (2018). Identifying Potential Biomarkers, Mechanisms and Protective Strategies for General Anesthetic-Induced Neurotoxicity in the Developing Nonhuman Primate. *FASEB Journal*, 32(1).

Keywords: Anesthetics; biomarkers; brain development; neurodevelopment; neurotoxicity

Slikker, W., Jr., Zhang, X., Paule, M. G., Newport, G. D., Liu, F., Callicott, R., Liu, S., Berridge, M., Apana, S. M., & Wang, C. (2013). MicroPET/CT Imaging of [18F]-FEPPA in the Nonhuman Primate: A Potential Biomarker of Pathogenic Processes Associated with Anesthetic-Induced Neurotoxicity. *Birth Defects Research Part A-Clinical and Molecular Teratology*, 97(5), 312–312.

Keywords: Anesthetics; biomarkers; brain development; Computed Tomography; imaging; neurodevelopment; neurotoxicity; Positron Emission Tomography

Yan, J., Li, J., Cheng, Y., Zhang, Y., Zhou, Z., Zhang, L., & Jiang, H. (2020). Dusp4 Contributes to Anesthesia Neurotoxicity via Mediated Neural Differentiation in Primates. *Frontiers in Cell and Developmental Biology*, 8. Scopus.

<https://doi.org/10.3389/fcell.2020.00786>

Keywords: Animal experiment; animal model; animal tissue; nonhuman; human; Article; controlled study; in vitro study; human cell; unclassified drug; down regulation; protein expression; embryo; anesthesia; sevoflurane; neurotoxicity; RNA sequencing; prefrontal cortex; nerve cell differentiation; dual specificity phosphatase; dual specificity protein phosphatase 4; DUSP4; human embryonic stem cell; neural differentiation

Yu, W., Wu, Z., & Zhao, P. (2020). Neurotoxicity effects of anesthetic exposure on the developing brain of non-human primates. *Medical Hypotheses*, 140. Scopus.
<https://doi.org/10.1016/j.mehy.2020.109647>

Keywords: Animal experiment; animal tissue; nonhuman; Article; histopathology; anesthesia; neurotoxicity; developmental toxicity; nerve degeneration; non invasive procedure; neuroimaging; Neurotoxicity; brain region; brain function; brain tissue; anesthetic agent; drug exposure; Brain development; General anesthetic; mental disease assessment; minimally invasive procedure; Neuroimaging methodologies; tissue structure

Zou, X., Patterson, T. A., Divine, B. L., Sadovova, N., Zhang, X., Hanig, J. P., Paule, M. G., Slikker, W. J., & Wang, C. (2009a). Gaseous anesthetics- Induced neurodegeneration in the developing monkey brain. *Society for Neuroscience Abstract Viewer and Itinerary Planner*, 39.

Keywords: Anesthetics; brain development; inhalation anesthetics; neurodevelopment; neurotoxicity

Zou, X., Patterson, T. A., Divine, R. L., Sadovova, N., Zhang, X., Hanig, J. P., Paule, M. G., Slikker, W., Jr., & Wang, C. (2009b). Prolonged exposure to ketamine increases neurodegeneration in the developing monkey brain. *International Journal of Developmental Neuroscience*, 27(7), 727–731. <https://doi.org/10.1016/j.ijdevneu.2009.06.010>

Keywords: Anesthetics; brain development; infants; ketamine; neurodevelopment; neurotoxicity; pediatrics

Zou, X., Sadovova, N., Patterson, T., Divine, B., Paule, M., Slikker, W., William, & Wang, C. (2008). Genotoxicity of ketamine and potential protection by midazolam in neonatal monkey cerebral cortical culture. *Society for Neuroscience Abstract Viewer and Itinerary Planner*, 38.

Keywords: Anesthetics; brain development; cerebral cortex; genotoxicity; midazolam; infants; neurodevelopment; neurotoxicity; pediatrics

Human Pain and Nociception Research, Pharmacology, and Drug Development

Description: These articles describe using nonhuman primates as models for studying pain and nociception in humans as well as for drug development, pharmacokinetics, and pharmacodynamics.

Results (7):

Ding, H., Kiguchi, N., Perrey, D. A., Thuy Nguyen, Czoty, P. W., Zhang, Y., & Ko, M.-C. (2018). Reinforcing, Antinociceptive, and Pruritic Effects of a G Protein-Biased Mu Opioid Receptor Agonist, PZM21, in Primates. *FASEB Journal*, 32(1).

Keywords: Drug antinociceptive effect; itch; meeting abstract; pruritis; thermal allodynia

Grace, J., Wong, H., Sinz, M., & Lentz, K. (2009). Comparison of the formation kinetics of acetaminophen in chimpanzee, cynomolgus monkey, marmoset, rhesus monkey and human liver microsomes. *Drug Metabolism Reviews*, 41, 58–59.

Keywords: Acetaminophen; analgesics; chimpanzees; cynomolgus monkeys; liver microsomes; marmosets; pharmacology; rhesus macaques; symposia, transactions and proceedings

Kiguchi, N., & Ko, M.-C. (2019). Effects of NOP-related ligands in nonhuman primates. In *Handbook of Experimental Pharmacology* (Vol. 254, p. 343). Springer New York LLC; Scopus. https://doi.org/10.1007/164_2019_211

Keywords: Humans; nonhuman; priority journal; human; metabolism; chemistry; drug efficacy; drug effect; pain; neuropathic pain; chronic pain; Analgesics; Ligands; drug safety; positron emission tomography; evidence based medicine; Opioids; analgesic activity; Analgesics, Opioid; narcotic analgesic agent; Chronic pain; rhesus monkey; EC50; drug protein binding; Parkinson's disease; mu opiate receptor agonist; Opioid Peptides; 8 (2,3,3a,4,5,6 hexahydro 1h phenalen 1 yl) 1 phenyl 1,3,8 triazaspiro[4.5]decan 4 one; at 121; Bifunctional ligands; bu 08028; cebranopadol; Drug abuse; drug dependence; Inflammatory pain; MOP receptor; nociceptin; nociceptin receptor; nociceptin receptor agonist; NOP receptor; opiate receptor; Receptors, Opioid; sch 221510; Spinal cord; sr 16435; ufp 112

Rauch, A., Rainer, G., Augath, M., Oeltermann, A., & Logothetis, N. K. (2008). Pharmacological MRI combined with electrophysiology in non-human primates: Effects of Lidocaine on primary visual cortex. *NeuroImage*, 40(2), 590–600. Scopus. <https://doi.org/10.1016/j.neuroimage.2007.12.009>

Shidahara, Y., Awaga, Y., Nakamura, M., Ogawa, S., Takashima, M., Hama, A., Matsuda, A., Takamatsu, H., & Umemura, K. (2016). Differential effects of clinical analgesics in a nonhuman primate and rat model of oxaliplatin-induced peripheral neuropathy. *Journal of Pharmacological Sciences*, 130(3), S97–S97.

Keywords: article; nonhuman; priority journal; controlled study; male; dose response; drug effect; Lidocaine; nuclear magnetic resonance imaging; pharmacodynamics; Magnetic Resonance Imaging;; Haplorhini; brain region; local anesthesia; Anesthetics, Local; Electrophysiology; independent component analysis; Visual Cortex; visual stimulation; brain electrophysiology; electric potential; evoked visual response; ICA; Independent component analysis; phMRI

Yeomans, D., Lu, Y., Laurito, C., Votta-Velis, G., & Wilson, S. (2003). Cutaneous application of HSV vectors encoding human preproenkephalin produces analgesia in primates. *Experimental Neurology*, 181(1), 110–110.

Keywords: Analgesia; meeting abstract; neurology; preproenkephalin

Baboons

This section contains citations on anesthesia and analgesia in baboons (genus *Papio*). Since baboons are a popular model in research in the area of xenotransplantation, we have added section on anesthesia and analgesia for this particular area of research.



Hamadryas baboon. Courtesy of Adobe Stock Photos.

Anesthesia

Description: Information on anesthesia protocols and monitoring of vital signs for baboons. Also includes citations that describe anesthesia protocols for a specific type of surgery (fetal surgery, stroke model), for chemical restraint, or for imaging.

Results (20):

Alsobayil, F., Sadan, M., & Al-Shoshan, A. A. (2018). Comparison between the anaesthetic effects of xylazine-ketamine and diazepam-ketamine: Physiological and blood parameters in young hamadryas baboons (*Papio hamadryas*). *Turkish Journal of Veterinary and Animal Sciences*, 42(1), 40–48. Scopus. <https://doi.org/10.3906/vet-1701-87>

Keywords: anesthesia; Animal and in-vitro Models for Pharmaceuticals; animal experiment; Animal Models of Human Diseases; Animal Physiology and Biochemistry (Excluding Nutrition); Article; Biological Resources (Animal); blood gas; blood pressure; bradycardia; breathing rate; Cercopithecidae; comparative study; cornea reflex; Diazepam; Hamadryas baboons; heart rate; hyperglycemia; hypothermia; Ketamine; lactic acid; male; mean arterial pressure; micturition; Non-Communicable Diseases and Injuries of Animals; nonhuman; oxygen affinity; oxygen saturation; Papio; Papio hamadryas;; rectal temperature; Veterinary Pharmacology and Anaesthesiology; Xylazine

Bentson, K. L., Capitanio, J. P., & Mendoza, S. P. (2003). Cortisol responses to immobilization with Telazol or ketamine in baboons (*Papio cynocephalus/anubis*) and rhesus macaques (*Macaca mulatta*). *Journal of Medical Primatology*, 32(3), 148–160. Scopus. <https://doi.org/10.1034/j.1600-0684.2003.00018.x>

Keywords: analysis of variance; Anesthetics, Dissociative; Anesthetics, Dissociative/*pharmacology; animal cell; animal experiment; arm movement; article; baboon; Benzodiazepine receptors; Benzodiazepines; Biorhythm; blood sampling; Blood sampling venipuncture; Circadian; controlled study; Drug Combinations; drug effect; Hydrocortisone; hydrocortisone blood level; Hydrocortisone/*blood; Immobilization; Immobilization/*physiology; immunological parameters; injection; Ketamine; Ketamine/*pharmacology; leukocyte count; Leukocytes; Lymphocytes; Macaca; Macaca mulatta; Macaca mulatta/*blood; Male; nonhuman; Novelty; Papio; Papio anubis; Papio cynocephalus; Papio hamadryas; Papio/*blood; priority journal; Psychoneuroimmunology; rhesus monkey; sodium chloride; species difference; Species Specificity; telazol; Tiletamine; Tiletamine/*pharmacology; time; Training; Zolazepam; Zolazepam/*pharmacology

Giffard, C., Young, A. R., Mézenge, F., Derlon, J.-M., & Baron, J.-C. (2005). Histopathological effects of delayed reperfusion after middle cerebral artery occlusion in the anesthetized baboon. *Brain Research Bulletin*, 67(4), 335–340. Scopus. <https://doi.org/10.1016/j.brainresbull.2005.08.001>

Keywords: *Anesthesia; *Reperfusion; Anesthesia*; animal experiment; animal model; animal tissue; article; Baboon; brain hemorrhage; Brain Infarction; brain infarction size; Brain Infarction/*pathology; Brain Infarction/etiology; Brain Infarction/etiology/*pathology; brain ischemia; cadaver; capsula interna; caudate nucleus; Cerebral ischemia; controlled study; Disease Models, Animal; frontal cortex; histopathology; Infarction, Middle Cerebral Artery; Infarction, Middle Cerebral Artery/*pathology; Infarction, Middle Cerebral Artery/complications; Infarction, Middle Cerebral Artery/complications/*pathology; Magnetic Resonance Imaging; Magnetic Resonance Imaging/methods; Male; Middle cerebral artery occlusion; nonhuman; Papio anubis; priority journal; putamen; Reperfusion; reperfusion injury; Reperfusion*; Staining and Labeling; stereology; Stroke; survival; Time Factors; tissue fixation; validation process

Ikai, A., Riemer, R. K., Ramamoorthy, C., Malhotra, S., Cassorla, L., Amir, G., Hanley, F. L., & Reddy, V. M. (2005). Preliminary results of fetal cardiac bypass in nonhuman

primates. *The Journal of Thoracic and Cardiovascular Surgery*, 129(1), 175–181.
<https://doi.org/10.1016/j.jtcvs.2004.09.003>

Keywords: *Pregnancy, Animal; Anesthesia, General/methods; Anesthetics, Intravenous/*administration & dosage; Blood Gas Analysis; Blood Pressure Determination; Cardiac Output; Cardiopulmonary Bypass/*methods; Female; Fentanyl/administration & dosage; Fetal Heart/abnormalities/*surgery; Hemodynamics/physiology; Isoflurane/administration & dosage; Papio; Pregnancy; Sensitivity and Specificity; Statistics, Nonparametric; Treatment Outcome

Isbell, L. A., Bidner, L. R., Omondi, G., Mutinda, M., & Matsumoto-Oda, A. (2019). Capture, immobilization, and Global Positioning System collaring of olive baboons (*Papio anubis*) and vervets (*Chlorocebus pygerythrus*): Lessons learned and suggested best practices. *American Journal of Primatology*, 81(6), e22997–e22997. Zoological Record.

Keywords: *Chlorocebus pygerythrus*, *Papio anubis*: Trapping; Tagging, Global positioning system collaring; Sedation, Immobilization; Tracking techniques; Injuries; Mortality, Mortality rate; Kenya; Cercopithecidae; Systematics: Cercopithecidae, *Chlorocebus pygerythrus*; Cercopithecidae, *Papio anubis*

Ivanov, V. A., Wolf, R. F., Papin, J. F., Anderson, M. P., Hill, C. L., & Welliver, R. C., Sr. (2018). Apnea induction for invasive lung function testing in infant olive baboons: Comparison of intravenous propofol versus hyperventilation. *Journal of Medical Primatology*, 47(1), 46–50. Scopus. <https://doi.org/10.1111/jmp.12306>

Keywords: **Papio anubis*; *apnea induction; *CO₂ washout; *hypocapnia; *lung function tests; Anesthetics, Intravenous; Anesthetics, Intravenous/*adverse effects; Anesthetics, Intravenous/administration & dosage; Anesthetics, Intravenous/administration & dosage/*adverse effects; animal experiment; Animals, Newborn; Ape Diseases; Ape Diseases/*etiology; Ape Diseases/chemically induced; Ape Diseases/chemically induced/*etiology; Apnea; apnea induction; apnea induction*; Apnea/*etiology; Apnea/chemically induced; Apnea/chemically induced/*etiology; Article; carbon dioxide; chemically induced; CO₂ washout*; comparative study; disease severity; Female; Hyperventilation; Hyperventilation/*etiology; hypocapnia*; infant; intermethod comparison; intravenous anesthetic agent; invasive lung function testing; lung compliance; lung function tests*; measurement accuracy; medical procedures; newborn; nonhuman; peak expiratory flow; peak inspiratory flow; positive end expiratory pressure; priority journal; procedures; propofol 28; Propofol; Propofol/*adverse effects; Propofol/administration & dosage/*adverse effects; Respiratory Function Tests; Respiratory Function Tests/*methods; therapeutic hyperventilation; trend study

Joshi, S., Hartl, R., Sun, L. S., Libow, A. D., Wang, M., Pile-Spellman, J., Young, W. L., Connolly, E. S., & Hirshman, C. A. (2003). Despite in vitro increase in cyclic guanosine monophosphate concentrations, intracarotid nitroprusside fails to augment cerebral blood flow of healthy baboons. *Anesthesiology*, 98(2), 412–419. Scopus. <https://doi.org/10.1097/00000542-200302000-00022>

Keywords: anesthesia; animal experiment; animal tissue; arteriole; artery resistance; artery tone; article; baboon; Blood Pressure; brain blood flow; brain circulation; carotid artery; Carotid Artery, Internal; Cerebrovascular Circulation; concentration response; controlled study; Cyclic GMP; diagnostic agent; drug effect; drug infusion; hypertension; in vitro study; in vivo study; Injections, Intra-Arterial; internal carotid artery; intraarterial drug administration; Iohexol; mean arterial pressure; metabolism; neuropharmacology; Nitroprusside; nitroprusside sodium; nonhuman; Papio; phenylephrine; priority journal; protein determination; radioimmunoassay; Vasodilator Agents; verapamil; xenon; Xenon Radioisotopes

Kamau, M. W., Hassell, J. M., Milnes, E. L., Hayek, L.-A. C., Mutinda, M. M., Harel, R., Matsumoto-Oda, A., Yu, J. H., Zimmerman, D., Crofoot, M., & Murray, S. (2021). Point of Care Blood Gas and Electrolyte Analysis in Anesthetized Olive Baboons (*Papio anubis*) in a Field Setting. *International Journal of Primatology*, 42(5), 667–681. Scopus.
<https://doi.org/10.1007/s10764-021-00241-3>

Keywords: ACP Countries; Africa; Africa South of Sahara; anesthetic; Anglophone Africa; Animal Welfare; Baboons; Biological Resources (Animal); blood; Blood gas; Cercopithecidae; Commonwealth of Nations; detection method; Developing Countries; East Africa; Electrolytes; Free ranging; Kenya; Laikipia; Olive baboons; Papio anubis; partial pressure; Physiology and Biochemistry (Wild Animals); Reference intervals; Veterinary Pharmacology and Anaesthesiology

Langoi, D. L., Mwethera, P. G., Abelson, K. S. P., Farah, I. O., & Carlsson, H. E. (2009). Reversal of Ketamine/Xylazine combination anesthesia by Atipamezole in olive baboons (*Papio anubis*). *Journal of Medical Primatology*, 38(6), 404–410. Scopus.
<https://doi.org/10.1111/j.1600-0684.2009.00378.x>

Keywords: *Papio anubis; Adrenergic alpha-Antagonists; Adrenergic alpha-Antagonists/*pharmacology; alpha adrenergic receptor blocking agent; anesthesia induction; anesthesia mechanism; anesthetic agent; Anesthetics, Dissociative; Anesthetics, Dissociative/*antagonists & inhibitors; Anesthetics, Dissociative/administration & dosage; Anesthetics, Dissociative/administration & dosage/*antagonists & inhibitors; animal experiment; animal model; Animal Welfare; arousal; article; atipamezole; Atipamezole; Baboon; Blood Pressure; Blood Pressure/drug effects; breathing rate; cardiopulmonary hemodynamics; Cercopithecidae; controlled study; drug antagonism; drug dose comparison; drug effect; Female; Heart Rate; Heart Rate/drug effects; hemoglobin; imidazole derivative; Imidazoles; Imidazoles/*pharmacology; Injections, Intramuscular; intramuscular drug administration; Ketamine; ketamine HCL; Ketamine/*antagonists & inhibitors; Ketamine/administration & dosage; Ketamine/administration & dosage/*antagonists & inhibitors; Laboratory Animal Science; male; Male; nonhuman; oxygen; oxygen saturation; Papio anubis; Papio anubis*; priority journal; rectum temperature; Respiratory Rate; Respiratory Rate/drug effects; Reversal anesthesia; salivation; sedation; Surgery; systolic blood pressure; unclassified drug; Veterinary Pharmacology and Anaesthesiology; vomiting; Xylazine; xylazine 100; Xylazine/*antagonists & inhibitors; Xylazine/administration & dosage; Xylazine/administration & dosage/*antagonists & inhibitors

Liu, F., Garland, M., Duan, Y., Stark, R. I., Xu, D., Bansal, R., Dong, Z., Peterson, B. S., & Kangarlu, A. (2010). Techniques for in utero, longitudinal MRI of fetal brain development in baboons at 3 T. *Methods*, 50(3), 147–156. Scopus.

<https://doi.org/10.1016/j.ymeth.2009.03.019>

Keywords: *Cerebrum/anatomy & histology/embryology; 3 T; Anesthesia; Anesthesia/*methods; animal experiment; article; baboon; brain development; Brain development; Cerebrum; Cerebrum*/anatomy & histology; Cerebrum*/embryology; Diffusion Tensor Imaging; Diffusion Tensor Imaging/*methods; Female; Fetal baboon; Fetus; fetus development; gestational age; Gestational Age; gray matter; Image Processing, Computer-Assisted; Image Processing, Computer-Assisted/*methods; In utero; Longitudinal; Models, Animal; MRI; neuroanatomy; neuroimaging; nonhuman; nuclear magnetic resonance imaging; Papio; Pregnancy; priority journal; Uterus; Uterus/embryology; white matter

Liu, F., Garland, M., Duan, Y., Stark, R. I., Xu, D., Dong, Z., Bansal, R., Peterson, B. S., & Kangarlu, A. (2008). Study of the development of fetal baboon brain using magnetic resonance imaging at 3 Tesla. *NeuroImage*, 40(1), 148–159. Scopus.

<https://doi.org/10.1016/j.neuroimage.2007.11.021>

Keywords: 3 T; Adjuvants, Anesthesia; Algorithms; anesthesia; Anesthesia; Anesthetics, Dissociative; animal experiment; animal tissue; article; Artifacts; Atropine; baboon; Body Temperature; Brain; brain development; Brain development; brain scintiscanning; Brain/*anatomy & histology; Brain/*anatomy & histology/*embryology; Brain/*embryology; Diffusion Magnetic Resonance Imaging; Fetal baboon; fetus; Gestational Age; gray matter; Hypnotics and Sedatives; Image Processing, Computer-Assisted; Ketamine; Magnetic Resonance Imaging; Magnetic Resonance Imaging/*methods; MRI; nonhuman; nuclear magnetic resonance imaging; Papio papio; Papio papio/*physiology; pregnancy; Pregnancy; priority journal; relaxation time; Relaxation times; T1; T2; Urinary Bladder; Urinary Bladder/physiology; white matter

Mutinda, M., Crofoot, M. C., Kishbaugh, J. C., Hayek, L.-A. C., Zimmerman, D., Tunseth, D. A., & Murray, S. (2019). Blood Biochemical Reference Intervals for Free-Ranging Olive Baboons (*Papio anubis*) in Kenya. *International Journal of Primatology*, 40(2), 187–196. Scopus.

<https://doi.org/10.1007/s10764-018-0074-2>

Keywords: abnormality; biochemistry; blood; Chemical immobilization; Health status; immobilization; Kenya; Papio anubis; phosphatase; phosphorus; serum; Serum chemistry; wild population

Saba, W., Goutal, S., Kuhnast, B., Dollé, F., Auvity, S., Fontyn, Y., Cayla, J., Peyronneau, M.-A., Valette, H., & Tournier, N. (2015). Differential influence of propofol and isoflurane anesthesia in a non-human primate on the brain kinetics and binding of [18F]DPA-714, a positron emission tomography imaging marker of glial activation. *European Journal of Neuroscience*, 42(1), 1738–1745. Scopus. <https://doi.org/10.1111/ejn.12946>

Keywords: Anesthetic; anesthetic agent; Anesthetics, General; Anesthetics, General/*pharmacology; animal cell; animal experiment; animal tissue; Article; Baboon; Brain; brain tissue; Brain/*diagnostic imaging/drug effects/metabolism; controlled study; dpa 714 f 18; drug binding; drug distribution; drug effects; drug elimination; drug metabolism; Fluorodeoxyglucose F18; glia; In vitro binding; in vitro study; in vivo study; Isoflurane; Isoflurane/*pharmacology; Male; metabolism; n sec butyl 1 (2 chlorophenyl) n methyl 3 isoquinolinecarboxamide; N,N-diethyl-2-(2-(4-(2-fluoroethoxy)phenyl)-5,7-dimethylpyrazolo(1,5-a)pyrimidin-3-yl)acetamide; Neuroglia; Neuroglia/*diagnostic imaging/drug effects/metabolism; neuroinflammation; Neuroinflammation; nonhuman; Papio; Papio anubis; Peripheral benzodiazepine receptor; positron emission tomography; Positron-Emission Tomography; Positron-Emission Tomography/*methods; priority journal; procedures; Propofol; Propofol/*pharmacology; pyrazole derivative; Pyrazoles; Pyrazoles/*pharmacokinetics; pyrimidine derivative; Pyrimidines; Pyrimidines/*pharmacokinetics; radioactivity; radioligand; scintiscanning; unclassified drug

Schuerch, F. S., Brown, G., O'Brien, J. K., Heffernan, S., Vogelnest, L., Dart, C., Thomson, P. C., & McGreevy, P. D. (2004). The effect of repeated oral administration of drugs for chemical restraint on behavioural responses in male baboons (*Papio hamadryas*). *Folia Primatologica*, 75, 411–411.

Keywords: Anesthetic drugs; baboons; behavioural response; chemical restraint; immobilization; oral restraining agents; Papio hamadryas

Sloan, T., Sloan, H., & Rogers, J. (2010). Nitrous oxide and isoflurane are synergistic with respect to amplitude and latency effects on sensory evoked potentials. *Journal of Clinical Monitoring and Computing*, 24(2), 113–123. <https://doi.org/10.1007/s10877-009-9219-3>

Keywords: Anesthetics, Inhalation/administration & dosage; Dose-Response Relationship, Drug; Drug Synergism; Evoked Potentials, Somatosensory/*drug effects/*physiology; Isoflurane/*administration & dosage; Nitrous Oxide/*administration & dosage; Papio; Reaction Time/*drug effects/*physiology

Ündar, A., Eichstaedt, H. C., Clubb Jr., F. J., Lu, M., Bigley, J. E., Deady, B. A., Porter, A., Vaughn, W. K., & Fung, M. (2004). Anesthetic induction with ketamine inhibits platelet activation before, during, and after cardiopulmonary bypass in baboons. *Artificial Organs*, 28(10), 959–962. Scopus. <https://doi.org/10.1111/j.1525-1594.2004.07377.x>

Keywords: Amines; Analysis of Variance; anesthesia induction; Anesthetics; Anesthetics, Dissociative; Anesthetics, Dissociative/pharmacology; Anesthetics, Intravenous; Anesthetics, Intravenous/pharmacology; animal experiment; Antibodies, Monoclonal; Antibodies, Monoclonal/pharmacology; Baboons; blood sampling; breathing rate; Cardiopulmonary Bypass; Cardiopulmonary Bypass*; Chemical activation; complement; Complement Factor D; Complement Factor D/immunology; conference paper; controlled study; cytokine production; cytometry; Diazepam; Diazepam/pharmacology; drug effect; Hypothermic; immunofluorescence; induced hypothermia; inspiratory capacity; Intramuscular injections; intravenous catheter; Isoflurane; Ketamine; Ketamine/*pharmacology; leukocyte activation; Mab

166-32; Mean weight; Models, Animal; Monoclonal antibodies; monoclonal antibody 166 32; Monoclonal antibody 166-32; monocyte; nonhuman; PADGEM protein; pancuronium bromide; Papio; paralysis; Platelet Activation; Platelet Activation/*drug effects; Platelet Activation/*drug effects/physiology; Platelet Activation/physiology; Platelet inhibition; Platelets; priority journal; protein expression; sodium chloride; thrombocyte activation; tidal volume; Time Factors; Treatment Outcome; unclassified drug

Valette, H., Bottlaender, M., Coulon, C., Ottaviani, M., & Syrota, A. (2002). Anesthesia affects the disposition of [18F]Fluoro-A-85380: A PET study in monkeys. *Synapse*, 44(1), 58–59. Scopus. <https://doi.org/10.1002/syn.10047>

Keywords: 3 (2 azetidinylmethoxy)pyridine; Adrenergic alpha-Agonists; Adrenergic alpha-Agonists/*pharmacology; Anesthetics, Dissociative; Anesthetics, Dissociative/*pharmacology; animal experiment; animal model; article; Azetidines; Azetidines/*metabolism; Brain; Brain/diagnostic imaging/*drug effects; controlled study; drug clearance; drug disposition; drug distribution; Drug Interactions; Drug Interactions/physiology; drug metabolism; drug potentiation; Fluorine Radioisotopes; Fluorine Radioisotopes/*metabolism; fluorodeoxyglucose f 18; general anesthesia; isoflurane; Ketamine; Ketamine/*pharmacology; Metabolic Clearance Rate; Metabolic Clearance Rate/drug effects/physiology; monkey; Neurons; Neurons/diagnostic imaging/*drug effects; nicotinic receptor; nonhuman; Nonlinear Dynamics; Papio; positron emission tomography; priority journal; Receptors, Nicotinic; Receptors, Nicotinic/*drug effects/metabolism; Tomography, Emission-Computed; Xylazine; Xylazine/*pharmacology

Wey, H.-Y., Li, J., Szabó, C. Á., Fox, P. T., Leland, M. M., Jones, L., & Duong, T. Q. (2010). BOLD fMRI of visual and somatosensory-motor stimulations in baboons. *NeuroImage*, 52(4), 1420–1427. Scopus. <https://doi.org/10.1016/j.neuroimage.2010.05.014>

Keywords: anesthesia induction; Anesthetic; animal experiment; Animal models; article; baboon; Blood oxygenation level-dependent (BOLD) fMRI; brain function; Brain mapping; Cerebral blood flow; Evoked Potentials, Somatosensory; Evoked Potentials, Visual; evoked response; female; functional magnetic resonance imaging; hemodynamics; hypercapnia; isoflurane; ketamine; lateral geniculate nucleus; Magnetic Resonance Imaging; motor activity; motor cortex; nonhuman; Oxygen Consumption; Papio hamadryas; paralysis; Photic Stimulation; Physical Stimulation; priority journal; Somatosensory Cortex; somatosensory stimulation; Thalamus; vecuronium; Visual Cortex; visual stimulation

Wey, H.-Y., Wang, D. J., & Duong, T. Q. (2011). Baseline CBF, and BOLD, CBF, and CMRO2 fMRI of visual and vibrotactile stimulations in baboons. *Journal of Cerebral Blood Flow and Metabolism*, 31(2), 715–724. Scopus. <https://doi.org/10.1038/jcbfm.2010.154>

Keywords: Algorithms; Anesthesia; Anesthetics, Dissociative; Anesthetics, Inhalation; animal experiment; article; baboon; blood oxygenation; Brain; brain blood flow; Brain/pathology; Calibration; cerebral blood flow; cerebral metabolic rate of oxygen; Cerebrovascular Circulation; Cerebrovascular Circulation/*physiology; epilepsy; Female; functional magnetic resonance imaging; gray matter; hemodynamic response; Hypercapnia; Hypercapnia/physiopathology; Image Processing, Computer-Assisted; Isoflurane; Ketamine; Kinetics; Magnetic Resonance

Imaging; Magnetic Resonance Imaging/*methods; neurovascular coupling; nonhuman; Oxygen; Oxygen Consumption; Oxygen Consumption/*physiology; Oxygen/*blood; Papio; Perfusion Imaging; Photostimulation; Physical Stimulation; priority journal; pseudo-continuous ASL; quantitative analysis; Spin Labels; stroke; tactile stimulation; Touch; Touch/physiology; Vibration; visual stimulation; white matter

Yeung, K. R., Lind, J. M., Heffernan, S. J., Sunderland, N., Hennessy, A., & Makris, A. (2014). Comparison of indirect and direct blood pressure measurements in baboons during ketamine anaesthesia. *Journal of Medical Primatology*, 43(4), 217–224. Scopus.
<https://doi.org/10.1111/jmp.12113>

Keywords: *Papio hamadryas; Anesthesia*; anesthetic agent; Anesthetics, Dissociative; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); article; automated oscillometry; Blood Pressure Determination; Blood Pressure Determination/*methods; blood pressure measurement; blood pressure meter; Cardiovascular; Cercopithecidae; comparative study; controlled study; correlation coefficient; diastolic blood pressure; evaluation study; Female; intermethod comparison; Intra-arterial radiotelemetry; Ketamine; Male; mercury sphygmomanometer; nonhuman; oscillometer; Oscillometry; Papio hamadryas; Papio hamadryas*; Pregnancy; priority journal; procedures; Sphygmomanometry; systolic blood pressure; Techniques and Methodology; Telemetry; Veterinary Pharmacology and Anaesthesiology

Analgesia

Description: Information on the use of analgesic drugs in baboons to treat postoperative pain.

Results (1):

Allison, S. O., Halliday, L. C., French, J. A., Novikov, D. D., & Fortman, J. D. (2007). Assessment of buprenorphine, carprofen, and their combination for postoperative analgesia in olive baboons (*Papio anubis*). *Journal of the American Association for Laboratory Animal Science*, 46(3), 24–31. Scopus.

Keywords: analgesia; analgesic effect; Analgesics; Analgesics/*therapeutic use; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); animal testing refinement; animal tissue; animal use; animal wellbeing; article; Body Weight; Buprenorphine; Buprenorphine/*therapeutic use; Carbazoles; Carbazoles/*therapeutic use; carprofen; Cercopithecidae; combination chemotherapy; combination drug therapy; controlled study; drug effect; drug efficacy; drug evaluation; Drug Therapy, Combination; eukaryotes; Feeding Behavior; Female; Hydrocortisone; Hydrocortisone/blood/urine; isoflurane; ketamine; monotherapy; nonhuman; pain; pain killers; Pain Measurement; Pain, Postoperative; Pain, Postoperative/prevention & control/*veterinary; Papio anubis; Papio anubis/anatomy & histology/physiology/*surgery; postoperative analgesia; postoperative care; postoperative pain; propofol; reliability; surveillance systems; tachycardia; Veterinary Pharmacology and Anaesthesiology

Adverse Effects

Description: This section features citations about adverse effects of anesthetic or analgesic drugs on baboons. Most of these citations address effects of these drugs on fetal or neonatal baboons.

Results (11):

Garland, M., Abildskov, K. M., Daniel, S. S., & Stark, R. I. (2001a). Distribution of morphine and its metabolites in the pregnant baboon. *Pediatric Research*, 49(4 Part 2), 453A-453A.

Keywords: Baboons; fetal drug metabolism; fetus; meeting abstract; morphine; opioids; Papio; pediatrics; pharmacology; pregnancy

Garland, M., Abildskov, K. M., Daniel, S. S., & Stark, R. I. (2001b). Quantification of morphine metabolism by the fetal baboon. *Pediatric Research*, 49(4 Part 2), 454A-454A.

Keywords: Baboons; fetal drug metabolism; fetus; meeting abstract; morphine; opioids; Papio; pediatrics; pharmacology; pregnancy

Garland, M., Abildskov, K. M., Kiu, T.-W., Daniel, S. S., & Stark, R. I. (2005). The contribution of fetal metabolism to the disposition of morphine. *Drug Metabolism and Disposition: The Biological Fate of Chemicals*, 33(1), 68–76.
<https://doi.org/10.1124/dmd.104.001388>

Keywords: Dose-Response Relationship, Drug; Female; Fetus/*metabolism; Metabolic Clearance Rate/drug effects/physiology; Morphine/administration & dosage/*metabolism; Papio; Pregnancy

Garland, M., Abildskov, K. M., Kiu, T.-W., Daniel, S. S., Weldy, P., & Stark, R. I. (2008). Placental transfer and fetal elimination of morphine-3- β -glucuronide in the pregnant baboon. *Drug Metabolism and Disposition*, 36(9), 1859–1868. Scopus.
<https://doi.org/10.1124/dmd.108.021352>

Keywords: *Maternal-Fetal Exchange; animal experiment; animal tissue; article; baboon; Chromatography, High Pressure Liquid; compartment model; controlled study; drug absorption; drug clearance; drug disposition; drug elimination; drug half life; drug penetration; Female; Fetus; fetus blood; Fetus/*metabolism; Glucuronides; Glucuronides/*pharmacokinetics; Glucuronides/blood; Glucuronides/blood/*pharmacokinetics; Half-Life; Maternal-Fetal Exchange; Maternal-Fetal Exchange*; Models, Biological; Morphine; morphine 3 glucuronide; morphine sulfate; Morphine/*pharmacokinetics; Morphine/administration & dosage; Morphine/administration & dosage/blood/*pharmacokinetics; Morphine/blood; nonhuman; Papio; Placenta; Placenta/*metabolism; placental transfer; pregnancy; Pregnancy; prenatal exposure; priority journal; steady state

Garland, M., Abildskov, K. M., Taylor, S., Benzeroual, K., Caspersen, C. S., Arroyo, S. E., Kiu, T.-W., Reznik, B., Weldy, P., Daniel, S. S., & Stark, R. I. (2006). Fetal morphine

metabolism and clearance are constant during late gestation. *Drug Metabolism and Disposition: The Biological Fate of Chemicals*, 34(4), 636–646.

<https://doi.org/10.1124/dmd.105.007567>

Keywords: Analgesics, Opioid/administration & dosage/*pharmacokinetics; Female; Fetus/*metabolism; Gestational Age; Infusions, Intravenous; Liver/embryology/metabolism; Metabolic Clearance Rate; Morphine Derivatives/administration & dosage/pharmacokinetics; Morphine/administration & dosage/*pharmacokinetics; Papio; Placenta/metabolism; Pregnancy

Garland, M., Benzeroual, K., Taylor, S., Kiu, T., Abildskov, K., & Stark, R. (2003). Morphine metabolism by the late gestation fetal baboon. *Pediatric Research*, 53(4), 558A-558A.

Keywords: Baboons; fetal drug metabolism; fetus; meeting abstract; morphine; opioids; Papio; pediatrics; pharmacology; pregnancy

Gibhard, L., Meyer, M., & Kotzé, H. F. (2009). Ozone autohaemotherapy protects against ketamine hydrochloride® induced liver and muscle damage in baboons. *African Journal of Biotechnology*, 8(5), 844–848. Scopus.

Keywords: alanine aminotransferase; alanine aminotransferase blood level; anesthesia; animal experiment; article; aspartate aminotransferase; aspartate aminotransferase blood level; baboon; blood sampling; blood volume; cell protection; clinical assessment; concentration (parameters); controlled study; creatine kinase; creatine kinase blood level; ketamine; Liver damage; liver injury; liver protection; Muscle damage; muscle injury; nonhuman; O2-AHT; O3-AHT; ozone; ozone autohemotherapy; Papio; therapy; therapy effect; treatment outcome

North, K., Tobiasz, A., Sullivan, R. D., Bursac, Z., Duncan, J., Sullivan, J. P., Davison, S., Tate, D. L., Barnett, S., Mari, G., & Bukiya, A. N. (2018). Prenatal alcohol exposure, anesthesia, and fetal loss in baboon model of pregnancy. *Journal of Drug and Alcohol Research*, 7. Scopus. <https://doi.org/10.4303/jdar/236064>

Keywords: Adverse pregnancy outcome; alcohol; alcohol consumption; Alcohol exposure in utero; anesthesia; Anesthesia during pregnancy; animal experiment; animal model; Article; baboon; body weight gain; breathing rate; carprofen; controlled study; diastolic blood pressure; echography; female; Fetal alcohol exposure; fetus; fetus echography; fetus outcome; fetus wastage; gestational age; hangover; heart rate; indometacin; isoflurane; ketamine; nonhuman; oxygen saturation; pregnancy outcome; prenatal exposure; protein diet; retrospective study; systolic blood pressure; vital sign

Santolaya-Forgas, J., Romero, R., & Mehendale, R. (2006). The effect of continuous morphine administration on maternal plasma oxytocin concentration and uterine contractions after open fetal surgery. *The Journal of Maternal-Fetal & Neonatal Medicine : The Official Journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians*, 19(4), 231–238. <https://doi.org/10.1080/14767050600593387>

Keywords: Analgesics, Opioid/administration & dosage/*pharmacology; Female; Fetus/*surgery; Hysterotomy/*adverse effects; Morphine/administration & dosage/*pharmacology; Obstetric Labor, Premature/prevention & control; Oxytocin/blood/*drug effects; Papio; Postoperative Care; Pregnancy; Uterine Contraction/*drug effects

Sutherland, M. R., Yoder, B. A., McCurnin, D., Seidner, S., Clyman, R. I., & Black, M. J. (2011). Non-Steroidal Anti-Inflammatory Drug Treatment: Effects on the Developing Preterm Baboon Kidney. *Journal of Developmental Origins of Health And Disease*, 2, S81–S81.

Keywords: Analgesic drugs; baboons; body weight; glomerular generation number; immature; kidneys; NSAIDs; Papio; urologic disease

Sutherland, M. R., Yoder, B. A., McCurnin, D., Seidner, S., Gubhaju, L., Clyman, R. I., & Jane Black, M. (2012). Effects of ibuprofen treatment on the developing preterm baboon kidney. *American Journal of Physiology - Renal Physiology*, 302(10), F1286–F1292. Scopus. <https://doi.org/10.1152/ajprenal.00216.2011>

Keywords: animal experiment; animal tissue; Animals, Newborn; Anti-Inflammatory Agents, Non-Steroidal; Anti-Inflammatory Agents, Non-Steroidal/*toxicity; article; baboon; Blood Pressure; Blood Pressure/physiology; Body Weight; Body Weight/drug effects; controlled study; Drinking; Drinking/physiology; drug effect; Drug Interactions; Ductus Arteriosus, Patent; Ductus Arteriosus, Patent/drug therapy; Enzyme Inhibitors; Enzyme Inhibitors/pharmacology; Female; gestation period; human; Ibuprofen; Ibuprofen/*toxicity; infant; Kidney; kidney development; Kidney Glomerulus; Kidney Glomerulus/cytology; Kidney Glomerulus/cytology/drug effects; Kidney Glomerulus/drug effects; kidney mass; Kidney/*drug effects; Kidney/*growth & development; Kidney/cytology; Kidney/cytology/*drug effects/*growth & development; morphology; n(g) methylarginine; Nephrogenesis; Nephrons; Nephrons/*drug effects; Nephrons/cytology; Nephrons/cytology/*drug effects; Nitric Oxide Synthase; Nitric Oxide Synthase/antagonists & inhibitors; nonhuman; NSAID; omega-N-Methylarginine; omega-N-Methylarginine/pharmacology; Organ Size; Organ Size/drug effects; Papio; Patent ductus arteriosus; Pregnancy; Premature Birth; prematurity; priority journal; Urine

Case Studies

Description: Below is a single baboon case study involving anesthesia or analgesia

Results (1):

Asselin, K. A., Carlson Scholz, J. A., & Zeiss, C. (2011). Tracheal stenosis and adenocarcinoma in an olive baboon (*Papio cynocephalus anubis*). *Comparative Medicine*, 61(6), 546–551. Scopus.

Keywords: Female; animal experiment; animal tissue; article; nonhuman; ketamine; bone formation; adults; isoflurane; Animals, Laboratory; histopathology; image analysis; immunohistochemistry; anesthetics; laboratory animals; risk; Immunohistochemistry; Ki 67 antigen; necropsy; computed tomography; immunoreactivity; antidepressant agent; vomiting;

Positron-Emission Tomography; humans; single photon emission computer tomography; Fatal Outcome; adenocarcinoma; fibrosis; positron-emission tomography; endotracheal intubation; larynx; Monkey Diseases; Papio anubis; Adenocarcinoma; adenoid cystic carcinoma; bone metastasis; iodine 123; laryngoscopy; Papio cynocephalus; psychostimulant agent; Tomography, Emission-Computed, Single-Photon; trachea calcification; trachea carcinoma; Tracheal Stenosis; Wart virus

Human Pain and Nociception Research, Pharmacology, and Drug Development

Description: These articles describe using baboons as models for studying pain and nociception in humans as well as for drug development, pharmacokinetics, and pharmacodynamics.

Results (10):

Abildskov, K., Weldy, P., & Garland, M. (2010). Molecular cloning of the baboon UDP-glucuronosyltransferase 2B gene family and their activity in conjugating morphine. *Drug Metabolism and Disposition*, 38(4), 545–553. Scopus.
<https://doi.org/10.1124/dmd.109.030635>

Keywords: 3 glucuronide; Amino Acid Sequence; Analgesics, Opioid; Analgesics, Opioid/*metabolism; animal cell; animal tissue; article; Cell Membrane; Cell Membrane/enzymology; Chromatography, High Pressure Liquid; complementary DNA; controlled study; DNA, Complementary; DNA, Complementary/biosynthesis/genetics; drug metabolism; genetic analysis; glucuronidation; Glucuronides; Glucuronides/metabolism; glucuronosyltransferase; Glucuronosyltransferase; glucuronosyltransferase 2B; glucuronosyltransferase 2b20; glucuronosyltransferase 2b39; glucuronosyltransferase 2b4; glucuronosyltransferase 2b40; glucuronosyltransferase 2b41; glucuronosyltransferase 2b42; glucuronosyltransferase 2b43; glucuronosyltransferase 2b44; glucuronosyltransferase 2b45; glucuronosyltransferase 2b46; glucuronosyltransferase 2B7; Glucuronosyltransferase/*genetics; high performance liquid chromatography; human cell; Humans; isoleucine; Liver; Liver/metabolism; Macaca; Macaca fascicularis; molecular cloning; Molecular Sequence Data; Morphine; Morphine/*metabolism; morphine 6 glucuronide; newborn; nonhuman; nuclear magnetic resonance spectroscopy; nucleotide sequence; Papio; Papio/*metabolism; perinatal development; morphine Phylogeny; priority journal; protein structure; Reverse Transcriptase Polymerase Chain Reaction; RNA; RNA/biosynthesis/isolation & purification; sequence analysis; Species Specificity; unclassified drug

Auvity, S., Saba, W., Goutal, S., Leroy, C., Buvat, I., Cayla, J., Caillé, F., Bottlaender, M., Cisternino, S., & Tournier, N. (2017). Acute Morphine Exposure Increases the Brain Distribution of [18F]DPA-714, a PET Biomarker of Glial Activation in Nonhuman Primates. *The International Journal of Neuropsychopharmacology*, 20(1), 67–71.
<https://doi.org/10.1093/ijnp/pyw077>

Keywords: Brain/*diagnostic imaging/*drug effects/immunology; Fluorine Radioisotopes/pharmacokinetics; Kinetics; Male; Morphine/*pharmacology;

Narcotics/*pharmacology; Neuroglia/*drug effects/immunology; *neuroimmunopharmacology; *neuroinflammation; *opioid; Papio anubis; Parotid Gland/diagnostic imaging/drug effects/metabolism; *Positron-Emission Tomography; Pyrazoles/pharmacokinetics; Pyrimidines/pharmacokinetics; Radiopharmaceuticals/pharmacokinetics; *translocator protein 18 kDa; *TSPO

Clauss, R. P., Dormehl, I. C., Oliver, D. W., Nel, W. H., Kilian, E., & Louw, W. K. (2001). Measurement of cerebral perfusion after zolpidem administration in the baboon model. *Arzneimittel-Forschung*, 51(8), 619–622. MEDLINE. <https://doi.org/10.1055/s-0031-1300090>

Keywords: Algorithms; Brain/diagnostic imaging; Cerebrovascular Circulation/*drug effects; Hypnotics and Sedatives/*pharmacology; Male; Papio/*physiology; Pyridines/*pharmacology; Radiopharmaceuticals; Technetium Tc 99m Exametazime Tomography, Emission-Computed, Single-Photon; Zolpidem

Kumar, J. S. D., Bai, B., Zanderigo, F., DeLorenzo, C., Prabhakaran, J., Parsey, R. V., & Mann, J. J. (2018). In Vivo Brain Imaging, Biodistribution, and Radiation Dosimetry Estimation of [(11)C]Celecoxib, a COX-2 PET Ligand, in Nonhuman Primates. *Molecules (Basel, Switzerland)*, 23(8). <https://doi.org/10.3390/molecules23081929>

Keywords: Body Weight/drug effects; biodistribution; Brain; Brain/*diagnostic imaging; Carbon Radioisotopes/*chemistry; celecoxib; *Celecoxib/blood/chemistry/*pharmacokinetics; COX-2; dosimetry; Ligands; Magnetic Resonance Imaging; Metabolome; *Neuroimaging; Papio; PET; *Positron-Emission Tomography; Radiometry; Time Factors; Tissue Distribution/drug effects

Miller, B., Marks, L. A., Koller, J. M., Newman, B. J., Bretthorst, G. L., & Black, K. J. (2013). Prolactin and fMRI response to SKF38393 in the baboon. *PeerJ*, 2013(1). Scopus. <https://doi.org/10.7717/peerj.195>

Keywords: 2, 3, 4, 5 tetrahydro 7, 8 dihydroxy 1 phenyl 1h 3 benzazepine; 3 allyl 6 chloro 2, 3, 4, 5 tetrahydro 7, 8 dihydroxy 1 phenyl 1h 3 benzazepine; adult; age; animal experiment; article; baboon; BOLD signal; Dopamine D1 receptor agonists; drug dose increase; drug response; endotracheal intubation; fMRI; functional magnetic resonance imaging; Isoflurane; Ketamine; male; nonhuman; Papio anubis; Pharmacological fMRI; Pramipexole; Prolactin; radioimmunoassay; SKF38393; SKF82958; unclassified drug

Price, J. C., Drevets, W. C., Ruszkiewicz, J., Greer, P. J., Villemagne, V. L., Xu, L., Mazumdar, S., Cantwell, M. N., & Mathis, C. A. (2002). Sequential H215O PET studies in baboons: Before and after amphetamine. *Journal of Nuclear Medicine*, 43(8), 1090–1100. Scopus.

Keywords: Amphetamine; Anesthesia; animal experiment; animal model; article; baboon; binding affinity; Blood flow; blood sampling; bolus injection; Brain; Brain/*diagnostic imaging; brain circulation; brain cortex; carbon 11; Carbon Radioisotopes; cerebellum; Cerebrovascular Circulation; Cerebrovascular Circulation/*drug effects; controlled study; corpus striatum; Dextroamphetamine*; Dopamine; Dopamine/metabolism; Dopamine Antagonists; dopamine

release; Magnetic Resonance Imaging; nonhuman; nuclear magnetic resonance imaging; Oxygen Radioisotopes*; Papio*; PET; positron emission tomography; priority journal; Raclopride; Tomography, Emission-Computed*; Water; water o 15

Schumann-Bard, P., Touzani, O., Young, A. R., Toutain, J., Baron, J.-C., Mackenzie, E. T., & Schmidt, E. A. (2005). Cerebrovascular effects of sodium nitroprusside in the anaesthetized baboon: A positron emission tomographic study. *Journal of Cerebral Blood Flow and Metabolism : Official Journal of the International Society of Cerebral Blood Flow and Metabolism*, 25(4), 535–544. MEDLINE. <https://doi.org/10.1038/sj.jcbfm.9600044>

Keywords: Adjuvants, Anesthesia/pharmacology; Anesthesia; Anesthetics, Intravenous; Brain/diagnostic imaging; Cerebrovascular Circulation/*drug effects; Etomidate; Ganglionic Blockers/pharmacology; Male; Nitroprusside/*pharmacology; Papio; Positron-Emission Tomography; Regression Analysis; Trimethaphan/pharmacology; Vasodilator Agents/*pharmacology

Schwartz, A. E., & Pile-Spellman, J. (2011). New model of reperfused stroke by occlusion of the anterior cerebral artery in baboons. *Acta Neurochirurgica*, 153(2), 327–331. Scopus. <https://doi.org/10.1007/s00701-010-0816-1>

Keywords: Animal; animal experiment; animal model; animal tissue; Anterior Cerebral Artery; article; Baboons; Blood Vessel Prosthesis Implantation; brain infarction; brain infarction size; Cerebral ischemia; coil embolization; controlled study; Disease models, animal; Disease Models, nonhuman; hemisphere; Humans; Infarction, Anterior Cerebral Artery; Intracranial Embolism; Male; neurologic disease; nuclear magnetic resonance imaging; occlusive cerebrovascular disease; Papio; priority journal; Reperfusion; Reperfusion Injury

Seah, S., Asad, A. B. A., Baumgartner, R., Feng, D., Williams, D. S., Manigbas, E., Beaver, J. D., Reese, T., Henry, B., Evelhoch, J. L., & Chin, C.-L. (2014). Investigation of cross-species translatability of pharmacological MRI in awake nonhuman primate—A buprenorphine challenge study. *PloS One*, 9(10), e110432. <https://doi.org/10.1371/journal.pone.0110432>

Keywords: Anesthesia, General; Analgesics, Opioid/*pharmacology; Buprenorphine/*pharmacology; Corpus Striatum/*drug effects/physiology; Female; Frontal Lobe/*drug effects/physiology; Gyrus Cinguli/*drug effects/physiology; Macaca fascicularis/physiology; Magnetic Resonance Imaging/methods; Receptors, Opioid, mu/agonists/metabolism; Thalamus/*drug effects/physiology; Translational Research, Biomedical; Wakefulness/physiology

Sloan, T., & Rogers, J. (2009). Dose and timing effect of etomidate on motor evoked potentials elicited by transcranial electric or magnetic stimulation in the monkey and baboon. *Journal of Clinical Monitoring and Computing*, 23(4), 253–261. Scopus. <https://doi.org/10.1007/s10877-009-9190-z>

Keywords: action potential; Action Potentials; Action Potentials/drug effects; Amines; Amplification; amplitude modulation; Anesthesia; anesthesia induction; Anesthesiology; Anesthetics; Anesthetics, Intravenous; Anesthetics, Intravenous/pharmacology; animal experiment; article; atropine; Baboon; Bioelectric potentials; Compound action potentials; controlled study; cortical electric motor evoked potential; cortical magnetic motor evoked potential; Cortical stimulation; Diffusers (optical); dose response; Dose-Response Relationship; Drug; drug megadose; Electric Stimulation; Electrophysiology; Etomidate; Etomidate/*pharmacology; experimental monkey; evoked muscle response; Evoked Potentials, Motor; Evoked Potentials, Motor/*drug effects; evoked somatosensory response; Female; Haplorhini; Intravenous injections; Isoflurane; Ketamine; latent period; Low dose; low drug dose; Magnetics*; Magnetic stimulation; Monkey; Motor evoked potentials; Motors; Muscle; Muscle action; muscle action potential; Muscle response; Muscles; Muscles/*drug effects; nonhuman; Papio; priority journal; single drug dose; Somatosensory evoked potentials; Spinal cords; synaptic potential; Time Factors; Transcranial; *Magnetics; transcranial magnetic stimulation

Xenotransplantation Research

Description: Baboons have become the prominent model for xenotransplantation research for transplanting porcine organs (pig-to-baboon transplantation). The following citations describing anesthesia and analgesia protocols for surgery for xenotransplantation research.

Results (7):

Bauer, A., Baschnegger, H., Abicht, J. M., Brandl, U., Brenner, P., Thein, E., Hammer, C., Reichart, B., Peter, K., Schmoeckel, M., & Christ, F. (2005). hDAF porcine cardiac xenograft maintains cardiac output after orthotopic transplantation into baboon—A perioperative study. *Xenotransplantation*, 12(6), 444–449. Scopus. <https://doi.org/10.1111/j.1399-3089.2005.00242.x>

Keywords: anesthesia induction; Animals, Genetically Modified; animal experiment; animal model; article; Antigens, CD55; Baboon; bleeding; blood gas; Cardiac output; cardiopulmonary bypass; cefuroxime; central venous pressure; cyclosporin A; controlled study; femoral artery; fentanyl; heart function; heart output; heart muscle oxygen consumption; heart rate; heart stroke volume; Heart Transplantation; hemodilution; hemoglobin; heparin; Humans; hypertensive factor; immunosuppressive treatment; inotropic agent; male; mean arterial pressure; methylprednisolone; nonhuman; orthotopic transplantation; Papio; perioperative period; priority journal; propofol; rapamycin; Swine; tacrolimus; Thermodilution; thymocyte antibody; Transgenes; transgenic animal; Transplantation, Heterologous; xenograft; Xenotransplantation

Bauer, A., Baschnegger, H., Renz, V., Brandl, U., Brenner, P., Thein, E., Reichart, B., Schmoeckel, M., & Christ, F. (2007). Comparison of propofol and isoflurane anesthesia in orthotopic pig-to-baboon cardiac xenotransplantation. *Xenotransplantation*, 14(3), 249–254. Scopus. <https://doi.org/10.1111/j.1399-3089.2007.00383.x>

Keywords: adrenalin; Anesthesia; Anesthesia, General; Anesthesia, General/methods/veterinary; Anesthetics, Inhalation/*pharmacology; Anesthetics, Inhalation; Anesthetics, Intravenous; Anesthetics, Intravenous/*pharmacology; animal model; Animal Physiology and Biochemistry (Excluding Nutrition); Animal Surgery and Non-drug Therapy; article; Artiodactyla; Baboon; Blood Pressure; Blood Pressure/drug effects; body weight; cardiopulmonary bypass; catecholamine; Central Venous Pressure; Central Venous Pressure/drug effects; Cercopithecidae; controlled study; Disease Models, Animal; fentanyl; heart rate; Heart Transplantation; Isoflurane; Isoflurane/*pharmacology; Heart Rate; Heart Rate/drug effects; heart hemodynamics; heart output; Heart Transplantation/*methods; heparin; long term care; Male; mean arterial pressure; noradrenalin; nonhuman; orthotopic transplantation; Papio; Papio hamadryas; pigs; priority journal; Propofol; Propofol/*pharmacology; statistical significance; surgical technique; Suidae; Suiformes; Sus; Sus scrofa; swine; transgenic pig; Transplantation, Heterologous; Transplantation, Heterologous/*methods Xenotransplantation; Veterinary Pharmacology and Anaesthesiology

Bauer, A., Renz, V., Baschnegger, H., Abicht, J.-M., Beiras-Fernandez, A., Brenner, P., Thein, E., Schmoeckel, M., Reichart, B., & Christ, F. (2011). Microcirculatory alterations after orthotopic pig-to-baboon heart transplantation. *Xenotransplantation*, 18(4), 232–238. Scopus. <https://doi.org/10.1111/j.1399-3089.2011.00645.x>

Keywords: animal experiment; Animals, Genetically Modified; animal tissue; Antigens, CD46; article; atg fresenius; baboon; blood gas analysis; cardiopulmonary bypass; cell interaction; correlation analysis; cyclophosphamide; graft rejection; heart index; Heart Transplantation; Hemodynamics; HLA antibody; HLA DR antibody; Humans; immunosuppressive treatment; intra-vital microscopy; lactate blood level; lactic acid; methylprednisolone; Microcirculation; microvasculature; nonhuman; orthogonal polarization spectral imaging; Papio; perioperative period; polarization microscope; polarization microscopy; priority journal; rapamycin; reperfusion; sublingual microcirculation; Swine; tacrolimus; T lymphocyte antibody transgenic pig; Transplantation, Heterologous; unclassified drug; xenotransplantation

Längin, M., Konrad, M., Reichart, B., Mayr, T., Vandewiele, S., Postrach, J., Mokolke, M., Radan, J., Brenner, P., Bauer, A., & Abicht, J.-M. (2020). Hemodynamic evaluation of anesthetized baboons and piglets by transpulmonary thermodilution: Normal values and interspecies differences with respect to xenotransplantation. *Xenotransplantation*, 27(5). Scopus. <https://doi.org/10.1111/xen.12576>

Keywords: adult; Anesthesia*; animal experiment; animal model; Article; baboon*; body surface; body weight; cardiac index; *cardiac transplantation; controlled study; general anesthesia; heart afterload; heart muscle contractility; heart preload; hemodynamics; *Hemodynamic Monitoring; Heterografts; Humans; Hemodynamics; hemodynamic monitoring; lung extravascular fluid; mean arterial pressure; nonhuman; Papio; Papio anubis; Papio hamadryas; *perioperative management; pig; piglet; priority journal; *reference range; reference value; Reference Values; species comparison; Swine; systemic vascular resistance; *Thermodilution; Transplantation, Heterologous; *transpulmonary thermodilution; xenograft; *xenotransplantation

Mayr, T., Bauer, A., Reichart, B., Guethoff, S., Schoenmann, U., Längin, M., Panelli, A., Kind, A., Brenner, P., & Abicht, J.-M. (2017). Hemodynamic and perioperative management in two different preclinical pig-to-baboon cardiac xenotransplantation models. *Xenotransplantation*, 24(3). Scopus. <https://doi.org/10.1111/xen.12295>

Keywords: amiodarone; Anesthesia; anesthesia management*; Heterografts; animal experiment; Animals, Genetically Modified; animal model; Article; *baboon; blood clotting; Blood Coagulation; cardiac transplantation*; cardioplegia; Cardiopulmonary Bypass; catecholamine; central venous catheter; dobutamine; extubation; Heart Transplantation; Heart Transplantation/*methods; Hemodynamics; hemostasis; Heterografts/*physiology; heterotopic transplantation; Humans; intensive care; iloprost; lung function; milrinone; nonhuman; Models, Animal; noradrenalin; orthotopic transplantation; operative blood loss; Papio anubis; Papio hamadryas; Perioperative Care; Perioperative Care/methods; perioperative management*; perioperative period; physiology; pig; plasma transfusion; pneumothorax; priority journal; procedures; transgenic animal; Sus scrofa; Swine; thermodilution; thrombocyte transfusion; Transplantation, Heterologous; Transplantation, Heterologous/*methods; transthoracic echocardiography; Ventilator Weaning; xenograft; xenotransplantation*

Santerre, D., Chen, R. H., Kadner, A., Lee-Parritz, D., & Adams, D. H. (2001). Anaesthetic Management of Baboons Undergoing Heterotopic Porcine Cardiac Xenotransplantation. *Veterinary Research Communications*, 25(4), 251–259. Scopus. <https://doi.org/10.1023/A:1010683907590>

Keywords: adverse reactions; Anesthesia; Anesthesia/methods/*veterinary; Anesthetics, Inhalation; Anesthetics, Inhalation/administration & dosage; Anesthetics, Intravenous; Anesthetics, Intravenous/administration & dosage; animal disease; Animal Surgery and Non-drug Therapy; article; Artiodactyla; Baboon; Blood Pressure; Blood Pressure/drug effects; Cardiovascular; Cercopithecidae; drug effect; Electrocardiography; Electrocardiography/drug effects/veterinary; Fentanyl; Fentanyl/administration & dosage; Heart Transplantation Heart Transplantation/methods/*veterinary; heterografts; heterotransplants; hogs; inhalation anesthetic agent; inhaled anesthetics; intravenous anesthetic agent; Isoflurane/administration & dosage/methodology; neuromuscular depolarizing agent; Neuromuscular Depolarizing Agents; Neuromuscular Depolarizing Agents/administration & dosage; Oximetry; Oximetry/veterinary; Pancuronium; Pancuronium/administration & dosage; Papio; Papio anubis; Papio/*surgery; Papio hamadryas; pigs; Suidae; Suiformes; Surgery; Sus; Sus scrofa; Swine; Swine/surgery; Technique; Transplantation, Heterologous; Transplantation, Heterologous/methods/*veterinary; Techniques and Methodology; Tissue and Organ Procurement; transplantation; xenograft; Veterinary Pharmacology and Anaesthesiology

Schirmer, J. M., Fass, D. N., Byrne, G. W., Tazelaar, H. D., Logan, J. S., & McGregor, C. G. A. (2004). Effective antiplatelet therapy does not prolong transgenic pig to baboon *Papio anubis* cardiac xenograft survival. *Xenotransplantation*, 11(5), 436–443. CAB Abstracts. <https://doi.org/10.1111/j.1399-3089.2004.00159.x>

Keywords: Anaesthesiology; Artiodactyla; Cell, Tissue and Embryo Manipulation; Cercopithecidae; Papio; Papio Anubis; pigs; Suidae; Suiformes; Sus; Sus scrofa; Veterinary Pharmacology and Diagnostic, Therapeutic and Pharmacological Biotechnology

Great Apes and Gibbons



Chimpanzee. Courtesy Adobe Stock Photos.

Description: This section contains citations on anesthesia and analgesia for great apes in a laboratory, zoo, or wild setting. Species covered include chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*). Gibbons (of the genus *Hylobates*) are also included, even though they are classified as lesser apes.

Anesthesia

Description: This section includes anesthesia protocols and citations on monitoring of vital signs during surgery for great apes and gibbons. It also includes citations that describe anesthesia protocols for a specific type of surgery (such as neurosurgery or eye surgery), for sedation/chemical restraint, or for diagnostic imaging (such as MRIs).

Results (27):

Adami, C., Wenker, C., Hoby, S., & Bergadano, A. (2012). Evaluation of effectiveness, safety and reliability of intramuscular medetomidine-ketamine for captive great apes. *The Veterinary Record*, 171(8), 196. <https://doi.org/10.1136/vr.100761>

Keywords: Anesthesia Recovery Period; Anesthesia/methods/*veterinary; Anesthetics, Inhalation/administration & dosage; Gorilla gorilla/physiology; Hominidae/*physiology; Injections, Intramuscular/veterinary; Isoflurane/administration & dosage; Ketamine/*administration & dosage; Medetomidine/*administration & dosage; Pan troglodytes/physiology; Pongo/physiology; Time Factors

Adami, C., Wenker, C., Hoby, S., Morath, U., & Bergadano, A. (2013). Anaesthesia with medetomidine-ketamine-isoflurane with and without midazolam, in eight captive chimpanzees (*Pan troglodytes*) premedicated with oral zuclopenthixol. *Schweizer Archiv Fur Tierheilkunde*, 155(8), 471–476. <https://doi.org/10.1024/0036-7281/a000493>

Keywords: *Anesthetics, Combined; Anesthesia; Anesthesia Recovery Period; Anesthesia/*veterinary; anesthetic agent; anesthetic recovery; Anesthetics, Combined*; Anesthetics, Dissociative; Anesthetics, Inhalation; Anesthetics, Intravenous; Animal Physiology and Biochemistry (Excluding Nutrition); Antipsychotic Agents; Blood Gas Analysis; Blood Gas Analysis/veterinary; chimpanzees; Clopenthixol; Hypnotics and Sedatives; inhalation anesthetic agent; intravenous anesthetic agent; Isoflurane; Ketamine; Laboratory Animal Science; Medetomidine; Midazolam; neuroleptic agent; Pan; Pan troglodytes; Pan troglodytes/*physiology; physiology; Pongidae; Preanesthetic Medication; Preanesthetic Medication/*veterinary; premedication; veterinary; Veterinary Pharmacology and Anaesthesiology; Zuclopenthixol

Adams, W. A., Robinson, K. J., Jones, R. S., & Sanderson, S. (2003). Isoflurane to prolong medetomidine/ ketamine anaesthesia in six adult female chimpanzees (*Pan troglodytes*). *The Veterinary Record*, 152(1), 18–20. MEDLINE. <https://doi.org/10.1136/vr.152.1.18>

Keywords: *Anesthetics, Inhalation; *Isoflurane; *Medetomidine; *Pan troglodytes; adults; anesthesia; anesthesia induction; anesthesia level; Anesthesia/*veterinary; anesthetic recovery; Anesthetics, Inhalation*; anthropometry; article; atipamezole; blood sampling; chimpanzees; contraceptives; controlled study; Dose-Response Relationship, Drug; drug potentiation; endotracheal intubation; females; general anesthesia; intramuscular injection; intrauterine contraceptive device; Isoflurane*; ketamine; lidocaine; Medetomidine*; microchip technology; nitric oxide; nitrous oxide; nonhuman; oxygen; Pan (ape); Pan troglodytes*; Pongidae; Time Factors; Troglodytes; Veterinary Pharmacology and Anaesthesiology; zalopine

Ardente, A., Chinnadurai, S., De Voe, R., Stringer, E., Webb, T., Ireland, J., & Saker, K. (2011). Relationship between gastrointestinal transit time and anesthetic fasting protocols in the captive chimpanzee, *Pan troglodytes*. *Journal of Medical Primatology*, 40(3), 181–187. MEDLINE. <https://doi.org/10.1111/j.1600-0684.2011.00468.x>

Keywords: *Fasting; *Gastric Emptying; *Gastrointestinal Transit; abdominal radiography; America; Anesthesia; Anesthesia/*veterinary; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); APEC countries; Appalachian States of USA; article; Barium; barium derivative; barium impregnated polyethylene sphere; Barium/administration & dosage; Barium/administration & dosage/pharmacokinetics

Ashley, A. L., Smith, C. K., Köster, L. S., Mulreany, L., & Cushing, A. C. (2021). Echocardiography and direct arterial blood pressure measurement in captive chimpanzees (*Pan troglodytes*) during two phases of an anesthetic protocol. *Journal of Zoo and Wildlife Medicine*, 52(2), 479–489. Scopus. <https://doi.org/10.1638/2020-0022>

Keywords: Adrenergic alpha-2 Receptor Antagonists; Adrenergic alpha-2 Receptor Antagonists/administration & dosage/pharmacology; adults; alpha 2 adrenergic receptor blocking agent; America; Anesthesia; Anesthesia/*veterinary; anesthetic agent; Anesthetics, Inhalation; Anesthetics, Inhalation/administration & dosage/pharmacology; antagonism; APEC countries; Appalachian States of USA; arterial pressure; Article; atipamezole; Blood Pressure; blood pressure monitoring; Blood Pressure Monitors; Blood Pressure/*physiology; chimpanzees; Developed Countries; Dexmedetomidine; Dexmedetomidine/administration & dosage/*pharmacology; Diagnosis of Animal Diseases; diastolic dysfunction; East South Central States of USA; Echocardiography; Echocardiography/*veterinary; heart afterload; heart left ventricle outflow tract; heart rate; heart valve diseases; heart ventricle filling; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage/pharmacology; imidazole derivative; Imidazoles; Imidazoles/administration & dosage/*pharmacology; inhalation anesthetic agent; Isoflurane; Isoflurane/administration & dosage/pharmacology; ketamine; medicine; midazolam; mitral valve regurgitation; nonhuman; North America; novaplus; OECD Countries; Pan; *Pan troglodytes; physiology; Pongidae; pulmonary artery; Southern States of USA; Techniques and Methodology; thickness; tissue Doppler imaging; tricuspid valve regurgitation; USA; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; wildlife; Zoo Animals; zoos

Atencia, R., Stohr, E. J., Drane, A. L., Stembridge, M., Howatson, G., Rodriguez Lopez del Rio, P., Feltrer, Y., Tafon, B., Redrobe, S., Peck, B., Eng, J., Unwin, S., Sanchez, C. R., & Shave, R. E. (2017). Heart rate and indirect blood pressure responses to four different field anesthetic protocols in wildborn captive chimpanzees (*Pan troglodytes*). *Journal of Zoo and Wildlife Medicine*, 48(3), 636–644. Zoological Record.

Keywords: *Anesthesia; *blood pressure; *chimpanzee; *heart disease; *heart rate; *Pan troglodytes; age; Anesthesia; anesthesia induction; anesthetic agent; Anesthetics; Anesthetics, Combined; Anesthetics, Combined/administration & dosage/*pharmacology; Anesthetics/administration & dosage/*pharmacology; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); Animals, Zoo; Article; atipamezole; Blood Pressure; Blood Pressure/*drug effects; body mass; breathing circuit; chimpanzees; confidence interval;

diastolic blood pressure; Drug Combinations; drug effect; flow rate; gender; heart disease; Heart Rate; Heart Rate/*drug effects; hemodynamics; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage/*pharmacology; Isoflurane; Isoflurane/administration & dosage/pharmacology; Ketamine; Ketamine/administration & dosage/pharmacology; Medetomidine; Medetomidine/administration & dosage/pharmacology; monitoring; Non-Communicable Diseases and Injuries of Animals; nonhuman; Pan; Pan troglodytes; Pongidae; protocols; systolic blood pressure; Tiletamine; tiletamine plus zolazepam; tiletamine, zolazepam drug combination; Tiletamine/administration & dosage/pharmacology; Veterinary Pharmacology and Anaesthesiology; Zolazepam; Zolazepam/administration & dosage/pharmacology; zoo animal

Bezner, J. (2019). Medical aspects of chimpanzee rehabilitation and sanctuary medicine. In *Fowler's Zoo and Wildlife Medicine: Current Therapy (Vol. 9)* (R. E. Miller, N. Lamberski, & P. P. Calle, Eds.; ZOOREC:ZOOR15503012320; p. 580).

Keywords: Anesthesia; breeding programs; chimpanzees; great apes; immobilization; Pan troglodytes; sedation; treatment techniques

Cervený, S., & Sleeman, J. (2014). Great Apes. In *Zoo Animal and Wildlife Immobilization and Anesthesia: Second Ed.* (pp. 573–584). Wiley Blackwell; Scopus. <https://doi.org/10.1002/9781118792919.ch39>

Keywords: Anesthesia; Great apes; Nonsteroidal anti-inflammatory drugs (NSAIDs); Opioids

Drane, A. L., Atencia, R., Cooper, S.-M., Feltrer, Y., Calvi, T., Strike, T., Palmer, C., Simcox, S., Rodriguez, P., Sanchez, C., van Bolhuis, H., Peck, B., Eng, J., Moittie, S., Unwin, S., Howatson, G., Oxborough, D., Stembridge, M. R., & Shave, R. E. (2020). Evaluation of relationships between results of electrocardiography and echocardiography in 341 chimpanzees (*Pan troglodytes*). *American Journal of Veterinary Research*, 81(6), 488–498. Scopus. <https://doi.org/10.2460/ajvr.81.6.488>

Keywords: anesthesia; Animal Health and Hygiene (General); Animal Physiology and Biochemistry (Excluding Nutrition); article; Biological Resources (Animal); chimpanzees; Diagnosis of Animal Diseases; diastole; ECG; Echocardiography; Electrocardiography; Heart Atria; heart atrium; heart left atrium; heart left ventricle wall; heart right atrium; Heart Ventricles; major clinical study; nonhuman; P wave; Pan; Pan troglodytes; Pongidae;; QRS interval; R wave amplitude; S wave amplitude; vertebrates; Zoo Animals; zoos

Drane, A. L., Atencia, R., Cooper, S.-M., Rodriguez, P., Sanchez, C., Simcox, S., Feltrer, Y., Peck, B., Eng, J., Moittie, S., Unwin, S., Howatson, G., Oxborough, D., Stembridge, M. R., & Shave, R. E. (2019). Cardiac structure and function characterized across age groups and between sexes in healthy wild-born captive chimpanzees (*Pan troglodytes*) living in

sanctuaries. *American Journal of Veterinary Research*, 80(6), 547–557. MEDLINE.
<https://doi.org/10.2460/ajvr.80.6.547>

Keywords: adult; Aging; anatomy and histology; anesthesia; anesthetics; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); Animals, Wild; Animals, Zoo; arterial wall thickness; Article; Blood Pressure; Body Weight; breathing rate; cardiac muscle; cardiovascular parameters; cardiovascular system; chimpanzees; controlled study; crown rump length; Doppler ultrasonography; Echocardiography; Echocardiography/veterinary; geometry; groups by age; Heart; heart auscultation; heart disease; heart function; heart stroke volume; heart valve regurgitation; Heart/*physiology; Heart/anatomy & histology; hemodynamics; Kolmogorov Smirnov test; nonhuman; Pan; Pan troglodytes; Pan troglodytes/*physiology; Pan troglodytes/anatomy & histology; physical examination; physiology; Pongidae; reference value; Reference Values; systolic blood pressure; tissue Doppler imaging; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; wild animal; zoo animal

Hess, L., Votava, M., Schreiberová, J., Málek, J., & Horáček, M. (2010). Experience with a naphthylmedetomidine-ketamine-hyaluronidase combination in inducing immobilization in anthropoid apes. *Journal of Medical Primatology*, 39(3), 151–159.
<https://doi.org/10.1111/j.1600-0684.2010.00404.x>

Keywords: *Pan troglodytes; *Pongo; Hyaluronoglucosaminidase/*administration & dosage; Immobilization/methods/*veterinary; Ketamine/*administration & dosage; Medetomidine/administration & dosage/*analogs & derivatives

Hill, L. R., Lee, R. D., & Keeling, M. E. (2001). Surgical technique for ambulatory management of airsacculitis in a chimpanzee (*Pan troglodytes*). *Comparative Medicine*, 51(1), 80–84. Scopus.

Keywords: Air Sacs; airsacculitis; ambulatory care; animal experiment; animal model; Animal Surgery and Non-drug Therapy; Anti-Bacterial Agents; antibiotic agent; antibiotic sensitivity; antimicrobial activity; article; bacterial infection; case studies; cephalexin; cephalosporins; chimpanzees; Combined Modality Therapy; controlled study; Drainage; Escherichia coli; Escherichia coli Infections; Escherichia infections; exudates; healing; intermethod comparison; laboratory mammals; leukocyte count; lung infection; Monkey Diseases; nonhuman; Pan; Pan troglodytes; Pongidae; postoperative period; Respiratory Tract Infections; stoma; surgery; surgical drainage; surgical technique; treatment planning; Veterinary Pharmacology and Anaesthesiology

Hyeroba, D., Apell, P., Goldberg, T., Shafer, L. A., Kidega, T., & Asimwe, C. (2013). Ketamine-medetomidine regimen for chemical immobilisation of free-ranging chimpanzees (*Pan troglodytes schweinfurthii*) in Uganda. *The Veterinary Record*, 172(18), 475.
<https://doi.org/10.1136/vr.101336>

Keywords: ACP Countries; Africa; Africa South of Sahara; anesthesia; Anesthesia Recovery Period; anesthetic agent; anesthetic recovery; Anesthetics, Dissociative; Anesthetics, Dissociative/administration & dosage/adverse effects/antagonists & inhibitors; Anglophone Africa; animal disease; Animals, Wild; chimpanzees; Commonwealth of Nations; Conservation medicine; Developing Countries; drug antagonism; East Africa; Human-animal interaction; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage/adverse effects/antagonists & inhibitors; Immobilization; Immobilization/methods/*veterinary; Ketamine/*administration & dosage/adverse effects/antagonists & inhibitors; Least Developed Countries; Medetomidine; Medetomidine/*administration & dosage/adverse effects/antagonists & inhibitors; methodology; Pan; Pan troglodytes; Pan troglodytes/*physiology; Pathogens, Parasites and Infectious Diseases (Wild Animals); physiology; Pongidae; short survey; Uganda; Veterinary Pharmacology and Anaesthesiology; wild animal; Wildlife

Johnson, J. A., Atkins, A. L., & Heard, D. J. (2010). Application of the laryngeal mask airway for anesthesia in three chimpanzees and one gibbon. *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 41(3), 535–537. <https://doi.org/10.1638/2009-0120.1>

Keywords: Anesthesia; Anesthesia, General; Anesthesia, General/instrumentation/*veterinary; animal disease; article; case report; chimpanzees; Farm and Horticultural Structures; general anesthesia; gibbon; Hominidae; Homo; *Hylobates; Hylobatidae; Industrial Wastes and Effluents; instrumentation; laryngeal mask airway; Laryngeal Masks; Laryngeal Masks/*veterinary; man; Non-communicable Human Diseases and Injuries; Non-drug Therapy and Prophylaxis of Humans; Pan; *Pan troglodytes; Pongidae

Magden, E. R., Sleeper, M. M., Buchl, S. J., Jones, R. A., Thiele, E. J., & Wilkerson, G. K. (2016). Use of an Implantable Loop Recorder in a Chimpanzee (*Pan troglodytes*) to Monitor Cardiac Arrhythmias and Assess the Effects of Acupuncture and Laser Therapy. *Comparative Medicine*, 66(1), 52–58. MEDLINE.

Keywords: Acupuncture Therapy/*veterinary; America; anesthetics; Animal Surgery and Non-drug Therapy; Ape Diseases/*diagnosis; Ape Diseases/*therapy; Ape Diseases/physiopathology; APEC countries; chimpanzees; circulatory system; clinical picture; coronary diseases; Developed Countries; Diagnosis of Animal Diseases; ECG; Electrocardiography, Ambulatory/*veterinary; Electrocardiography, Ambulatory/instrumentation; Equipment Design; Heart Rate; laser beams; laser radiation; Laser Therapy/*veterinary; Non-Communicable Diseases and Injuries of Animals; North America; OECD Countries; Pan; Pan troglodytes*; Pongidae; Predictive Value of Tests; Time Factors; Treatment Outcome; United States of America; Ventricular Premature Complexes/*veterinary; Ventricular Premature Complexes/diagnosis; Ventricular Premature Complexes/physiopathology; Ventricular Premature Complexes/therapy

Melis, S., Schauvliege, S., van Bolhuis, H., Hoyer, M., & Gasthuys, F. (2012). Chemical immobilization of chimpanzees (*Pan troglodytes*) using a combination of detomidine and ketamine. *Veterinary Anaesthesia and Analgesia*, 39(5), 520–528. <https://doi.org/10.1111/j.1467-2995.2012.00758.x>

Keywords: adults; Anesthetics, Combined/administration & dosage/*pharmacology; Animal Physiology and Biochemistry (Excluding Nutrition); Animals, Zoo; antagonists; Atipamezole; body temperature; Chemical immobilization; Chimpanzees; Cleaning, Grading, Handling, Storage and Transport Equipment; Detomidine; Drug Therapy, Combination; heart rate; hemoglobin; Humans; Imidazoles/administration & dosage/*pharmacology; Immobilization/*veterinary; Ketamine; Ketamine/administration & dosage/*pharmacology; observational studies; oxygen; Pan; Pan troglodytes; Pongidae; Veterinary Pharmacology and Anaesthesiology

Milnes, E. L., Calvi, T., Feltrer, Y., Drane, A. L., Howatson, G., Shave, R. E., Curry, B. A., Tremblay, J. C., & Williams, D. L. (2020). Factors affecting tear production and intraocular pressure in anesthetized chimpanzees (*Pan troglodytes*). *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 51(3), 687–690. <https://doi.org/10.1638/2020-0014>

Keywords: Anesthesia; Anesthesia/veterinary; anesthetic agent; Anesthetics; Anesthetics, Combined; Anesthetics, Combined/*administration & dosage; Anesthetics/*administration & dosage; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); Article; Biological Resources (Animal); body position; chimpanzees; contraceptive agent; Diagnosis of Animal Diseases; Combinations; drug effect; echocardiography; electrocardiogram; eye examination; Intraocular Pressure; Intraocular Pressure/*physiology; Intraocular Pressure/drug effects; Intraocular Pressure/drug effects/*physiology; lacrimal fluid; Medetomidine; Medetomidine/*administration & dosage; mouth examination; Non-Communicable Diseases and Injuries of Animals; nonhuman; ophthalmoscopy; Pan; Pan troglodytes; Pan troglodytes/*physiology; physical examination; physiology; Pongidae; primates; Random Allocation; randomization; recumbency; Tears; Tears/*physiology; Tears/drug effects; Tears/drug effects/*physiology; Tiletamine; tiletamine plus zolazepam; tiletamine, zolazepam drug combination; Tiletamine/*administration & dosage; tonometry; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; Zolazepam; Zolazepam/*administration & dosage

Miyabe-Nishiwaki, T., Kaneko, A., Yamanaka, A., Maeda, N., Suzuki, J., Tomonaga, M., Matsuzawa, T., Muta, K., Nishimura, R., Yajima, I., Eleveld, D. J., Absalom, A. R., & Masui, K. (2021). Propofol infusions using a human target controlled infusion (TCI) pump in chimpanzees (*Pan troglodytes*). *Scientific Reports*, 11(1), 1214. <https://doi.org/10.1038/s41598-020-79914-7>

Keywords: Anesthesia, General; Anesthesia, General/methods; Anesthesia, Intravenous; Anesthesia, Intravenous/methods; Anesthetics, Intravenous; Anesthetics, Intravenous/*administration & dosage; biological model; general anesthesia; Humans; Infusion Pumps; Infusions, Intravenous; Infusions, Intravenous/methods; intravenous anesthesia; intravenous anesthetic agent; intravenous drug administration; Models, Biological; Pan troglodytes; procedures; Propofol; Propofol/*administration & dosage

Moittié, S., Dobbs, P., Redrobe, S., Liptovszky, M., & White, K. (2021). Evaluation of the agreement of two oscillometric blood pressure devices with invasive blood pressure in anaesthetized chimpanzees (*Pan troglodytes*). *Veterinary Anaesthesia and Analgesia*, 48(5), 688–696. MEDLINE. <https://doi.org/10.1016/j.vaa.2021.01.010>

Keywords: adult; anesthesia; anesthesia induction; animal experiment; animal model; Arterial Pressure*; Article; Blood Pressure; Blood Pressure Determination*/veterinary; Blood Pressure Monitors/veterinary; chimpanzee; controlled study; correlation analysis; diastolic arterial pressure; invasive blood pressure; isoflurane; ketamine; limit of agreement; medetomidine; midazolam; nonhuman; noninvasive blood pressure; Pan troglodytes*; Prospective Studies; prospective study; systolic arterial pressure; tiletamine plus zolazepam; validation

Mosley, C. A. (2017). Anesthesia Equipment. In *Veterinary Anesthesia and Analgesia: The Fifth Ed. of Lumb and Jones* (pp. 23–85). Wiley; Scopus. <https://doi.org/10.1002/9781119421375.ch3>

Keywords: Anesthesia equipment; Endotracheal tube; Laryngeal mask airways; Nasotracheal intubation; Orotracheal intubation; Retrograde intubation; Supraglottic airway devices; Tracheostomy; Wire- or tube-guided techniques

Mulreany, L. M., Cushing, A. C., Ashley, A. L., & Smith, C. K. (2020). Potential for electroencephalographic monitoring of anesthetic depth in captive chimpanzees (*Pan troglodytes*) using a novel brain function monitor. *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 51(3), 729–732. <https://doi.org/10.1638/2019-0193>

Keywords: algorithm; alopecia; Anesthesia; anesthesia induction; anesthesia level; Anesthesia/*veterinary; anesthetic agent; anesthetic recovery; Anesthetics; Anesthetics/*metabolism; animal welfare; Article; atipamezole; atracurium besilate; Biological Resources (Animal); bispectral index; brain function; breathing rate; capnometry; case report; chimpanzees; clinical article; devices; dexmedetomidine; Diagnosis of Animal Diseases; echocardiography; electrocardiography; electroencephalogram; Electroencephalography; Electroencephalography/*methods; Electroencephalography/*veterinary; Electroencephalography/instrumentation; Electroencephalography/instrumentation/*methods/*veterinary; endotracheal intubation; extubation; eye position; fentanyl; general anesthesia; guinea pig; heart rate; intensive care unit;

isoflurane; ketamine; larynx spasm; metabolism; midazolam; Monitoring, Physiologic; Non-Communicable Diseases and Injuries of Animals; nonhuman; Pan; Pan troglodytes; patient monitoring; physiologic monitoring; Pongidae; predictive value; procedures; propofol; sedation; seizure; squamous cell carcinoma; tibial artery; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; waveform; Zoo Animals

Naples, L. M., Langan, J. N., & Kearns, K. S. (2010). Comparison of the anesthetic effects of oral transmucosal versus injectable medetomidine in combination with tiletamine-zolazepam for immobilization of chimpanzees (*Pan troglodytes*). *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 41(1), 50–62. <https://doi.org/10.1638/2009-0096.1>

Keywords: *Pan troglodytes; Administration, Topical; Althaea; Anesthesia; anesthetic agent; Anesthetics; Anesthetics/administration & dosage; Anesthetics/administration & dosage/pharmacology; Anesthetics/pharmacology; animal disease; Animals, Zoo; article; chimpanzees; clinical trial; Control; controlled clinical trial; controlled study; Drug Combinations; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage; Hypnotics and Sedatives/administration & dosage/pharmacology; Hypnotics and Sedatives/pharmacology; Immobilization; Immobilization/*veterinary; Injections, Intramuscular; intramuscular drug administration; Medetomidine; Medetomidine/*pharmacology; Medetomidine/administration & dosage; Medetomidine/administration & dosage/*pharmacology; Pan; Pan troglodytes; Pan troglodytes*; Pesticides and Drugs; Pongidae; randomized controlled trial; Tiletamine; Tiletamine-zolazepam; tiletamine, zolazepam drug combination; Tiletamine/*pharmacology; Tiletamine/administration & dosage; Tiletamine/administration & dosage/*pharmacology; topical drug administration; veterinary; Veterinary Pharmacology and Anaesthesiology; Zolazepam; Zolazepam/administration & dosage/*pharmacology; zoo animal

Olberg, R.-A. (2007). Monkeys and Gibbons. In *Zoo Animal and Wildlife Immobilization and Anesthesia* (G. West, D. Heard, & N. Caulkett, Eds.; BCI:BCI201300567135; p. 386).

Keywords: Anesthesia; gibbons; Hylobates

Olberg, R.-A., & Sinclair, M. (2014). Monkeys and Gibbons. In *Zoo Animal and Wildlife Immobilization and Anesthesia, Second Edition* (G. West, D. Heard, & N. Caulkett, Eds.; BCI:BCI201500234348; p. 571).

Keywords: Anesthesia; gibbons; Hylobates

Sigmund, A. B., Cushing, A. C., & Hendrix, D. V. H. (2020). Ophthalmic findings in 10 captive, anesthetized chimpanzees (*Pan troglodytes*). *Veterinary Ophthalmology*, 23(4), 760–763. Scopus. <https://doi.org/10.1111/vop.12766>

Keywords: America; animal experiment; Animals, Zoo; APEC countries; Article; atipamezole; blood sampling; case report; chimpanzees; conjunctivitis; controlled study; corneal surface; Developed Countries; dexmedetomidine; Diagnosis of Animal Diseases; dorsal recumbency; eye; eye examination; eye position; Intraocular Pressure; ketamine; lipid storage; medical information; midazolam; miosis; mydriasis; Non-Communicable Diseases and Injuries of Animals; nonhuman; North America; novaplust; oculoplethysmography; OECD Countries; ophthalmoscopy; Pan; Pan troglodytes; physical examination; physiology; Pongidae; pupil; pupillary diameter; recumbency; refraction error; Schirmer test; slit lamp microscopy; tear production; Tonometry, Ocular; tropicamide; tuberculosis control; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; visual acuity; visual impairment; visual system parameters; Zoo Animals

Strong, V., Möller, T., Tillman, A.-S., Träff, S., Guevara, L., Martin, M., Redrobe, S., & White, K. (2018). A clinical study to evaluate the cardiopulmonary characteristics of two different anaesthetic protocols for immobilization of healthy chimpanzees (*Pan troglodytes*). *Veterinary Anaesthesia and Analgesia*, 45(6), 794–801.
<https://doi.org/10.1016/j.vaa.2018.06.015>

Keyword: anesthesia; anesthesia level; anesthetic agent; anesthetic recovery; Anesthetics; Anesthetics, Combined; Anesthetics, Combined/pharmacology; Anesthetics/*pharmacology; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); arterial oxygen saturation; arterial pressure; Article; atipamezole; auscultation; biomarkers; blood pressure monitoring; body weight; breathing; breathing rate; cardiopulmonary function; cardiovascular diseases; cardiovascular parameters; chimpanzees; Clinical Protocols; clinical trial; color; comparative study; diastolic blood pressure; drug activity; Drug Combinations; drug effect; echocardiography; electrocardiography; endotracheal intubation; eye position; eyelid reflex; heart function; heart rate; heart ventricle septum defect; hematology; Hemodynamics; Hemodynamics/*drug effects; hemoglobin; hypotension; immobilization; ketamine; ketaminol; left ventricular end diastolic diameter; left ventricular end systolic diameter; Longitudinal Studies; mean arterial pressure; Medetomidine; Medetomidine/*pharmacology; midazolam; mucosa; muscle relaxation; muscles; Non-Communicable Diseases and Injuries of Animals; nonhuman; oxygen; oxygen affinity; oxygen saturation; Pan; Pan troglodytes; Pongidae; Prospective Studies; prospective study; pulse rate; rectal temperature; Respiration; Respiration/*drug effects; respiratory rate; systolic blood pressure; t-test; Techniques and Methodology; temperature; Tiletamine; tiletamine plus zolazepam; tiletamine–zolazepam; tiletamine, zolazepam drug combination; Tiletamine/*pharmacology; Veterinary Pharmacology and Anaesthesiology; voluntary movement; zalopine; Zolazepam; Zolazepam/*pharmacology

Unwin, S. J. (2007). Is a crush cage a viable alternative to darting when anaesthetising chimpanzees? In *Proceedings of the Institute for Zoo and Wildlife Research, Berlin* (G. Wibbelt, N. Bergholz, S. Seet, & H. Hofer, Eds.; Issue No.7, pp. 76–81). Institute for Zoo and Wildlife Research; CAB Abstracts.

<https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20083077018&site=ehost-live>

Keywords: Animal Welfare; British Isles; chimpanzees; Commonwealth of Nations; Developed Countries; Europe; European Union Countries; OECD Countries; Pan; Pongidae; Veterinary Pharmacology and Anaesthesiology; Western Europe; Zoo Animals

Analgesia

Description: This section features information on the use of analgesic drugs and therapies such as acupuncture in great apes and gibbons to treat postoperative or other pain.

Results (2):

Magden, E. R., Haller, R. L., Thiele, E. J., Buchl, S. J., Lambeth, S. P., & Schapiro, S. J. (2013). Acupuncture as an adjunct therapy for osteoarthritis in chimpanzees (*Pan troglodytes*). *Journal of the American Association for Laboratory Animal Science*, 52(4), 475–480. Scopus.

Keywords: Acupuncture Therapy; animal model; Ape Diseases; article; chimpanzee; diagnostic test accuracy study; nonhuman; Osteoarthritis; Pain Management; Pan troglodytes; reinforcement; treatment outcome

Videan, E. N., Lammey, M. L., & Lee, D. R. (2011). Diagnosis and treatment of degenerative joint disease in a captive male chimpanzee (*Pan troglodytes*). *Journal of the American Association for Laboratory Animal Science*, 50(2), 263–266. Scopus.

Keywords: America; Animal Surgery and Non-drug Therapy; Ape Diseases; APEC countries; article; carprofen; case studies; celecoxib; chimpanzees; chondroitin; Developed Countries; Diagnosis of Animal Diseases; disease course; disease severity; drug therapy; free range husbandry; geriatrics; glucosamine; glycosaminoglycan polysulfate; Great Plains States of USA; humans; ketorolac; knee osteoarthritis; Laboratory Animal Science; 86; Macaca; methylprednisolone; Mountain States of USA; Non-Communicable Diseases and Injuries of Animals; nonhuman; North America; OECD Countries; Osteoarthritis; pain; Pan; Pan troglodytes; Pongidae; quality of life; Recovery of Function; Southwestern States of USA; tramadol; Treatment Outcome; USA; Veterinary Pharmacology and Anaesthesiology; Western States of USA

Adverse Effects:

Description: This section contains citations about adverse effects of anesthetic or analgesic drugs on great apes and gibbons.

Results (7):

Anestis, S. F. (2009). Urinary cortisol responses to unusual events in captive chimpanzees (*Pan troglodytes*). *Stress (Amsterdam, Netherlands)*, 12(1), 49–57.
<https://doi.org/10.1080/10253890802041308>

Keywords: Aggression; Aggression/physiology; Agonistic Behavior; Anesthesia; Anesthesia/adverse effects; animal experiment; article; Behavior, Animal; Behavior, Animal/physiology; Chimpanzees; controlled study; Cortisol; Drug Combinations; Environment; exercise; hurricane; Hydrocortisone; hydrocortisone urine level; Hydrocortisone/*urine; nonhuman; Novelty; Pan troglodytes; Pan troglodytes/*urine; Play and Playthings; priority journal; Psychosocial stress; radioimmunoassay; Social Behavior; Social Dominance; stress; Stress, Psychological; Stress, Psychological/*urine; Tiletamine; Tiletamine/adverse effects; urinalysis; urinary excretion; Urine; Zolazepam; Zolazepam/adverse effects

Anestis, S. F., Bribiescas, R. G., & Hasselschwert, D. L. (2006). Age, rank, and personality effects on the cortisol sedation stress response in young chimpanzees. *Physiology & Behavior*, 89(2), 287–294. MEDLINE. <https://doi.org/10.1016/j.physbeh.2006.06.010>

Keywords: Adaptation, Psychological; Age; age distribution; Age Factors; animal behavior; animal experiment; article; Behavioral style; blood sampling; Captivity; Chimpanzees; controlled study; Cortisol; Dominance rank; hydrocortisone; hydrocortisone blood level; Hydrocortisone/*blood; Hypnotics and Sedatives; Juveniles; Ketamine; nonhuman; Pan troglodytes/*psychology; Pan troglodytes/physiology; personality; Personality; Personality/*physiology; priority journal; scoring system; Sedation; sex difference; Social Dominance*; Stress, Psychological/*blood; Stress, Psychological/chemically induced; Testosterone

Burrows, A., Liptovszky, M., & Self, I. (2021). Physiological and anesthetic effects of hand injection versus darting to induce anesthesia in chimpanzees (*Pan troglodytes*). *Journal of Zoo and Wildlife Medicine*, 52(2), 445–452. Scopus. <https://doi.org/10.1638/2019-0191>

Keywords: *Pan troglodytes; anesthesia; anesthetic agent; anesthetics; Anesthetics, Dissociative; Anesthetics, Dissociative/administration & dosage/pharmacology; animal experiment; Anti-Anxiety Agents; Anti-Anxiety Agents/administration & dosage/pharmacology; anxiolytic agent; article; body temperature; breathing rate; captive animals; carbon dioxide; chimpanzees; controlled study; diastolic blood pressure; Drug Combinations; end tidal carbon dioxide tension; heart rate; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage/pharmacology; Injections, Intramuscular; Injections, Intramuscular/methods/*veterinary; intramuscular drug administration; male; Medetomidine; Medetomidine/administration & dosage/*pharmacology; medicine; Midazolam; Midazolam/pharmacology; muscle relaxation; muscles; nonhuman; oxygen; oxygen saturation; Pan; Pan troglodytes; physiological stress; Pongidae; procedures; respiratory rate; risk; Tiletamine; tiletamine, zolazepam drug combination; Tiletamine/administration & dosage/*pharmacology; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; wildlife; Zolazepam; Zolazepam/administration & dosage/*pharmacology; Zoo Animals; zoos

Drane, A. L., Calvi, T., Feltrer, Y., Curry, B. A., Tremblay, J. C., Milnes, E. L., Stöhr, E. J., Howatson, G., Oxborough, D., Stembridge, M., & Shave, R. (2021). The influence of anesthesia with and without medetomidine on cardiac structure and function in sanctuary captive chimpanzees (*Pan troglodytes*). *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 52(3), 986–996.
<https://doi.org/10.1638/2020-0024>

Keywords: *Anesthesia/veterinary; *Anesthetics/pharmacology; anesthesia; Anesthesia*/veterinary; Anesthetics*/pharmacology; Animal Health and Hygiene (General); Animal Physiology and Biochemistry (Excluding Nutrition); Article; atipamezole; Biological Resources (Animal); blood pressure; blood pressure monitoring; body mass; chimpanzees; diastolic blood pressure; echocardiography; heart function; Heart Rate; hemodynamics; medetomidine; Medetomidine/pharmacology; mitral valve; nonhuman; oxygen saturation; Pan; Pan troglodytes; Pongidae; systolic blood pressure; tiletamine plus zolazepam; tissue Doppler imaging; tricuspid annular plane systolic excursion; Veterinary Pharmacology and Anaesthesiology

Grassi, C., Glover, E. J., & Vazquez, M. (2005). The effects of sedation on chimpanzee (*Pan troglodytes*) behavior. *American Journal of Primatology*, 66, 148–149.

Keywords: Behavioral pattern; chimpanzees; feeding pattern; food ingestion time; Pan troglodytes; physiological pattern

Grassi, C., Glover, E. J., & Vazquez, M. (2006). The effects of sedation and research protocol on chimpanzee (*Pan troglodytes*) fecal cortisol levels. *American Journal of Primatology*, 68, 112–112.

Keywords: Chimpanzees; meeting abstract; Pan troglodytes; sedation effect

Masters, N. J., Burns, F. M., & Lewis, J. C. M. (2007). Peri-anaesthetic and anaesthetic-related mortality risks in great apes (Hominidae) in zoological collections in the UK and Ireland. *Veterinary Anaesthesia and Analgesia*, 34(6), 431–442.
<https://doi.org/10.1111/j.1467-2995.2007.00345.x>

Keywords: *Hominidae; Anesthesia/adverse effects/*veterinary; Animals, Zoo; England/epidemiology; Ireland/epidemiology; Postoperative Complications/chemically induced/mortality/*veterinary; Records; Retrospective Studies; Veterinary Medicine

Case Studies

Description: Here are six anesthesia or analgesia case studies featuring individual wild and captive chimpanzees (*Pan troglodytes*) and a gibbon/Siamang monkey (*Hylobates syndactylus*).

Results (6):

Champeaux, C., & Raballand, E. (2015). Craniocerebral gunshot wound in a baby chimpanzee—An uncommon experience of neurosurgical treatment conducted in the Guinean forest. *Journal of Medical Primatology*, 44(1), 49–52. Scopus. <https://doi.org/10.1111/jmp.12156>

Keywords: amoxicillin; Antibiotherapy; antibiotic therapy; Ape Diseases; Article; bone remodeling; brain abscess; brain contusion; Brain Injuries; case report; cefixime; cerebrospinal fluid; Chimpanzee; clavulanic acid; complication; Craniocerebral gunshot wound; Craniocerebral infection; diazepam; drug substitution; dura mater; Female; foreign body; general anesthesia; Guinean; gunshot injury; head injury; hemiparesis; hexamidine isetionate; infant; ketamine; local anesthesia; local therapy; long term care; marbofloxacin; medetomidine; neurosurgery; Neurosurgical procedure; nonhuman; Pan; Pan troglodytes; Paresis; penetrating trauma; pia mater; priority journal; skin flap; subarachnoid hemorrhage; sulfamethoxazole; trimethoprim; weight gain; Wound Healing; Wounds, Gunshot

D’Agostino, J., Isaza, R., Fingland, R., Hoskinson, J., & Ragsdale, J. (2007). Acute appendicitis in a chimpanzee (*Pan troglodytes*). *Journal of Medical Primatology*, 36(3), 119–123. Scopus. <https://doi.org/10.1111/j.1600-0684.2007.00198.x>

Keywords: abdominal pain; abdominal radiography; abnormal laboratory result; acute appendicitis; amoxicillin; anesthesia induction; animal tissue; Animals, Zoo; anorexia; Ape Diseases; Appendectomy; Appendicitis; article; blood analysis; buprenorphine; butorphanol; Chimpanzee; computer assisted tomography; constipation; enema; Female; histopathology; hot water; inflammatory infiltrate; intestine mucosa; intestine muscle; laparotomy; lethargy; mesentery; nonhuman; outcome assessment; Pan; Pan troglodytes; paracetamol; physical examination; postoperative pain; postoperative period; priority journal; procaine penicillin; Radiography, Abdominal; Ringer lactate solution; Tomography, X-Ray Computed; Treatment Outcome

Jimenez Baigorria, M. V. L. (2004). Anesthetic protocol for the surgery on a chimpanzee (*Pan troglodytes*). *Internet Journal of Veterinary Medicine*, 1(2). CAB Abstracts. <https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20053026908&site=ehost-live>

Keywords: anesthesia; anesthetics; Animal Surgery and Non-drug Therapy; chimpanzees; Non-Communicable Diseases and Injuries of Animals; Pan; Pongidae; Veterinary Pharmacology and Anaesthesiology

Lonsdorf, E., Travis, D., Ssuna, R., Lantz, E., Wilson, M., Gamble, K., Terio, K., Leendertz, F., Ehlers, B., Keele, B., Hahn, B., Gillespie, T., Pond, J., Raphael, J., & Collins, A. (2014). Field immobilization for treatment of an unknown illness in a wild chimpanzee (*Pan troglodytes schweinfurthii*) at Gombe National Park, Tanzania: Findings, challenges, and lessons learned. *Primates; Journal of Primatology*, 55(1), 89–99. <https://doi.org/10.1007/s10329-013-0372-4>

Keywords: *Pan troglodytes; animal disease; Ape Diseases; Ape Diseases/*diagnosis/etiology; article; Blood Chemical Analysis; Blood Chemical Analysis/veterinary; blood examination; case report; Communicable Diseases; Communicable Diseases/diagnosis/etiology/*veterinary; Diagnosis, Differential; Diagnostics; differential diagnosis; Disease; Gombe National Park; health care; Hematologic Tests; Hematologic Tests/veterinary; Immobilization; Immobilization/veterinary; infectious disease; Injections, Intramuscular; Injections, Intramuscular/veterinary; Intervention; intramuscular drug administration; Ketamine; Ketamine/administration & dosage; Kigoma [Tanzania]; Locomotion; male; Male; Pan troglodytes schweinfurthii; pathogen; species conservation; Tanzania; videorecording; Videotape Recording

Matyas, L., Dobbs, P., & Moittie, S. (2021). Acute fatal upper respiratory obstruction in a chimpanzee (*Pan troglodytes*) during anaesthesia Case report. *Magyar Allatorvosok Lapja*, 143(1), 39–46.

Keywords: Airway obstruction; anesthesia; anesthesiology; hypoxia; medetomidine; midazolam; nutrition-malnutrition and obesity; respiratory system; routine health check; tiletamin-zolazepam

Weiland, L., Vlamincx, L., Tavernier, P., & Gasthuys, F. (2007). Anaesthesia of a Siamang monkey (*Hylobates syndactylus*) for the surgical correction of a hand injury. *The Veterinary Record*, 161(7), 234–236. <https://doi.org/10.1136/vr.161.7.234>

Keywords: Female; Countries; Europe; European Union Countries; OECD Countries; Western Europe; Benelux; Anesthesia/*veterinary; Non-Communicable Diseases and Injuries of Animals; Veterinary Pharmacology and Anaesthesiology; Zoo Animals; Animal Surgery and Non-drug Therapy; Hylobatidae; Hylobates; Hand Injuries/surgery/*veterinary; Hylobates/*physiology/surgery; Orthopedic Procedures/veterinary; Hylobates syndactylus

Human Pain and Nociception Research, Pharmacology, and Drug Development

Description: These articles describe great apes as models for studying pain and nociception in humans as well as for drug development, pharmacokinetics, and pharmacodynamics.

Results (3):

Grace, J., Wong, H., Sinz, M., & Lentz, K. (2009). Comparison of the formation kinetics of acetaminophen in chimpanzee, cynomolgus monkey, marmoset, rhesus monkey and human liver microsomes. *Drug Metabolism Reviews*, 41, 58–59.

Keywords: Acetaminophen; analgesics; chimpanzees; cynomolgus monkeys; liver microsomes; marmosets; pharmacology; rhesus macaques; symposia, transactions and proceedings

Wong, H., Grace, J. E. J., Wright, M. R., Browning, M. R., Grossman, S. J., Bai, S. A., & Christ, D. D. (2006). Glucuronidation in the chimpanzee (*Pan troglodytes*): Studies with

acetaminophen, oestradiol and morphine. *Xenobiotica; the Fate of Foreign Compounds in Biological Systems*, 36(12), 1178–1190. <https://doi.org/10.1080/00498250600911028>

Keywords: Acetaminophen; Acetaminophen/*metabolism; Acetaminophen/administration & dosage; Acetaminophen/administration & dosage/*metabolism/pharmacokinetics; Acetaminophen/pharmacokinetics; Administration, Oral; animal cell; animal experiment; animal tissue; article; Chimpanzees; controlled study; drug clearance; drug conjugation; drug distribution; drug glucuronidation; drug half life; Enzyme kinetics; Estradiol; estradiol 17 glucuronide; estradiol 3 glucuronide; estradiol derivative; Estradiol/*metabolism; Estradiol/administration & dosage; Estradiol/administration & dosage/*metabolism/pharmacokinetics; Estradiol/pharmacokinetics; experimental animal; Glucuronidation; Glucuronides; Glucuronides/metabolism; human cell; human versus animal comparison; Humans; In Vitro Techniques; liver microsome; Microsomes, Liver; Microsomes, Liver/metabolism; Models, Animal; Morphine; morphine 3 glucuronide; morphine 6 glucuronide; Morphine/administration & dosage/*metabolism/pharmacokinetics; nonhuman; Pan troglodytes; Pan troglodytes/*metabolism; paracetamol; paracetamol glucuronide; paracetamol sulfate; Pharmacokinetics; single drug dose; Species Specificity; Sulphate conjugation; urinary excretion; Western blotting

Wong, H., Grossman, S. J., Bai, S. A., Diamond, S., Wright, M. R., Grace, J. E. J., Qian, M., He, K., Yeleswaram, K., & Christ, D. D. (2004). The chimpanzee (*Pan troglodytes*) as a pharmacokinetic model for selection of drug candidates: Model characterization and application. *Drug Metabolism and Disposition: The Biological Fate of Chemicals*, 32(12), 1359–1369. <https://doi.org/10.1124/dmd.104.000943>

Keywords: *Pharmacokinetics; Acetaminophen/pharmacokinetics; Adrenergic beta-Antagonists/pharmacokinetics; Analgesics, Non-Narcotic/pharmacokinetics; Blotting, Western; Bronchodilator Agents/pharmacokinetics; Calcium Channel Blockers/pharmacokinetics; Chromatography, High Pressure Liquid; Humans; In Vitro Techniques; Male; ass Spectrometry; Microsomes, Liver/metabolism; Models, Biological; Pan troglodytes/*physiology; Pharmaceutical Preparations/*metabolism; Propranolol/pharmacokinetics; Protein Binding; Rats; Rats, Sprague-Dawley; Species Specificity; Spectrometry, Fluorescence; Spectrophotometry, Ultraviolet; Theophylline/pharmacokinetics; Verapamil/pharmacokinetics

Positive Reinforcement Training

Description: These citations describe the use of positive reinforcement training (PRT) techniques to train chimpanzees (*Pan troglodytes*), orangutans (genus *Pongo*); and gorillas (*Gorilla gorilla*) to accept the administration of anesthetic and analgesic drugs or to submit to certain procedures without sedation or anesthesia.

Results (10):

Gresswell, C., & Goodman, G. (2011). Case study: Training a chimpanzee (Pan troglodytes) to use a nebulizer to aid the treatment of airsacculitis. *Zoo Biology*, 30(5), 570–578. Scopus. <https://doi.org/10.1002/zoo.20388>

Keywords: air sac; Air Sacs; animal; animal behavior; animal disease; Animal Physiology and Biochemistry (Excluding Nutrition); Animal Surgery and Non-drug Therapy; Animals; Anti-Bacterial Agents; antiinfective agent; article; artificial ventilation; Bacteria (microorganisms); Behavior, Animal; Chemistry and Formulation; chimpanzees; Colistin; Desensitization; Education, Extension, Information and Training (General); Female; Host Resistance and Immunity; isolation and purification; methodology; microbiology; nebulizer; Nebulizers and Vaporizers; Pan; Pan troglodytes; pathology; Pesticide and Drug Resistance; Pesticides and Drugs; Pongidae; Positive reinforcement; PRT; Pseudomonas aeruginosa; Pseudomonas infection; Pseudomonas Infections; reinforcement; Reinforcement (Psychology); Respiratory Therapy; Respiratory Tract Infections; Techniques and Methodology; Veterinary Pharmacology and Anaesthesiology; Zoo Animals

Hunter, R. P., Isaza, R., Carpenter, J. W., & Koch, D. E. (2004). Clinical effects and plasma concentrations of fentanyl after transmucosal administration in three species of great ape. *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 35(2), 162–166. <https://doi.org/10.1638/03-008>

Keywords: Adjuvants, Anesthesia/administration & dosage/*pharmacokinetics; Administration, Buccal; Administration, Oral; Animals, Zoo; Dose-Response Relationship, Drug; Fentanyl/administration & dosage/*pharmacokinetics; Gorilla gorilla/*physiology; Mouth Mucosa/metabolism; Pan troglodytes/*physiology; Pongo pygmaeus/*physiology; Safety; Time Factors

Lambeth, S. P., Hau, J., Perlman, J. E., Martino, M., & Schapiro, S. J. (2006). Positive reinforcement training affects hematologic and serum chemistry values in captive chimpanzees (*Pan troglodytes*). *American Journal of Primatology*, 68(3), 245–256. *Zoological Record*.

Keywords: Acute stress response; Anesthesia; animal behavior; article; Behavior, blood; Blood Cell Count; Blood Glucose; Blood serum chemistry; Chimpanzees; comparative study; glucose blood level; Hematocrit; Hematology; mental stress; metabolism; methodology; Neutrophils; Pan troglodytes; physiology; Positive reinforcement training; psychological aspect; reinforcement; Reinforcement (Psychology); Stress, Psychological

Lambeth, S. P., Perlman, J. E., Thiele, E., & Schapiro, S. J. (2005). Changes in hematology and blood chemistry parameters in captive chimpanzees (*Pan troglodytes*) as a function of blood sampling technique: Trained vs. Anesthetized samples. *American Journal of Primatology*, 66, 182–183.

Keywords: Anesthesia; behavioral effect; behavioral management program; blood sampling; chimpanzees; general biology - Symposia, transactions and proceedings; Pan troglodytes; training

Perlman, J. E., Franklin, A. N., Brennan, C. R., & Bloomsmith, M. A. (2015). Positive reinforcement training to voluntarily present for injection: identifying factors to predict

cooperation with injection of anesthesia in chimpanzees. *American Journal of Primatology*, 77, 91–91.

Keywords: Anesthetic injection; behavioral manager; behavior, method and techniques; chimpanzees; general biology - Symposia, transactions and proceedings; Pan troglodytes; positive reinforcement training; researcher; veterinarian; Yerkes National Primate Research Center

Reamer, L. A., Haller, R. L., Thiele, E. J., Freeman, H. D., Lambeth, S. P., & Schapiro, S. J. (2014). Factors affecting initial training success of blood glucose testing in captive chimpanzees (*Pan troglodytes*). *Zoo Biology*, 33(3), 212–220. CAB Abstracts. <https://doi.org/10.1002/zoo.21123>

Keywords: anesthetics; animal behavior; animal disease; Animal Nutrition (Physiology); Animal Physiology and Biochemistry (Excluding Nutrition); animal rights; Animal Welfare; Animals, Zoo; article; Behavior, Animal; Blood Glucose; blood sampling; Blood Specimen Collection; captive animals; chimpanzees; Diabetes; diabetes mellitus; disinfection; Education, Extension, Information and Training (General); glucose blood level; glucose in blood; group size; Non-Communicable Diseases and Injuries of Animals; noninsulin-dependent diabetes mellitus; Pan; Pan troglodytes; Personality; Pesticides and Drugs (General); physiology; Pongidae; Positive reinforcement training (PRT); rearing; reinforcement; Reinforcement (Psychology); sex difference; Sex Factors; standard; Teaching; therapeutics; Zoo Animals; zoos

Schapiro, S. J., Perlman, J. E., Thiele, E., & Lambeth, S. P. (2005). Training chimpanzees to voluntarily present for intramuscular injections using positive reinforcement training techniques. *American Journal of Primatology*, 66, 175–176.

Keywords: Animal care; captive management-related effort; chimpanzees; general biology - Symposia, transactions and proceedings; Pan troglodytes; positive reinforcement training; species behavior; veterinary management

Schapiro, S. J., Reamer, L. A., Maren, M. C., & Lambeth, S. P. (2014). Providing chimpanzees with opportunities to voluntarily participate in their own care: choice of medications. *American Journal of Primatology*, 76, 73–73.

Keywords: Analgesic drugs; behavioral biology-animal behavior; Behavioral management; chimpanzees; ibuprofen; meeting abstract; meloxicam; Pan troglodytes

Videan, E. N., Fritz, J., Murphy, J., Borman, R., Smith, H. F., & Howell, S. (2005). Training captive chimpanzees to cooperate for an anesthetic injection. *Lab Animal*, 34(5), 43–48. MEDLINE. <https://doi.org/10.1038/labon0505-43>

Keywords: animal behavior; Animals, Laboratory; Animals, Laboratory*; article; Behavior, Animal; Behavior, Animal/*physiology; comparative study; Conditioning, Operant; experimental animal; Injections; Injections*; instrumental conditioning; laboratory; Laboratory Animal Science; Laboratory Animal Science/*methods; Linear Models; methodology; Pan

troglodytes; Pan troglodytes/*physiology; physiology; reinforcement; Reinforcement (Psychology); Reinforcement, Psychology*; statistical model

Webb, S. J. N., Hau, J., & Schapiro, S. J. (2018). Refinements to captive chimpanzee (*Pan troglodytes*) care: A self-medication paradigm. *Animal Welfare*, 27(4), 327–341. Scopus. <https://doi.org/10.7120/09627286.27.4.327>

Keywords: Animal Welfare; Behavioural Management; Captivity; Chimpanzees; Choice; Health Economics; Non-Communicable Diseases and Injuries of Animals; Pan; Pongidae; Voluntary Participation

Macaques



A macaque family. Courtesy of Adobe Stock Photos.

Anesthesia

Description: This section features information on anesthesia protocols and monitoring of vital signs for macaques (genus *Macaca*). This section also includes citations that describe anesthesia protocols for a specific type of surgery (such as neurosurgery or eye surgery), for chemical restraint, or for imaging.

Results (89):

Authier, S., Chaurand, F., Legaspi, M., Breault, C., & Troncy, E. (2006). Comparison of three anesthetic protocols for intraduodenal drug administration using endoscopy in rhesus monkeys (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science*, 45(6), 73–79. Scopus.

Keywords: Administration, Rectal; Anesthesia; anesthesia induction; Anesthesia/*methods; Anesthesia Recovery Period; Anesthetics, Inhalation; Anesthetics, Inhalation/administration & dosage/adverse effects/pharmacology; anesthetic recovery; Anesthetics, Intravenous; Anesthetics, Intravenous/administration & dosage/adverse effects/pharmacology; anesthetics; animals; animal experiment; animal model; Animal Physiology and Biochemistry (Excluding Nutrition); article; blood pressure; body temperature; Cercopithecidae; comparative study; controlled study; cornea reflex; device; drug delivery systems; *Duodenoscopy; eyelid reflex; endoscopy; evaluation; gases; Glucose; Glucose/administration & dosage/pharmacokinetics; glucose absorption; glucose blood level; heart rate; hypothermia; inhalation anesthesia; intestinal absorption; intestine absorption; intramuscular injection; ; intravenous anesthetic agent; intravenous injection; Isoflurane; Isoflurane/administration & dosage/adverse effects/pharmacology; Ketamine; Ketamine/administration & dosage/adverse effects/pharmacology; Laboratory Animal Science; *Macaca mulatta; methodology; Midazolam; Midazolam/administration & dosage/adverse effects/pharmacology; *Models, Animal; muscle relaxation; nonhuman; Propofol; Propofol/administration & dosage/adverse effects/pharmacology; rectal drug administration; Veterinary Pharmacology and Anaesthesiology

Ballesteros, J. J., Huang, P., Patel, S. R., Eskandar, E. N., & Ishizawa, Y. (2020). Dynamics of Ketamine-induced Loss and Return of Consciousness across Primate Neocortex. *Anesthesiology*, 132(4), 750–762. <https://doi.org/10.1097/ALN.0000000000003159>

Keywords: Anesthetics, Dissociative/*administration & dosage; Consciousness/*drug effects/physiology; Electroencephalography/drug effects/methods; Excitatory Amino Acid Antagonists/*administration & dosage; Infusions, Intravenous; Ketamine/*administration & dosage; Macaca mulatta; Male; Neocortex/*drug effects/physiology; Unconsciousness/*chemically induced/physiopathology

Bertrand, H. G. M. J., Ellen, Y. C., O'Keefe, S., & Flecknell, P. A. (2016). Comparison of the effects of ketamine and fentanyl-midazolam-medetomidine for sedation of rhesus macaques (*Macaca mulatta*). *BMC Veterinary Research*, 12(1). Scopus. <https://doi.org/10.1186/s12917-016-0721-9>

Keywords: Anesthesia Recovery Period; Cleaning, Grading, Handling, Storage and Transport Equipment; Animal Physiology and Biochemistry (Excluding Nutrition); Cercopithecidae; Deep Sedation; Drug Therapy, Combination; combination drug therapy; deep sedation; Deep Sedation/veterinary; Fentanyl; Fentanyl/*pharmacology; Hypnotics and Sedatives; Hypnotics and Sedatives/*pharmacology; hypnotic sedative agent; Ketamine; Ketamine/*pharmacology; Macaca; *Macaca mulatta; macaque; Medetomidine; Medetomidine/*pharmacology;

Midazolam; Midazolam/*pharmacology; Recover; rhesus monkey; Sedation; veterinary; Veterinary Pharmacology and Anaesthesiology

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<https://doi.org/10.1177/0023677216675385>

Keywords: Anesthesia; buprenorphine; fentanyl; fluanisone; flumazenil; Hypnorm; neuroleptanalgesia; *Macaca mulatta*; midazolam; naloxone; respiratory depression; respiratory system disease; rhesus macaques; sedation

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Keywords: Adjuvants, Anesthesia/pharmacology; *anaesthesia; Anesthetics/pharmacology; Anesthetics, Combined/*pharmacology; Hypnotics and Sedatives/pharmacology; Immobilization/*methods; *ketamine; *Macaca mulatta*/*physiology; Medetomidine/*pharmacology; Midazolam/*pharmacology; Pregnanediones/*pharmacology; *sedation

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Keywords: alfentanil; anesthesia; anesthesia induction; anesthetic recovery; Anesthesia Recovery Period; Anesthetics, Inhalation; anesthetic vaporizer; animal experiment; Animal Models of Human Diseases; Animal Surgery and Non-drug Therapy; Article; artificial ventilation; breathing adaptor; buprenorphine; Cercopithecidae; comparative study; controlled study; endotracheal tube; ether derivative; fentanyl; Humans; inhalation anesthetic agent; intravenous injection; isoflo; Isoflurane; ketamine; meloxicam; Laboratory Animal Science; laboratory animals; *Macaca mulatta*; mechanical ventilator; Methyl Ethers; methylprednisolone sodium succinate; neurosurgery; Neurosurgical Procedures; Non-Communicable Diseases and Injuries of Animals; nonhuman; physiology; propofol; propoven; respiration depression; rhesus monkey; sevoflurane; sitting; ventilator; vetergesic; Veterinary Pharmacology and Anaesthesiology

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Keywords: anaesthesia; Anesthetics, Inhalation/*adverse effects; Desflurane; Isoflurane/adverse effects/*analogs & derivatives; *Macaca mulatta*/*surgery; Methyl Ethers/adverse effects; neurosurgery; Neurosurgical Procedures/*methods; Sevoflurane

Bohannon, J. K., Honko, A. N., Reeder, R. J., Cooper, K., Byrum, R., Bollinger, L., Kuhn, J. H., Wada, J., Qin, J., Jahrling, P. B., & Lackemeyer, M. G. (2016). Comparison of respiratory inductive plethysmography versus head-out plethysmography for anesthetized nonhuman primates in an animal biosafety level 4 facility. *Inhalation Toxicology*, 28(14), 670–676. Scopus. <https://doi.org/10.1080/08958378.2016.1247199>

Keywords: abdomen; ABSL-4; Administration, Inhalation; administration and dosage; aerobiology; aerosol; Aerosols; Anesthesia; anesthesia level; animal experiment; Article; biosafety; breathing; breathing mechanics; breathing rate; BSL-4; comparative study; Containment of Biohazards; dosimetry; exhalation; hazardous waste; head out plethysmography; infusion pump; inhalational drug administration; inspiratory capacity; lung minute volume; *Macaca mulatta*; measurement accuracy; nonhuman; Plethysmography; pneumotachograph; priority journal; procedures; Respiration; respiratory inductive plethysmography; rhesus monkey; telemetry; thorax; Tidal Volume; toxicity testing; tiletamine plus zolazepam; Toxicity Tests

Brownlee, R. D., Kass, P. H., & Sammak, R. L. (2020). Blood Pressure Reference Intervals for Ketamine-sedated Rhesus Macaques (*Macaca mulatta*). *Journal of The American Association for Laboratory Animal Science*, 59(1), 24–29. <https://doi.org/10.30802/AALAS-JAALAS-19-000072>

Keywords: Anesthesia; blood pressure; cardiovascular system (transport and circulation); equipment apparatus devices and instrumentation; ketamine; *Macaca mulatta*; rhesus macaques; neuropharmacology

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Keywords: Anesthesia; isoflurane; *Macaca mulatta*; ophthalmology; pentobarbital; rhesus macaques

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Keywords: *Anesthesia; Anesthetics, Dissociative; Anesthetics, Dissociative/*administration & dosage; animal experiment; article; continuous infusion; controlled study; Dehydration; Dehydration/chemically induced/prevention & control; Drug Administration Schedule; Fluid Therapy; Fluid Therapy/methods; ketamine; Injections, Intramuscular; Intraocular; Intraocular Pressure/*drug effects; Infusions, Intravenous; Ketamine; Ketamine/*administration & dosage; Ketamine anesthesia; **Macaca fascicularis*; Mean arterial pressure; nonhuman; Monkey eye; oculoplethysmography; priority journal

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Keywords: Anesthesia; animal welfare; attention bias; long-tailed macaques; *Macaca fascicularis*

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Keywords: Laboratory Animal Science; Veterinary Pharmacology and Anaesthesiology

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Keywords: Anesthesiology (Medical Sciences); Blood-blood cell studies; ketamine; *Macaca mulatta*; meeting abstract; Rhesus macaques; telazol

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Keywords: Anesthesiology; *Macaca mulatta*; neuromuscular blocking; reversal agent; rocuronium; sugammadex (Org 25969)

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Keywords: anesthesia induction; anesthetic recovery; Animal experiment; article; atropine; beta cyclodextrin; cyclodextrin; bolus injection; chelation; Chemical encapsulation; controlled study; blood pressure; chemical compound; continuous infusion; cyclodextrins; derivative; drug dose regimen; drug infusion; encapsulation; experimental design; female; gamma cyclodextrin; gamma cyclodextrin derivative; heart rate; ketamine; muscle excitation; muscle twitch; neostigmine; Neuromuscular block; neuromuscular blocking; nitrous oxide; nonhuman; oxygen; pentobarbital; priority journal; Reversal agent; rhesus monkey; rocuronium; steady state

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Keywords: Androstanols; anesthesia; anesthesia induction; anesthetic agent; animal experiment; article; Blood Pressure; Cholinesterase Inhibitors; controlled study; drug mechanism; drug megadose; encapsulation; Female; gamma-Cyclodextrins; Heart Rate;

inhibition kinetics; ketamine; *Macaca mulatta*; Neuromuscular Blockade; neuromuscular blocking; Neuromuscular Nondepolarizing Agents; nonhuman; pentobarbital; priority journal; rhesus monkey; rocuronium; sodium chloride; statistical significance; stimulation; sugammadex

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Keywords: anesthesia induction; animal experiment; animal model; atracurium; article; atracurium; blood pressure; bolus injection; continuous infusion; controlled study; drug dose regimen; drug efficacy; drug mechanism; female; general anesthesia; heart rate; mivacurium; monkey; muscle twitch; Neuromuscular block; neuromuscular blocking; nonhuman; pentobarbital; priority journal; Reversal agent; rocuronium; steady state; sugammadex; sugammadex (Org 25969)

Engel, R. M., Thomas, M. L., Iii, & Banks, R. E. (2019). Regional anesthesia for dentistry and orofacial surgery in rhesus macaques (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science*, 58(2), 223–230. Scopus. <https://doi.org/10.30802/AALAS-JAALAS-18-000068>

Keywords: Humans; Cadaver; surgery; adult; animal experiment; article; nonhuman; cadaver; procedures; anatomy and histology; animal rights; Animal Welfare; veterinary medicine; anesthesia; lung alveolus; Laboratory Animal Science; regional anesthesia; local anesthesia; surgical techniques; *Macaca*; rhesus monkey; *Macaca mulatta*; Surgical Procedures, Operative; diffusion; Dentistry; Non-Communicable Diseases and Injuries of Animals; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Animal Health and Hygiene (General); Animal Models of Human Diseases; Animal Surgery and Non-drug Therapy; mandibular nerve; pain management; Anesthesia, Conduction; dentistry; inferior alveolar nerve; infraorbital nerve; Lingual Nerve; Mandible; Mandibular Nerve; maxillary nerve; nerve cells; nerves; neurones; orofacial surgery

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Keywords: animal experiment; article; nonhuman; priority journal; controlled study; Body Temperature; three dimensional imaging; nuclear magnetic resonance imaging; Heart Rate/drug effects; propofol; Magnetic Resonance Imaging; accuracy; breathing rate; Anesthesia; inhalation anesthesia; Anesthetics, Intravenous; rhesus monkey; *Macaca mulatta*; Heart Rate; Respiration; **Macaca mulatta*; Propofol; Respiration/drug effects; magnetic field; Anesthesia, Intravenous/*methods; *Stereotaxic Techniques; Propofol/*pharmacology; Anesthesia, Intravenous; stereotaxic surgery; Stereotaxic Techniques; Anesthetics,

Intravenous/*pharmacology; *Magnetic Resonance Imaging; Brain Tissue Transplantation; Neural transplantation

Galván-Montaño, A., Hernández-Godínez, B., Ibáñez-Contreras, A., Cárdenas-Lailson, L. E., Ramírez-Hernández, R., & Aragón-Inclán, J. (2010). Anesthetic management in intrauterine surgery to evaluate an experimental model of myelomeningocele in non human primates (*Macaca mulatta*). *Acta Cirurgica Brasileira*, 25(3), 294–297. Scopus. <https://doi.org/10.1590/S0102-86502010000300013>

Keywords: Time Factors; article; nonhuman; human; Blood Pressure; oxygen saturation; Longitudinal Studies; Models, Animal; temperature; Pregnancy; Body Temperature; hypothermia; Laminectomy; breathing rate; Anesthesia; arterial pressure; *Macaca mulatta*; Heart Rate; Fetus; Heart Rate/physiology; Anesthesia/*methods; anesthesiological techniques; Hypothermia; Respiratory Rate; *Meningomyelocele/etiology; Blood Pressure/physiology; Body Temperature/physiology; Fetus/*surgery; Laminectomy/*methods; Respiratory Rate/physiology; fetus death; fetus surgery; maternal mortality; Meningomyelocele

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Keywords: anesthetic protocol; dissociative anesthesia; microstimulation; immobility; electrolyte imbalance; electro-physiology study; extended duration; fluid balance; intracerebral pressure

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Keywords: Anesthesia; pentobarbital; *Macaca mulatta*; meeting abstract; ophthalmology; rhesus macaques

Hernandez-Godinez, B., Bonilla Jaime, H., Poblano, A., Arteaga-Silva, M., Medina Hernandez, A., Contreras-Uribe, A., & Ibanez-Contreras, A. (2019). Effect of different anesthetic mixtures-ketamine-xylazine, ketamine-acepromazine and tiletamine-zolazepam-on the physiological and blood biochemistry parameters of male rhesus monkeys (*Macaca mulatta*) at different ages. *Animal Models and Experimental Medicine*, 2(2), 83–97. <https://doi.org/10.1002/ame2.12062>

Keywords: Acepromazine; anesthesia; chemical restraint; dissociative anesthetics; blood-blood cell studies; immobilization; *Macaca mulatta*; physiological parameter; rhesus macaques; tiletamine; xylazine; zolazepam

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Keywords: Psychomotor Performance; animal experiment; article; nonhuman; priority journal; controlled study; Blood Pressure; oxygen saturation; drug effect; hemoglobin; medetomidine; oxygen; Ketamine; Anaesthesia; Anesthetics, Dissociative; rhesus monkey; Macaca mulatta; Hypnotics and Sedatives; Anesthesia Recovery Period; anesthetic recovery; Animal Models of Human Diseases; Animal and in-vitro Models for Pharmaceuticals; Medetomidine; Non-food/Non-feed Plant Products; pulse rate; Adrenergic Agents; Alpha2-adrenergic agonist; Ephedrine; esketamine; hemoglobin blood level; hyaluronidase; psychomotor activity; Pulse

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Keywords: Models, Animal; Dose-Response Relationship, Drug; Heart Rate/drug effects; Sensitivity and Specificity; Drug Evaluation, Preclinical; Action Potentials/drug effects; Macaca fascicularis; Electrophysiology; Anesthetics, Inhalation/administration & dosage/adverse effects/*pharmacology; Anti-Arrhythmia Agents/adverse effects/*pharmacology; Halothane/administration & dosage/adverse effects/*pharmacology; Long QT Syndrome/*chemically induced/physiopathology; Sotalol/administration & dosage/*pharmacology

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Keywords: Male; animal experiment; nonhuman; priority journal; Article; controlled study; blood pressure; procedures; data analysis; comparative study; drug effect; Isoflurane; anesthesia induction; anesthesia; Isoflurane/*administration & dosage; Ketamine/*administration & dosage; dexmedetomidine; Ketamine; Telemetry; glaucoma; intubation; anesthetic agent; Xylazine; Anesthesia; wireless communication; Anesthetics, Dissociative; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; Macaca mulatta; Dexmedetomidine; Telemetry/methods; Intraocular Pressure; Intraocular Pressure/*drug effects; Anesthetics, Inhalation/administration & dosage; Anesthetics, Combined; Anesthesia/*methods; oculoplethysmography; Tonometry, Ocular; Xylazine/*administration & dosage; Anesthetics, Dissociative/administration & dosage; Anesthetics, Combined/*administration & dosage; Dexmedetomidine/*administration & dosage; data processing; manometry

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Keywords: nonhuman; Article; controlled study; ketamine; anesthesia induction; Mycobacterium bovis; sedation; dexmedetomidine; low drug dose; anesthesiological procedure; drug megadose;

Macaca; rhesus monkey; Macaca mulatta; blood cell count; atipamezole; physical examination; Mycobacterium tuberculosis; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; *Ketamine; *Anesthetics; *Anesthesia/veterinary; *Dexmedetomidine; Macacine herpesvirus 1

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Keywords: Female; animal experiment; article; nonhuman; priority journal; controlled study; ketamine; drug effect; propofol; Retina; Anesthesia; pentobarbital; Anesthetics, Intravenous; Rhesus macaque; rhesus monkey; Macaca mulatta; Hypnotics and Sedatives; Propofol; signal noise ratio; 4 aminobutyric acid A receptor; Hypnotics and Sedatives/pharmacology; Anesthesia/*methods; Pentobarbital; Propofol/*pharmacology; Electroretinography; Anesthetics, Intravenous/pharmacology; Electroretinography/*drug effects; Evoked Potentials, Visual/drug effects; Pentobarbital/*pharmacology; Retina/*drug effects/physiology; Retinoscopy; Signal-To-Noise Ratio; electroretinogram; Evoked Potentials, Visual; glutamate receptor; glycine receptor; low frequency noise; Multifocal electroretinogram; Pentobarbital sodium; Root mean square; Signal-to-noise ratio

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Keywords: Creatine Kinase/blood; Leukocyte Count; Lymphocyte Count; Anesthesia/*veterinary; Alanine Transaminase/blood; Aspartate Aminotransferases/blood; Blood Glucose/analysis; Macaca fascicularis/*blood; Anesthetics, Dissociative/*adverse effects; Ketamine/*adverse effects; Phosphates/blood; Potassium/blood; Sodium/blood

Kim, J. M., Shin, J.-S., Yoon, I. H., Min, B. H., Jeong, W. Y., Lee, G. E., Kim, M. S., Kim, J. E., Jang, J. Y., & Park, C.-G. (2014). The effect of propofol on intravenous glucose tolerance test in rhesus monkey. *Journal of Medical Primatology*, 43(4), 242–246. Scopus. <https://doi.org/10.1111/jmp.12128>

Keywords: Male; adult; animal experiment; article; nonhuman; priority journal; controlled study; male; Blood Pressure; heart rate; blood; drug effects; Body Temperature; anesthesia induction; propofol; Blood Glucose; Insulin; Glucose Tolerance Test; Anesthesia; hydrocortisone blood level; Anesthetics, Intravenous; intravenous anesthetic agent; rhesus monkey; Cortisol; Hydrocortisone; Macaca mulatta; Heart Rate; glucose metabolism; Propofol; Rhesus monkey; glucose blood level; glucose tolerance test; continuous infusion; hemodynamic parameters; C-Peptide; insulin release; Insulin secretion; Intravenous glucose tolerance test

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Keywords: Male; pathophysiology; Developed Countries; OECD Countries; America; animal disease; drug effect; APEC countries; Isoflurane; anesthesia; Anesthesia/*veterinary; Ketamine; Anesthetics; North America; note; anesthetic agent; Anesthesia; Macaca; rhesus monkey; Macaca mulatta; *Macaca mulatta; Ketamine/administration & dosage; Intraocular Pressure; Glaucoma; Intraocular Pressure/*drug effects; Non-Communicable Diseases and Injuries of Animals; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Isoflurane/administration & dosage; Monkey Diseases; oculoplethysmography; Tonometry, Ocular; Anesthetics/administration & dosage; Monkey Diseases/*physiopathology/surgery; Ocular Hypertension/physiopathology/surgery/*veterinary; Tonometry, Ocular/veterinary; Intra ocular pressure; intraocular hypertension; Ocular Hypertension

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Keywords: Animals; Male; Female; Reference Values; Drug Combinations; Macaca/*physiology; Saliva/enzymology; Anesthesia/methods/*veterinary; alpha-Amylases/metabolism; Hypnotics and Sedatives/adverse effects/*pharmacology; Medetomidine/adverse effects/*pharmacology; Midazolam/adverse effects/*pharmacology

**Koo, B.-S., HO, L. D., philyong, kang, Jin, J. K., sangil, L., Jin, K. K., Lee, Y., Huh, J.-W., Kim, Y.-H., SANG-JE, P., jin, Y. B., Kim, S.-U., Kim, J.-S., SON, Y., & Lee, S.-R. (2019). Reference values of hematological and biochemical parameters in young-adult cynomolgus monkey (*Macaca fascicularis*) and rhesus monkey (*Macaca mulatta*) anesthetized with ketamine hydrochloride. *Laboratory Animal Research*, 35(2), 39–44.
<https://doi.org/10.1186/s42826-019-0006-0>**

Keywords: Anesthesia; biochemistry studies-general; blood-blood cell studies; cynomolgus macaque; ketamine; Macaca fascicularis; Macaca mulatta; rhesus macaque

**Kops, M. S., Pesic, M., Petersen, K.-U., Schmalix, W. A., & Stöhr, T. (2021). Impact of concurrent remifentanyl on the sedative effects of remimazolam, midazolam and propofol in cynomolgus monkeys. *European Journal of Pharmacology*, 890. Scopus.
<https://doi.org/10.1016/j.ejphar.2020.173639>**

Keywords: Cross-Over Studies; Male; animal experiment; nonhuman; priority journal; Article; comparative study; crossover procedure; gait; midazolam; sedation; Drug Interactions; intravenous drug administration; Macaca fascicularis; Analgesics, Opioid; narcotic analgesic agent; sensory stimulation; Hypnotics and Sedatives; Administration, Intravenous; Propofol; avoidance behavior; drug potentiation; body position; benzodiazepine derivative; drug dose escalation; eyelid; Midazolam; hypnotic sedative agent; Cynomolgus monkey; Remifentanyl; Benzodiazepines; Drug-drug interaction; midazolam maleate; position; Remimazolam

Lee, H.-S., Kim, D.-H., Kim, S.-H., Kang, M.-S., & Suh, H. N. (2021). A comparative study on intraocular pressure under various anesthetics in cynomolgus monkeys (*Macaca*

fascicularis). *Laboratory Animal Research*, 37(1), 15-Article No.: 15.
<https://doi.org/10.1186/s42826-021-00092-2>

Keywords: Anesthetic drugs; cynomolgus macaques; gender difference; intraocular pressure; ketamine; *Macaca fascicularis*; ophthalmology; pharmacology; zylazine; zoletil

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Keywords: anesthesia; anesthetics; *Macaca*; Veterinary Pharmacology and Anaesthesiology; Zoo Animals; Cercopithecidae; *Macaca fuscata*; tiletamine; zolazepam

Lee, V. K., Flynt, K. S., Haag, L. M., & Taylor, D. K. (2010). Comparison of the effects of ketamine, ketamine-medetomidine, and ketamine-midazolam on physiologic parameters and anesthesia-induced stress in rhesus (*Macaca mulatto*) and cynomolgus (*Macaca fascicularis*) macaques. *Journal of the American Association for Laboratory Animal Science*, 49(1), 57–63. Scopus.

Keywords: animal experiment; animal model; article; nonhuman; controlled study; ketamine; adverse effects; Random Allocation; Injections, Intramuscular; corticosterone; animal stress; anesthesia induction; Administration, Oral; Heart Rate/drug effects; Ketamine/*administration & dosage; intramuscular injection; anesthetics; medetomidine; sedation; Laboratory Animal Science; Ketamine; laboratory animals; diastolic blood pressure; systolic blood pressure; respiratory function; *Macaca fascicularis*; physiological response; oral administration; breathing rate; *Macaca*; rhesus monkey; Oxygen; *Macaca mulatta*; Heart Rate; Respiration; Oxygen/metabolism; *Macaca mulatta*/*physiology; *Macaca fascicularis*/*physiology; glucocorticoids; metabolite; Injections, Intramuscular/veterinary; Respiration/drug effects; anesthesia level; Veterinary Pharmacology and Anaesthesiology; Animal Physiology and Biochemistry (Excluding Nutrition); Cercopithecidae; Animal Models of Human Diseases; Midazolam; Anesthetics, Combined; Medetomidine; cardiovascular effect; muscle relaxation; depth of anesthesia; Medetomidine/*administration & dosage; Midazolam/*administration & dosage; drug evaluation

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Keywords: animal experiment; nonhuman; priority journal; Article; controlled study; blood pressure; physiology; comparative study; vascularization; heart rate; drug effect; Isoflurane; Heart Rate/drug effects; Ketamine; functional magnetic resonance imaging; mean arterial pressure; Brain; nerve cell network; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; drug exposure; *Macaca mulatta*; Heart Rate; arterial spin labeling; Cerebrovascular Circulation/*drug effects; Cerebrovascular Circulation; nerve function; alfaxalone;

Pregnanediones; Pregnanediones/administration & dosage/*pharmacology; Ketamine/*pharmacology; brain blood flow; brain circulation; Anesthetics, Inhalation/administration & dosage/pharmacology; Brain/blood supply/*drug effects/*physiology; Isoflurane/administration & dosage/pharmacology; functional anatomy

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Keywords: Female; animal experiment; animal model; article; nonhuman; priority journal; controlled study; blood pressure; oxygen saturation; Dose-Response Relationship, Drug; dose response; concentration response; Isoflurane; anesthesia induction; nuclear magnetic resonance imaging; cerebellum; thalamus; Magnetic Resonance Imaging; mean arterial pressure; Cerebral Cortex; neuroimaging; low drug dose; drug megadose; Anesthetics, Inhalation; rhesus monkey; Macaca mulatta; Cerebrovascular Circulation; frontal cortex; caudate nucleus; cingulate gyrus; brain blood flow; autoregulation; echo planar imaging; motor cortex; maintenance drug dose; Dose-dependent effect; Cerebral blood flow (CBF); Arterial spin labeling (ASL); Auto-regulation; brain metabolism; ventromedial prefrontal cortex; whole body scanner

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Keywords: Female; adult; animal experiment; article; nonhuman; priority journal; controlled study; blood flow velocity; physiology; procedures; Dose-Response Relationship, Drug; drug effects; dose response; concentration response; Isoflurane; nuclear magnetic resonance imaging; image analysis; brain cortex; cerebellum; thalamus; Blood Flow Velocity; Administration, Inhalation; inhalational drug administration; Brain; neuroimaging; brain function; drug megadose; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; Macaca mulatta; prefrontal cortex; Cerebrovascular Circulation; frontal cortex; caudate nucleus; brain blood flow; brain circulation; motor cortex; anterior cingulate; Pseudo continuous arterial-spin-labeling (pCASL); Dose-dependent effect; Autoregulation; Cerebral blood flow (CBF); magnetic resonance angiography; Magnetic Resonance Angiography; nuclear magnetic resonance scanner; pseudo continuous arterial spin labeling; spin labeling; Spin Labels

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Keywords: Female; Time Factors; adult; animal experiment; nonhuman; priority journal; Article; Blood Pressure; physiology; Longitudinal Studies; longitudinal study; vascularization; time factor; Dose-Response Relationship, Drug; drug effects; dose response; rest; Isoflurane; image processing; nuclear magnetic resonance imaging; brain cortex; anesthesia; Image Processing, Computer-Assisted; Magnetic Resonance Imaging; functional magnetic resonance imaging; Cerebral Cortex; long term care; diagnostic imaging; inhalation anesthesia; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; drug exposure; Macaca mulatta; Heart

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Keywords: article; physiology; comparative study; adverse effects; animal disease; drug effect; Injections, Intramuscular; intramuscular drug administration; Body Temperature; thermoregulation; anesthesia; anesthetics; chemically induced disorder; Ketamine; Telemetry; *Macaca fascicularis*; Drug Combinations; animal use alternatives; anesthetic agent; Anesthesia, General; general anesthesia; combination drug therapy; Anesthetics, Dissociative; *Macaca*; **Macaca fascicularis*; Telemetry/veterinary; Anesthesia, General/*veterinary; neuroleptics; Injections, Intramuscular/veterinary; circadian rhythm; laboratory mammals; animal use refinement; Fever; Tiletamine; Zolazepam; Anesthetics, Dissociative/adverse effects; Acepromazine; Body Temperature/*drug effects/physiology; Fever/chemically induced/veterinary

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Keywords: Cross-Over Studies; animal experiment; article; nonhuman; priority journal; controlled study; Random Allocation; Creatine Kinase/blood; hematocrit; Ketamine/*administration & dosage; medetomidine; Alanine Transaminase/blood; Aspartate Aminotransferases/blood; Creatinine/blood; Ketamine; Alkaline Phosphatase/blood; aspartate aminotransferase blood level; Anesthesia; Anesthetics, Dissociative; *Macaca*; *Macaca mulatta*; Blood Cell Count; Creatinine; erythrocyte count; hematological parameters; circadian rhythm;

Blood Urea Nitrogen; Aspartate Aminotransferases; Alkaline Phosphatase; Hematocrit; Veterinary Pharmacology and Anaesthesiology; Animal Physiology and Biochemistry (Excluding Nutrition); Parameters; Cercopithecidae; alkaline phosphatase blood level; thrombocyte count; Anesthesia/methods/*veterinary; Medetomidine; Adrenergic alpha-Agonists; Medetomidine/*administration & dosage; creatine kinase blood level; Creatine Kinase; Anesthetics, Dissociative/*administration & dosage; Blood Cell Count/veterinary; Adrenergic alpha-Agonists/*administration & dosage; Hematocrit/veterinary; Macaca mulatta/*blood; hemoglobin blood level; Alanine Transaminase; Cumulative; Sedation-interaction; Washout-combination

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Keywords: adult; animal model; nonhuman; priority journal; Article; physiology; heart rate; Dose-Response Relationship, Drug; drug effects; dose response; body temperature; Isoflurane; nuclear magnetic resonance imaging; cell function; cerebellum; functional magnetic resonance imaging; mean arterial pressure; Brain; observational study; Anesthesia; nerve cell network; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; Macaca mulatta; visual cortex; arousal; Brain Mapping; Nerve Net; default mode network; resting state network; limbic system; frontal eye field; Functional MRI; amplitude modulation; Dose-dependent effect; inferior temporal cortex; premotor cortex

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Keywords: Pilot Projects; Heart Rate/drug effects; Drug Combinations; Macaca mulatta/*physiology; Imidazoles/pharmacology; Immobilization/*veterinary; Analgesics, Opioid/pharmacology; Hypnotics and Sedatives/*pharmacology; Medetomidine/administration & dosage/*pharmacology; Butorphanol/administration & dosage/*pharmacology; Azaperone/administration & dosage/*pharmacology

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Keywords: animal experiment; article; nonhuman; controlled study; oxygen saturation; heart rate; temperature; Random Allocation; Animals, Newborn; blood sampling; unclassified drug; newborn; Isoflurane; anesthesia; Isoflurane/*administration & dosage; Ketamine/*administration & dosage; hypotension; hemodynamics; Ketamine; diastolic blood pressure; mean arterial pressure; systolic blood pressure; Anesthetics; animal wellbeing; breathing rate; general anesthesia; Macaca; rhesus monkey; drug exposure; Macaca mulatta; tachycardia; *Macaca mulatta; Propofol; Anesthetics/*administration & dosage; end tidal carbon dioxide tension; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; *Animals, Newborn; blood gas; extubation; Propofol/*administration & dosage; Vital Signs/drug effects; ketathesia; venous blood; Vital Signs

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Keywords: Time Factors; time; physiology; Dose-Response Relationship, Drug; veterinary; dose response; Injections, Intramuscular; intramuscular drug administration; Anesthesia/*veterinary; midazolam; Anesthetics; Macaca fascicularis; anesthetic agent; Anesthesia; Macaca; Macaca fascicularis/*physiology; Injections, Intramuscular/veterinary; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Midazolam; Midazolam/administration & dosage/*pharmacology; Anesthetics/*pharmacology; Anesthetics, Combined; Medetomidine/administration & dosage/*pharmacology; Medetomidine; Butorphanol; Anesthetics, Combined/administration & dosage/*pharmacology; Butorphanol/administration & dosage/*pharmacology

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Keywords: adult; animal experiment; nonhuman; Article; controlled study; oxygen saturation; physiology; comparative study; heart rate; Pesticides and Drugs; Random Allocation; veterinary medicine; Control; drug effect; randomization; oxygen; sedation; Ketamine; diastolic blood pressure; systolic blood pressure; Hominidae; oxygen tension; Immobilization; Homo; man; rectal temperature; breathing rate; anesthetic agent; arterial pressure; Anesthetics, Dissociative; Anesthetics, Intravenous; intravenous anesthetic agent; Macaca; naloxone; Fentanyl; Hypnotics and Sedatives; Animals, Zoo; Macaca/*physiology; atipamezole; hypoxia; Immobilization/*veterinary; pulse oximetry; Veterinary Pharmacology and Anaesthesiology; Non-drug Therapy and Prophylaxis of Humans; Human Physiology and Biochemistry; Cercopithecidae; zoo animal; Macaca fuscata; Hypnotics and Sedatives/administration & dosage/pharmacology; Midazolam; Midazolam/administration & dosage/*pharmacology; Ketamine/administration & dosage/*pharmacology; Medetomidine/administration & dosage/*pharmacology; Anesthetics, Dissociative/administration & dosage/pharmacology; hypnotic sedative agent; Medetomidine; hypoventilation; Anesthetics, Intravenous/administration & dosage/pharmacology; Fentanyl/administration & dosage/*pharmacology

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Keywords: animal experiment; animal model; article; nonhuman; controlled study; Blood Pressure; disease severity; Dose-Response Relationship, Drug; dose response; Body Temperature; nitrous oxide; anesthesia induction; atropine; oxygen; propofol; sevoflurane; drug safety; statistical significance; Brain; low drug dose; Positron-Emission Tomography; metabolic rate; drug megadose; Anesthetics, Intravenous; rhesus monkey; Macaca mulatta; Heart Rate; Propofol; Cerebrovascular Circulation; mathematical analysis; vecuronium; Hypothermia, Induced; induced hypothermia; anesthesia mechanism; continuous infusion; brain blood flow; Cerebral blood flow; pediatric anesthesia; brain metabolism; Cerebral metabolism; Coupling of cerebral metabolism and blood flow; Mild hypothermia

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Keywords: Male; adult; animal experiment; nonhuman; priority journal; Article; controlled study; pathophysiology; physiology; task performance; animal cell; local field potential; Macaca;

Auditory Perception; hearing; rhesus monkey; Unconsciousness; auditory stimulation; touch; wakefulness; Propofol; Anesthesia Recovery Period; somatosensory cortex; tactile stimulation; anesthetic recovery; Consciousness; arousal; Action Potentials; Acoustic Stimulation; alertness; Electroencephalography; electroencephalogram; nerve tract; Neural Pathways; Arousal; neocortex; Brain Waves; General anaesthesia; Local field potentials; Motor Cortex; oscillation; Return of consciousness; Sensory premotor network; Somatosensory Cortex; Touch Perception

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Keywords: Female; animal experiment; animal tissue; article; nonhuman; controlled study; unclassified drug; drug effect; anesthesia; animal use; Cholesterol/blood; Triglycerides/blood; Ketamine; cholesterol blood level; Lipids; triacylglycerol; parameter; Anesthetics, Intravenous; Macaca; Cholesterol; Techniques and Methodology; Veterinary Pharmacology and Anaesthesiology; Animal Nutrition (Physiology); 10; Animal Physiology and Biochemistry (Excluding Nutrition); Cercopithecidae; thiopental; Ketamine/*pharmacology; Anesthetics, Intravenous/*pharmacology; Thiopental/*pharmacology; Macaca radiata; Lipids/*blood; Cholesterol, HDL/blood; Cholesterol, VLDL/blood; Lipid Metabolism/drug effects; Macaca radiata/*blood; Thiopental; Lipid Metabolism; Cholesterol, HDL; Cholesterol, VLDL; high density lipoprotein; ketmin; lipoprotein blood level; tiopronin; Triglycerides; very low density lipoprotein; drug evaluation; adult animals; blood lipids; triacylglycerols

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Keywords: Rabbits; Injections, Subcutaneous; Macaca mulatta; Behavior, Animal/*drug effects; Anesthetics, Local/pharmacology; Evoked Potentials/drug effects; Nerve Block/*methods; Drug Delivery Systems/*instrumentation/*methods; Lidocaine/pharmacology; Muscle, Skeletal/drug effects/innervation; Neural Conduction; Peripheral Nerves/*drug effects; Procaine/analogs & derivatives/pharmacology

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Keywords: Time Factors; animal experiment; animal model; article; Disease Models, nonhuman; priority journal; controlled study; task performance; animal behavior; Behavior, Animal; Injections, Intramuscular; Schizophrenia; post hoc analysis; Ketamine; latent period; Reaction Time; Anesthetics, Dissociative; Macaca; Drug Tolerance; Excitatory Amino Acid Antagonists; saccadic eye movement; eye movement control; Saccades; Antisaccade; Hallucinogens; Neuropharmacology; Nystagmus, Pathologic; Tolerance

Pulley, A. C. S., Roberts, J. A., & Lerche, N. W. (2004). Four preanesthetic oral sedation protocols for rhesus macaques (*Macaca mulatta*). *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 35(4), 497–502. <https://doi.org/10.1638/03-092>

Keywords: Treatment Outcome; Male; Random Allocation; Dose-Response Relationship, Drug; Administration, Oral; Midazolam/administration & dosage; Medetomidine/administration & dosage; Drug Combinations; Macaca; Macaca mulatta; Macaca mulatta/*physiology; Ketamine/administration & dosage; Anesthesia Recovery Period; Veterinary Pharmacology and Anaesthesiology; Animal Physiology and Biochemistry (Excluding Nutrition); Zoo Animals; Cercopithecidae; Hypnotics and Sedatives/*administration & dosage; Preanesthetic Medication/methods/*veterinary; Tiletamine/administration & dosage; Zolazepam/administration & dosage; Anesthetics, Dissociative/*administration & dosage; Anti-Anxiety Agents/*administration & dosage

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Keywords: Female; Heart Rate/drug effects; Magnetic Resonance Imaging; Anesthesia; Macaca mulatta; Respiration/drug effects; Rest; Ketamine/*pharmacology; *Ketamine; *Brain Mapping; *Local functional properties; *Resting-state; *Rhesus monkey; Anesthetics, Dissociative/pharmacology; Brain/*diagnostic imaging/physiopathology; Caudate Nucleus/diagnostic imaging; Cognition Disorders/diagnostic imaging; Hippocampus/diagnostic imaging; Prefrontal Cortex/diagnostic imaging; Putamen/diagnostic imaging

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Keywords: Male; animal experiment; animal model; article; nonhuman; controlled study; drug effect; Injections, Intramuscular; concentration (parameters); anesthesia; Drug Interactions; Ketamine; Drug Administration Schedule; n methyl dextro aspartic acid; N-Methylaspartate; n methyl dextro aspartic acid receptor; Receptors, N-Methyl-D-Aspartate; Anesthetics, Dissociative; rhesus monkey; Prolactin; Macaca mulatta; Stimulation, Chemical; Ketamine hydrochloride; glutamic acid; Excitatory Amino Acid Antagonists; prolactin; prolactin release; adenoypophysis; aspartic acid; hypophysis hormone; Male rhesus monkey; N-methyl-D-aspartate receptor; prolactin blood level

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Keywords: Male; surgery; animal experiment; nonhuman; Article; ketamine; heart rate; veterinary; Analgesia; Animals, Laboratory; experimental animal; Anesthesia/*veterinary; Anesthetics, Intravenous/*administration & dosage; pain killers; circulatory system; hemodynamics; sedation; dexmedetomidine; Laboratory Animal Science; systolic blood pressure; *Animals, Laboratory; Macaca fascicularis; skull; Anesthesia; Anesthetics, Intravenous; intravenous anesthetic agent; Macaca; brain surgery; *Macaca fascicularis; atipamezole; Dexmedetomidine; antinociceptive properties; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Animal Surgery and Non-drug Therapy; Animal and in-vitro Models for Pharmaceuticals; crab-eating macaque; Skull; Dexmedetomidine/*administration & dosage; Skull/*surgery; Thiopental/*administration & dosage; infusion rate; Thiopental

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Keywords: animal experiment; nonhuman; priority journal; Article; controlled study; physiology; drug effects; brain cortex; Ketamine/*administration & dosage; Ketamine; brain function; anesthetic agent; Anesthesia; nerve cell network; Anesthetics, Dissociative; Macaca; rhesus monkey; unconsciousness; Macaca mulatta; stimulus response; touch; *Consciousness; Physical Stimulation; tactile stimulation; Consciousness; *Anesthesia; *Ketamine; Functional connectivity; Anesthetics, Dissociative/*administration & dosage; *Functional connectivity; *Information integration; *Sensorimotor; Consciousness/drug effects/physiology; Motor Cortex/*drug effects/*physiology; Somatosensory Cortex/*drug effects/*physiology; Touch Perception/drug effects/physiology; Motor Cortex; Somatosensory Cortex; Touch Perception; physical stimulation; corticocortical information transfer; entropy; Information integration; Sensorimotor; sensory cortex

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Keywords: animal experiment; animal model; article; nonhuman; priority journal; controlled study; Blood Pressure; drug effect; Isoflurane; Heart Rate/drug effects; drug mechanism; mean arterial pressure; pressor response; carbon dioxide tension; Macaca fascicularis; Anesthesia; Anesthetics, Inhalation; Carbon Dioxide; Heart Rate; lung ventilation; Blood Pressure/*drug effects; Respiration, Artificial; *Anesthesia; *Isoflurane; Adrenergic alpha-Agonists; *Anesthetics, Inhalation; Carbon Dioxide/blood; brain blood flow; Adrenergic alpha-Agonists/*pharmacology; Hypocapnia/*physiopathology; Phenylephrine/*pharmacology; Vasoconstrictor Agents/*pharmacology; Hypocapnia; Phenylephrine; systemic vascular resistance; Vasoconstrictor Agents; α -adrenoceptor agonists

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Keywords: Cross-Over Studies; animal experiment; article; nonhuman; priority journal; controlled study; Blood Pressure; Random Allocation; Body Weight; Body Temperature; Ketamine/*administration & dosage; medetomidine; sedation; Laboratory Animal Science; Heart rate; Ketamine; mean arterial pressure; Hemoglobins; recumbency; ataxia; breathing rate; Anesthesia; Anesthetics, Dissociative; Macaca; Sedation; Macaca mulatta; Macaca mulatta/*physiology; Body Weight/physiology; Conscious Sedation; anesthetic recovery; Heart Rate/physiology; movement (physiology); anesthesia level; Veterinary Pharmacology and Anaesthesiology; Animal Physiology and Biochemistry (Excluding Nutrition); Cercopithecidae; Anesthesia/methods/*veterinary; Medetomidine; Adrenergic alpha-Agonists; Medetomidine/*administration & dosage; Anesthetics, Dissociative/*administration & dosage; Blood Pressure/physiology; Body Temperature/physiology; Adrenergic alpha-Agonists/*administration & dosage; Conscious Sedation/methods/standards/veterinary; Hemoglobins/analysis; Oximetry/veterinary; Oximetry; Drug tolerance; Phencyclidine; Righting reflex; α 2-adrenoceptor agonist

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Keywords: Magnetic Resonance Imaging; Macaca mulatta; Anesthetics, Inhalation/pharmacology; *Anesthesia; Ketamine/pharmacology; Propofol/pharmacology; Sevoflurane/pharmacology; *GNW; *Ignition; *IIT; *Integration; *Measures of Consciousness; Anesthetics, Intravenous/pharmacology; Cerebral Cortex/*diagnostic imaging/drug effects; Consciousness/drug effects/*physiology; Nerve Net/*diagnostic imaging/drug effects

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Keywords: Female; animal experiment; article; nonhuman; priority journal; controlled study; concentration response; lidocaine; anesthesia induction; atropine; oxygen; Ketamine; Anesthetics; drug sensitivity; Macaca fascicularis; latent period; intermethod comparison; stimulus response; Electrophysiology; Anesthesiology; Amines; electrostimulation; Monitoring, Intraoperative; Halothane; continuous infusion; Monitoring, Intraoperative/*methods; Motor Cortex/*drug effects/*physiology; Evoked Potentials, Motor/*drug effects/*physiology; Halothane/*administration & dosage; Transcranial Magnetic Stimulation/*drug effects; Motor Cortex; amplitude modulation; Compound action potentials; Cortical stimulation; evoked muscle response; Evoked Potentials, Motor; Magnetic stimulation; Motor evoked potentials; Motors; Transcranial; Differential effect; Electrical stimulations; Physiological mechanisms; transcranial electric stimulation; Transcranial Magnetic Stimulation

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Keywords: Time Factors; time; article; animal welfare; food intake; drug effect; behavioral response; Stress; Eating; Ketamine; *Chlorocebus aethiops*; anesthetic agent; Anesthetics, Dissociative; *Macaca*; Rhesus macaque; *Macaca mulatta*; Eating/*drug effects; **Macaca mulatta*; Food intake; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; *Cercopithecus*; *Cercopithecus aethiops*; *Chlorocebus*; anesthetic; Ketamine/administration & dosage/*adverse effects; **Chlorocebus aethiops*; Anesthetics, Dissociative/administration & dosage/*adverse effects; African green monkey; Anorexia; Research variables

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Keywords: Female; Time Factors; animal experiment; animal model; article; nonhuman; controlled study; unclassified drug; anesthesia induction; Injections, Intravenous; Infusions, Intravenous; Recovery of Function; *Macaca mulatta*; Electric Stimulation; Rhesus monkey; anesthetic recovery; neuromuscular blocking; Neuromuscular Nondepolarizing Agents; Vecuronium Bromide; Action Potentials; continuous infusion; 3-desacetyl-vecuronium; gamma-Cyclodextrins; Neuromuscular block; Neuromuscular Junction; Reversal; Sugammadex; Vecuronium; vecuronium derivative

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Keywords: Rats; Male; animal experiment; animal tissue; article; nonhuman; controlled study; pathology; comparative study; tissue injury; animal behavior; Behavior, Animal; animal disease; drug effect; Drug Therapy, Combination; necrosis; Injections, Intramuscular; intramuscular drug administration; inflammation; rodents; adults; anesthesia induction; histopathology; muscles; intramuscular injection; Ketamine; Muridae; Immobilization; low drug dose; injection site; clinical protocol; anesthetic agent; Anesthesia; drug combination; Anesthetics, Dissociative; *Macaca*; *Macaca mulatta*; atipamezole; alpha adrenergic receptor blocking agent; Muscle, Skeletal; skeletal muscle; Anesthesia Recovery Period; tissue reaction; anesthetic recovery; Veterinary Pharmacology and Anaesthesiology; quarantine; drug antagonism; Medetomidine; imidazole derivative; Imidazoles; balanced anesthesia; Adrenergic alpha-Antagonists; alpha adrenergic receptor stimulating agent; myositis; muscle necrosis; muscle tissues

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***Journal of the American Association for Laboratory Animal Science*, 45(4), 44–48. CAB Abstracts.**

Keywords: Laboratory Animal Science; Hominidae; Homo; man; Macaca; Techniques and Methodology; Veterinary Pharmacology and Anaesthesiology; Diagnosis of Animal Diseases; Cercopithecidae; Animal Surgery and Non-drug Therapy; Macaca nemestrina

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Keywords: Models, Animal; Macaca fascicularis; Positron-Emission Tomography/methods; Anesthetics, Inhalation/*pharmacology; Sevoflurane/*pharmacology; *brain imaging; *monoamine oxidase-B; *positron emission tomography; *sevoflurane; *volatile anaesthetics; Brain/diagnostic imaging/*drug effects/metabolism; Monoamine Oxidase/*drug effects/metabolism; Radioligand Assay/methods

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Keywords: Female; animal experiment; article; nonhuman; priority journal; Blood Pressure; procedures; comparative study; metabolism; Dose-Response Relationship, Drug; drug effects; dose response; diazepam; sedation; glucose; dexmedetomidine; Ketamine; insulin blood level; Anesthetics; Pharmacology; Glucose Tolerance Test; Drug Combinations; breathing rate; anesthetic agent; Anesthesia; drug combination; Macaca; Rhesus macaque; rhesus monkey; Macaca mulatta; Heart Rate; Diazepam; Dexmedetomidine; Dexmedetomidine/pharmacology; glucose blood level; Veterinary Pharmacology and Anaesthesiology; Animal Physiology and Biochemistry (Excluding Nutrition); Blood Pressure/*drug effects; Cercopithecidae; Diazepam/pharmacology; Anesthetics/*pharmacology; Anesthesia/*methods; tiletamine plus zolazepam; Tiletamine; Zolazepam; Ketamine/pharmacology; Respiratory Rate/*drug effects;

Heart Rate/*drug effects; Tiletamine/pharmacology; Zolazepam/pharmacology; Respiratory Rate; IVGTT; Macaca mulatta/*metabolism; intravenous glucose tolerance test; Glucose regulation; tiletamine, zolazepam drug combination

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Keywords: Female; Leukocyte Count/veterinary; Animals, Laboratory; Blood Glucose/analysis; Alkaline Phosphatase/blood; Calcium/blood; Blood Chemical Analysis/veterinary; Ketamine/*pharmacology; Anesthetics, Dissociative/*pharmacology; Hemoglobins/analysis; Hematocrit/veterinary; Potassium/blood; Sodium/blood; Macaca radiata/*blood; Aging/*blood; Erythrocyte Count/veterinary; Lymphocyte Count/veterinary

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Keywords: Time Factors; Heart Rate/drug effects; *Macaca mulatta; Injections, Intramuscular/veterinary; Blood Gas Analysis/veterinary; Immobilization/methods/*veterinary; Drug Therapy, Combination/veterinary; *Fentanyl/administration & dosage/pharmacology; *Hypnotics and Sedatives/administration & dosage/pharmacology; *Medetomidine/administration & dosage/pharmacology; *Midazolam/administration & dosage/pharmacology

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Keywords: Male; adult; immobilization; animal experiment; nonhuman; Article; controlled study; Blood Pressure; oxygen saturation; physiology; scoring system; sodium chloride; blood; veterinary medicine; drug effect; Injections, Intramuscular; intramuscular drug administration; Body Temperature; anesthesia induction; single drug dose; Heart Rate/drug effects; Respiratory Rate/drug effects; hypotension; hypothermia; Alfaxalone; Anesthetics; Macaca fascicularis; rectal temperature; recumbency; breathing rate; anesthetic agent; Sedation; Oxygen; Heart Rate; Hypnotics and Sedatives; endotracheal intubation; Injections, Intramuscular/veterinary; anesthetic recovery; Blood Pressure/drug effects; Body Temperature/drug effects; hypoxemia;

Oxygen/blood; Pregnanediones; Pregnanediones/administration & dosage/*pharmacology; Hypnotics and Sedatives/administration & dosage/*pharmacology; Anesthetics/administration & dosage/*pharmacology; alfaxan; hypnotic sedative agent; Intubation, Intratracheal; Respiratory Rate; pulse rate; Cynomolgus monkey; Intubation, Intratracheal/veterinary; dysthymia; Intramuscular administration

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Keywords: adult; animal experiment; animal tissue; nonhuman; priority journal; Article; controlled study; pathology; metabolism; task performance; unclassified drug; drug effect; Learning; Microglia; Cognition; Brain; Encephalitis; Anesthesia; general anesthesia; Anesthetics, Inhalation; inhalation anesthetic agent; Conditioning, Operant; instrumental conditioning; rhesus monkey; Macaca mulatta; positron emission tomography-computed tomography; radiopharmaceutical agent; Sevoflurane; Adult monkey; capnometry; conditioned positioned responding task; delayed matching to sample task; fluoroethoxybenzyl n (4 phenoxy)pyridin 3 yl)acetamide f 18; incremental repeated acquisition task; microPET imaging; Neural inflammation; progressive ratio task; temporal response differentiation task

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Keywords: Time Factors; time; animal experiment; article; nonhuman; priority journal; controlled study; body temperature; carbon dioxide; anesthesia; functional magnetic resonance imaging; neuroimaging; Macaca; Oxygen; Oxygen Consumption; fMRI; BOLD; Cerebrovascular Circulation; contrast medium; Visual Cortex; visual stimulation; Brain Mapping; Photic Stimulation; blood oxygenation; brain blood flow; Evoked Potentials, Visual; Adaptation, Physiological; Anaesthetized; blood oxygen level dependent; blood vessel reactivity; Deoxyhemoglobin dilution model; Geniculate Bodies; Hyperoxia; lateral geniculate nucleus; monocrySTALLINE iron oxide nanoparticle

Wilcox, K. M., Kimmel, H. L., Lindsey, K. P., Votaw, J. R., Goodman, M. M., & Howell, L. L. (2005). In vivo comparison of the reinforcing and dopamine transporter effects of local anesthetics in rhesus monkeys. *Synapse*, 58(4), 220–228. Scopus. <https://doi.org/10.1002/syn.20199>

Keywords: animal experiment; animal model; animal tissue; article; nonhuman; priority journal; controlled study; behavior; unclassified drug; Brain; neuroimaging; Positron emission tomography; corpus striatum; Dopamine; reinforcement; Reinforcement (Psychology); Anesthetics, Local; local anesthetic agent; Macaca mulatta; cocaine; wakefulness; Microdialysis; Brain Chemistry

Wilcox, K. M., Zhou, Y., Wong, D., Stansfield, K., Alexander, M., Brasic, J., Rahmim, A., Kumar, A., & Weed, M. (2009). Comparison of propofol and isoflurane or Saffan anesthesia on [C-11] MPH binding potentials at the dopamine transporter in rhesus monkeys using high resolution research tomography PET. *Society for Neuroscience Abstract Viewer and Itinerary Planner*, 39.

Keywords: Anesthesia; isoflurane; Macaca mulatta; positron emission tomography; propofol; rhesus macaques; saffan

Winterborn, A. N., Bates, W. A., Feng, C., & Wyatt, J. D. (2008). The efficacy of orally dosed ketamine and ketamine/medetomidine compared with intramuscular ketamine in rhesus macaques (*Macaca mulatta*) and the effects of dosing route on haematological stress markers. *Journal of Medical Primatology*, 37(3), 116–127. Scopus.
<https://doi.org/10.1111/j.1600-0684.2007.00234.x>

Keywords: Time Factors; animal experiment; article; nonhuman; priority journal; controlled study; drug efficacy; Stress; Heart Rate/drug effects; bradycardia; sedation; glucose; Drug Administration Routes; Ketamine; Biological Markers; hydrocortisone; immobilization stress; ataxia; hydrocortisone blood level; Anesthetics, Dissociative; Macaca; Macaca mulatta; Restraint, Physical; Heart Rate; Hypnotics and Sedatives; Respiration; respiration depression; Restraint, Physical/veterinary; atipamezole; Respiration/drug effects; licking; arterial oxygen saturation; glucose blood level; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Hypnotics and Sedatives/administration & dosage/pharmacology; Anesthetics, Dissociative/administration & dosage/pharmacology; Medetomidine; anesthesiological techniques; drug indication; Biomarkers/*blood; Ketamine/*administration & dosage/*pharmacology; Medetomidine/*administration & dosage/*pharmacology; Stress, Physiological/*blood; salivation; Cortisol Levels; drug dosage form comparison; Leukogram; Psychoneuroendocrinology

Xiao JianHua, Gao Li, Liu HuanQi, Fan HongGang, Ma HaiKun, Liu Yun, & Wang HongBin. (2009). Application and assessment of ketamine-xylidinothiazoline combinations for anaesthesia in rhesus monkey. *Journal of Northeast Agricultural University (English Edition)*, 16(1), 45–50. CAB Abstracts.

Keywords: Macaca; Macaca mulatta; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae

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Keywords: Anesthesia; Macaca; macaques; positron emission tomography; propofol

Young, J. T., Vlasova, R. M., Howell, B. R., Knickmeyer, R. C., Morin, E., Kuitchoua, K. I., Lubach, G. R., Noel, J., Hu, X., Shi, Y., Caudill, G., Alexander, A. L., Niethammer, M., Paule, M. G., Coe, C. L., Sanchez, M., & Styner, M. (2021). General anaesthesia during

infancy reduces white matter micro-organisation in developing rhesus monkeys. *British Journal of Anaesthesia*, 126(4), 845–853. Scopus. <https://doi.org/10.1016/j.bja.2020.12.029>

Keywords: adult; animal experiment; animal model; nonhuman; priority journal; Article; ketamine; metabolism; Animals, Newborn; drug effect; isoflurane; neurotoxicity; Brain; brain region; diagnostic imaging; adverse event; Anesthesia, General; general anaesthesia; Macaca mulatta; Diffusion Tensor Imaging; brain development; infancy; White Matter; tiletamine; tiletamine plus zolazepam; zolazepam; rhesus monkeys; *diffusion MRI; *general anaesthesia isoflurane; *ketamine; *neurotoxicity; *rhesus monkeys; *white matter; Anesthesia, General/*adverse effects; Brain/*diagnostic imaging/*drug effects/metabolism; Diffusion Tensor Imaging/trends; White Matter/*diagnostic imaging/*drug effects; diffusion MRI; diffusion weighted imaging; fractional anisotropy; general anaesthesia isoflurane; radial diffusivity

Young, S., Skeans, S., Lamca, J., & Chapman, R. (2002). Agreement of SpO₂, SaO₂ and ScO₂ in anesthetized cynomolgus monkeys (*Macaca fascicularis*). *Veterinary Anaesthesia and Analgesia*, 29(3), 150–155. <https://doi.org/10.1046/j.1467-2995.2002.00086.x>

Keywords: Anesthesia; cynomolgus macaques; hemoglobin saturation; Macaca fascicularis; monitoring; oxygen saturation; pulse oximeter

Yun-Jung Choi, Hye-Jin Park, Hyeon-Ho Kim, Yun-Jin Lee, Kyeong-Cheon Jung, Seong-Hoe Park, & Jae Il-Lee. (2016). Cardiopulmonary effects of thiopental versus propofol as an induction agent prior to isoflurane anesthesia in chair trained rhesus macaques (*Macaca mulatta*). *Laboratory Animal Research*, 32(1), 8–15.

Keywords: Anesthesia; cardiopulmonary; induction; isoflurane; Macaca mulatta; propofol; rhesus macaque; thiopental

Zhang, X., Liu, S., Newport, G. D., Paule, M. G., Callicott, R., Thompson, J., Liu, F., Patterson, T. A., Berridge, M. S., Apana, S. M., Brown, C. C., Maisha, M. P., Hanig, J. P., Slikker, W., & Wang, C. (2016). In Vivo Monitoring of Sevoflurane-induced Adverse Effects in Neonatal Nonhuman Primates Using Small-animal Positron Emission Tomography. *Anesthesiology*, 125(1), 133–146. Scopus. <https://doi.org/10.1097/ALN.0000000000001154>

Keywords: animal experiment; nonhuman; priority journal; Article; computer assisted tomography; controlled study; procedures; in vivo study; metabolism; Tomography, X-Ray Computed; Animals, Newborn; drug effects; unclassified drug; newborn; quantitative analysis; image processing; histopathology; thalamus; sevoflurane; neurotoxicity; Image Processing, Computer-Assisted; Radiopharmaceuticals; Drug-Related Side Effects and Adverse Reactions; medical device; Positron-Emission Tomography; ether derivative; diagnostic imaging; Pyridines; Anesthesia, General; general anaesthesia; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; drug exposure; Macaca mulatta; adverse drug reaction; frontal cortex; Frontal Lobe; radiopharmaceutical agent; x-ray computed tomography; temporal cortex; tracer; glia; anesthesia level; physiologic monitoring; Electroencephalography; Methyl Ethers; fluoroethoxybenzyl n (4 phenoxy pyridin 3 yl)acetamide f 18; acetylcarnitine; Anilides;

capnometer; computed tomography scanner; N-(2-((N-(4-phenoxy)pyridin-3-yl)acetamido)methyl)phenoxy)ethyl fluoride; nerve cell lesion; PET scanner; PET-CT scanner; pulse oximeter; pyridine derivative; sphygmomanometer; Temporal Lobe

Analgesia

Description: This section contains information on the use of analgesic drugs and therapies such as acupuncture in macaques (genus *Macaca*) to treat postoperative or other pain.

Results (29):

Ding, H., Kiguchi, N., Perrey, D. A., Nguyen, T., Czoty, P. W., Hsu, F.-C., Zhang, Y., & Ko, M.-C. (2020). Antinociceptive, reinforcing, and pruritic effects of the G-protein signalling-biased mu opioid receptor agonist PZM21 in non-human primates. *British Journal of Anaesthesia*, 125(4), 596–604. Scopus. <https://doi.org/10.1016/j.bja.2020.06.057>

Keywords: adult; animal experiment; animal model; nonhuman; priority journal; Article; controlled study; drug synthesis; Dose-Response Relationship, Drug; unclassified drug; dose response; analgesic agent; Analgesics; drug potency; drug screening; drug determination; latent period; antinociception; oxycodone; rhesus monkey; *Macaca mulatta*; Pruritus; Reinforcement, Psychology; Urea; scratching; rhesus macaque; opioid; mu opiate receptor; mu opiate receptor agonist; Receptors, Opioid, mu; beta arrestin 2; G protein; opioid addiction; pruritus; pzm 21; PZM21 compound; side effect; spinal analgesics; thermal allodynia; thiophene derivative; Thiophenes

Fantegrossi, W. E., Ko, M. C. H., Woods, J. H., & Richelson, E. (2005). Antinociceptive, hypothermic, hypotensive, and reinforcing effects of a novel neurotensin receptor agonist, NT69L, in rhesus monkeys. *Pharmacology Biochemistry and Behavior*, 80(2), 341–349. Scopus. <https://doi.org/10.1016/j.pbb.2004.12.005>

Keywords: animal experiment; animal model; article; nonhuman; priority journal; controlled study; animal behavior; Dose-Response Relationship, Drug; unclassified drug; drug effect; Pain Measurement; Analgesics; hypothermia; drug potency; antihypertensive agent; Reaction Time; Antinociception; Opioids; Reinforcement (Psychology); drug megadose; *Macaca mulatta*; cocaine; core temperature; Peptide Fragments; allodynia; capsaicin; drug self administration; premedication; Hypotension; Hypothermia; Rhesus monkeys; alfentanil; Self-administration; antihypertensive activity; antinociceptive agent; n methylarginyllysylprolyl neo tryptophyl tert leucylleucine; Neurotensin; neurotensin derivative; neurotensin receptor; nt 69l; Receptors, Neurotensin

Grace, J., Wong, H., Sinz, M., & Lentz, K. (2009). Comparison of the formation kinetics of acetaminophen in chimpanzee, cynomolgus monkey, marmoset, rhesus monkey and human liver microsomes. *Drug Metabolism Reviews*, 41, 58–59.

Keywords: Acetaminophen; analgesics; chimpanzees; cynomolgus monkeys; liver microsomes; marmosets; pharmacology; rhesus macaques; symposia, transactions and proceedings

Hama, A., Natsume, T., Ogawa, S., Awaga, Y., Hayashi, I., Matsuda, A., & Takamatsu, H. (2018). Pain-related behavior and brain activation in a cynomolgus macaque model of postoperative pain. *CNS and Neurological Disorders - Drug Targets*, 17(5), 348–360. Scopus. <https://doi.org/10.2174/1871527317666180515121350>

Keywords: Male; Time Factors; adult; animal experiment; animal model; Disease Models, Article; pathology; pathophysiology; young adult; wound healing; pressure; drug efficacy; time factor; drug effect; body temperature; hypersensitivity; nociception; stimulation; analgesia; buprenorphine; postoperative pain; image processing; analgesic agent; Analgesics; Pain, Postoperative; single drug dose; morphine; Image Processing, Computer-Assisted; Magnetic Resonance Imaging; fascicularis; diclofenac; Brain; sensitivity analysis; brain region; diagnostic imaging; adverse event; Oxygen; incision; Physical Stimulation; Hyperalgesia; enrofloxacin; Analgesics/*therapeutic use; single blind procedure; electroencephalogram; cingulate gyrus; echo planar imaging; brain scintiscanning; *cingulate; *functional magnetic resonance imaging; *insula; *Pain, Postoperative/drug therapy/pathology/physiopathology; *Pressure hyperalgesia; *primary hyperalgesia; *translational preclinical model.; Brain/diagnostic imaging/*drug effects; Hyperalgesia/*drug therapy/etiology; Physical Stimulation/adverse effects; Pregabalin/*therapeutic use; algometry; Cingulate; Functional magnetic resonance imaging; Insula; macaque model; physical stimulation; Pregabalin; Pressure hyperalgesia; pressure hypersensitivity; pressure measurement; pressure pain threshold; Primary hyperalgesia; Translational preclinical model; wound integrity

Hayashi, I., Matsuda, A., Natsume, T., Yano, M., Ogawa, S., Awaga, Y., Hama, A., & Takamatsu, H. (2018). Naturally occurring endometriosis in the cynomolgus macaque: Effects of analgesics on pain-related behavior and brain activation. *Human Reproduction*, 33, 252–252.

Keywords: Abdominopelvic pressure; analgesics; cynomolgus macaques; endometriosis; hypersensitivity; Macaca fascicularis; nervous system (neural coordination); pain; pharmacology; reproductive system (reproduction)

Iino, M., Fujiwara, A., Otsuka, T., & Wakasa, Y. (2015). Analgesic effects of pregabalin and diazepam in a neuropathic pain model of cynomolgus monkeys by single and combination dosing. *Journal of Pharmacological Sciences*, 128(3), S233–S233.

Keywords: Male; adult; animal experiment; nonhuman; priority journal; Article; controlled study; blood; oral drug administration; dermatoses; blood serum; metabolites; pain; adults; Administration, Oral; analgesics; pain killers; sedation; intravenous injection; Area Under Curve; Injections, Intravenous; intravenous drug administration; mass spectrometry; liquid chromatography; area under the curve; drug blood level; maximum plasma concentration; pharmacokinetics; drug bioavailability; drug clearance; drug distribution; dogs; Canis familiaris; bioavailability; oral administration; Canidae; Canis; Fissipeda; veterinarians; veterinary surgeons; vets; cats; Felidae; Felis; biomedical research; Analgesics, Opioid; narcotic analgesic agent; drug half life; mean residence time; Macaca; rhesus monkey; Macaca mulatta; drug metabolite; *Macaca mulatta; therapeutics; steady state; half life time; Half-Life; Veterinary

Pharmacology and Anaesthesiology; 70; Pets and Companion Animals; Cercopithecidae; Tramadol; Analgesics, Opioid/administration & dosage/blood/*pharmacokinetics; Tramadol/administration & dosage/blood/*pharmacokinetics; pruritus; itchiness; itching

Iino, M., Hoshino, M., Fujiwara, A., & Wakasa, Y. (2012). Analgesic effects of pregabalin and morphine in a cynomolgus monkey model of neuropathic pain. *Journal of Pharmacological Sciences*, 118, 195P-195P.

Keywords: Analgesia; cynomolgus macaques; hyperalgesia; *Macaca fascicularis*; mechanical pressure stimulus; morphine; neuropathic pain; neuropharmacology; pain; pregabalin; response latency; tail-pain relief study

Iino, M., Hoshino, M., Fujiwara, A., & Wakasa, Y. (2013). Analgesic effects of pregabalin and paroxetine in a neuropathic pain model of cynomolgus monkeys by single and combination dosing. *Journal of Pharmacological Sciences*, 121, 187P-187P.

Keywords: Analgesics; cynomolgus macaques; drug therapy; neuropathic pain; pain; paroxetine; pregabalin; therapeutic approach; von Frey filament based nerve ligation

Kelly, K. R., Pypendop, B. H., & Christe, K. L. (2014a). Pharmacokinetics of hydromorphone after intravenous and intramuscular administration in male rhesus macaques (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 53(5), 512–516. Scopus.

Keywords: Male; veterinary; Injections, Intramuscular; intramuscular drug administration; Pain; Injections, Intravenous; Kinetics; intravenous drug administration; Biological Availability; bioavailability; Analgesics, Opioid; narcotic analgesic agent; rhesus monkey; *Macaca mulatta*; kinetics; half life time; Half-Life; Hydromorphone

Kelly, K. R., Pypendop, B. H., & Christe, K. L. (2014b). Pharmacokinetics of buprenorphine following intravenous and intramuscular administration in male rhesus macaques (*Macaca mulatta*). *Journal of Veterinary Pharmacology and Therapeutics*, 37(5), 480–485. <https://doi.org/10.1111/jvp.12113>

Keywords: Male; Injections, Intramuscular; Administration, Intravenous; *Macaca mulatta*/*blood; Analgesics, Opioid/administration & dosage/blood/*pharmacokinetics; Buprenorphine/administration & dosage/blood/*pharmacokinetics

Kelly, K. R., Pypendop, B. H., & Christe, K. L. (2015). Pharmacokinetics of tramadol following intravenous and oral administration in male rhesus macaques (*Macaca mulatta*). *Journal of Veterinary Pharmacology and Therapeutics*, 38(4), 375–382. Scopus. <https://doi.org/10.1111/jvp.12194>

Keywords: Male; adult; animal experiment; nonhuman; priority journal; Article; controlled study; blood; oral drug administration; dermatoses; blood serum; metabolites; pain; adults; Administration, Oral; analgesics; pain killers; sedation; intravenous injection; Injections,

Intravenous; intravenous drug administration; mass spectrometry; liquid chromatography; area under the curve; drug blood level; maximum plasma concentration; pharmacokinetics; drug bioavailability; drug clearance; drug distribution; dogs; *Canis familiaris*; bioavailability; oral administration; *Canidae*; *Canis*; carnivores; *Fissipeda*; veterinarians; veterinary surgeons; vets; cats; *Felidae*; *Felis*; biomedical research; Analgesics, Opioid; narcotic analgesic agent; drug half life; mean residence time; *Macaca*; rhesus monkey; *Macaca mulatta*; drug metabolite; **Macaca mulatta*; therapeutics; steady state; half life time; Half-Life; Veterinary Pharmacology and Anaesthesiology; Pets and Companion Animals; *Cercopithecidae*; Tramadol; Analgesics, Opioid/administration & dosage/blood/*pharmacokinetics; Tramadol/administration & dosage/blood/*pharmacokinetics; pruritus; itchiness; itching

Kiguchi, N., Ding, H., Cami-Kobeci, G., Sukhtankar, D. D., Czoty, P. W., DeLoid, H. B., Hsu, F.-C., Toll, L., Husbands, S. M., & Ko, M.-C. (2019). BU10038 as a safe opioid analgesic with fewer side-effects after systemic and intrathecal administration in primates. *British Journal of Anaesthesia*, 122(6), e146–e156. Scopus.
<https://doi.org/10.1016/j.bja.2018.10.065>

Keywords: adult; animal experiment; nonhuman; priority journal; Article; controlled study; physiology; procedures; drug delivery system; in vitro study; Dose-Response Relationship, Drug; unclassified drug; dose response; drug effect; body temperature; respiration; buprenorphine; meloxicam; analgesic agent; single drug dose; analgesics; morphine; Drug Evaluation, Preclinical; drug safety; preclinical study; antinociception; analgesic activity; Analgesics, Opioid; narcotic analgesic agent; rhesus monkey; *Macaca mulatta*; respiration depression; Drug Tolerance; long term exposure; opiate agonist; Hyperalgesia; Pain Threshold; Nociception; scratching; rhesus macaque; chronic drug administration; naltrexone; Injections, Spinal; intraspinal drug administration; thermal allodynia; 1 (1 cyclooctylmethyl 3 hydroxymethyl 4 piperidyl) 3 ethyl 1,3 dihydro 2h benzimidazol 2 one; bu 10038; CHO cell line; opiate addiction; Opioid-Related Disorders

Lee, H., Naughton, N. N., Woods, J. H., & Ko, M.-C. (2007). Effects of butorphanol on morphine-induced itch and analgesia in primates. *Anesthesiology*, 107(3), 478–485. Scopus.
<https://doi.org/10.1097/01.anes.0000278876.20263.a7>

Keywords: Time Factors; animal experiment; animal model; article; Disease Models, nonhuman; priority journal; controlled study; drug efficacy; animal behavior; Behavior, Animal; Dose-Response Relationship, Drug; unclassified drug; dose response; drug effect; Analgesia; Behavior, Animal/drug effects; Analgesics, Opioid; Morphine; rhesus monkey; *Macaca mulatta*; Pruritus; butorphanol tartrate; drug potentiation; scratching; drug induced disease; drug antagonism; Analgesia/*methods; morphine sulfate; Butorphanol; Butorphanol/*therapeutic use; Analgesics, Opioid/adverse effects/*therapeutic use; Morphine/*adverse effects; Pruritus/*chemically induced/*drug therapy; Receptors, Opioid/drug effects; pruritus; Receptors, Opioid; norbinaltorphimine; kappa opiate receptor antagonist; 5' guanidinylnaltrindole; clocinnamox

Liao, Z., Dai, S.-J., Liu, X.-W., Tang, Z.-M., & Liang, S.-P. (2003). Pharmacokinetics of [125I]Huwentoxin-1 after epidural and intravenous administration to rhesus monkeys. *Chinese Pharmacological Bulletin*, 19(8), 944–949. Scopus.

Keywords: Animal experiment; article; nonhuman; controlled study; needle; unclassified drug; dose response; drug effect; analgesic agent; Pharmacokinetics; injection; isotope labeling; technique; drug blood level; drug bioavailability; drug activity; rhesus monkey; radioactivity; neurotoxin; reversed phase high performance liquid chromatography; epidural space; Epidural administration; Huwentoxin-1; iodine 125; lumbar puncture; nez 033r

MacKiewicz, A. L., Salyards, G. W., Knych, H. K., Hill, A. E., & Christe, K. L. (2019). Pharmacokinetics of a long-lasting, highly concentrated buprenorphine solution after subcutaneous administration in rhesus macaques (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science*, 58(4), 501–509. Scopus. <https://doi.org/10.30802/AALAS-JAALAS-18-000115>

Keywords: Cross-Over Studies; adult; animal experiment; nonhuman; Article; crossover procedure; blood; sex difference; adverse reactions; Pain; Buprenorphine; pain killers; Injections, Subcutaneous; Laboratory Animal Science; Area Under Curve; half-life; maximum plasma concentration; time to maximum plasma

Maenaka, T., Tano, K., Nakanishi, S., Tsukada, H., & Ishida, T. (2006). Positron emission tomography analysis of the analgesic effects of acupuncture in rhesus monkeys. *American Journal of Chinese Medicine*, 34(5), 787–801. Scopus. <https://doi.org/10.1142/S0192415X06004296>

Keywords: Male; animal experiment; animal model; article; nonhuman; controlled study; Blood Pressure; Hot Temperature; Body Temperature; Pain; Pain Measurement; Analgesia; thalamus; Brain; latent period; Positron-Emission Tomography; Pain Measurement/methods; analgesic activity; rhesus monkey; *Macaca mulatta*; Heart Rate; PET; Positron-Emission Tomography/*methods; Cerebrovascular Circulation; nerve cell; metacarpal bone; Brain Mapping; Acupuncture; Electroacupuncture; brain depth stimulation; cingulate gyrus; Regional Blood Flow; brain blood flow; Hot Temperature/adverse effects; Acupuncture Analgesia/*methods; Brain/blood supply/pathology/*physiopathology; Pain/etiology/*physiopathology; hot water; insula; Acupuncture Analgesia; Brain activity; Heat pain; leg muscle

Nunamaker, E. A., Halliday, L. C., Moody, D. E., Fang, W. B., Lindeblad, M., & Fortman, J. D. (2013). Pharmacokinetics of 2 formulations of buprenorphine in macaques (*Macaca mulatta* and *Macaca fascicularis*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 52(1), 48–56.

Keywords: Male; Animal Welfare; Injections, Intramuscular; Animals, Laboratory; Tandem Mass Spectrometry; Chromatography, Liquid; Delayed-Action Preparations; Buprenorphine/administration & dosage/blood/*pharmacokinetics; Analgesics, Opioid/administration & dosage/blood/pharmacokinetics; *Macaca fascicularis*/blood/*metabolism; *Macaca mulatta*/blood/*metabolism

Ogawa, S., Awaga, Y., Takashima, M., Hama, A., Matsuda, A., & Takamatsu, H. (2016). Antinociceptive effect of clinical analgesics in a nonhuman primate model of knee osteoarthritis. *European Journal of Pharmacology*, 786, 179–185. Scopus. <https://doi.org/10.1016/j.ejphar.2016.06.008>

Keywords: Pressure; Weight-Bearing; Female; knee; animal experiment; animal model; animal tissue; Disease Models, Animal; nonhuman; priority journal; Article; controlled study; pathology; pathophysiology; pressure; drug effects; Pain; analgesic agent; Analgesics; morphine; complication; *Macaca fascicularis*; antinociception; Osteoarthritis; pregabalin; *Cynomolgus* macaque; Hyperalgesia; Knee Joint; Analgesics/*pharmacology/therapeutic use; Duloxetine HCl (PubChem CID: 60834); Knee Joint/drug effects/pathology/physiopathology; Morphine HCl (PubChem CID: 5464110); Osteoarthritis, Knee/complications/*drug therapy/pathology/physiopathology; Pain/complications; pregabalin (PubChem CID: 5486971); Target validation; Translational research; pressure pain threshold; duloxetine; knee osteoarthritis; meniscectomy; Osteoarthritis, Knee

Saccone, P. A., Lindsey, A. M., Koeppe, R. A., Zelenock, K. A., Shao, X., Sherman, P., Quesada, C. A., Woods, J. H., & Scott, P. J. H. (2016). Intranasal opioid administration in rhesus monkeys: PET imaging and antinociception. *Journal of Pharmacology and Experimental Therapeutics*, 359(2), 366–373. Scopus. <https://doi.org/10.1124/jpet.116.235192>

Keywords: animal experiment; nonhuman; priority journal; Article; controlled study; validation study; animal behavior; Behavior, Animal; drug effects; unclassified drug; dose response; Injections, Intramuscular; intramuscular drug administration; experimental study; buprenorphine; drug potency; latent period; antinociception; Positron-Emission Tomography; Behavior, Animal/drug effects; Analgesics, Opioid; narcotic analgesic agent; opiate; drug megadose; rhesus monkey; *Macaca mulatta*; naloxone; Fentanyl; Administration, Intranasal; Nociception; Naloxone; *Positron-Emission Tomography; Analgesics, Opioid/*administration & dosage/*pharmacology; Fentanyl/administration & dosage/pharmacology; Naloxone/administration & dosage/pharmacology; Nociception/*drug effects; opiate receptor; carbon 11; carfentanil; carfentanil c 11; intranasal drug administration

Salyards, G. W., Lemoy, M.-J., Knych, H. K., Hill, A. E., & Christer, K. L. (2017). Pharmacokinetics of a Novel, Transdermal Fentanyl Solution in Rhesus Macaques (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 56(4), 443–451.

Keywords: Cross-Over Studies; Administration, Cutaneous; **Macaca mulatta*; Half-Life; Analgesics, Opioid/administration & dosage/*pharmacokinetics; Fentanyl/administration & dosage/*pharmacokinetics; Pain/drug therapy/*veterinary

Schwienteck, K. L., Negus, S. S., & Banks, M. L. (2019). Sex differences in the effectiveness of buprenorphine to decrease rates of responding in rhesus monkeys. *Behavioural Pharmacology*, 30(4), 358–362. Scopus. <https://doi.org/10.1097/FBP.0000000000000437>

Keywords: adult; animal experiment; nonhuman; Article; controlled study; metabolism; drug efficacy; animal behavior; Behavior, Animal; Dose-Response Relationship, Drug; Sex Factors; dose response; drug effect; sex difference; food; Buprenorphine; analgesic agent; Analgesics; drug potency; Ligands; drug response; Conditioning, Operant; instrumental conditioning; rhesus monkey; binding affinity; Macaca mulatta; Fentanyl; Guanosine 5'-O-(3-Thiotriphosphate); Naltrexone; sex differences; ED50; mu opiate receptor; Receptors, Opioid, mu; guanosine 5' o (3 thiotriphosphate); μ -opioid receptors

Seah, S., Asad, A. B. A., Baumgartner, R., Feng, D., Williams, D. S., Manigbas, E., Beaver, J. D., Reese, T., Henry, B., Evelhoch, J. L., & Chin, C.-L. (2014). Investigation of cross-species translatability of pharmacological MRI in awake nonhuman primate—A buprenorphine challenge study. *PloS One*, 9(10), e110432. <https://doi.org/10.1371/journal.pone.0110432>

Keywords: Female; Translational Medical Research; Anesthesia, General; Analgesics, Opioid/*pharmacology; Buprenorphine/*pharmacology; Magnetic Resonance Imaging/methods; Wakefulness/physiology; Corpus Striatum/*drug effects/physiology; Frontal Lobe/*drug effects/physiology; Gyrus Cinguli/*drug effects/physiology; Macaca fascicularis/physiology; Receptors, Opioid, mu/agonists/metabolism; Thalamus/*drug effects/physiology

Smith, A. A., Halliday, L. C., Lindeblad, M. O., & Fortman, J. D. (2019). Evaluation of Analgesic Patches in Cynomolgus Macaques (*Macaca fascicularis*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 58(3), 356–361. <https://doi.org/10.30802/AALAS-JAALAS-18-000101>

Keywords: Cross-Over Studies; Male; Dose-Response Relationship, Drug; Administration, Cutaneous; Area Under Curve; Macaca fascicularis/*physiology; Half-Life; Pain/drug therapy/veterinary; Analgesics, Opioid/administration & dosage/*pharmacokinetics/pharmacology; Buprenorphine/administration & dosage/*pharmacokinetics/pharmacology; Fentanyl/administration & dosage/*pharmacokinetics/pharmacology

Tang, X., Di, X., Zhong, Z., Xie, Q., Chen, Y., Wang, F., Ling, Z., Xu, P., Zhao, K., Wang, Z., Liu, L., & Liu, X. (2016). In vitro metabolism of L-corydalmine, a potent analgesic drug, in human, cynomolgus monkey, beagle dog, rat and mouse liver microsomes. *Journal of Pharmaceutical and Biomedical Analysis*, 128, 98–105. <https://doi.org/10.1016/j.jpba.2016.05.024>

Keywords: Analgesic drugs; cytochrome P450s; cynomolgus macaques; dogs; drug-drug interaction; hepatic microsome; humans; hydroxylation; interspecies difference; L-Corydalmine; liver microsome; Macaca fascicularis; metabolism; mouse; O-demethylation; rats

Weed, M. R., & Hienz, R. D. (2006). Effects of morphine on circadian rhythms of motor activity and body temperature in pig-tailed macaques. *Pharmacology Biochemistry and Behavior*, 84(3), 487–496. Scopus. <https://doi.org/10.1016/j.pbb.2006.06.012>

Keywords: Male; Time Factors; animal experiment; article; nonhuman; priority journal; controlled study; Temperature; dose response; drug effect; Body Temperature; Motor Activity; Data Interpretation, Statistical; Software; telemetry; measurement; Monitoring, Physiologic; Analgesics, Opioid; Morphine; Macaca; Circadian Rhythm; hyperthermia; Radio-telemetry; Motor activity; Macaca nemestrina; Circadian rhythm; morphine sulfate; drug dose regimen; chronopharmacology; Pig-tailed macaque

Weed, P. F., Gerak, L. R., & France, C. P. (2018). Ventilatory-depressant effects of opioids alone and in combination with cannabinoids in rhesus monkeys. *European Journal of Pharmacology*, 833, 94–99. Scopus. <https://doi.org/10.1016/j.ejphar.2018.05.041>

Keywords: adult; animal experiment; animal model; nonhuman; priority journal; Article; controlled study; body weight; dose response; drug effect; Respiratory Rate/drug effects; Drug Interactions; Tidal Volume; 4 (1,1 dimethylheptyl) 1',2',3',4',5',6' hexahydro 2,3' dihydroxy 6' (3 hydroxypropyl)biphenyl; dronabinol; Analgesics, Opioid; narcotic analgesic agent; breathing rate; Morphine; Macaca mulatta; Fentanyl; Respiration; respiration depression; Ventilation; Rhesus monkey; drug dose comparison; lung ventilation; Pulmonary Ventilation; drug potentiation; drug interaction; lung minute volume; Analgesics, Opioid/*pharmacology; Cercopithecidae; Animal and in-vitro Models for Pharmaceuticals; VV450; morphine sulfate; Non-food/Non-feed Plant Products; SS200; Fentanyl/pharmacology; Dronabinol; Respiratory Rate; Morphine/pharmacology; Cannabinoid receptor agonist; Cannabinoids/*pharmacology; Cyclohexanols/pharmacology; Dronabinol/pharmacology; Drug-drug interactions; mu opioid receptor agonist; Pulmonary Ventilation/*drug effects; Tidal Volume/drug effects; 3-(2-hydroxy-4-(1,1-dimethylheptyl)phenyl)-4-(3-hydroxypropyl)cyclohexanol; Cannabinoids; cyclohexanol derivative; Cyclohexanols; lung diffusion; morphine-induced antinociception; sterile water

Xiang, X.-H., Chen, Y.-M., Zhang, J.-M., Tian, J.-H., Han, J.-S., & Cui, C.-L. (2014). Low- and high-frequency transcutaneous electrical acupoint stimulation induces different effects on cerebral μ -opioid receptor availability in rhesus monkeys. *Journal of Neuroscience Research*, 92(5), 555–563. <https://doi.org/10.1002/jnr.23351>

Keywords: Male; Time Factors; Radiography; Positron-Emission Tomography; Macaca mulatta; Protein Binding/drug effects; Afferent Pathways/physiology; Brain Mapping; *Acupuncture Points; Receptors, Opioid, mu/*metabolism; *Transcutaneous Electric Nerve Stimulation; Analgesics, Opioid/pharmacokinetics; Biophysical Phenomena/*physiology; Cerebral Cortex/diagnostic imaging/*metabolism; Fentanyl/analogs & derivatives/pharmacokinetics; Tomography Scanners, X-Ray Computed; transcutaneous electrical acupoint stimulation (TEAS); μ -opioid receptor (MOR)

Xu, J., Zhou, X., Guo, X., Wang, G., Fu, S., & Zhang, L. (2018). Effects of Unilateral Electroacupuncture on Bilateral Proprioception in a Unilateral Anterior Cruciate Ligament Injury Model. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*, 24, 5473–5479. <https://doi.org/10.12659/MSM.909508>

Keywords: Disease Models, Animal; Macaca fascicularis; Knee Joint; Acupuncture Points; Anterior Cruciate Ligament Injuries/*therapy; Anterior Cruciate Ligament/physiology; Electroacupuncture/*methods; Knee Injuries; Proprioception/*physiology

Yeomans, D. C., Lu, Y., Laurito, C. E., Peters, M. C., Vota-Vellis, G., Wilson, S. P., & Pappas, G. D. (2006). Recombinant herpes vector-mediated analgesia in a primate model of hyperalgesia. *Molecular Therapy*, 13(3), 589–597. Scopus. <https://doi.org/10.1016/j.ymthe.2005.08.023>

Keywords: animal experiment; animal model; article; Disease Models, Animal; nonhuman; controlled study; skin nerve; behavior; Behavior, Animal; Pain; chronic pain; Analgesia; immunohistochemistry; Skin/metabolism; Herpesviridae; Reaction Time; Skin; Behavior, Animal/drug effects; sensitization; analgesic activity; Analgesics, Opioid; Morphine; Macaca; naloxone; radioimmunoassay; Gene expression; Hyperalgesia; Genetic Vectors; nociceptive receptor; Analgesics, Opioid/pharmacology; Analgesia/*methods; morphine sulfate; thermal stimulation; Nociceptors; sensory nerve cell; *Genetic Therapy; Capsaicin/pharmacology; Enkephalins/cerebrospinal fluid/genetics/metabolism; Ganglia, Spinal/chemistry/metabolism; Genetic Vectors/*administration & dosage; Hyperalgesia/chemically induced/physiopathology/*therapy/*virology; Morphine/pharmacology; Nociceptors/metabolism; Reaction Time/genetics; Simplexvirus/*genetics; Capsaicin; C fiber; Enkephalins; Ganglia, Spinal; Gene Therapy; Herpes; herpesvirus vector; Opiate; preproenkephalin; Simplexvirus; virus recombinant

Adverse Effects

Description: This section features citations about adverse effects of anesthetic or analgesic drugs on macaques (genus *Macaca*).

Results(38):

Andresen, J. H., & Saugstad, O. D. (2019). 50 Years Ago in *The Journal of Pediatrics*: The Effect of Pentobarbital Anesthesia on Resuscitation and Brain Damage in Fetal Rhesus Monkeys Asphyxiated on Delivery. *Journal of Pediatrics*, 212, 43. Scopus. <https://doi.org/10.1016/j.jpeds.2019.02.001>

Keywords: Humans; resuscitation; Disease Models, Animal; nonhuman; priority journal; Article; disease model; procedures; disease severity; incidence; breathing; drug effect; central depressant agent; metabolic acidosis; complication; fetus; risk reduction; Resuscitation; brain damage; rhesus monkey; Macaca mulatta; apnea; neuroprotection; assisted ventilation; thiopental; Pentobarbital; Adjuvants, Anesthesia; Asphyxia Neonatorum; Brain Damage, Chronic; chronic brain disease; fetus hypoxia; newborn hypoxia

Arakawa, R., Farde, L., Matsumoto, J., Kanegawa, N., Yakushev, I., Yang, K.-C., & Takano, A. (2018). Potential Effect of Prolonged Sevoflurane Anesthesia on the Kinetics of [11C]Raclopride in Non-human Primates. *Molecular Imaging and Biology*, 20(2), 183–187. Scopus. <https://doi.org/10.1007/s11307-017-1120-8>

Keywords: Female; Time Factors; nonhuman; priority journal; Article; metabolism; drug effect; Kinetics; carbon; *Macaca fascicularis*; Positron emission tomography; brain function; Anesthesia; corpus striatum; radioactivity; Corpus Striatum/metabolism; Carbon Radioisotopes; Cerebellum; Raclopride; *Anesthesia; Sevoflurane; Sevoflurane/*pharmacology; *[11C]Raclopride; *Binding potential; *Positron emission tomography; *Sevoflurane; *Time to peak; *Time-activity curve; Carbon Radioisotopes/*pharmacokinetics; Cerebellum/metabolism; Raclopride/*pharmacokinetics; [11C]Raclopride; binding kinetics; Binding potential; Carbon-11; Corpus Striatum; raclopride c 11

Bentson, K. L., Capitanio, J. P., & Mendoza, S. P. (2003). Cortisol responses to immobilization with Telazol or ketamine in baboons (*Papio cynocephalus/anubis*) and rhesus macaques (*Macaca mulatta*). *Journal of Medical Primatology*, 32(3), 148–160. Scopus. <https://doi.org/10.1034/j.1600-0684.2003.00018.x>

Keywords: Male; Training; time; animal experiment; article; nonhuman; priority journal; controlled study; sodium chloride; Species Specificity; blood sampling; leukocyte count; animal cell; species difference; drug effect; analysis of variance; injection; Ketamine; Leukocytes; Lymphocytes; Immobilization; Novelty; Drug Combinations; hydrocortisone blood level; Anesthetics, Dissociative; *Macaca*; rhesus monkey; Hydrocortisone; *Macaca mulatta*; *Papio*; immunological parameters; Hydrocortisone/*blood; baboon; *Papio hamadryas*; Tiletamine; Zolazepam; telazol; Ketamine/*pharmacology; Psychoneuroimmunology; Anesthetics, Dissociative/*pharmacology; *Macaca mulatta*/*blood; Immobilization/*physiology; *Papio*/*blood; Tiletamine/*pharmacology; Zolazepam/*pharmacology; Benzodiazepines; *Papio anubis*; *Papio cynocephalus*; arm movement; Benzodiazepine receptors; Biorhythm; Blood sampling venipuncture; Circadian

Brambrink, A. M., Evers, A. S., Avidan, M. S., Farber, N. B., Smith, D. J., Martin, L. D., Dissen, G. A., Creeley, C. E., & Olney, J. W. (2012). Ketamine-induced neuroapoptosis in the fetal and neonatal rhesus macaque brain. *Anesthesiology*, 116(2), 372–384. <https://doi.org/10.1097/ALN.0b013e318242b2cd>

Keywords: Female; Random Allocation; Pregnancy; Animals, Newborn; Infusions, Intravenous; *Macaca mulatta*; Brain/*drug effects/pathology; Apoptosis/*drug effects/physiology; Fetus/*drug effects/pathology; Ketamine/administration & dosage/*toxicity; Nerve Degeneration/*chemically induced/pathology

Castañeda-Martínez, L., Noguchi, K. K., Ikonomidou, C., Zagzebski, J. A., Hall, T. J., & Rosado-Mendez, I. M. (2020). Optimization of Ultrasound Backscatter Spectroscopy to Assess Neurotoxic Effects of Anesthesia in the Newborn Non-human Primate Brain. *Ultrasound in Medicine and Biology*, 46(8), 2044–2056. Scopus. <https://doi.org/10.1016/j.ultrasmedbio.2020.04.004>

Keywords: Ultrasonography/*methods; animal experiment; animal model; nonhuman; priority journal; Article; controlled study; female; procedures; drug effect; prevalence; newborn; Quality control; sensitivity and specificity; nuclear magnetic resonance imaging; image analysis;

Apoptosis; neurotoxicity; Anesthetics; drug safety; process optimization; neuroimaging; anesthetic agent; echography; Ultrasonography; rhesus monkey; *Macaca mulatta*; Anesthesiology; spectroscopy; kernel method; probability; cross-sectional study; Cell death; Spectrum Analysis; signal noise ratio; Apoptosis/drug effects; *Apoptosis; Thalamus; Sevoflurane; Anesthetics/*adverse effects; Inter quartile ranges; *Sevoflurane; *Effective scatterer size; *Newborn brain; *Quantitative ultrasound; *Thalamus; Sevoflurane/adverse effects; Spectrum Analysis/*methods; Thalamus/*drug effects; fractional anisotropy; Acceptance criteria; Acoustic wave backscattering; B scan; Effective scatterer size; Fourier transform; Frequency dependence; frequency modulation; high frequency

Cheng, Y., Wang, J., Wu, N., Zhang, L., & Jiang, H. (2020). Multiple sevoflurane exposures don't disturb the T-cell receptor repertoire in infant rhesus monkeys' thymus. *Life Sciences*, 248. Agricola. <https://doi.org/10.1016/j.lfs.2020.117457>

Keywords: Surgery; immune response; antigens; genes; anesthesia; sevoflurane; risk; Thymus; *Macaca mulatta*; Macaque; thymus gland; T-lymphocytes; children; entropy; childhood; T-cell receptor repertoire

Christe, K. L., Lee, U. J., Lemoy, M.-J., & Havton, L. A. (2013). Generalized seizure activity in an adult rhesus macaque (*Macaca mulatta*) during ketamine anesthesia and urodynamic studies. *Comparative Medicine*, 63(5), 445–447. Scopus.

Keywords: Female; animal experiment; animal model; article; nonhuman; sodium chloride; Developed Countries; OECD Countries; America; APEC countries; evaluation; anesthesia; diazepam; propofol; Laboratory Animal Science; bladder; Ketamine; Anesthetics; North America; USA; Seizures; *Macaca*; rhesus monkey; *Macaca mulatta*; benzodiazepine; Veterinary Pharmacology and Anaesthesiology; Western States of USA; Cercopithecidae; Pacific States of USA; electromyography; Monkey Diseases; continuous infusion; Monkey Diseases/*chemically induced; Ketamine/administration & dosage/*adverse effects; Anesthetics/administration & dosage/*adverse effects; Seizures/chemically induced/*veterinary; Urodynamics; oscillation; tonic clonic seizure; cystometry; external urethral sphincter muscle; sphincter; tic

Coleman, K., Robertson, N. D., Dissen, G. A., Neuringer, M. D., Martin, L. D., Cuzon Carlson, V. C., Kroenke, C., Fair, D., & Brambrink, A. M. (2017). Isoflurane Anesthesia Has Long-term Consequences on Motor and Behavioral Development in Infant Rhesus Macaques. *Anesthesiology*, 126(1), 74–84. Scopus. <https://doi.org/10.1097/ALN.0000000000001383>

Keywords: time; animal experiment; animal model; nonhuman; priority journal; Article; controlled study; Models, Animal; animal behavior; Behavior, Animal; Animals, Newborn; drug effects; dose response; newborn; Motor Activity; Isoflurane; infant; chemically induced; neurotoxicity; behavior disorder; anxiety; general anesthesia; drug reexposure; Anesthetics, Inhalation; inhalation anesthetic agent; Anxiety; rhesus monkey; *Macaca mulatta*; social environment; child behavior; Reflex; Time; motor development; primate model; perinatal drug exposure

Dror, M. (2010). Accidental induced seizures in three cynomologus macaques following administration of ceftriaxone dissolved in 1% lidocaine diluent. *Laboratory Animals*, 44(1), 30–32. Scopus. <https://doi.org/10.1258/la.2009.009002>

Keywords: Male; animal experiment; article; nonhuman; infection prevention; postoperative care; Anti-Bacterial Agents; Injections, Intramuscular; Lidocaine; Cytokines; Injections, Subcutaneous; *Macaca fascicularis*; Seizures; Anesthetics, Local; *Macaca*; rhesus monkey; *Macaca mulatta*; implant; Ceftriaxone; Monkey Diseases; Skull; central nervous system disease; central nervous system infection; clonic seizure; craniotomy; *Cynomologus* monkeys; device removal; diluent; drug dose reduction; dura mater infection; seizure threshold; surgical infection; Vehicles

Hamby, S. M., Pierre, P. J., Becker, M., DePetrillo, P. B., Higley, J. D., Suomi, S. J., & Bennett, A. J. (2004). The effects of acute ketamine anesthesia on monoamine metabolites in ketamine-naïve versus ketamine-experienced infant rhesus monkeys (*Macaca mulatta*). *American Journal of Primatology*, 62(1), 92–92.

Keywords: Anesthesia; ketamine; *Macaca mulatta*; meeting abstract; neuropharmacology; rhesus macaques

Havton, L. A., Biscola, N. P., Christe, K. L., & Colman, R. J. (2020). Ketamine-induced neuromuscular reactivity is associated with aging in female rhesus macaques. *PloS One*, 15(9), e0236430. <https://doi.org/10.1371/journal.pone.0236430>

Keywords: Female; *Macaca mulatta*/*physiology; Electromyography; Anesthetics, Dissociative/*adverse effects; Ketamine/*adverse effects; *Aging/drug effects; Muscles/*drug effects/innervation/physiology

Herrington, J. A., Del Rosso, L., & Capitanio, J. P. (2019). Behavioral effects of postnatal ketamine exposure in rhesus macaque infants are dependent on MAOA-LPR genotype. *Developmental Psychobiology*, 61(4), 605–614. <https://doi.org/10.1002/dev.21843>

Keywords: Female; Pregnancy; Genotype; Motor Activity/*drug effects; *Macaca mulatta*; Behavior, Animal/*drug effects; *Prenatal Exposure Delayed Effects; Ketamine/*pharmacology; Monoamine Oxidase/*genetics; Excitatory Amino Acid Antagonists/*pharmacology; Receptors, N-Methyl-D-Aspartate/antagonists & inhibitors

Hotchkiss, C. E., Wang, C., & Slikker Jr., W. (2007). Effect of prolonged ketamine exposure on cardiovascular physiology in pregnant and infant rhesus monkeys (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science*, 46(6), 21–28. Scopus.

Keywords: Time Factors; time; article; nonhuman; controlled study; Blood Pressure; oxygen saturation; physiology; reproducibility; Reproducibility of Results; comparative study; animal housing; Housing, Animal; Pregnancy; Animals, Newborn; animal disease; breeding; drug effect; body temperature; pH; Animals, Laboratory; experimental animal; Heart Rate/drug

effects; sedation; Ketamine; Restraint, Physical/physiology/veterinary; Blood Glucose; Hominidae; breathing mechanics; Respiratory Mechanics; Homo; man; breathing rate; anesthetic agent; Anesthetics, Dissociative; Macaca; rhesus monkey; Pregnancy, Animal; Macaca mulatta; exercise; Restraint, Physical; Heart Rate; Macaca mulatta/*physiology; Pregnancy, Animal/*physiology; Animals, Newborn/*physiology; Blood Gas Analysis; Blood Pressure/drug effects; glucose blood level; Hematocrit; Veterinary Pharmacology and Anaesthesiology; Animal Reproduction and Embryology; 50; Animal Nutrition (Physiology); 10; Animal Physiology and Biochemistry (Excluding Nutrition); Cercopithecidae; cardiovascular function; Blood Glucose/drug effects; Ketamine/*pharmacology; Anesthetics, Dissociative/*pharmacology; Cardiovascular Physiological Phenomena/*drug effects; Respiratory Mechanics/drug effects; Cardiovascular Physiology; expired air

Ikonomidou, C., Kirvassilis, G., Swiney, B. S., Wang, S. H., Huffman, J. N., Williams, S. L., Masuoka, K., Capuano, S., III, Brunner, K. R., Crosno, K., Simmons, H. S., Mejia, A. F., Turski, C. A., Brambrink, A., & Noguchi, K. K. (2019). Mild hypothermia ameliorates anesthesia toxicity in the neonatal macaque brain. *Neurobiology of Disease*, 130. Scopus. <https://doi.org/10.1016/j.nbd.2019.104489>

Keywords: Animals; animal experiment; animal model; animal tissue; nonhuman; priority journal; Article; controlled study; pathology; oxygen saturation; procedures; Animals, Newborn; animal cell; drug effect; newborn; body temperature; infant; enzyme activation; immunohistochemistry; Apoptosis; Development; caspase 3; Brain; Anesthesia; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; Macaca mulatta; Neuroprotection; nerve cell; Neurons; oligodendroglia; Apoptosis/drug effects; *Apoptosis; *Development; therapy effect; gray matter; white matter; *Anesthesia; Sevoflurane; Hypothermia, Induced; induced hypothermia; *Brain injury; *Neuroprotection; Anesthetics, Inhalation/*toxicity; Brain/drug effects/*pathology; Hypothermia, Induced/*methods; Neurons/drug effects/pathology; Sevoflurane/*toxicity; brain nerve cell; brain toxicity; drug tolerability

Jevtovic-Todorovic, V. (2018). Monkey business: The importance of mounting behavioural evidence for anaesthesia-induced developmental neurotoxicity. *British Journal of Anaesthesia*, 120(4), 617–619. Scopus. <https://doi.org/10.1016/j.bja.2018.02.001>

Keywords: Animals; priority journal; human; anesthesia; neurotoxicity; developmental toxicity; Editorial; Haplorhini; glucocorticoid; anxiety; Anesthesia; inhalation anesthesia; rhesus monkey; cognitive defect; drug exposure; Macaca mulatta; Anesthesiology; Neurotoxicity Syndromes; toxicity and intoxication; brain development; synaptogenesis; memory disorder; maternal deprivation; displacement behavior; catecholamine; cognitive development; Sevoflurane; anesthesiology

Jevtovic-Todorovic, V. (2021). Detrimental effects of general anaesthesia on young primates: Are we closer to understanding the link? *British Journal of Anaesthesia*, 126(3), 575–577. Scopus. <https://doi.org/10.1016/j.bja.2020.12.019>

Keywords: nonhuman; priority journal; human; Social Behavior; emotion; Isoflurane; neurotoxicity; Cognition; developmental toxicity; Editorial; meta analysis (topic); anxiety;

anesthetic agent; adverse event; Anesthesia, General; general anesthesia; rhesus monkey; prefrontal cortex; brain development; juvenile animal; infancy; oligodendroglia; amygdala; cognitive development; cingulate gyrus; anaesthetic neurotoxicity; neuroapoptosis; psychosocial development; socio-emotional behaviour

Kim, C.-Y., Lee, H.-S., Han, S.-C., Heo, J.-D., Kwon, M.-S., Ha, C.-S., & Han, S.-S. (2005). Hematological and serum biochemical values in cynomolgus monkeys anesthetized with ketamine hydrochloride. *Journal of Medical Primatology*, 34(2), 96–100. <https://doi.org/10.1111/j.1600-0684.2005.00097.x>

Keywords: Creatine Kinase/blood; Leukocyte Count; Lymphocyte Count; Anesthesia/*veterinary; Alanine Transaminase/blood; Aspartate Aminotransferases/blood; Blood Glucose/analysis; Macaca fascicularis/*blood; Anesthetics, Dissociative/*adverse effects; Ketamine/*adverse effects; Phosphates/blood; Potassium/blood; Sodium/blood

Kim, J. M., Shin, J.-S., Yoon, I. H., Min, B. H., Jeong, W. Y., Lee, G. E., Kim, M. S., Kim, J. E., Jang, J. Y., & Park, C.-G. (2014). The effect of propofol on intravenous glucose tolerance test in rhesus monkey. *Journal of Medical Primatology*, 43(4), 242–246. Scopus. <https://doi.org/10.1111/jmp.12128>

Keywords: Male; adult; animal experiment; article; nonhuman; priority journal; controlled study; Blood Pressure; blood; drug effects; Body Temperature; anesthesia induction; propofol; Blood Glucose; Insulin; Glucose Tolerance Test; Anesthesia; hydrocortisone blood level; Anesthetics, Intravenous; intravenous anesthetic agent; rhesus monkey; Cortisol; Hydrocortisone; Macaca mulatta; Heart Rate; glucose metabolism; Propofol; Rhesus monkey; glucose blood level; glucose tolerance test; continuous infusion; hemodynamic parameters; C-Peptide; insulin release; Insulin secretion; Intravenous glucose tolerance test

Ko, M. C. H., Song, M. S., Edwards, T., Lee, H., & Naughton, N. N. (2004). The role of central mu opioid receptors in opioid-induced itch in primates. *The Journal of Pharmacology and Experimental Therapeutics*, 310(1), 169–176. <https://doi.org/10.1124/jpet.103.061101>

Keywords: Animals; Disease Models, Animal; Narcotics/adverse effects; Macaca mulatta; Morphine/*adverse effects; Narcotic Antagonists/pharmacology; Analgesics, Opioid/*adverse effects; Enkephalin, Ala(2)-MePhe(4)-Gly(5)-/adverse effects; Histamine/pharmacology; Pruritus/*chemically induced; Receptors, Opioid, mu/*physiology

Ko, M.-C., & Husbands, S. M. (2009). Effects of atypical kappa-opioid receptor agonists on intrathecal morphine-induced itch and analgesia in primates. *The Journal of Pharmacology and Experimental Therapeutics*, 328(1), 193–200. <https://doi.org/10.1124/jpet.108.143925>

Keywords: animal experiment; animal model; article; nonhuman; priority journal; controlled study; physiology; statistics; behavior; dose response; drug effect; Hot Temperature; heat; Analgesia; morphine; sedation; Spiro Compounds; Reaction Time; antinociception; treatment response; reaction time; Morphine; Macaca; rhesus monkey; Macaca mulatta; exercise;

Restraint, Physical; respiration depression; Analgesia/*statistics & numerical data; nerve cell; Neurons; drug dose comparison; drug structure; drug potentiation; scratching; Pyrrolidines/pharmacology; drug antagonism; piperazine derivative; Piperazines; Morphine/administration & dosage/*pharmacology; kappa opiate receptor; Pyrrolidines; Injections, Spinal; intraspinal drug administration; Benzomorphans/pharmacology; Morphinans/pharmacology; Neurons/drug effects/physiology; Piperazines/pharmacology; Receptors, Opioid, kappa; Receptors, Opioid, kappa/*agonists/antagonists & inhibitors/drug effects; Spiro Compounds/pharmacology; pruritus; mu opiate receptor antagonist; kappa opiate receptor agonist; 3,4 dichloro n methyl n [2 (1 pyrrolidinyl)cyclohexyl]benzeneacetamide methanesulfonate; norbinaltorphimine; 4 [(3,4 dichlorophenyl)acetyl] 3 (1 pyrrolidinylmethyl) 1 piperazinecarboxylic acid methyl ester; benzomorphan derivative; Benzomorphans; bremazocine; kappa opiate receptor antagonist; morphinan derivative; Morphinans; nalfurafine; pyrrolidine derivative

Koo, E., Oshodi, T., Meschter, C., Ebrahimnejad, A., & Dong, G. (2014). Neurotoxic effects of dexmedetomidine in fetal cynomolgus monkey brains. *The Journal of Toxicological Sciences*, 39(2), 251–262. <https://doi.org/10.2131/jts.39.251>

Keywords: Female; Pregnancy; Dose-Response Relationship, Drug; *Macaca fascicularis*; Apoptosis/*drug effects; Prefrontal Cortex; Maternal-Fetal Exchange; Adrenergic alpha-2 Receptor Agonists/administration & dosage/blood/*toxicity; Brain/*drug effects/*embryology/enzymology/pathology; Caspase 3/metabolism; Dexmedetomidine/administration & dosage/blood/*toxicity; Hypnotics and Sedatives/administration & dosage/blood/*toxicity; Ketamine/administration & dosage/blood/toxicity; Neurodegenerative Diseases/chemically induced

Lee, V. K., Flynt, K. S., Haag, L. M., & Taylor, D. K. (2010). Comparison of the effects of ketamine, ketamine-medetomidine, and ketamine-midazolam on physiologic parameters and anesthesia-induced stress in rhesus (*Macaca mulatta*) and cynomolgus (*Macaca fascicularis*) macaques. *Journal of the American Association for Laboratory Animal Science*, 49(1), 57–63. Scopus.

Keywords: animal experiment; animal model; article; nonhuman; controlled study; ketamine; adverse effects; Random Allocation; Injections, Intramuscular; corticosterone; animal stress; anesthesia induction; Administration, Oral; Heart Rate/drug effects; Ketamine; Ketamine/*administration & dosage; intramuscular injection; anesthetics; sedation; Laboratory Animal Science; laboratory animals; diastolic blood pressure; systolic blood pressure; respiratory function; physiological response; oral administration; breathing rate; *Macaca*; rhesus monkey; Oxygen; *Macaca mulatta*; Heart Rate; Respiration; Oxygen/metabolism; *Macaca mulatta*/*physiology; *Macaca fascicularis*; *Macaca fascicularis*/*physiology; glucocorticoids; metabolite; Injections, Intramuscular/veterinary; Respiration/drug effects; anesthesia level; Veterinary Pharmacology and Anaesthesiology; Animal Physiology and Biochemistry (Excluding Nutrition); Cercopithecidae; Animal Models of Human Diseases; VV400; Midazolam; Midazolam/*administration & dosage; Anesthetics, Combined; Medetomidine; Medetomidine/*administration & dosage; cardiovascular effect; muscle relaxation; depth of anesthesia; drug evaluation

Liu, F., Rainosek, S. W., Frisch-Daiello, J. L., Patterson, T. A., Paule, M. G., Slikker, W., Jr, Wang, C., & Han, X. (2015). Potential Adverse Effects of Prolonged Sevoflurane Exposure on Developing Monkey Brain: From Abnormal Lipid Metabolism to Neuronal Damage. *Toxicological Sciences*, 147(2), 562–572. Scopus.
<https://doi.org/10.1093/toxsci/kfv150>

Keywords: exposure; animal experiment; animal model; animal tissue; nonhuman; Article; controlled study; oxygen saturation; cholesterol; metabolism; cell survival; cell viability; adverse effects; heart rate; Animals, Newborn; growth, development and aging; drug effects; newborn; body temperature; oxidative stress; gene expression; infant; interleukin 17; Cytokines; biological marker; cell death; reactive oxygen metabolite; neurotoxicity; diastolic blood pressure; systolic blood pressure; epidermal growth factor; macrophage inflammatory protein 1alpha; protein analysis; Development; Inhalation Exposure; Oligonucleotide Array Sequence Analysis; triacylglycerol; Brain; lipid peroxidation; ether derivative; DNA microarray; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; Macaca mulatta; nerve cell; Neurons; long term exposure; brain development; frontal cortex; lipidomics; fatty acid metabolism; lipid; brain chemistry; Brain Chemistry; primate model; Sevoflurane; Methyl Ethers; nerve cell lesion; biological functions; CXCL9 chemokine; Lipid Metabolism; lipid oxidation; Neuronal degeneration; phosphatidylserine; steroid metabolism

Liu, S., Zhang, X., Liu, F., Paule, M. G., Callicott, R., Newport, G. D., Ali, S. F., Patterson, T. A., Apana, S. M., Berridge, M. S., Maisha, M. P., Hanig, J. P., Slikker, W., & Wang, C. (2017). The utility of a nonhuman primate model for assessing anesthetic-induced developmental neurotoxicity. *Journal of Drug and Alcohol Research*, 6. Scopus.
<https://doi.org/10.4303/jdar/236011>

Keywords: Animal experiment; animal model; animal tissue; nonhuman; Article; controlled study; blood pressure; disease model; oxygen saturation; physiology; nerve injury; heart rate; hematocrit; newborn; gamma interferon; interleukin 10; interleukin 2; interleukin 4; interleukin 5; tumor necrosis factor; granulocyte macrophage colony stimulating factor; interleukin 1beta; interleukin 6; protein expression; nervous system inflammation; monocyte chemotactic protein 1; interleukin 12; sevoflurane; granulocyte colony stimulating factor; neurotoxicity; electron microscopy; positron emission tomography; breathing rate; rhesus monkey; Developmental neurotoxicity; end tidal carbon dioxide tension; respiratory acidosis; anesthetic induced developmental neurotoxicity; levacecarnine; sphygmomanometry; Volatile anesthetic

López, K. R., Gibbs, P. H., & Reed, D. S. (2002). A Comparison of Body Temperature Changes Due to the Administration of Ketamine-Acepromazine and Tiletamine-Zolazepam Anesthetics in Cynomolgus Macaques. *Contemporary Topics in Laboratory Animal Science*, 41(2), 47–50. Scopus.

Keywords: ketamine; physiology; comparative study; adverse effects; animal disease; drug effect; Injections, Intramuscular; intramuscular drug administration; Body Temperature; thermoregulation; anesthesia; anesthetics; chemically induced disorder; Ketamine; Telemetry; Macaca fascicularis; Drug Combinations; animal use alternatives; anesthetic agent; Anesthesia,

General; general anesthesia; combination drug therapy; Anesthetics, Dissociative; Macaca; *Macaca fascicularis; Telemetry/veterinary; Anesthesia, General/*veterinary; neuroleptics; Injections, Intramuscular/veterinary; fever; circadian rhythm; laboratory mammals; animal use refinement; Fever; Tiletamine; Zolazepam; acepromazine; Anesthetics, Dissociative/adverse effects; Acepromazine; Body Temperature/*drug effects/physiology; Fever/chemically induced/veterinary

Neudecker, V., Perez-Zoghbi, J. F., Martin, L. D., Dissen, G. A., Grafe, M. R., & Brambrink, A. M. (2021). Astrogliosis in juvenile non-human primates 2 years after infant anaesthesia exposure. *British Journal of Anaesthesia*, 127(3), 447–457. <https://doi.org/10.1016/j.bja.2021.04.034>

Keywords: Time Factors; Animals, Newborn; Age Factors; isoflurane; anaesthesia; apoptosis; Administration, Inhalation; Macaca mulatta; Apoptosis/drug effects; Brain/*drug effects/metabolism/pathology; Anesthesia, Inhalation/*adverse effects; Anesthetics, Inhalation/administration & dosage/*toxicity; astrogliosis; Calcium-Binding Proteins/metabolism; Glial Fibrillary Acidic Protein/metabolism; glial fibrillary protein; Gliosis/*chemically induced/metabolism/pathology; Isoflurane/administration & dosage/*toxicity; Microfilament Proteins/metabolism; Microglia/*drug effects/metabolism/pathology

Noguchi, K. K., Johnson, S. A., Dissen, G. A., Martin, L. D., Manzella, F. M., Schenning, K. J., Olney, J. W., & Brambrink, A. M. (2017). Isoflurane exposure for three hours triggers apoptotic cell death in neonatal macaque brain. *British Journal of Anaesthesia*, 119(3), 524–531. <https://doi.org/10.1093/bja/aex123>

Keywords: Disease Models, Animal; Animals, Newborn; isoflurane; anaesthesia; apoptosis; Apoptosis/*drug effects; Macaca mulatta; growth and development; Time; Anesthetics, Inhalation/*adverse effects; Isoflurane/*adverse effects; Brain/*drug effects/pathology; Neurotoxicity Syndromes/*etiology/pathology

Noguchi, K. K., Johnson, S. A., Kristich, L. E., Martin, L. D., Dissen, G. A., Olsen, E. A., Olney, J. W., & Brambrink, A. M. (2016). Lithium protects against anaesthesia neurotoxicity in the infant primate brain. *Scientific Reports*, 6. Scopus. <https://doi.org/10.1038/srep22427>

Keywords: Disease Models, Animal; Animals, Newborn; isoflurane; anaesthesia; apoptosis; Apoptosis/*drug effects; Macaca mulatta; growth and development; Time; Anesthetics, Inhalation/*adverse effects; Isoflurane/*adverse effects; Brain/*drug effects/pathology; Neurotoxicity Syndromes/*etiology/pathology

Noguchi, K. K., Johnson, S. A., Manzella, F. M., Masuoka, K. L., Williams, S. L., Martin, L. D., Dissen, G. A., Ikonomidou, C., Schenning, K. J., Olney, J. W., & Brambrink, A. M. (2018). Caffeine Augments Anesthesia Neurotoxicity in the Fetal Macaque Brain. *Scientific Reports*, 8. <https://doi.org/10.1038/s41598-018-23560-7>

Keywords: Anesthesia; apoptotic death; caffeine; drug-induced; drug therapy; Macaca; macaques; neurotoxicity; nervous system disease; neurodevelopmental age; pharmacology-neuropharmacology

Paule, M. G., Li, M., Allen, R. R., Liu, F., Zou, X., Hotchkiss, C., Hanig, J. P., Patterson, T. A., Slikker, W., & Wang, C. (2011). Ketamine anesthesia during the first week of life can cause long-lasting cognitive deficits in rhesus monkeys. *Neurotoxicology and Teratology*, 33(2), 220–230. Scopus. <https://doi.org/10.1016/j.ntt.2011.01.001>

Keywords: Time Factors; animal experiment; animal model; article; nonhuman; priority journal; controlled study; ketamine; learning; Weaning; Behavior, Animal; Animals, Newborn; motivation; neurotoxicity; Cognition; Data Interpretation, Statistical; Ketamine; Drug Administration Schedule; Infusions, Intravenous; general anesthesia; Reinforcement (Psychology); Anesthetics, Dissociative; rhesus monkey; cognitive defect; Macaca mulatta; stimulus response; Developmental neurotoxicity; perinatal period; Motivation; mental performance; Discrimination Learning; short term memory; Memory, Short-Term; prenatal drug exposure; Cognition Disorders; response time; continuous infusion; color discrimination; Brain function; Ketamine anesthesia

Paule, M., Li, M., Zhang, X., Liu, S., Hanig, J., Slikker, W., & Wang, C. (2015). Long-lasting cognitive deficits in rhesus monkeys after neonatal general anesthesia induced by isoflurane plus nitrous oxide. *Neurotoxicology and Teratology*, 49, 145–145. <https://doi.org/10.1016/j.ntt.2015.04.143>

Keywords: Anesthesia; isoflurane; Macaca mulatta; meeting abstract; neuroscience & neurology; nitrous oxide; rhesus macaques; toxicology

Paule, M., Li, M., Zhang, X., Liu, S., Hanig, J., Slikker, W., & Wang, C. (2016). Long-Lasting Cognitive Deficits in Rhesus Monkeys after Neonatal General Anesthesia Induced by Isoflurane/Nitrous Oxide: Protection by Acetyl-L-carnitine. *Neurotoxicology and Teratology*, 55, 69.

Keywords: Acetyl-L-carnitine; anesthesia; isoflurane; Macaca mulatta; meeting abstract; neuroscience & neurology; nitrous oxide; rhesus macaques; toxicology

Raper, J., Alvarado, M. C., Murphy, K. L., & Baxter, M. G. (2015). Multiple anesthetic exposure in infant monkeys alters emotional reactivity to an acute stressor. *Anesthesiology*, 123(5), 1084–1092. Scopus. <https://doi.org/10.1097/ALN.0000000000000851>

Keywords: Humans; animal experiment; nonhuman; priority journal; Article; controlled study; psychology; Animals, Newborn; drug effects; newborn; emotion; acute stress; infant; hippocampus; anesthesia; sevoflurane; chemically induced; Drug Administration Schedule; ether derivative; observational study; anxiety; mental stress; Stress, Psychological; Emotions; drug administration; Anesthetics, Inhalation; inhalation anesthetic agent; rhesus monkey; Macaca mulatta; perinatal period; maternal deprivation; mother; Methyl Ethers; amygdaloid nucleus; anesthetic exposure; emotional reactivity; orbital cortex

Slikker, W. J., Zou, X., Hotchkiss, C. E., Divine, R. L., Sadovova, N., Twaddle, N. C., Doerge, D. R., Scallet, A. C., Patterson, T. A., Hanig, J. P., Paule, M. G., & Wang, C. (2007). Ketamine-induced neuronal cell death in the perinatal rhesus monkey. *Toxicological Sciences : An Official Journal of the Society of Toxicology*, 98(1), 145–158. <https://doi.org/10.1093/toxsci/kfm084>

Keywords: Immunohistochemistry; Reference Standards; Mass Spectrometry; Neurons/*drug effects; Organic Chemicals; Macaca mulatta; In Situ Nick-End Labeling; Animals, Newborn/*physiology; Microscopy, Electron; Cell Death/drug effects; In Situ Hybridization; Excitatory Amino Acid Antagonists/*toxicity; Caspase 3/metabolism; Anesthetics, Dissociative/pharmacokinetics/*toxicity; Autoradiography; Fluoresceins; Ketamine/pharmacokinetics/*toxicity; Oximetry; Receptors, N-Methyl-D-Aspartate/drug effects; RNA, Messenger/biosynthesis/genetics; Silver Staining

Talpos, J. C., Chelonis, J. J., Li, M., Hanig, J. P., & Paule, M. G. (2019). Early life exposure to extended general anesthesia with isoflurane and nitrous oxide reduces responsivity on a cognitive test battery in the nonhuman primate. *NeuroToxicology*, 70, 80–90. Scopus. <https://doi.org/10.1016/j.neuro.2018.11.005>

Keywords: animal experiment; nonhuman; priority journal; Article; controlled study; physiology; scoring system; trends; task performance; body weight; drug effect; Behavior; motivation; Learning; memory; nitrous oxide; Isoflurane; oxygen; Cognition; Anesthesia, General; general anesthesia; reinforcement; Conditioning, Operant; instrumental conditioning; rhesus monkey; Nitrous Oxide; Macaca mulatta; *Motivation; *Behavior; *Learning; Memory; measurement accuracy; Motivation; Timing; incubation time; *Memory; Progressive ratio; Isoflurane/administration & dosage/*toxicity; *Operant; *Progressive ratio; *Timing; Anesthesia, General/*adverse effects/trends; Cognition/*drug effects/physiology; Conditioning, Operant/*drug effects/physiology; Nitrous Oxide/administration & dosage/*toxicity; color discrimination; experimental cognitive test; operant test battery

Weed, M. R., & Hienz, R. D. (2006). Effects of morphine on circadian rhythms of motor activity and body temperature in pig-tailed macaques. *Pharmacology Biochemistry and Behavior*, 84(3), 487–496. Scopus. <https://doi.org/10.1016/j.pbb.2006.06.012>

Keywords: Male; Time Factors; animal experiment; article; nonhuman; priority journal; controlled study; Temperature; dose response; drug effect; Body Temperature; Motor Activity; Data Interpretation, Statistical; Software; telemetry; measurement; Monitoring, Physiologic; Analgesics, Opioid; Morphine; Macaca; Body temperature; Circadian Rhythm; hyperthermia; Radio-telemetry; Motor activity; Macaca nemestrina; morphine sulfate; drug dose regimen; chronopharmacology; Pig-tailed macaque

Yoshizawa, K., Oishi, Y., Matsumoto, M., & Nyska, A. (2005). Ischemic brain damage after ketamine and xylazine treatment in a young laboratory monkey (*Macaca fascicularis*). *Contemporary Topics in Laboratory Animal Science*, 44(5), 19–24.

Keywords: Female; Injections, Intramuscular; *Macaca fascicularis; Anesthesia/adverse effects/*veterinary; Brain Ischemia/*chemically induced/complications/pathology; Cerebellar Cortex/pathology; Cerebral Cortex/pathology; Corpus Striatum/pathology; Hippocampus/pathology; Ketamine/administration & dosage/*adverse effects; Xylazine/administration & dosage/*adverse effects

Zou, X., Liu, F., Zhang, X., Patterson, T. A., Callicott, R., Liu, S., Hanig, J. P., Paule, M. G., Slikker, W., & Wang, C. (2011). Inhalation anesthetic-induced neuronal damage in the developing rhesus monkey. *Neurotoxicology and Teratology*, 33(5), 592–597. Scopus. <https://doi.org/10.1016/j.ntt.2011.06.003>

Keywords: animal experiment; animal tissue; article; nonhuman; priority journal; controlled study; animal behavior; Animals, Newborn; newborn; Necrosis; Isoflurane; Apoptosis; cytoplasm; neurotoxicity; Rodentia; Anesthetics, Inhalation; rhesus monkey; Macaca mulatta; Hippocampus; Rhesus monkey; Developmental neurotoxicity; perinatal period; long term exposure; Cell Death; brain development; frontal cortex; Frontal Lobe; Molecular Imaging; Drug Synergism; nerve cell lesion; Temporal Lobe; cell swelling; Isoflurane (ISO); Nerve Degeneration; Nitrous oxide (N₂O); silver staining; temporal gyrus; toxic inhalation

Case Studies

Description: Here are four anesthesia or analgesia case studies featuring macaques (genus *Macaca*).

Results (4):

Deschamps, J.-Y., Gaulier, J.-M., Podevin, G., Cherel, Y., Ferry, N., & Roux, F. A. (2012). Fatal overdose after ingestion of a transdermal fentanyl patch in two non-human primates. *Veterinary Anaesthesia and Analgesia*, 39(6), 653–656. <https://doi.org/10.1111/j.1467-2995.2012.00749.x>

Keywords: Male; Administration, Cutaneous; *Macaca fascicularis; Naloxone/administration & dosage/pharmacology; Analgesics, Opioid/administration & dosage/poisoning; Drug Overdose/*pathology; Fentanyl/*poisoning; Narcotic Antagonists/administration & dosage/pharmacology

Matchett, C. A., Dillehay, D. L., Goodman, M. M., & Pullium, J. K. (2003). Postanesthesia death and suspected peracute endotoxic shock due to *Pseudomonas putida* in a cynomolgous macaque (*Macaca fascicularis*). *Comparative Medicine*, 53(3), 309–312.

Keywords: Male; Macaca fascicularis; Fatal Outcome; Anesthesia, General/adverse effects/*veterinary; Death, Sudden/etiology/*veterinary; Intraoperative Complications/etiology/pathology/veterinary; Lung/microbiology/pathology; Monkey Diseases/etiology/*pathology; Pseudomonas Infections/complications/pathology/*veterinary; Pseudomonas putida/*isolation & purification/pathogenicity/physiology; Shock, Septic/etiology/pathology/*veterinary

Nolosco, T. P., Rao, G. D., William, B. J., & Prathaban, S. (2007). Diazepam-ketamine anaesthesia for the surgical management of electric burns in bonnet macaque monkeys (*Macaca radiata*)—Report of 2 cases. *Tamilnadu Journal of Veterinary and Animal Sciences*, 3(2), 113–115. CAB Abstracts.

Keywords: Asia; Commonwealth of Nations; Developing Countries; India; South Asia; Macaca; Other Wildlife Diseases; YY800; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Animal Surgery and Non-drug Therapy; *Macaca radiata*

Yoshizawa, K., Oishi, Y., Matsumoto, M., & Nyska, A. (2005). Ischemic brain damage after ketamine and xylazine treatment in a young laboratory monkey (*Macaca fascicularis*). *Contemporary Topics in Laboratory Animal Science*, 44(5), 19–24.

Keywords: Female; Injections, Intramuscular; **Macaca fascicularis*; Anesthesia/adverse effects/*veterinary; Brain Ischemia/*chemically induced/complications/pathology; Cerebellar Cortex/pathology; Cerebral Cortex/pathology; Corpus Striatum/pathology; Hippocampus/pathology; Ketamine/administration & dosage/*adverse effects; Xylazine/administration & dosage/*adverse effects

Human Pain and Nociception Research, Pharmacology, and Drug Development

Description: These articles describe using macaques (genus *Macaca*) as models for studying pain and nociception in humans as well as for drug development, pharmacokinetics, and pharmacodynamics.

Results (50):

Authier, S., Tanguay, J. F., Fournier, S., Gauvin, D., Legaspi, M., Chaurand, F., Breault, C., & Troncy, E. (2008). Conscious and anesthetized non-human primate safety pharmacology models: Hemodynamic sensitivity comparison. *Journal of Pharmacological and Toxicological Methods*, 58(2), 94–98. <https://doi.org/10.1016/j.vascn.2008.05.004>

Keywords: Telemetry; *Macaca fascicularis*; *Consciousness; Hemodynamics/*drug effects; *Anesthesia; Adrenergic beta-Antagonists/adverse effects; Dopamine/*adverse effects; Hypnotics and Sedatives/adverse effects; Piperidines/*adverse effects; Propanolamines/*adverse effects; Remifentanyl; Sympathomimetics/adverse effects

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Keywords: Analgesics; antinociceptive effect; behavioral effect; clomipramine; drug-drug interaction; Macaca mulatta; neuropharmacology; rhesus macaques; schedule-controlled response; thermal allodynia

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Keywords: Rats; Male; animal experiment; animal model; article; nonhuman; controlled study; Behavior, Animal; Dose-Response Relationship, Drug; Analysis of Variance; drug effect; Mice; mouse; analgesia; Pain Measurement; Mice, Inbred ICR; morphine; drug mechanism; Inhibitory Concentration 50; antinociception; diamorphine; tail flick test; 1,4 benzoquinone; oxycodone; analgesic activity; Rats, Long-Evans; Reinforcement (Psychology); Morphine; Discrimination (Psychology); rhesus monkey; medical documentation; Macaca mulatta; Behavior, Addictive; substance abuse; Substance-Related Disorders; Narcotics; morphine addiction; withdrawal syndrome; Discrimination Learning; Self Administration; drug self administration; hot plate test; mu opiate receptor; mu opiate receptor agonist; Nociceptors; drug dependence; Oxycodone; discriminative stimulus; drug abuse; writhing test

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Keywords: Psychomotor Performance; animal experiment; article; Disease Models, Animal; nonhuman; priority journal; adolescent; task performance; Dose-Response Relationship, Drug; neuropathic pain; attention; Analgesics; drug mechanism; Analgesics, Non-Narcotic; Reaction Time; cognition; Macaca; Neuralgia; Neuropsychological Tests; Allodynia; Working memory;

Amitriptyline; Amines; working memory; Memory, Short-Term; Macaca nemestrina; Antidepressant; Attention deficit; Cyclohexanecarboxylic Acids; distractibility; gabapentin; gamma-Aminobutyric Acid; Operant task

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Keywords: Female; Disease Models, Animal; Pain Measurement; Macaca mulatta; *Benzeneacetamides; Analgesics/*therapeutic use; *Capsaicin; Aminobutyrate/therapeutic use; Dizocilpine Maleate/therapeutic use; Dynorphins/therapeutic use; Ketamine/therapeutic use; Pain/*chemically induced/drug therapy/prevention & control; Peptide Fragments/therapeutic use; Pyrrolidines/therapeutic use

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Keywords: Female; animal experiment; animal model; article; nonhuman; priority journal; controlled study; in vivo study; unclassified drug; dose response; Administration, Topical; Pain; Pain Measurement; Analgesics; blood brain barrier; antinociception; tail flick test; Loperamide; Dopamine; rhesus monkey; Macaca mulatta; Fentanyl; allodynia; naltrexone; Analgesics/*therapeutic use; mu opiate receptor; thermal stimulation; Pain Measurement/drug effects; Capsaicin; Dopamine/*analogs & derivatives; Fentanyl/*therapeutic use; Loperamide/*therapeutic use; Pain/chemically induced/*drug therapy/prevention & control; 17 methyl naltrexone; antiallodynic activity; muscle spindle afferent nerve; reversal reaction; vanilloid receptor 1

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Keywords: Male; animal experiment; article; nonhuman; priority journal; controlled study; in vivo study; Dose-Response Relationship, Drug; drug effect; Biomarkers; fentanyl; Injections, Intravenous; Biological Markers; Biotransformation; loperamide; Biomarker; Opioid; Loperamide; Analgesics, Opioid; Macaca; Prolactin; nucleotide sequence; Macaca mulatta; Fentanyl; Narcotic Antagonists; neuropeptide; single nucleotide polymorphism; matrix assisted laser desorption ionization time of flight mass spectrometry; Polymorphism, Single Nucleotide; beta-Endorphin; Spectrometry, Mass, Matrix-Assisted Laser Desorption-Ionization; Analgesics, Opioid/*pharmacology; neuroendocrine system; Naltrexone; Receptors, Opioid, mu; Fentanyl/*pharmacology; Naltrexone/pharmacology; Narcotic Antagonists/pharmacology; Antidiarrheals/*pharmacology; beta-Endorphin/pharmacokinetics/*pharmacology; Loperamide/*pharmacology; Neurosecretory Systems/*drug effects; Receptors, Opioid,

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Keywords: Cross-Over Studies; Pilot Projects; Random Allocation; Administration, Cutaneous; *Macaca fascicularis*; Chromatography, Liquid; Mass Spectrometry; Half-Life; Analgesics, Opioid/administration & dosage/chemistry/pharmacokinetics; Fentanyl/administration & dosage/blood/chemistry/*pharmacokinetics

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Keywords: Male; Dose-Response Relationship, Drug; Models, Statistical; Drug Interactions; Ligands; *Macaca mulatta*; *Drug Design; Fentanyl/*pharmacology; Naltrexone/*pharmacology; Receptors, Opioid, mu/*agonists/*antagonists & inhibitors/metabolism

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Keywords: Male; Antinociception; *Macaca mulatta*; Rhesus monkey; Kappa-opioid receptor; Mu-opioid receptor; Analgesics, Opioid/*therapeutic use; Imidazoles/*therapeutic use; Nociceptin opioid peptide receptor; Opioid Peptides/*therapeutic use; Pain/*drug therapy; Receptors, Opioid/*agonists; Spiro Compounds/*therapeutic use; Warm water tail-withdrawal

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Keywords: adult; time; animal experiment; animal model; nonhuman; priority journal; Article; controlled study; pathophysiology; physiology; drug efficacy; Dose-Response Relationship, Drug; unclassified drug; dose response; diamorphine; Analgesics, Opioid; narcotic analgesic agent; rhesus monkey; *Macaca mulatta*; Narcotic Antagonists; respiration depression; drug dose comparison; cinnamic acid derivative; lung minute volume; naltrexone; mu opiate receptor; Receptors, Opioid, mu; respiratory failure; Respiratory Insufficiency; Cinnamates; Heroin; methocinnamox; Morphine Derivatives; mu opiate receptor antagonist; narcotic antagonist

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Keywords: Dose-Response Relationship, Drug; *Macaca mulatta*; Analgesics, Opioid/*pharmacology; Analgesics/pharmacology; Cannabinoids/*pharmacology; Dronabinol/pharmacology; Benzoxazines/pharmacology; Cannabinoid Receptor Agonists/pharmacology; Morphine/*pharmacology; Morpholines/pharmacology; Naphthalenes/pharmacology; Drug Tolerance/*physiology; Pain Measurement/drug effects/methods

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Keywords: animal experiment; article; nonhuman; priority journal; controlled study; behavior; Behavior, Animal; unclassified drug; dose response; drug effect; Analgesics; Mass Spectrometry; antinociception; *Macaca mulatta*; drug cerebrospinal fluid level; drug metabolite; opiate antagonist; matrix assisted laser desorption ionization time of flight mass spectrometry; pain threshold; scratching; Spectrometry, Mass, Matrix-Assisted Laser Desorption-Ionization; Naltrexone; nociceptive stimulation; Spinal Cord; Opioid Peptides; Injections, Spinal; pruritus; 1 (1 cyclooctylmethyl 3 hydroxymethyl 4 piperidyl) 3 ethyl 1,3 dihydro 2h benzimidazol 2 one; nociceptin; nociceptin receptor; opiate receptor; Receptors, Opioid; nociceptin receptor antagonist; nociceptin(2-17)

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Keywords: animal experiment; animal model; article; Disease Models, Animal; nonhuman; priority journal; controlled study; treatment duration; animal behavior; Dose-Response

Relationship, Drug; Benzimidazoles/pharmacology; unclassified drug; drug effect; Benzimidazoles; Pain Measurement; Analgesics; single drug dose; drug mechanism; Piperidines/pharmacology; antinociception; treatment response; hyperalgesia; Morphine; experimental monkey; Macaca mulatta; Hyperalgesia; Pain Threshold; scratching; capsaicin; Naltrexone; drug antagonism; Analgesics/*therapeutic use; nociceptive stimulation; Opioid Peptides; Injections, Spinal; Piperidines; Capsaicin/adverse effects; Hyperalgesia/chemically induced/*drug therapy/physiopathology; Injections, Spinal/methods; Morphine/therapeutic use; Naltrexone/pharmacology; Opioid Peptides/*agonists/*therapeutic use; Pain Threshold/drug effects; Capsaicin; pruritus; 1 (1 cyclooctylmethyl 3 hydroxymethyl 4 piperidyl) 3 ethyl 1,3 dihydro 2h benzimidazol 2 one; nociceptin receptor agonist; Spinal cord; ufp 112; Nociceptin/orphanin FQ; NOP receptors; phenylalanylalphaaminoisobutyric acid arginyllysine; UFP-112

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Keywords: Male; Ketamine/*administration & dosage; Anesthesia/methods; Tissue Distribution; Kinetics; Metabolic Clearance Rate; Macaca mulatta; Artifacts; Adjuvants, Anesthesia/administration & dosage; Anesthetics, Dissociative/administration & dosage; Brain/*diagnostic imaging/drug effects/*metabolism; Fluorodeoxyglucose F18/*pharmacokinetics; Pentobarbital/*administration & dosage; Radionuclide Imaging; Radiopharmaceuticals/pharmacokinetics

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Keywords: animal experiment; animal model; article; Disease Models, Animal; nonhuman; priority journal; controlled study; dose response; morphine; sedation; Injections, Subcutaneous; drug mechanism; Analgesics, Non-Narcotic; Drug Interactions; drug receptor binding; antinociception; Morphine; Macaca mulatta; Pruritus; Narcotic Antagonists; scratching; Naltrexone; mu opiate receptor; kappa opiate receptor; Injections, Spinal

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Keywords: Analgesic drugs; antinociception; antipruritic-drug; kappa opioid agonists; kappa opioid receptor; morphine; pruritis

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Keywords: animal experiment; animal model; article; nonhuman; treatment outcome; controlled study; Behavior, Animal; Dose-Response Relationship, Drug; dose response; drug effect; heat; analgesia; pain; Pain Measurement; Analgesics; single drug dose; morphine; low drug dose; antinociception; drug response; Analgesics, Opioid; hyperalgesia; Morphine; Macaca mulatta; Pruritus; Hyperalgesia; Drug Synergism; scratching; nociceptive stimulation; Opioid Peptides; Enkephalin, Ala(2)-MePhe(4)-Gly(5)-; enkephalin[2 dextro alanine 4 methylphenylalanine 5 glycine]; Injections, Spinal; pruritus; nociceptin; Receptors, Opioid; Spinal cord; NOP receptors; Substance P; thermal hyperalgesia

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Keywords: animal experiment; article; nonhuman; priority journal; controlled study; Behavior, Animal; Dose-Response Relationship, Drug; dose response; drug effect; Benzimidazoles; Hot Temperature; analgesia; Pain; Spiro Compounds; Antinociception; Opioid; Analgesics, Opioid; Reinforcement (Psychology); Analgesic; Macaca mulatta; cocaine; Pruritus; Narcotic Antagonists; scratching; drug self administration; Naltrexone; Imidazoles; Receptors, Opioid, mu; Respiratory Insufficiency; Piperidines; Capsaicin; 1 (1 cyclooctylmethyl 3 hydroxymethyl 4 piperidyl) 3 ethyl 1,3 dihydro 2h benzimidazol 2 one; 8 (2,3,3a,4,5,6 hexahydro 1h phenalen 1 yl) 1 phenyl 1,3,8 triazaspiro[4.5]decan 4 one; nociceptin; nociceptin receptor; Receptors, Opioid; Abuse liability; Alfentanil; Central Nervous System Agents; methohexital; Self-administration

Kops, M. S., Pesic, M., Petersen, K.-U., Schmalix, W. A., & Stöhr, T. (2021). Impact of concurrent remifentanil on the sedative effects of remimazolam, midazolam and propofol in cynomolgus monkeys. *European Journal of Pharmacology*, 890. Scopus. <https://doi.org/10.1016/j.ejphar.2020.173639>

Keywords: Cross-Over Studies; Male; animal experiment; nonhuman; priority journal; Article; comparative study; crossover procedure; gait; midazolam; sedation; Drug Interactions; intravenous drug administration; Macaca fascicularis; Analgesics, Opioid; narcotic analgesic agent; sensory stimulation; Hypnotics and Sedatives; Administration, Intravenous; Propofol; avoidance behavior; drug potentiation; drug interaction; body position; benzodiazepine derivative; drug dose escalation; eyelid; Midazolam; hypnotic sedative agent; remifentanil; Cynomolgus monkey; Remifentanil; Benzodiazepines; Drug-drug interaction; midazolam maleate; position; Remimazolam

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Keywords: Acetaminophen; antipyrine; analgesic drugs; *Canis familiaris*; *cynomolgus* macaques; diazepam; diphenhydramine; dogs; gastric PH; *Macaca fascicularis*; neuropharmacology; ofloxacin

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Keywords: Anesthesia; antidyskinetic-drug; autonomic-drug; capsaicin; heat-evoked withdrawal response; intravenous administration; *Macaca*; macaques; meeting abstract; morphine; propofol

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Keywords: Cannabinoid; drug discrimination; drug-drug interactions; fentanyl; *Macaca mulatta*; rhesus macaques; opioid; pain

Negrusz, A., Adamowicz, P., Saini, B. K., Webster, D. E., Juhascik, M. P., Moore, C. M., & Schlemmer, R. F. (2005). Detection of ketamine and norketamine in urine of nonhuman primates after a single dose of ketamine using microplate enzyme-linked immunosorbent assay (ELISA) and NCI-GC-MS. *Journal of Analytical Toxicology*, 29(3), 163–168. <https://doi.org/10.1093/jat/29.3.163>

Keywords: Time Factors; Reproducibility of Results; Models, Animal; Injections, Intramuscular; Sensitivity and Specificity; *Macaca*; Enzyme-Linked Immunosorbent Assay/instrumentation/methods; Gas Chromatography-Mass Spectrometry/instrumentation/methods; Ketamine/administration & dosage/*analogs & derivatives/*urine; Substance Abuse Detection/*methods

Negus, S. S., Banks, M. L., Schrode, K., Morrissey, E., & Rice, K. C. (2009). Selective but Slight Enhancement of Delta Agonist-Induced Antinociception by Repeated Morphine in Rhesus Monkeys. *FASEB Journal*, 23.

Keywords: Analgesics; antinociception; *Macaca mulatta*; meeting abstract; morphine; neuropharmacology; pharmacology; rhesus macaques

Negus, S. S., Morrissey, E. M., Folk, J. E., & Rice, K. C. (2012). Interaction between Mu and Delta Opioid Receptor Agonists in an Assay of Capsaicin-Induced Thermal Allodynia in Rhesus Monkeys. *Pain Research and Treatment*, 2012, 867067. <https://doi.org/10.1155/2012/867067>

Keywords: Analgesics; antiallodynia; delta opioid receptor agonist; drug-drug interactions; *Macaca mulatta*; methadone; morphine; mu opioid receptor agonist; nalbuphine; rhesus macaques; SNC80; thermal allodynia

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Keywords: Analgesic drugs; fentanyl; *Macaca mulatta*; opioid; quadazocine; sex; receptor; rhesus macaques; U50,488

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Keywords: Antinociceptive effect; heroin; *Macaca mulatta*; pharmacology; rhesus macaques

Nunamaker, E. A., Halliday, L. C., Moody, D. E., Fang, W. B., Lindeblad, M., & Fortman, J. D. (2013). Pharmacokinetics of 2 formulations of buprenorphine in macaques (*Macaca mulatta* and *Macaca fascicularis*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 52(1), 48–56.

Keywords: Male; Animal Welfare; Injections, Intramuscular; Animals, Laboratory; Tandem Mass Spectrometry; Chromatography, Liquid; Delayed-Action Preparations; Buprenorphine/administration & dosage/blood/*pharmacokinetics; Analgesics, Opioid/administration & dosage/blood/pharmacokinetics; *Macaca fascicularis*/blood/*metabolism; *Macaca mulatta*/blood/*metabolism

Ogawa, S., Awaga, Y., Takashima, M., Hama, A., Matsuda, A., & Takamatsu, H. (2016). Antinociceptive effect of clinical analgesics in a nonhuman primate model of knee osteoarthritis. *European Journal of Pharmacology*, 786, 179–185. Scopus. <https://doi.org/10.1016/j.ejphar.2016.06.008>

Keywords: Pressure; Weight-Bearing; Female; knee; animal experiment; animal model; animal tissue; Disease Models, Animal; nonhuman; priority journal; Article; controlled study; pathology; pathophysiology; disease model; weight bearing; pressure; drug effects; Pain; analgesic agent; Analgesics; morphine; complication; *Macaca fascicularis*; antinociception; Osteoarthritis; pregabalin; *Cynomolgus* macaque; Hyperalgesia; Knee Joint; Analgesics/*pharmacology/therapeutic use; Duloxetine HCl (PubChem CID: 60834); Knee Joint/drug effects/pathology/physiopathology; Morphine HCl (PubChem CID: 5464110); Osteoarthritis, Knee/complications/*drug therapy/pathology/physiopathology; Pain/complications; pregabalin (PubChem CID: 5486971); Target validation; Translational research; pressure pain threshold; duloxetine; knee osteoarthritis; meniscectomy; Osteoarthritis, Knee

Ohba, H., Harada, N., Nishiyama, S., Kakiuchi, T., & Tsukada, H. (2009). Ketamine/Xylazine Anesthesia Alters [C-11]MNPA Binding to Dopamine D-2 Receptors and Response to Methamphetamine Challenge in Monkey Brain. *Synapse*, 63(6), 534–537. <https://doi.org/10.1002/syn.20632>

Keywords: Anesthesia; ketamine; Macaca mulatta; methamphetamine; neuropharmacology; rhesus macaques; xylazine

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Keywords: animal experiment; animal tissue; article; nonhuman; priority journal; controlled study; animal behavior; Dose-Response Relationship, Drug; blood sampling; dose response; Area Under Curve; HPA axis; corticotropin; Analgesics, Opioid; hydrocortisone blood level; rhesus monkey; Cortisol; Hydrocortisone; Macaca mulatta; radioimmunoassay; Fentanyl; hypothalamus hypophysis adrenal system; ACTH; corticotropin blood level; Hypothalamo-Hypophyseal System; Pituitary-Adrenal System; Piperazines; mu opiate receptor agonist; Receptors, Opioid, mu; Adrenocorticotrophic Hormone; Receptors, Opioid; delta opiate receptor agonist; kappa opiate receptor agonist; 3,4 dichloro n methyl n [2 (1 pyrrolidiny)cyclohexyl]benzeneacetamide methanesulfonate; 3,4-Dichloro-N-methyl-N-(2-(1-pyrrolidiny)-cyclohexyl)-benzeneacetamide, (trans)-Isomer; 4 [alpha (4 allyl 2,5 dimethyl 1 piperaziny) 3 methoxybenzyl] n,n diethylbenzamide; Benzamides; norbinaltorphimine; Receptors, Opioid, kappa; corticotropin release; Opioid receptor agonists; Opioid receptor antagonists; Receptors, Opioid, delta

Saccone, P. A., Zelenock, K. A., Lindsey, A. M., Sulima, A., Rice, K. C., Prinssen, E. P., Wichmann, J., & Woods, J. H. (2016). Characterization of the discriminative stimulus effects of a NOP receptor agonist ro 64-6198 in rhesus monkeys. *Journal of Pharmacology and Experimental Therapeutics*, 357(1), 17–23. Scopus. <https://doi.org/10.1124/jpet.115.231134>

Keywords: Dose-Response Relationship, Drug; drug effects; dose response; benzimidazole derivative; Benzimidazoles; Pain Measurement; agonists; antagonists and inhibitors; Spiro Compounds; Analgesics, Opioid; narcotic analgesic agent; Conditioning, Operant; Discrimination (Psychology); instrumental conditioning; perceptive discrimination; rhesus monkey; Macaca mulatta; Fentanyl; Narcotic Antagonists; Diazepam; Naltrexone; imidazole derivative; Imidazoles; GABA Modulators; Piperidines; 1 (1 cyclooctylmethyl 3 hydroxymethyl 4 piperidyl) 3 ethyl 1,3 dihydro 2h benzimidazol 2 one; narcotic antagonist; 8 (2,3,3a,4,5,6 hexahydro 1h phenalen 1 yl) 1 phenyl 1,3,8 triazaspiro[4.5]decan 4 one; nociceptin receptor; opiate receptor; Receptors, Opioid; benzodiazepine receptor affecting agent; piperidine derivative

Schou, M., Varnäs, K., Lundquist, S., Nakao, R., Amini, N., Takano, A., Finnema, S. J., Halldin, C., & Farde, L. (2015). Large Variation in Brain Exposure of Reference CNS Drugs: A PET Study in Nonhuman Primates. *The International Journal of Neuropsychopharmacology*, 18(10), pyv036. <https://doi.org/10.1093/ijnp/pyv036>

Keywords: Models, Biological; Female; Dose-Response Relationship, Drug; Radiopharmaceuticals; Models, Chemical; CNS; Macaca fascicularis; Positron-Emission

Tomography; Macaca mulatta; PET; Carbon Radioisotopes; Brain/*diagnostic imaging/*drug effects/metabolism; Central Nervous System Agents/administration & dosage/*pharmacokinetics; microdosing; Morphine/administration & dosage/*pharmacokinetics; Sulpiride/administration & dosage/*pharmacokinetics; Verapamil/administration & dosage/*pharmacokinetics

Schwienteck, K. L., Negus, S. S., & Banks, M. L. (2019). Sex differences in the effectiveness of buprenorphine to decrease rates of responding in rhesus monkeys. *Behavioural Pharmacology*, 30(4), 358–362. Scopus. <https://doi.org/10.1097/FBP.0000000000000437>

Keywords: adult; animal experiment; nonhuman; Article; controlled study; metabolism; drug efficacy; animal behavior; Behavior, Animal; Dose-Response Relationship, Drug; Sex Factors; dose response; drug effect; sex difference; food; Buprenorphine; analgesic agent; Analgesics; drug potency; Ligands; drug response; Conditioning, Operant; instrumental conditioning; rhesus monkey; binding affinity; Macaca mulatta; Fentanyl; Guanosine 5'-O-(3-Thiotriphosphate); Naltrexone; sex differences; ED50; mu opiate receptor; Receptors, Opioid, mu; guanosine 5' o (3 thiotriphosphate); μ -opioid receptors

Seah, S., Asad, A. B. A., Baumgartner, R., Feng, D., Williams, D. S., Manigbas, E., Beaver, J. D., Reese, T., Henry, B., Evelhoch, J. L., & Chin, C.-L. (2014). Investigation of cross-species translatability of pharmacological MRI in awake nonhuman primate—A buprenorphine challenge study. *PloS One*, 9(10), e110432. <https://doi.org/10.1371/journal.pone.0110432>

Keywords: Female; Translational Medical Research; Anesthesia, General; Analgesics, Opioid/*pharmacology; Buprenorphine/*pharmacology; Magnetic Resonance Imaging/methods; Wakefulness/physiology; Corpus Striatum/*drug effects/physiology; Frontal Lobe/*drug effects/physiology; Gyrus Cinguli/*drug effects/physiology; Macaca fascicularis/physiology; Receptors, Opioid, mu/agonists/metabolism; Thalamus/*drug effects/physiology

Signorelli, C. M., Uhrig, L., Kringelbach, M., Jarraya, B., & Deco, G. (2021). Hierarchical disruption in the cortex of anesthetized monkeys as a new signature of consciousness loss. *NeuroImage*, 227, 117618. <https://doi.org/10.1016/j.neuroimage.2020.117618>

Keywords: Magnetic Resonance Imaging; Macaca mulatta; Anesthetics, Inhalation/pharmacology; *Anesthesia; Ketamine/pharmacology; Propofol/pharmacology; Sevoflurane/pharmacology; *GNW; *Ignition; *IIT; *Integration; *Measures of Consciousness; Anesthetics, Intravenous/pharmacology; Cerebral Cortex/*diagnostic imaging/drug effects; Consciousness/drug effects/*physiology; Nerve Net/*diagnostic imaging/drug effects

Stevenson, G., Folk, J., Rice, K., & Negus, S. (2004). Interactions between the rate-altering, antinociceptive and reinforcing effects of delta and mu opioid agonists in rhesus monkeys: Studies with SNC80 and heroin. *FASEB Journal*, 18(5), A960–A960.

Keywords: Analgesic drugs; delta opioid agonists; heroin; Macaca mulatta; meeting abstract; mu opioid agonists; rhesus macaques; SNC80

Stevenson, G. W., Folk, J. E., Linsenmayer, D. C., Rice, K. C., & Negus, S. S. (2003). Opioid Interactions in Rhesus Monkeys: Effects of $\delta + \mu$ and $\delta + \kappa$ Agonists on Schedule-Controlled Responding and Thermal Nociception. *Journal of Pharmacology and Experimental Therapeutics*, 307(3), 1054–1064. Scopus. <https://doi.org/10.1124/jpet.103.056515>

Keywords: Male; animal experiment; article; nonhuman; priority journal; controlled study; behavior; Dose-Response Relationship, Drug; dose response; Heat; nociception; Pain; fentanyl; morphine; Drug Interactions; drug potency; methadone; antinociception; Analgesics, Opioid; opiate; reinforcement; Conditioning, Operant; rhesus monkey; *Macaca mulatta*; nalbuphine; Narcotic Antagonists; drug potentiation; Naltrexone; Piperazines; Reinforcement Schedule; mu opiate receptor agonist; Receptors, Opioid, mu; Benzeneacetamides; delta opiate receptor; kappa opiate receptor; n methyl n [7 (1 pyrrolidiny) 1 oxaspiro[4.5]dec 8 yl]benzeneacetamide; naltrindole; Pyrrolidines; delta opiate receptor agonist; kappa opiate receptor agonist; 4 [alpha (4 allyl 2,5 dimethyl 1 piperaziny) 3 methoxybenzyl] n,n diethylbenzamide; Benzamides; drug selectivity; Benzomorphans; bremazocine; Receptors, Opioid, kappa; Receptors, Opioid, delta; heat sensation

Sukhtankar, D. D., Lee, H., Rice, K. C., & Ko, M.-C. (2014). Differential effects of opioid-related ligands and NSAIDs in nonhuman primate models of acute and inflammatory pain. *Psychopharmacology*, 231(7), 1377–1387. Scopus. <https://doi.org/10.1007/s00213-013-3341-0>

Keywords: animal experiment; animal model; article; Disease Models, Animal; nonhuman; priority journal; controlled study; drug efficacy; Dose-Response Relationship, Drug; drug effects; dose response; Inflammation; Pain Measurement; agonists; chemically induced; complication; drug potency; Spiro Compounds; drug receptor binding; antinociception; drug response; Opioids; Analgesics, Opioid; Anti-Inflammatory Agents, Non-Steroidal; narcotic analgesic agent; nonsteroid antiinflammatory agent; Acute Pain; inflammatory pain; ketorolac; Carrageenan; *Macaca*; rhesus monkey; Fentanyl; opiate agonist; Hyperalgesia; naltrexone; primate model; piperazine derivative; Piperazines; imidazole derivative; Imidazoles; nociceptive stimulation; Nociceptive Pain; 3,4 dichloro n methyl n [2 (1 pyrrolidiny)cyclohexyl]benzeneacetamide; naltrindole; Pain Measurement/drug effects; naproxen; Analgesics, Opioid/*therapeutic use; Receptors, Opioid/*agonists; 3,4-Dichloro-N-methyl-N-(2-(1-pyrrolidiny)-cyclohexyl)-benzeneacetamide, (trans)-Isomer/therapeutic use; Acute Pain/complications/*drug therapy; Anti-Inflammatory Agents, Non-Steroidal/*therapeutic use; Benzamides/therapeutic use; Fentanyl/therapeutic use; Hyperalgesia/chemically induced/drug therapy; Imidazoles/therapeutic use; Inflammation/complications/*drug therapy; Nociceptive Pain/*drug therapy; Piperazines/therapeutic use; Spiro Compounds/therapeutic use; 1 (1 cyclooctylmethyl 3 hydroxymethyl 4 piperidy) 3 ethyl 1,3 dihydro 2h benzimidazol 2 one; 8 (2,3,3a,4,5,6 hexahydro 1h phenalen 1 yl) 1 phenyl 1,3,8 triazaspiro[4.5]decan 4 one; Receptors, Opioid; 3,4 dichloro n methyl n [2 (1 pyrrolidiny)cyclohexyl]benzeneacetamide methanesulfonate; 3,4-Dichloro-N-methyl-N-(2-(1-pyrrolidiny)-cyclohexyl)-benzeneacetamide, (trans)-Isomer; 4 [alpha (4 allyl 2,5 dimethyl 1 piperaziny) 3 methoxybenzyl] n,n diethylbenzamide; 4-(alpha-(4-allyl-2,5-dimethyl-1-piperaziny)-3-methoxybenzyl)-N,N-

diethylbenzamide; benzamide derivative; Benzamides; drug selectivity; Monkey pain model; Nociceptin/orphanin FQ; NOP receptors; norbinaltorphimine; NSAIDs; Opioid receptors; receptor down regulation; receptor upregulation

Uhrig, L., Janssen, D., Dehaene, S., & Jarraya, B. (2016). Cerebral responses to local and global auditory novelty under general anesthesia. *NeuroImage*, 141, 326–340. <https://doi.org/10.1016/j.neuroimage.2016.08.004>

Keywords: Dose-Response Relationship, Drug; Cortex; Anesthesia; Macaca mulatta; fMRI; Ketamine/administration & dosage; Thalamus; Anesthesia, General/*methods; Anesthetics, General/*administration & dosage; Propofol/administration & dosage; Consciousness/drug effects/*physiology; Auditory Perception/drug effects/*physiology; Cerebral Cortex/drug effects/*physiology; Sequence violation; Wakefulness/drug effects/*physiology

Vardigan, J. D., Houghton, A. K., Lange, H. S., Adarayan, E. D., Pall, P. S., Ballard, J. E., Henze, D. A., & Uslander, J. M. (2018). Pharmacological validation of a novel nonhuman primate measure of thermal responsivity with utility for predicting analgesic effects. *Journal of Pain Research*, 11, 735–741. Scopus. <https://doi.org/10.2147/JPR.S152879>

Keywords: animal experiment; nonhuman; Article; controlled study; drug efficacy; forearm; analgesia; Pain; analgesic agent; diazepam; fentanyl; morphine; sedation; tramadol; mass spectrometry; drug sensitivity; drug blood level; validation process; Opioid; treatment response; experimental behavioral test; rhesus monkey; drug exposure; precipitation; ultra performance liquid chromatography; thermal stimulation; noxious heat

Weed, P. F., Gerak, L. R., & France, C. P. (2018). Ventilatory-depressant effects of opioids alone and in combination with cannabinoids in rhesus monkeys. *European Journal of Pharmacology*, 833, 94–99. Scopus. <https://doi.org/10.1016/j.ejphar.2018.05.041>

Keywords: adult; animal experiment; animal model; nonhuman; priority journal; Article; controlled study; body weight; dose response; drug effect; Respiratory Rate/drug effects; fentanyl; morphine; Drug Interactions; Tidal Volume; 4 (1,1 dimethylheptyl) 1',2',3',4',5',6' hexahydro 2,3' dihydroxy 6' (3 hydroxypropyl)biphenyl; dronabinol; Analgesics, Opioid; narcotic analgesic agent; breathing rate; Morphine; Macaca; Macaca mulatta; Fentanyl; Respiration; respiration depression; Ventilation; Rhesus monkey; drug dose comparison; lung ventilation; Pulmonary Ventilation; drug potentiation; drug interaction; lung minute volume; Analgesics, Opioid/*pharmacology; Cercopithecidae; Animal and in-vitro Models for Pharmaceuticals; VV450; morphine sulfate; Non-food/Non-feed Plant Products; SS200; Fentanyl/pharmacology; Dronabinol; Dronabinol/pharmacology; Respiratory Rate; Morphine/pharmacology; Cannabinoid receptor agonist; Cannabinoids; Cannabinoids/*pharmacology; Cyclohexanols/pharmacology; Drug-drug interactions; mu opioid receptor agonist; Pulmonary Ventilation/*drug effects; Tidal Volume/drug effects; 3-(2-hydroxy-4-(1,1-dimethylheptyl)phenyl)-4-(3-hydroxypropyl)cyclohexanol; cyclohexanol derivative; Cyclohexanols; lung diffusion; morphine-induced antinociception; sterile water

Xiang, X.-H., Chen, Y.-M., Zhang, J.-M., Tian, J.-H., Han, J.-S., & Cui, C.-L. (2014). Low- and high-frequency transcutaneous electrical acupoint stimulation induces different effects on cerebral μ -opioid receptor availability in rhesus monkeys. *Journal of Neuroscience Research*, 92(5), 555–563. <https://doi.org/10.1002/jnr.23351>

Keywords: Male; Time Factors; Radiography; Positron-Emission Tomography; *Macaca mulatta*; positron emission tomography (PET); Protein Binding/drug effects; Afferent Pathways/physiology; Brain Mapping; *Acupuncture Points; Receptors, Opioid, μ /*metabolism; *Transcutaneous Electric Nerve Stimulation; Analgesics, Opioid/pharmacokinetics; Biophysical Phenomena/*physiology; Cerebral Cortex/diagnostic imaging/*metabolism; Fentanyl/analogs & derivatives/pharmacokinetics; Tomography Scanners, X-Ray Computed; transcutaneous electrical acupoint stimulation (TEAS); μ -opioid receptor (MOR)

Xu, J., Zhou, X., Guo, X., Wang, G., Fu, S., & Zhang, L. (2018). Effects of Unilateral Electroacupuncture on Bilateral Proprioception in a Unilateral Anterior Cruciate Ligament Injury Model. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, 24, 5473–5479. <https://doi.org/10.12659/MSM.909508>

Keywords: Disease Models, Animal; *Macaca fascicularis*; Knee Joint; Acupuncture Points; Anterior Cruciate Ligament Injuries/*therapy; Anterior Cruciate Ligament/physiology; Electroacupuncture/*methods; Knee Injuries; Proprioception/*physiology

Yeomans, D. C., Lu, Y., Laurito, C. E., Peters, M. C., Vota-Vellis, G., Wilson, S. P., & Pappas, G. D. (2006). Recombinant herpes vector-mediated analgesia in a primate model of hyperalgesia. *Molecular Therapy*, 13(3), 589–597. Scopus. <https://doi.org/10.1016/j.ymthe.2005.08.023>

Keywords: animal experiment; animal model; article; Disease Models, Animal; nonhuman; controlled study; skin nerve; behavior; Behavior, Animal; analgesia; Pain; chronic pain; Analgesia; immunohistochemistry; Skin/metabolism; Herpesviridae; Reaction Time; Skin; Behavior, Animal/drug effects; sensitization; analgesic activity; Analgesics, Opioid; Morphine; *Macaca*; naloxone; radioimmunoassay; Gene expression; Hyperalgesia; Genetic Vectors; capsaicin; nociceptive receptor; Analgesics, Opioid/pharmacology; Analgesia/*methods; morphine sulfate; thermal stimulation; Nociceptors; sensory nerve cell; *Genetic Therapy; Capsaicin/pharmacology; Enkephalins/cerebrospinal fluid/genetics/metabolism; Ganglia, Spinal/chemistry/metabolism; Genetic Vectors/*administration & dosage; Hyperalgesia/chemically induced/physiopathology/*therapy/*virology; Morphine/pharmacology; Nociceptors/metabolism; Reaction Time/genetics; Simplexvirus; Simplexvirus/*genetics; Capsaicin; C fiber; Enkephalins; Ganglia, Spinal; Gene Therapy; Herpes; herpesvirus vector; Opiate; proenkephalin; virus recombinant

Callitrichids



Goeldi's monkey/marmoset. Courtesy of Adobe Stock Photos.

Anesthesia

Description: This section of the bibliography contains citations describing anesthesia protocols and monitoring of vital signs for nonhuman primates of the subfamily Callitrichinae that consists of four genera: *Callithrix* (marmosets), *Callimico* (Goeldi's monkey), *Leontopithecus* (lion tamarins), and *Saguinus* (long-tusked tamarins). All members of the subfamily Callitrichinae are forest-dwelling “New World monkeys” native to Central and South America. This section also includes citations that describe anesthesia protocols for a specific type of surgery (such as neurosurgery or eye surgery), for chemical restraint, or for imaging.

Results(54):

Ansel, T. V., Nour, A. K., & Benavente-Perez, A. (2016). The effect of anesthesia on blood pressure measured noninvasively by using the tail-cuff method in marmosets (*Callithrix jacchus*). *Journal of the American Association for Laboratory Animal Science*, 55(5), 594–600. Scopus.

Keywords: Alfaxalone; alphaxalone; America; Anesthesia; Anesthesia/*veterinary; anesthetic agent; Anesthetics; Anesthetics/pharmacology; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); APEC countries; Article; Blood Pressure; Blood Pressure Determination; Blood Pressure Determination/*veterinary; blood pressure measurement; Blood Pressure/*physiology; calculation; Callithrix; Callithrix jacchus; Callithrix/*physiology; Callitrichidae; controlled study; Developed Countries; diastolic blood pressure; drug effect; feasibility study; Humans; measurement repeatability; Middle Atlantic States of USA; non invasive procedure; nonhuman; North America; Northeastern States of USA; OECD Countries; physiology; Pregnanediones; Pregnanediones/pharmacology; reproducibility; Reproducibility of Results; systolic blood pressure; Tail; Tail/*blood supply; United States of America; USA; validation study; vascularization; veterinary; Veterinary Pharmacology and Anaesthesiology

Bakker, J., Pelt, E., Brok, H., Remarque, E., Uilenreef, J., & Langermans, J. (2012). Comparison of three different sedatives in common marmosets (*Callithrix jacchus*). In C. A. Szentiks (Ed.), *Proceedings of the International Conference on Diseases of Zoo and Wild Animals 2012, May 16th—19th, 2012, Bussolengo/Italy*. (pp. 10–12). Zoological Record. <https://search.ebscohost.com/login.aspx?direct=true&db=lsdzor&AN=ZOOR14812077762&site=ehost-live>

Keywords: Callithrix jacchus: Sedation, Sedative drug regimes evaluation; Behavioural techniques, Operant conditioning for husbandry purposes, use of multifunctional nest box; Care in captivity, Multifunctional nest box for operant conditioning protocols & stress reduction during handling; Sedation, Use of multifunctional nest box to reduce stress during handling; Sedation, Chemical immobilization protocols, comparative study; Body temperature, Rectal temperature; Haemodynamics, Systolic arterial pressure; Heart beat, Heart rate; Ventilation rate, Respiratory rate; Sedation, Transversus abdominis plane block, First description, adult; Surgical techniques, Laparotomy; Super Taxa: Animalia, Chordata, Vertebrata, Mammalia, Primates, Callithricidae; Systematics: Callithricidae, Callithrix jacchus; Taxa Notes: Chordates, Mammals, Primates, Vertebrates

Bakker, J., Roubos, S., Remarque, E. J., Arndt, S. S., Kronen, P. W., & Langermans, J. A. (2018). Effects of buprenorphine, butorphanol or tramadol premedication on anaesthetic induction with alfaxalone in common marmosets (*Callithrix jacchus*). *Veterinary Anaesthesia and Analgesia*, 45(3), 309–319. Scopus. <https://doi.org/10.1016/j.vaa.2017.06.009>

Keywords: *Callithrix; adult; alfaxalone; alfaxan; anesthesia; anesthesia induction; anesthesia level; Anesthesia, Intravenous; Anesthesia, Intravenous/methods/*veterinary; anesthetic agent; Anesthetics, Combined; Anesthetics, Combined/*administration & dosage; animal experiment; animal model; Animal Physiology and Biochemistry (Excluding Nutrition); apnea; arterial pressure; Article; aspartate aminotransferase; aspartate transaminase; atropine; behavior disorder; Blood Pressure; Blood Pressure/drug effects; blood sampling; Body Temperature; Body Temperature/drug effects; breathing rate; buprecare; Buprenorphine; Buprenorphine/*administration & dosage; Butorphanol; Butorphanol/*administration & dosage; butorphanol tartrate; Callithrix; Callithrix jacchus; Callitrichidae; controlled study; creatine kinase; Cross-Over Studies; crossover procedure; drug effect; eyelid reflex; foaming; Heart Rate; Heart Rate/drug effects; hemoglobin; hypotension; hypoxia; immobilization; injection pain; intravenous anesthesia; intravenous injection; lactate dehydrogenase; marmosets; meloxicam; models; monitoring; muscle relaxation; muscle twitch; muscles; nonhuman; oxygen; oxygen saturation; Preanesthetic Medication; Preanesthetic Medication/methods/*veterinary; pregnanedione; Pregnanediones; Pregnanediones/*administration & dosage; premedication; procedures; prospective study; pulse oximetry; pulse rate; quadriceps femoris muscle; randomized controlled trial; rectal temperature; reflexes; Respiratory Rate; Respiratory Rate/drug effects; sample size; social interaction; temperature; Tramadol; Tramadol/*administration & dosage; tramal 100; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; withdrawal reflex

Bakker, J., Uilenreef, J. J., Pelt, E. R. J., Brok, H. P. M., Remarque, E. J., & Langermans, J. A. M. (2013). Comparison of three different sedative-anaesthetic protocols (ketamine, ketamine-medetomidine and alphaxalone) in common marmosets (*Callithrix jacchus*). *BMC Veterinary Research*, 9. Scopus. <https://doi.org/10.1186/1746-6148-9-113>

Keywords: adults; adverse effects; agonists; alfaxalone; Alphaxalone; anesthetic agent; Anesthetics, Combined; Anesthetics, Combined/administration & dosage/pharmacology; Animal Health and Hygiene (General); aspartate aminotransferase; Aspartate Aminotransferases; Aspartate Aminotransferases/blood; aspartate transaminase; Atipamezole; blood; Blood Pressure; Blood Pressure/physiology; Body Temperature; Body Temperature/physiology; Callithrix; Callithrix jacchus; Callithrix/*metabolism; Callitrichidae; Cleaning, Grading, Handling, Storage and Transport Equipment; Common marmoset; comparative study; controlled study; Creatine Kinase; Creatine Kinase/blood; Cross-Over Studies; crossover procedure; double blind procedure; Double-Blind Method; hands; Heart Rate; Heart Rate/physiology; heat; Immobilisation; Immobilization; Immobilization/methods/*veterinary; Induction; intramuscular injection; Ketamine; Ketamine/administration & dosage/*pharmacology; L-Lactate Dehydrogenase; L-Lactate Dehydrogenase/blood; lactate dehydrogenase; marmosets; Medetomidine; Medetomidine/administration & dosage/*pharmacology; metabolism; monitoring; muscles; NN460; nonparametric test; physiology; Pregnanediones;

Pregnanediones/administration & dosage/*pharmacology; procedures; randomized controlled trial; Recovery; reflexes; salivation; Sedation; Statistics, Nonparametric; veterinary; Veterinary Pharmacology and Anaesthesiology

Bourne, J. A., & Rosa, M. G. P. (2003). Preparation for the in vivo recording of neuronal responses in the visual cortex of anaesthetised marmosets (*Callithrix jacchus*). *Brain Research Protocols*, 11(3), 168–177. Scopus. [https://doi.org/10.1016/S1385-299X\(03\)00044-8](https://doi.org/10.1016/S1385-299X(03)00044-8)

Keywords: Action Potentials/drug effects; Action Potentials/physiology; adrenalin; amino acid; Anaesthetised monkey; Anesthesia*; anesthetic agent; Anesthetics/pharmacology; animal experiment; animal model; article; association cortex; atropine; benzathine penicillin; brain cell; brain electrophysiology; brain protection; Callithrix/*physiology; carbon dioxide; carboxymethylcellulose; cell isolation; chloramphenicol; chloroptone; controlled study; dexamethasone; dexamethasone sodium phosphate; diazepam; doxapram; drug overdose; Electrophysiology/methods; evoked cortical response; eye drops; gramicidin; hydrocortisone acetate; hydroxypropylmethylcellulose; in vivo study; ketamine; lidocaine; Male; marmoset; Microelectrodes; Monitoring; Monitoring, Physiologic/methods; neomycin; neosporin; Neuromuscular Blocking Agents/pharmacology; Neurons/*physiology; Neurons/drug effects; neurophysiology; nonhuman; norocillin; pancuronium bromide; pentobarbital; phenylephrine; Photostimulation; phytomenadione; polymyxin B; povidone iodine; priority journal; procaine penicillin; Rats; Refraction, Ocular; respiration depression; resuscitation; sensitive eyes; Sensory Deprivation; Single neurone electrophysiology; sofradex; Species Specificity; Stereotaxic Techniques/instrumentation; sufentanil citrate; Surgery technique; synthamin; unindexed drug; Visual cortex; Visual Cortex/*physiology; Visual Cortex/drug effects; xylazine

Buchanan-Smith, H. M. (2010). Marmosets and Tamarins. In *The UFAW Handbook on the Care and Management of Laboratory and Other Research Animals: Eighth Ed.* (pp. 543–563). Wiley-Blackwell; Scopus. <https://doi.org/10.1002/9781444318777.ch36>

Budoff, S. A., Rodrigues Neto, J. F., Arboes, V., Lima Nascimento, M. S., Kunicki, C. B., & Pereira de Araujo, M. F. (2019). Stereotaxic Surgery for Implantation of Microelectrode Arrays in the Common Marmoset (*Callithrix jacchus*). *JOVE-Journal of Visualized Experiments*, 151. <https://doi.org/10.3791/60240>

Chinnadurai, S. K., Johnson, J. G., III, & Langan, J. N. (2017). Comparison of 3 methods for preventing perianesthetic hypothermia in callimicos (*Callimico goeldii*). *Journal of the American Association for Laboratory Animal Science*, 56(3), 318–321. Scopus.

Keywords: adult; anesthesia; anesthesia complication; anesthesia level; anesthetics; Anesthetics, Inhalation; Anesthetics, Inhalation/adverse effects; animal; Animals; Article; bed; Bedding and Linens; *Body Temperature; body temperature monitoring; breathing circuit; *Callimico; Callimico goeldii; Callitrichidae; comparative study; controlled study; core temperature; esophagus; female; forced air warming blanket set; heat loss; heated anesthetic circuit; Hypothermia; Hypothermia/prevention & control/*veterinary; infrared photography; inhalation anesthetic agent; intermethod comparison; Isoflurane; Isoflurane/adverse effects; Male; Monkey Diseases; Monkey Diseases/*prevention & control; Non-Communicable Diseases and Injuries of

Animals; nonhuman; perianesthetic hypothermia; preanesthetic medication; prophylaxis; radiation; recumbency; reflective blanket; thermal regulating system; thermoregulation; vertebrates; veterinary; Veterinary Pharmacology and Anaesthesiology

du Plessis, W. M., Groenewald, H. B., & Elliott, D. (2017). Computed Tomography of the Abdomen in Eight Clinically Normal Common Marmosets (*Callithrix jacchus*). *Anatomia Histologia Embryologia*, 46(4), 365–372. <https://doi.org/10.1111/ahe.12278>

Keywords: anesthesia; Animal Anatomy and Morphology; animals; Automation and Control; body components; Callithrix; Callithrix jacchus; Callitrichidae; Canidae; Canis; carnivores; cats; dogs; Felidae; Felis; Fissipeda; marmosets; Pets and Companion Animals; small animals; Veterinary Pharmacology and Anaesthesiology

Ferraro, M. A., Molina, C. V., Catão-Dias, J. L., Kierulff, M. C. M., Pissinatti, A., Bueno, M. G., & Cortopassi, S. R. G. (2018). Evaluation of three chemical immobilization protocols in golden-headed lion tamarins (*Leontopithecus chrysomelas*) undergoing vasectomy surgery. *Journal of Medical Primatology*, 47(2), 101–109. <https://doi.org/10.1111/jmp.12322>

Keywords: America; anesthesia; animal experiment; Animal Surgery and Non-drug Therapy; antinociception; Article; Biological Resources (Animal); bradycardia; Brazil; *Brazilian primates; Callitrichidae; cetamina; clinical protocol; Community of Portuguese Language Countries; controlled study; convalescence; Developing Countries; Dexmedetomidine; Dexmedetomidine/*pharmacology; *dexmedetomidine; esketamine; heart rate; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/*pharmacology; Immobilization; Immobilization/methods/*veterinary; *Ketamine; Ketamine/*pharmacology; Latin America; Leontopithecus; Leontopithecus/*surgery; Leontopithecus chrysomelus; Leontopithecus rosalia; lidocaine; Male; Midazolam; Midazolam/*pharmacology; *midazolam; monkeys; muscle relaxation; nonhuman; outcome assessment; priority journal; procedures; Reproduction, Development and Life Cycle (Wild Animals); sedation; South America; surgery; Threshold Countries; Vasectomy; Vasectomy/methods/*veterinary; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; *wild animals

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Keywords: * α 2 agonist; adult; alpha 2 adrenergic receptor blocking agent; America; *anesthesia; animal experiment; Article; atipamezole; Biological Resources (Animal); bradycardia; Brazil; *Brazilian primates; Callitrichidae; Community of Portuguese Language Countries; controlled study; coordination disorder; Developing Countries; Dexmedetomidine; Dexmedetomidine/*pharmacology; dose response; Dose-Response Relationship, Drug; drug dose comparison; head movement; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/*pharmacology; imidazole derivative; Imidazoles; Imidazoles/*pharmacology; Ketamine; Ketamine/*pharmacology; Latin America; Leontopithecus; Leontopithecus/*physiology; Leontopithecus chrysomelus; licking; Male; muscle relaxation; *new world primates; nonhuman; physiology; Physiology and Biochemistry (Wild Animals); priority journal; Random Allocation; randomization; *recovery; salivation; sedation; South America; surgery; Threshold Countries; Vasectomy; Vasectomy/veterinary; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

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Keywords: America; anesthesia; blood red cells; Brazil; Callithrix; Callithrix geoffroyi; Callitrichidae; Community of Portuguese Language Countries; Developing Countries; hematology; hemoglobin; Latin America; marmosets; Physiology and Biochemistry (Wild Animals); red blood cells; South America; Threshold Countries

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Keywords: allergic encephalomyelitis; article; Axons; basal ganglion; Brain; brain cortex; Brain Mapping; brain size; brain ventricle; Callithrix; Callitrichinae; caudate nucleus; Common marmoset; concentration (parameters); Contrast Media; controlled study; Data Interpretation, Statistical; Diffusion Tensor Imaging; disease model; drug excretion; drug half life; Encephalomyelitis, Autoimmune, Experimental; excretion; Experimental autoimmune encephalomyelitis; follow up; gadobutrol; Gadolinium; globus pallidus; human versus animal comparison; Humans; Image Processing, Computer-Assisted; iron; Magnetic Resonance Imaging; magnetism; nerve fiber; Neural Pathways; Neuroimaging; nonhuman; nuclear magnetic resonance imaging; nuclear magnetic resonance scanner; Organometallic Compounds; priority journal; quantitative analysis; Quantitative magnetic resonance imaging; Signal-To-Noise Ratio; structure analysis; temporal lobe; three dimensional imaging; Translational studies; white matter

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Keywords: *Default mode network; *isoflurane; *marmoset; *Rest/physiology; *resting-state functional MRI; *thalamus; *Wakefulness/physiology; Anesthetics, Inhalation/*pharmacology; Animals; Brain/*drug effects; Brain/*drug effects/physiology; Brain/physiology; Callithrix; default mode network; default mode network*; Female; isoflurane; isoflurane*; Isoflurane/*pharmacology; Magnetic Resonance Imaging; Male; marmoset; marmoset*; Neural Pathways/*drug effects; Neural Pathways/*drug effects/physiology; Neural Pathways/physiology; Rest*/physiology; resting-state functional MRI; resting-state functional MRI*; thalamus; thalamus*; Wakefulness*/physiology

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Keywords: *Anesthetics, Combined; *Callithrix; anesthesia; Anesthesia; Anesthesia induction; Anesthesia/*veterinary; anesthetic agent; Anesthetics, Combined; Anesthetics, Combined*; Balanced anesthesia; Butorphanol; Callithrix; Callithrix jacchus; Callithrix*; Callitrichidae; ether derivative; Ketamine; marmosets; Methyl Ethers; Multi-modal analgesia; Pulse rate; Retrospective Studies; Sevoflurane; veterinary; Veterinary Pharmacology and Anaesthesiology

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Keywords: adrenal disease; Adrenal gland*; Adrenal Glands; Adrenal Glands/*anatomy & histology/diagnostic imaging; analytical parameters; anatomy and histology; Anesthetics, Inhalation; Anesthetics, Inhalation/administration & dosage; Animal Physiology and Biochemistry (Excluding Nutrition); Article; blood cell count; Callimico; Callimico goeldii; Callimico/*anatomy & histology; Callitrichidae; comparative study; computed tomography; computed tomography*; computer assisted tomography; diagnostic imaging; echography; Haplorhini; inhalation anesthetic agent; iohexol; Isoflurane; Isoflurane/administration & dosage; Kidney; kidney disease; kidney size; kidney*; Kidney/*anatomy & histology; Kidney/*anatomy & histology/diagnostic imaging; Kidney/diagnostic imaging; nonhuman; Organ Size; physical examination; Techniques and Methodology; Tomography, X-Ray Computed; Tomography, X-Ray Computed/veterinary; Ultrasonography; Ultrasonography/veterinary; ultrasound*; urinalysis; veterinarian; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; x-ray computed tomography

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Keywords: *alfaxalone; analgesic agent; Analgesics; Analgesics*/administration & dosage; anesthesia; anesthesia level; animal experiment; animal model; Animal Surgery and Non-drug Therapy; Article; atipamezole; Biological Resources (Animal); Callitrichidae; combination drug therapy; Dexmedetomidine; Dexmedetomidine*; Drug Therapy, Combination; heart rate; hypothermia; hypoxemia; incision; Ketamine; Ketamine*/administration & dosage; ketoprofen; Leontopithecus*; lidocaine; local anesthesia; Male; mean arterial pressure; Midazolam; Midazolam*/administration & dosage; muscle tremors; New World monkey; nonhuman; oxygen therapy; pain; PP710; Pregnanediones; Pregnanediones*/administration & dosage; Prospective Studies; prospective study; Reproduction, Development and Life Cycle (Wild Animals); sedation; tramadol; Tramadol; Tramadol*/administration & dosage; tremor; Veterinary Pharmacology and Anaesthesiology

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Keywords: Anesthetics, Intravenous; Anesthetics, Intravenous/pharmacology; animal experiment; article; Awake non-human primate; BOLD signal; Brain; Brain/drug effects/*physiology; Callithrix; Callitrichinae; caudate nucleus; controlled study; drug megadose; Evoked Potentials, Somatosensory; Evoked Potentials, Somatosensory/drug effects; Evoked Potentials, Somatosensory/drug effects/physiology; Evoked Potentials, Somatosensory/physiology; evoked somatosensory response; fentanyl; forearm; functional connectivity; functional magnetic resonance imaging; Functional MRI; geriatric anesthesia;

hemodynamics; intermethod comparison; low drug dose; Magnetic Resonance Imaging*; Models, Animal*; Neural Pathways; Neural Pathways/drug effects/*physiology; Neuroanesthesia; New world monkey; nonhuman; nuclear magnetic resonance scanner; primary somatosensory cortex; priority journal; Propofol; Propofol/pharmacology; Resting-state functional connectivity; secondary somatosensory cortex; somatosensory stimulation; thalamus; Wakefulness; Wakefulness/drug effects/*physiology

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Keywords: Anesthesia; aging; animal behavior; animal research; behavior; Callithrix; Callitrichidae; communicable diseases; DNA sequences; genetically engineered animals; genetically modified animals; GMOs; mental development; sight; visual impairments

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Keywords: alfaxalone*; anaesthesia*; Anesthesia; anesthesia level; Anesthesia/statistics & numerical data; anesthetic agent; anesthetic recovery; Anesthetics, Combined; Anesthetics, Combined/*administration & dosage; animal experiment; Article; atipamezole; Biological Resources (Animal); bradycardia; Butorphanol; Butorphanol/*administration & dosage; Callithrix; Callithrix jacchus; Callithrix*; Callitrichidae; cardiovascular disease; consciousness; controlled study; drug effect; drug potentiation; Female; Heart Rate; Heart Rate/drug effects; immobilization*; Injections, Intramuscular; Injections, Intramuscular/veterinary; intramuscular drug administration; Ketamine; Ketamine/*administration & dosage; marmoset*; marmosets; Medetomidine; Medetomidine/*administration & dosage; Non-human primate*; nonhuman; oxygen; oxygen saturation; oxygen therapy; Physiology and Biochemistry (Wild Animals); Pregnanediones; Pregnanediones/*administration & dosage; priority journal; recumbency; respiratory tract disease; treatment duration; tremor; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; vomiting

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Keywords: adult; anesthesia induction; animal model; Animals, Newborn; Article; body temperature monitoring; Brain; brain surgery; Callithrix; Callithrix jacchus; computer assisted surgery; craniotomy; diagnostic imaging; electrocardiography; fiducial marker; fluorescence imaging; infant; local anesthesia; Magnetic Resonance Imaging; Models, Animal; multiphoton microscopy; neurosurgery; Neurosurgical Procedures; newborn; nonhuman; nuclear magnetic

resonance imaging; priority journal; procedures; stereotactic device; stereotaxic surgery; surgery; Surgery, Computer-Assisted

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Keywords: anesthesia; Anesthesia, Intravenous; Anesthesia, Intravenous/veterinary; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); apnea; Article; Biological Resources (Animal); body weight; Callithrix; Callithrix jacchus; Callithrix/metabolism/*physiology; Callitrichidae; common marmoset; controlled study; drug blood level; drug clearance; drug elimination; general anesthesia; half life time; Half-Life; high performance liquid chromatography; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage/*pharmacokinetics/*pharmacology; immobilization; intravenous anesthesia; intravenous injection; Male; marmosets; metabolism; models; nonhuman; pharmacokinetics; physiology; population pharmacokinetics; population research; prediction; priority journal; Propofol; Propofol/administration & dosage/*pharmacokinetics/*pharmacology; scoring system; sedation; sevoflurane; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

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Keywords: Aging; anesthesia; animal experiment; animal model; animal tissue; Article; artificial ventilation; bone marrow; breathing; breathing pattern; Callithrix; chromatin; computer assisted tomography; euthanasia; Hydra vulgaris; image reconstruction; lipidomics; metabolomics; multiomics; nerve cell; nerve cell network; neutrophil; non invasive procedure; nonhuman; respiratory gated imaging; transcriptomics

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Keywords: APEC countries; ASEAN Countries; Asia; Callithrix; Callitrichidae; Developing Countries; marmosets; Pets and Companion Animals; South East Asia; Veterinary Pharmacology and Anaesthesiology

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Keywords: Awake marmoset; conscious awake marmoset; embedded RF coils; functional magnetic resonance imaging; MRI phased arrays; neuroscience; receive-only RF coils; whole-brain coverage

Rodrigues Falcao, B. M., Rocha Vieira, A. K., de Souza, J. G., Carreiro, A. da N., Fernandes de Araujo, D. V., Soares dos Santos, J. R., Ayres de Menezes, D. J., & Medeiros, G. X. (2018). Lobation and bronchopulmonary segmentation of *Callithrix jacchus* (Linnaeus, 1758). *Biota Neotropica*, 18(2). <https://doi.org/10.1590/1676-0611-BN-2017-0451>

Keywords: Anatomy; anesthesia; bronchial tree; bronchopulmonary segmentation; *Callithrix jacchus*; common marmoset; respiratory system

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Keywords: **Callithrix*; *GCaMP; *Neurovascular coupling; *Non-human primates; *Somatosensory activation; *Two-photon laser scanning microscopy; *Vascular topology; Anesthesia; Anesthetics, Inhalation; Anesthetics, Inhalation/*pharmacology; animal experiment; animal tissue; arteriole; Article; astrocyte; blood vessel reactivity; Brain; brain blood flow; brain circulation; Brain/blood supply/cytology/drug effects/*physiology; Calcium; Calcium/metabolism; *Callithrix**; *Callitrichinae*; capillary; cell activation; Cerebrovascular Circulation; Cerebrovascular Circulation/physiology; Cognition; controlled study; cytology; Dependoparvovirus; Dependovirus; Dependovirus/genetics; drug effects; fluorescence imaging; fluorescence microscopy; GCaMP; GCaMP*; gene vector; Genetic Vectors; genetics; Hemodynamics; Hemodynamics/drug effects/*physiology; immunohistochemistry; inhalation anesthetic agent; Isoflurane; Isoflurane/*pharmacology; Longitudinal Studies; longitudinal study; Male; metabolism; Microscopy, Fluorescence; Microscopy, Fluorescence/*methods; motor performance; Motor Skills; nerve cell; neuroimaging; Neurons; Neurons/cytology/drug effects/physiology; Non-human primates*; nonhuman; Optical Imaging; Optical Imaging/methods; physiology; priority journal; procedures; sensory stimulation; Somatosensory activation; Somatosensory activation*; somatosensory cortex; Two-photon laser scanning microscopy; Two-photon laser scanning microscopy*; Vascular Remodeling; Vascular Remodeling/drug effects/physiology; Vascular topology*; vascularization; vasodilatation; venule; Wakefulness; Wakefulness/drug effects/physiology

Schaeffer, D. J., Adam, R., Gilbert, K. M., Gati, J. S., Li, A. X., Menon, R. S., & Everling, S. (2017). Diffusion-weighted tractography in the common marmoset monkey at 9.4T. *Journal of Neurophysiology*, 118(2), 1344–1354. <https://doi.org/10.1152/jn.00259.2017>

Keywords: Alzheimer's disease; anesthesia; diffusion-weighted imaging; fiber tractography; marmoset; multiple sclerosis; schizophrenia; structural brain changes; translational research

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Keywords: Anesthesia; Callithrix/*physiology; Cluster Analysis; Electromagnetic Radiation; Female; Image Processing, Computer-Assisted; lateral frontal cortex*; Magnetic Resonance Imaging/instrumentation; Magnetic Resonance Imaging/methods; Male; marmoset*; Neural Pathways/anatomy & histology; Neural Pathways/physiology; Prefrontal Cortex/*anatomy & histology; Prefrontal Cortex/*physiology; resting-state fMRI*; ultra-high field*

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Keywords: Anesthesia; awake fMRI; magnetic resonance imaging; marmoset

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Keywords: Anesthesia; blood pressure measurement; Callithrix; cardiovascular system; conscious marmosets

Selmi, A. L., Mendes, G. M., Figueiredo, J. P., Barbudo-Selmi, G. R., & Lins, B. T. (2004). Comparison of medetomidine-ketamine and dexmedetomidine-ketamine anesthesia in golden-headed lion tamarins. *Canadian Veterinary Journal*, 45(6), 481–485. Scopus.

Keywords: alpha 2 adrenergic receptor stimulating agent; Analgesia; Analgesia/veterinary; analgesic activity; anesthesia; anesthetics; Anesthetics, Combined; *Anesthetics, Combined/pharmacology; Anesthetics, Dissociative; *Anesthetics, Dissociative/pharmacology; article; *Dexmedetomidine/pharmacology; *Hypnotics and Sedatives/pharmacology; *Ketamine/pharmacology; *Medetomidine/pharmacology; Blood Pressure; Blood Pressure/drug effects; body weight; breathing rate; Callitrichidae; Callitrichinae; Callitrichinae/*physiology; cardiovascular effect; controlled study; Dexmedetomidine; diastolic blood pressure; dose time effect relation; drug efficacy; drug potentiation; drug receptor binding; drug safety; Female; Heart Rate; Heart Rate/drug effects; Hypnotics and Sedatives; Ketamine; Leontopithecus; Leontopithecus chrysomelas; lion; Male; mean arterial pressure; Medetomidine; monkeys; muscle relaxation; nonhuman; Panthera leo; Random Allocation; rectum temperature; Respiration; Respiration/drug effects; respiratory function; respiratory rate; Safety; scoring system; sedation; statistical significance; systolic blood pressure; temperature; Time Factors; vetaset; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; xylazine

Silva, I. de O. e, Rodrigues da Silva, F. de F., Fuzessy, L. F., Tavela, A. de O., Carretta Junior, M., Dornelas e Silva, V. H., Rego de Paula, T. A., & Boere, V. (2014). Hematology and blood biochemistry in wild hybrid marmosets from the Atlantic Forest, Brazil. *Ciencia Rural*, 44(9), 1596–1602. <https://doi.org/10.1590/0103-8478cr20120822>

Keywords: Anesthesia; blood and lymphatics (transport and circulation); *Callithrix geoffroyi*; *Callithrix penicillata*; hybrid marmosets; ketamine; xylazine

Thomas, A. A., Leach, M. C., & Flecknell, P. A. (2012). An alternative method of endotracheal intubation of common marmosets (*Callithrix jacchus*). *Laboratory Animals*, 46(1), 71–76. Scopus. <https://doi.org/10.1258/la.2011.011092>

Keywords: Alphaxalone; anatomy; anesthesia; anesthesia induction; anesthesiological procedure; Anesthetics; Anesthetics/administration & dosage; article; *Callithrix*; *Callithrix jacchus*; *Callithrix*/anatomy & histology/*surgery; *Callitrichinae*; catheters; Endotracheal; endotracheal intubation; Injections, Intramuscular; Injections, Intravenous; intravenous injection; Intubation; Intubation, Intratracheal; Intubation, Intratracheal/instrumentation/*methods; *Laryngoscopes; Larynx; Larynx/anatomy & histology; marmosets; nonhuman; prediction; Pregnanediones; Pregnanediones/administration & dosage; thoracotomy; Trachea; Trachea/anatomy & histology

Tokuno, H., Moriya-Ito, K., & Tanaka, I. (2012). Experimental techniques for neuroscience research using common marmosets. *Experimental Animals*, 61(4), 389–397. Scopus. <https://doi.org/10.1538/expanim.61.389>

Keywords: Anesthesia induction; animal behavior; Animal Husbandry; body weight; Brain; Brain atlas; breeding; *Callithrix*; *Callithrix jacchus*; cesarean section; Common marmoset; experimental monkey; histology; isoflurane; ketamine; marmosets; medical research; microscopy; nerve cell culture; neuroanatomy; Neurons; neuroscience; Neuroscience research; Neurosciences; nonhuman; Organ Culture Techniques; pathological gambling; pentobarbital; *Platyrrhini*; rearing; review; Stereotaxic surgery; Stereotaxic Techniques; task performance; thiopental; Virtual microscopy

Valero, M. D., & Ratnam, R. (2011). Reliability of distortion-product otoacoustic emissions in the common marmoset (*Callithrix jacchus*). *Hearing Research*, 282(1–2), 265–271. Scopus. <https://doi.org/10.1016/j.heares.2011.07.004>

Keywords: Acoustic Stimulation; Anesthesia; Anesthesia/methods; Anesthetics, Dissociative; animal experiment; article; audiography; auditory stimulation; *Callithrix*; *Callithrix*/*physiology; *Callitrichinae*; controlled study; correlation coefficient; distortion product otoacoustic emission; frequency modulation; hearing test; Ketamine; nonhuman; *Otoacoustic Emissions, Spontaneous; priority journal; Reproducibility of Results; sex difference; Sex Factors; Signal Processing, Computer-Assisted; test retest reliability; Time Factors; time series analysis

Vieira Freitag, F. A., Reis, J. A., Fagundes, L. D., da Veiga Argus, A. P., Martini, R., Lange, R. R., & Duque Moreno, J. C. (2020). Transversus abdominis plane block in two marmosets (*Callithrix* sp.) undergoing laparotomy. *Journal of Exotic Pet Medicine*, 32(C), 47–48. Zoological Record.

Keywords: *Callithrix jacchus*: Sedation, Sedative drug regimes evaluation; Behavioural techniques, Operant conditioning for husbandry purposes, use of multifunctional nest box; Care

in captivity, Multifunctional nest box for operant conditioning protocols & stress reduction during handling; Sedation, Use of multifunctional nest box to reduce stress during handling; Sedation, Chemical immobilization protocols, comparative study; Body temperature, Rectal temperature; Haemodynamics, Systolic arterial pressure; Heart beat, Heart rate; Ventilation rate, Respiratory rate; Sedation, Transversus abdominis plane block, First description, adult; Surgical techniques, Laparotomy; Callithricidae

Watsa, M., Erkenswick, G., Halloran, D., Kane, E. E., Poirier, A., Klonoski, K., Cassalett, S., Maciag, E., Mangalea, M. R., Dinsmore, M. P., McCready, H., Boughan, B. K., Parker, C., Hickmott, A., Nole Bazan, I. E., & Zuniga, A. (2015). A field protocol for the capture and release of callitrichids. *Neotropical Primates*, 22(2), 59–68.

Keywords: anesthesia; callitrichidae; capture and release; chemical restraint; emperor tamarin; Peru; saddleback tamarin; Saguinus imperator; Saguinus weddelli; trapping

Yokoyama, C., Kawasaki, A., Mawatari, A., Doi, H., Zimmer, L., & Onoe, H. (2014). 5-HT1A receptor mapping in the marmoset brain: PET study with an agonist radiotracer F-18-F13714 under conscious and isoflurane anesthetic conditions. *European Journal of Nuclear Medicine and Molecular Imaging*, 41, S625–S626.

Keywords: Anesthesia; Callithrix; isoflurane; marmoset; meeting abstract; positron emission tomography

Yokoyama, C., Mawatari, A., Kawasaki, A., Takeda, C., Onoe, K., Doi, H., Newman-Tancredi, A., Zimmer, L., & Onoe, H. (2016). Marmoset serotonin 5-HT1a receptor mapping with a biased agonist PET probe 18F-F13714: Comparison with an antagonist tracer 18F-MPPF in awake and anesthetized states. *International Journal of Neuropsychopharmacology*, 19(12). Scopus. <https://doi.org/10.1093/ijnp/pyw079>

Keywords: *5-hydroxytryptamine; *Anesthesia, General; *biased agonism; *Consciousness; *F13714; *Positron-Emission Tomography; 3-chloro-4-fluorophenyl-(4-fluoro-4-(((5-methyl-6-methylaminopyridin-2-yl)methyl)amino)methyl)piperidin-1-yl)methanone; 4 (2' methoxyphenyl) 1 [2' (n 2" pyridinyl) para fluorobenzamido] f 18; 4-(2'-methoxyphenyl)-1-(2'-(N-2'-pyridinyl)-p-(18F)fluorobenzamido)ethylpiperazine; 5-hydroxytryptamine; 5-hydroxytryptamine*; adult; aminopyridine derivative; Aminopyridines; Aminopyridines/*metabolism; Aminopyridines/*metabolism/pharmacokinetics; Aminopyridines/pharmacokinetics; amygdala; Anesthesia, General*; animal experiment; Article; Biased agonism; biased agonism*; Brain; Brain/*diagnostic imaging/metabolism; Callithrix; Callithrix jacchus*; Callithrix/*metabolism; caudate nucleus; cingulate gyrus; comparative study; Consciousness*; controlled study; diagnostic imaging; drug structure; f 13714 f 18; F13714; F13714*; fluorine; Fluorine Radioisotopes; Fluorine Radioisotopes/*metabolism; Fluorine Radioisotopes/*metabolism/pharmacokinetics; Fluorine Radioisotopes/pharmacokinetics; general anesthesia; hippocampus; insula; isoflurane; Male; metabolism; Molecular Imaging; Molecular Imaging/*methods; nonhuman; PET scanner; piperazine derivative; Piperazines; Piperazines/*metabolism/pharmacokinetics; piperidine derivative; Piperidines; Piperidines/*metabolism/pharmacokinetics; Positron-Emission Tomography*; predictive value;

Predictive Value of Tests; priority journal; procedures; Protein Binding; putamen; pyridine derivative; Pyridines;; Pyridines/*metabolism/pharmacokinetics; radiopharmaceutical agent; Radiopharmaceuticals; Radiopharmaceuticals/*metabolism/pharmacokinetics; raphe nucleus; Receptor, Serotonin, 5-HT1A; Receptor, Serotonin, 5-HT1A/*metabolism; serotonin 1 agonist; serotonin 1A receptor; Serotonin 5-HT1 Receptor Agonists; Serotonin 5-HT1 Receptor Agonists/*metabolism/pharmacokinetics; thalamus; Tissue Distribution; tracer; unclassified drug; wakefulness

Analgesia

Description: This section features information on the use of analgesic drugs and therapies such as acupuncture to treat postoperative or other pain in primates of the subfamily Callithricinae.

Results (5):

Arnold, C., & Einspanier, A. (2013). Medical treatment improves social behavior in a primate endometriosis model (*Callithrix jacchus*). *Journal of Medical Primatology*, 42(3), 112–119. CAB Abstracts. <https://doi.org/10.1111/jmp.12042>

Keywords: Animal and in-vitro Models for Pharmaceuticals; animal behavior; Animal Models of Human Diseases; animal rights; Animal Welfare; behavior; Callithrix; Callithrix jacchus; Callitrichidae; chemotherapy; endometrial area; Hominidae; Homo; intelligence; Laboratory Animal Science; man; marmosets; metritis; Non-Communicable Diseases and Injuries of Animals; pain killers; social behavior; Veterinary Pharmacology and Anaesthesiology

Boyer, S. H., Ugarkar, B. G., Solbach, J., Kopcho, J., Matelich, M. C., Ollis, K., Gomez-Galeno, J. E., Mendonca, R., Tsuchiya, M., Nagahisa, A., Nakane, M., Wiesner, J. B., & Erion, M. D. (2005). Adenosine kinase inhibitors. 5. Synthesis, enzyme inhibition, and analgesic activity of diaryl-erythro-furanosyltubercidin analogues. *Journal of Medicinal Chemistry*, 48(20), 6430–6441. <https://doi.org/10.1021/jm0503650>

Keywords: Adenosine Kinase/*antagonists & inhibitors; Adenosine/adverse effects/*analogs & derivatives/chemical synthesis/pharmacology; Administration, Oral; Analgesics/adverse effects/*chemical synthesis/pharmacology; Area Under Curve; Biological Availability; Callithrix; Dogs; Humans; Male; Rats; Rats, Sprague-Dawley; Stereoisomerism; Structure-Activity Relationship; Tubercidin/adverse effects/*analogs & derivatives/*chemical synthesis/pharmacology

Fabian, N. J., Moody, D. E., Averin, O., Fang, W. B., Jamiel, M., Fox, J. G., Burns, M. A., & Haupt, J. L. (2021). Pharmacokinetics of Single-Dose Intramuscular and Subcutaneous Injections of Buprenorphine in Common Marmosets (*Callithrix jacchus*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 60(5), 568–575. <https://doi.org/10.30802/AALAS-JAALAS-20-000151>

Keywords: *Analgesia; *Buprenorphine; Analgesia; Analgesia*; Analgesics, Opioid; anesthesia; anesthetics; Buprenorphine; Buprenorphine*; Callithrix; Callithrix jacchus; Callitrichidae; drug

action; Injections, Intramuscular; Injections, Intramuscular/veterinary; Injections, Subcutaneous; intramuscular drug administration; marmosets; mechanism of drug action; narcotic analgesic agent; pain killers; plasma (blood); subcutaneous drug administration; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

Fitz, C. B., Goodroe, A. E., Moody, D. E., Fang, W. B., & Capuano, S. V. I. (2021). Pharmacokinetics of Buprenorphine and Sustained-release Buprenorphine in Common Marmosets (*Callithrix jacchus*). *Journal of the American Association for Laboratory Animal Science : JAALAS*, 60(2), 188–194. <https://doi.org/10.30802/AALAS-JAALAS-20-000082>

Keywords: administration and dosage; adult; adverse reactions; Analgesics, Opioid; Analgesics, Opioid/administration & dosage/*pharmacokinetics; animal experiment; animal tissue; area under the curve; Article; Biological Resources (Animal); BSR; BUP; Buprenorphine; buprenorphine HCl; Buprenorphine/*pharmacokinetics; Buprenorphine/administration & dosage; Buprenorphine/administration & dosage/*pharmacokinetics; Callithrix; Callithrix jacchus; Callithrix/*metabolism; Callitrichidae; clinical picture; controlled study; delayed release formulation; Delayed-Action Preparations; Delayed-Action Preparations/administration & dosage; drug blood level; drug clearance; drug half life; half life time; Half-Life; marmosets; maximum concentration; mean residence time; metabolism; narcotic analgesic agent; nonhuman; pain killers; pharmacokinetic parameters; plasma (blood); plasma concentration-time curve; slow release; sustained drug release; sustained-release buprenorphine; time to maximum plasma concentration; Veterinary Pharmacology and Anaesthesiology

Vierboom, M. P. M., Breedveld, E., Keehnen, M., Klomp, R., & Bakker, J. (2017). Pain Relief in Nonhuman Primate Models of Arthritis. *Methods in Molecular Biology (Clifton, N.J.)*, 1559, 411–417. https://doi.org/10.1007/978-1-4939-6786-5_28

Keywords: *Analgesics, Opioid; *Autoimmunity; *Buprenorphine; *Inflammatory arthritis; *Nonhuman primates; *NSAID; *Pain relief; *Refinement; Arthritis, Experimental/*complications/pathology/physiopathology; Callithrix; Drug Administration Schedule; Macaca mulatta; Pain Management/*methods; Pain/complications/physiopathology/*prevention & control; Severity of Illness Index

Adverse Effects

Description: This section contains citations about adverse effects of anesthetic or analgesic drugs on callitrichids.

Results (6):

Bales, K., O'Herron, M., Baker, A. J., & Dietz, J. M. (2001). Sources of variability in numbers of live births in wild golden lion tamarins (*Leontopithecus rosalia*). *American Journal of Primatology*, 54(4), 211–221. Scopu. <https://doi.org/10.1002/ajp.1031>

Keywords: Anesthesia; birth rate; body mass; Callitrichid; chemical restraint; golden lion tamarin; immobilization; Leontopithecus rosalia; litter size

Coletta, N. J., Marcos, S., & Troilo, D. (2010). Ocular wavefront aberrations in the common marmoset *Callithrix jacchus*: Effects of age and refractive error. *Vision Research*, 50(23), 2515–2529. <https://doi.org/10.1016/j.visres.2010.08.027>

Keywords: Age effect; anesthesia; *Callithrix jacchus*; development; emmetropization; eye disease; marmoset; ocular wavefront aberration; optical aberrations; optical quality; refractive error; spherical aberration; visual experience

Drummer, C., Heistermann, M., & Behr, R. (2018). The effects of repeated anesthesia on fertility and stress parameters in common marmosets (*Callithrix jacchus*). *Reproduction in Domestic Animals*, 53, 8–8.

Keywords: Anesthesia; *Callithrix jacchus*; common marmoset; meeting abstract; reproduction; stress

Helms, G., Garea-Rodriguez, E., Schlumbohm, C., König, J., Dechent, P., Fuchs, E., & Wilke, M. (2013). Structural and quantitative neuroimaging of the common marmoset monkey using a clinical MRI system. *Journal of Neuroscience Methods*, 215(1), 121–131. Scopus. <https://doi.org/10.1016/j.jneumeth.2013.02.011>

Keywords: allergic encephalomyelitis; article; Axons; basal ganglion; Brain; brain cortex; Brain Mapping; brain size; brain ventricle; *Callithrix*; *Callitrichinae*; caudate nucleus; Common marmoset; concentration (parameters); Contrast Media; controlled study; Data Interpretation, Statistical; Diffusion Tensor Imaging; disease model; drug excretion; drug half life; Encephalomyelitis, Autoimmune, Experimental; excretion; Experimental autoimmune encephalomyelitis; follow up; gadobutrol; Gadolinium; globus pallidus; human; human versus animal comparison; Humans; Image Processing, Computer-Assisted; iron; Magnetic Resonance Imaging; magnetism; nerve fiber; Neural Pathways; Neuroimaging; nonhuman; nuclear magnetic resonance imaging; nuclear magnetic resonance scanner; Organometallic Compounds; priority journal; quantitative analysis; Quantitative magnetic resonance imaging; Signal-To-Noise Ratio; structure analysis; temporal lobe; three dimensional imaging; Translational studies; white matter

Konoike, N., Miwa, M., Ishigami, A., & Nakamura, K. (2017). Hypoxemia after single-shot anesthesia in common marmosets. *Journal of Medical Primatology*, 46(3), 70–74. Scopus. <https://doi.org/10.1111/jmp.12262>

Keywords: *alphaxalone; *arterial blood gas; **Callithrix*/physiology; *ketamine; *non-human primates; Adjuvants, Anesthesia; Adjuvants, Anesthesia/*adverse effects; alphaxalone; alphaxalone; Anesthesia; Anesthesia/adverse effects/*veterinary; anesthetic agent; Anesthetics; Anesthetics/*adverse effects; animal experiment; animal model; Animal Welfare; arterial blood gas; arterial carbon dioxide tension; arterial oxygen saturation; arterial oxygen tension; Article; Atropine; Atropine/adverse effects; blood; blood oxygen tension; breathing; *Callithrix*; *Callithrix jacchus*; *Callitrichidae*; central depressant agent; chemically induced; controlled study; drug effects; hypoxemia; Hypoxia; Hypoxia/chemically induced/physiopathology/*veterinary; Ketamine; Ketamine/adverse effects; Laboratory Animal Science; marmosets; Monkey

Diseases; Monkey Diseases/chemically induced/*physiopathology; Non-Communicable Diseases and Injuries of Animals; nonhuman; Oxygen; oxygen blood level; Oxygen/blood; oxygenation; pathophysiology; physiology; Pregnanediones; Pregnanediones/adverse effects; priority journal; Respiration; Respiration/drug effects; veterinary; Veterinary Pharmacology and Anaesthesiology; Xylazine; Xylazine/adverse effects

Whatham, A. R., Lunn, D., & Judge, S. J. (2019). Effects of Monocular Atropinization on Refractive Error and Eye Growth in Infant New World Monkeys. *Investigative Ophthalmology & Visual Science*, 60(7), 2623–2630. <https://doi.org/10.1167/iovs.18-24490>

Keywords: Accommodation, Ocular/drug effects/physiology; Administration, Ophthalmic; Animals, Newborn; Atropine/*administration & dosage; Axial Length, Eye/*drug effects; Callithrix; Emmetropia/physiology; Eye/*growth & development; Male; Muscarinic Antagonists/*administration & dosage; Myopia/*etiology/physiopathology; Ophthalmic Solutions; Retinoscopy; Vitreous Body/drug effects

Case Studies

Description: Below are two anesthesia or analgesia case studies involving individual callitrichids.

Results (2):

Choi, E., Childs-Sanford, S. E., Abou-Madi, N., King, E. E., Caserto, B. G., Priest, H., Behling-Kelly, E., & Miller, A. D. (2016). Hepatic osteodystrophy in a golden lion tamarin (*Leontopithecus rosalia*). *Journal of Zoo and Wildlife Medicine*, 47(3), 907–911. Scopus. <https://doi.org/10.1638/2015-0201.1>

Keywords: Alanine transaminase; alkaline phosphatase; anesthesia; Animal Physiology and Biochemistry (Excluding Nutrition); aspartate transaminase; blood pressure; blood serum; Bone Diseases, Metabolic; bones; Callitrichidae; case report; Cirrhosis; clinical examination; developmental orthopedic disease; Fatal Outcome; fatality; females; Golden lion tamarin; hepatic osteodystrophy; hyperbilirubinemia; hypoglycemia; hypotension; hypothermia; Leontopithecus; Leontopithecus rosalia; leukemia; liver; liver cirrhosis; Liver Diseases; metabolic bone disease; microscopy; monitoring; Monkey Diseases; Non-Communicable Diseases and Injuries of Animals; osteomalacia; osteopenia; pathology; Protozoan, Helminth, Mollusc and Arthropod Parasites of Animals; veterinary; Veterinary Pharmacology and Anaesthesiology; weight loss

Nimittritip, U. (2016). Anesthesia in common marmoset with isoflurane: A case report. *Thai Journal of Veterinary Medicine* 46(Supplement), 311. CAB Abstracts. <https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20183121575&site=ehost-live>

Keywords: APEC countries; ASEAN Countries; Asia; Callithrix; Callitrichidae; Developing Countries; marmosets; Pets and Companion Animals; South East Asia; Veterinary Pharmacology and Anaesthesiology

Human Pain and Nociception Research, Pharmacology, and Drug Development

Description: These articles describe using callitrichids as models for studying pain and nociception in humans as well as for drug development, pharmacokinetics, and pharmacodynamics.

Results (17):

Bookser, B. C., Ugarkar, B. G., Matelich, M. C., Lemus, R. H., Allan, M., Tsuchiya, M., Nakane, M., Nagahisa, A., Wiesner, J. B., & Erion, M. D. (2005). Adenosine kinase inhibitors. 6. Synthesis, water solubility, and antinociceptive activity of 5-phenyl-7-(5-deoxy-beta-D-ribofuranosyl)pyrrolo[2,3-d]pyrimidines substituted at C4 with glycinamides and related compounds. *Journal of Medicinal Chemistry*, 48(24), 7808–7820. <https://doi.org/10.1021/jm050394a>

Keywords: Adenosine Kinase/*antagonists & inhibitors; Analgesics/*chemical synthesis/chemistry/pharmacology; Biological Availability; Callithrix; Dogs; Drug Stability; Glycine/*analogs & derivatives/chemistry; Humans; In Vitro Techniques; Male; Microsomes, Liver/metabolism; Nucleosides/*chemical synthesis/chemistry/pharmacology; Pain Measurement; Pyrimidine Nucleosides/chemical synthesis/chemistry/pharmacology; Rats; Solubility; Structure-Activity Relationship; Water

Bowes, C., Burish, M., Cerkevich, C., & Kaas, J. (2013). Patterns of cortical reorganization in the adult marmoset after a cervical spinal cord injury. *Journal of Comparative Neurology*, 521(15), 3451–3463. Scopus. <https://doi.org/10.1002/cne.23360>

Keywords: anesthesia induction; animal experiment; animal tissue; arcuate fasciculus; article; brain cortex; Brain Mapping; Brain Stem; Callithrix; Callitrichinae; Cerebral Cortex; cervical spinal cord injury; Cholera Toxin; controlled study; Cortical plasticity; craniotomy; Electrophysiological Processes; Fingers; Forelimb; Functional Laterality; Hand; Male; microelectrode; New World monkey; nonhuman; priority journal; Somatosensory; Somatosensory Cortex; Spinal Cord; Spinal Cord Injuries; spinal cord lesion

Clapp, N. K., Nardi, R. V., & Tobi, M. (2018). Future directions for colon disease research using cotton-top tamarins. In *A Primate Model for the Study of Colitis and Colonic Carcinoma the Cotton-Top Tamarin (Saguinus oedipus)* (pp. 319–324). CRC Press; Scopus. <https://doi.org/10.1201/9781351069410>

Keywords: Anesthesia; colon disease research; cotton-top tamarin; European code; rhesus monkey; Saguinus oedipus

Crofts, H. S., Wilson, S., Muggleton, N. G., Nutt, D. J., Scott, E. A. M., & Pearce, P. C. (2001). Investigation of the sleep electrocorticogram of the common marmoset (*Callithrix jacchus*) using radiotelemetry. *Clinical Neurophysiology*, 112(12), 2265–2273. Scopus. [https://doi.org/10.1016/S1388-2457\(01\)00699-X](https://doi.org/10.1016/S1388-2457(01)00699-X)

Keywords: Anesthesia; animal experiment; article; brain electrophysiology; Callithrix; Cerebral Cortex; controlled study; data analysis; Electrocardiography; Electrocorticogram; electrocorticography; Electroencephalogram; Feasibility Studies; implantation; laboratory; Marmoset; night sleep; nonhuman; nonREM sleep; priority journal; Reaction Time; REM sleep; sleep pattern; Sleep Stages; sleep time; sleep waking cycle; Telemetry; Time Factors; videorecording; Wakefulness

Gouarderes, C., Puget, A., & Zajac, J. (2004). Detailed distribution of neuropeptide FF receptors (NPFF1 and NPFF2) in the rat, mouse, octodon, rabbit, guinea pig, and marmoset monkey brains: A comparative autoradiographic study. *Synapse*, 51(4), 249–269. <https://doi.org/10.1002/syn.10305>

Keywords: autoradiography; Callithricidae; guinea pig; marmoset; mouse; nervous system (neural coordination); neuropeptide FF; octodon; rabbit; rat; receptor; sensory input

Grace, J., Wong, H., Sinz, M., & Lentz, K. (2009). Comparison of the formation kinetics of acetaminophen in chimpanzee, cynomolgus monkey, marmoset, rhesus monkey and human liver microsomes. *Drug Metabolism Reviews*, 41, 58–59.

Keywords: Acetaminophen; analgesics; chimpanzees; cynomolgus monkeys; liver microsomes; marmosets; pharmacology; rhesus macaques; symposia, transactions and proceedings

Marshall, J. W. B., & Ridley, R. M. (2003). Assessment of cognitive and motor deficits in a marmoset model of stroke. *ILAR Journal*, 44(2), 153–160. Scopus. <https://doi.org/10.1093/ilar.44.2.153>

Keywords: Alfaxalone; althesin; animal behavior; animal care; animal experiment; animal model; clomethiazole; cognitive defect; controlled study; drug effect; drug efficacy; drug mechanism; flunixin meglumine; histology; marmosets; Motor deficit; motor dysfunction; Neglect; neuroprotection; neurosurgery; nonhuman; postoperative care; review; Stroke; task performance

Nakanishi, K., Uehara, S., Kusama, T., Inoue, T., Shimura, K., Kamiya, Y., Murayama, N., Shimizu, M., Uno, Y., Sasaki, E., & Yamazaki, H. (2018). In vivo and in vitro diclofenac 5-hydroxylation mediated primarily by cytochrome P450 3A enzymes in common marmoset livers genotyped for P450 2C19 variants. *Biochemical Pharmacology*, 152, 272–278. <https://doi.org/10.1016/j.bcp.2018.04.002>

Keywords: *CYP2C19; *CYP3A4; *Genetic Variation; *Marmoset; *PBPK; *Polymorphism; Anti-Inflammatory Agents, Non-Steroidal/*metabolism/pharmacokinetics; Callithrix; Cytochrome P-450 CYP2C19/*genetics; Cytochrome P-450 CYP3A/genetics/*metabolism; Diclofenac/*metabolism/pharmacokinetics; Gene Expression Regulation, Enzymologic; Genotype; Hydroxylation; Liver/enzymology/metabolism

Oshio, T., Uehara, S., Uno, Y., Inoue, T., Sasaki, E., & Yamazaki, H. (2019). Marmoset cytochrome P450 2B6, a propofol hydroxylase expressed in liver. *Xenobiotica; the Fate of*

***Foreign Compounds in Biological Systems*, 49(3), 265–269.**
<https://doi.org/10.1080/00498254.2018.1439204>

Keywords: Callithrix/*metabolism; Common marmoset; Coumarins/metabolism; CYP2B6; Cytochrome P-450 Enzyme System/chemistry/metabolism/*physiology; drug oxidation; Escherichia coli/genetics; Liver/*enzymology; Oxazines/metabolism; Oxidation-Reduction; Propofol/*metabolism; Real-Time Polymerase Chain Reaction; RNA, Messenger/metabolism; Sequence Homology; Testosterone/metabolism

Soars, M. G., Riley, R. J., & Burchell, B. (2001). Evaluation of the marmoset as a model species for drug glucuronidation. *Xenobiotica*, 31(12), 849–860. Scopus.
<https://doi.org/10.1080/00498250110069690>

Keywords: 1 naphthol; androstanediol; animal tissue; article; bilirubin; Callithrix; Callithrix/*metabolism; Canis familiaris; codeine; conjugation; drug glucuronidation; ethinylestradiol; furosemide; gemfibrozil; Glucuronates; Glucuronates/*metabolism; glucuronosyltransferase; human; human tissue; hydromorphone; hyodeoxycholic acid; Imipramine; Imipramine/pharmacokinetics; Inactivation, Metabolic; ketoprofen; Kidney; Kidney/drug effects/*metabolism; liver microsome; marmosets; Metabolic Detoxication, Drug; Microsomes, Liver; Microsomes, Liver/*drug effects/*metabolism; model; Models, Animal*; Morphine; Morphine/pharmacokinetics; naloxone; naproxen; nonhuman; Propofol; Propofol/pharmacokinetics; Rats; Rats, Sprague-Dawley; Species Specificity; valproic acid

Toda, A., Shimizu, M., Uehara, S., Sasaki, T., Miura, T., Mogi, M., Utoh, M., Suemizu, H., & Yamazaki, H. (2021). Plasma and hepatic concentrations of acetaminophen and its primary conjugates after oral administrations determined in experimental animals and humans and extrapolated by pharmacokinetic modeling. *Xenobiotica; the Fate of Foreign Compounds in Biological Systems*, 51(3), 316–323.
<https://doi.org/10.1080/00498254.2020.1849872>

Keywords: Acetaminophen/*pharmacokinetics; Administration, Oral; Callithrix; common marmoset; cynomolgus monkey; humanised-liver mouse; Humans; Liver/*chemistry; Macaca fascicularis; Mice; minipig; paracetamol; Physiologically based kinetic model; Plasma/*chemistry; Rats; Swine; Swine, Miniature

Toda, A., Uehara, S., Inoue, T., Utoh, M., Kusama, T., Shimizu, M., Uno, Y., Mogi, M., Sasaki, E., & Yamazaki, H. (2018). Effects of aging and rifampicin pretreatment on the pharmacokinetics of human cytochrome P450 probes caffeine, warfarin, omeprazole, metoprolol and midazolam in common marmosets genotyped for cytochrome P450 2C19. *Xenobiotica; the Fate of Foreign Compounds in Biological Systems*, 48(7), 720–726.
<https://doi.org/10.1080/00498254.2017.1353716>

Keywords: Administration, Intravenous; Aging/drug effects/*physiology; Caffeine/administration & dosage/blood/*pharmacokinetics/pharmacology; Callithrix; Cytochrome P-450 CYP2C19/*genetics; Genotype; Hepatic clearance; Humans; induction; Male; marmoset; Metoprolol/administration & dosage/blood/*pharmacokinetics/pharmacology;

Midazolam/administration & dosage/blood/*pharmacokinetics/pharmacology;
Omeprazole/administration & dosage/blood/*pharmacokinetics/pharmacology; P450 substrates;
Rifampin/*pharmacology; Substrate Specificity/drug effects; Warfarin/administration &
dosage/blood/*pharmacokinetics/pharmacology

Uehara, S., Inoue, T., Utoh, M., Toda, A., Shimizu, M., Uno, Y., Sasaki, E., & Yamazaki, H. (2016). Simultaneous pharmacokinetics evaluation of human cytochrome P450 probes, caffeine, warfarin, omeprazole, metoprolol and midazolam, in common marmosets (*Callithrix jacchus*). *Xenobiotica; the Fate of Foreign Compounds in Biological Systems*, 46(2), 163–168. <https://doi.org/10.3109/00498254.2015.1057270>

Keywords: Administration, Intravenous; Administration, Oral; Biological Availability; Caffeine/blood/*pharmacokinetics; Callithrix/metabolism; Chromatography, Liquid; CYP3A4; Cytochrome P-450 CYP3A/genetics/*metabolism; Dose-Response Relationship, Drug; hepatic clearance; Humans; Intestine, Small/drug effects/metabolism; Liver/drug effects/metabolism; marmoset; Metoprolol/blood/*pharmacokinetics; Midazolam/blood/*pharmacokinetics; Models, Animal; Omeprazole/blood/*pharmacokinetics; P450 substrates; Tandem Mass Spectrometry; Warfarin/blood/*pharmacokinetics

Uehara, S., Shimizu, M., Uno, Y., Inoue, T., Sasaki, E., & Yamazaki, H. (2017). Marmoset Flavin-Containing Monooxygenase 3 in the Liver Is a Major Benzydamine and Sulindac Sulfide Oxygenase. *Drug Metabolism and Disposition: The Biological Fate of Chemicals*, 45(5), 497–500. <https://doi.org/10.1124/dmd.117.075184>

Keywords: Amino Acid Sequence; Benzydamine/*pharmacokinetics; *Callithrix/genetics/metabolism; Drug Evaluation, Preclinical/methods; Escherichia coli/genetics; Female; Hot Temperature; Humans; Liver/*enzymology; Male; Microsomes, Liver/enzymology; Organ Specificity; Oxygenases/genetics/*metabolism; Sequence Homology, Amino Acid; Species Specificity; Sulindac/*analogs & derivatives/pharmacokinetics

Uehara, S., Uno, Y., Inoue, T., Kawano, M., Shimizu, M., Toda, A., Utoh, M., Sasaki, E., & Yamazaki, H. (2015). Novel Marmoset Cytochrome P450 2C19 in Livers Efficiently Metabolizes Human P450 2C9 and 2C19 Substrates, S-Warfarin, Tolbutamide, Flurbiprofen, and Omeprazole. *Drug Metabolism and Disposition: The Biological Fate of Chemicals*, 43(10), 1408–1416. <https://doi.org/10.1124/dmd.115.066100>

Keywords: Amino Acid Sequence; Callithrix; Cytochrome P-450 CYP2C19/genetics/*metabolism; Cytochrome P-450 CYP2C9/genetics/*metabolism; Flurbiprofen/*metabolism; Humans; Macaca fascicularis; Microsomes, Liver/*enzymology; Molecular Sequence Data; Omeprazole/*metabolism; Phylogeny; Species Specificity; Substrate Specificity; Tolbutamide/*metabolism; Warfarin/*metabolism

Uehara, S., Uno, Y., Nakanishi, K., Ishii, S., Inoue, T., Sasaki, E., & Yamazaki, H. (2017). Marmoset Cytochrome P450 3A4 Ortholog Expressed in Liver and Small-Intestine Tissues Efficiently Metabolizes Midazolam, Alprazolam, Nifedipine, and Testosterone. *DRUG Metabolism and Disposition*, 45(5), 457–467. <https://doi.org/10.1124/dmd.116.074898>

Keywords: Alprazolam; Callitrichidae; Callithrix jacchus; common marmosets; Digestive System(Ingestion and Assimilation); liver disease; midazolam; nifedipine; neuropharmacology; testosterone

Zinke, W., Roberts, M. J., Guo, K., McDonald, J. S., Robertson, R., & Thiele, A. (2006). Cholinergic modulation of response properties and orientation tuning of neurons in primary visual cortex of anaesthetized Marmoset monkeys. *The European Journal of Neuroscience*, 24(1), 314–328. MEDLINE. <https://doi.org/10.1111/j.1460-9568.2006.04882.x>

Keywords: Acetylcholine/*physiology; Acetylcholine/pharmacology; Action Potentials; Anesthesia; Callithrix; Neurons/*physiology; Neurons/drug effects; Normal Distribution; Orientation*; Photic Stimulation; Visual Cortex/cytology; Visual Cortex/drug effects

Training

Description: The following citation demonstrates how to combine training and a nest box to reduce callitrichid stress during handling and sedation.

Results (1):

Farmerie, M. (2004). Designing a multifunctional callitrichid nest box to combine with operant conditioning to increase animal husbandry and decrease the potential for stress when chemical restraint is necessary. *Proceedings of the National Conference of the American Association of Zoo Keepers Inc*, 30, 177–181. Zoological Record.

Keywords: Callitrichidae: Behavioural techniques, Operant conditioning for husbandry purposes, use of multifunctional nest box; Care in captivity, meeting paper; Multifunctional nest box for operant conditioning protocols & stress reduction during handling; Sedation, Use of multifunctional nest box to reduce stress during handling

Other Nonhuman Primates



Baby and a parent squirrel monkeys. Courtesy Adobe Stock Photos.

Description: This section of the bibliography includes citation on the use of anesthesia and analgesia in other non-human primate species (both Old and New World monkeys) not included in the previous categories. These include:

- African green monkeys or vervets (*Chlorocebus aethiops*)
- Capuchin monkeys (Genera *Cebus* or *Sapajus*) which are a popular model for laboratory research.
- Howler monkeys (Genus *Alouatta*)
- Mangabeys (Genus *Cercocebus*)
- Owl monkeys (also known as night monkeys) (Genus *Aotus*)
- Patas monkey (*Erythrocebus patas*)
- Prosimians (Strepsirhini), a primate suborder, including true lemurs (Lemuridae family), lemurs (Genus *Lemur*), lorises (Lorisidae family), pottos (*Perodicticus potto*), galagos or bushbabies (*Otolemur garnettii*), and Verreaux's sifakas (*Propithecus verreauxi*).
- Spider monkeys (*Ateles geoffroyi*)
- Squirrel monkeys (Genus *Saimiri*)
- Tarsiers (Tarsiidae family)

- Titi monkeys (Genus *Callicebus*)

Anesthesia

Description: This section contains information on anesthesia protocols and monitoring of vital signs for non-human primates as described above. It also includes citations that describe anesthesia protocols for a specific type of surgery (fetal surgery, stroke model), for chemical restraint, or for imaging.

Results (66):

Achcar Capriglione, L. G., Garcia Soresini, G. C., Fuchs, T., Sant' Anna, N. T., D' Amico Fam, A. L., Pimpao, C. T., & Sarraff-Lopes, A. P. (2013). Electrocardiographic assessment of capuchin monkeys (*Sapajus apella*) under chemical contention with midazolam and propofol. *Semina-Ciencias Agrarias*, 34(6), 3801–3810. <https://doi.org/10.5433/1679-0359.2013v34n6Supl2p3801>

Keywords: Anesthesia; capuchin monkeys; electrocardiogram; midazolam; propofol; *Sapajus apella*

Alfonso, J., Lescano, J., Quevedo, M., & Fernández, V. (2020). Comparison of three reversible injectable chemical restraint protocols in Spix's Owl monkeys (*Aotus vociferans*) using ketamine, xylazine and midazolam. *Journal of Medical Primatology*, 49(3), 136–143. Scopus. <https://doi.org/10.1111/jmp.12462>

Keywords: *anaesthesia; *flumazenil; *hypotension; adult; America; analgesic agent; Analgesics; Analgesics/*pharmacology; anesthesia induction; anesthesia level; anesthetic recovery; animal experiment; Animal Health and Hygiene (General); Animal Physiology and Biochemistry (Excluding Nutrition); Animal Welfare; Aotidae; Aotidae/*physiology; Aotus; Aotus (Mammalia); Aotus vociferans; arterial pressure; Article; Biological Resources (Animal); breathing rate; cardiopulmonary insufficiency; Cebidae; comparative effectiveness; comparative study; controlled study; Cross-Over Studies; crossover procedure; dormixyl 2; double blind procedure; Double-Blind Method; Drug Combinations; flumazenil; hemoglobin; hypotension; hypothermia; Immobilization; Immobilization/*veterinary; Injections, Intramuscular; Injections, Intramuscular/veterinary; intramuscular drug administration; Ketamine; Ketamine/*pharmacology; midanex; Midazolam; Midazolam/*pharmacology; muscle relaxation; nonhuman; oxygen saturation; physical parameters; physiological process; physiology; Physiology and Biochemistry (Wild Animals); priority journal; protocol compliance; pulse rate; quality control; rectal temperature; veterinary medicine; Veterinary Pharmacology and Anaesthesiology; *wildlife; Xylazine; Xylazine/*pharmacology; yohimbine

Barros Monteiro, F. O., Barros Monteiro, M. V., Scofield, A., Whiteman, C. W., Alfieri, A. F., & Alfieri, A. A. (2015). Hematological and biochemistry evaluation in capuchin monkeys from the illegal captivity. *Acta Veterinaria Brasilica*, 9(4), 92–97.

Keywords: Anesthesia; animals and man; biochemistry; biometrics; blood; Brazil; capuchin monkeys; circulatory system; commercial activities; disturbance by man; illegal capture land zones; neotropical region; reproduction; Sapajus; serum biochemistry; South America; trade in animals

Boyett-Anderson, J. M., Lyons, D. M., Schmitt, J. E., Buckmaster, C., & Menon, V. (2001). FMRI of olfactory processing in unconscious squirrel monkeys (*Saimiri sciureus*). *Society for Neuroscience Abstracts*, 27(2), 1926–1926.

Keywords: Anesthesia; atropine; functional magnetic resonance imaging (fMRI); ketamine; lateral temporal cortex; meeting abstract; nervous system; odor-related activation; olfactory processing; piriform cortex; prefrontal cortex; *Saimiri sciureus*; squirrel monkeys; xylazine

Braun Chagas, J. A., Oleskovicz, N., de Moraes, A. N., Flores, F. N., Correa, A. L., Souza Junior, J. C., Soares, A. V., & Costa, A. (2010). S(+) ketamine and midazolam association by the conventional method of calculation and allometric extrapolation in red howler monkeys (*Alouatta guariba clamitans*)—Clinical and cardiopulmonary response. *Ciencia Rural*, 40(1), 109–114. <https://doi.org/10.1590/S0103-84782010000100018>

Keywords: Allometric extrapolation; *Alouatta guariba clamitans*; anesthesia; capillary refill time; cardiorespiratory depression; caudal reflex; Cebidae; clinical response; heart rate; interdigital pinch; ketamine (S plus); midazolam; muscle relaxation; non invasive systolic arterial pressure; pedal reflex; recovery time; rectal temperature; recumbency time; red howler monkeys; respiratory rate

Caramalac, S. M., de Souza, A. F., Caramalac, S. M., de Albuquerque, V. B., da Silva Azuaga, L. B., & Frazilio, F. de O. (2022). Comparative study between ketamine-S-dexmedetomidine and ketamine-S-midazolammethadone in the anesthesia of capuchin monkeys (*Sapajus apella*). *Ciencia Rural*, 52(4). <https://doi.org/10.1590/0103-8478cr20200823>

Keywords: Alpha-2 adrenergic agonist; anesthesia; arterial blood gas; benzodiazepine; capuchin monkeys; Cebidae; diastolic arterial pressure; heart rate; immobilization; ketamine-S-dexmedetomidine; ketamine-S-midazolammethadone; mean blood pressure; opioid; respiratory rate; *Sapajus apella*

Chagas, J. A. B., Santos, L. C. P., Silva Filho, J. R., & Bondan, C. (2018). Anaesthetic and cardiorespiratory effects of ketamine plus dexmedetomidine for chemical restraint in black capuchin monkeys (*Sapajus nigratus*). *New Zealand Veterinary Journal*, 66(2), 79–84. Scopus. <https://doi.org/10.1080/00480169.2017.1403975>

Keywords: analgesia; anesthesia; anesthetic agent; Anesthetics, Dissociative; Anesthetics, Dissociative/*pharmacology; Animal Physiology and Biochemistry (Excluding Nutrition); arrhythmia; body temperature; Brazil; breathing rate; Capuchin monkey; Cebidae; Cebus; chemical restraint; clinical examination; Dexmedetomidine; Dexmedetomidine/*pharmacology; dose response; Dose-Response Relationship; Drug; Drug Combinations; drug effect;

electrocardiography; Heart Rate; Heart Rate/*drug effects; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/*pharmacology; Ketamine; Ketamine/*pharmacology; Monitoring, Physiologic; Monitoring, Physiologic/veterinary; muscles; physiologic monitoring; Random Allocation; randomization; Respiratory Rate; Respiratory Rate/*drug effects; Sapajus; sedation; systolic blood pressure; veterinary; Veterinary Pharmacology and Anaesthesiology

Chaves, R. H. F., de Souza, N. F., Imbeloni, A. A., Neves, A. C. S., Teixeira, R. K. C., & dos Santos, C. C. (2015). Evaluation of blood pressure in feline night monkeys (*Aotus azarae infulatus*) under different restraint protocols. *Journal of Medical Primatology*, 44(6), 349–354. Scopus. <https://doi.org/10.1111/jmp.12183>

Keywords: adult; agitation; Anesthesia; anesthesiological procedure; anesthetic agent; Anesthetics; Anesthetics/*pharmacology; animal experiment; Animal Welfare; Aotidae; Aotidae/*physiology; Aotus; Aotus (Mammalia); Aotus azarae; Aotus azarae infulatus; Article; Blood Pressure; blood pressure measurement; Blood Pressure/*drug effects/*physiology; Cebidae; clinical protocol; controlled study; diastolic blood pressure; drug effects; exercise; immobilization stress; intermethod comparison; isoflurane; ketamine; Laboratory Animal Science; male; mean arterial pressure; midazolam; nonhuman; normal value; Oscillometric method; Physical restraint; physiology; priority journal; procedures; Restraint, Physical; Restraint, Physical/methods/*veterinary; systolic blood pressure; tiletamine plus zolazepam; veterinary; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

Chaves, R. H. F., Souza, N. F., Muniz, J. A. P. C., Imbeloni, A. A., Neves, A. C. S., & Teixeira, R. K. C. (2017). Influence of different restraint protocols for the electrocardiogram values of feline night monkeys (*Aotus azarae infulatus*). *Pesquisa Veterinaria Brasileira*, 37(2), 156–159. Scopus. <https://doi.org/10.1590/S0100-736X2017000200010>

Keywords: Adult; animal experiment; anesthetic protocols; Aotus; Article; controlled study; electrocardiography; heart rate; heart rhythm; isoflurane; ketamine; male; midazolam; nonhuman; stress; tiletamine plus zolazepam

Chen, L. M., Friedman, R. M., Ramsden, B. M., LaMotte, R. H., & Roe, A. W. (2001). Fine-scale organization of SI (area 3b) in the squirrel monkey revealed with intrinsic optical imaging. *Journal of Neurophysiology*, 86(6), 3011–3029. Scopus. <https://doi.org/10.1152/jn.2001.86.6.3011>

Keywords: Anesthesia; Anesthetics, Inhalation; animal experiment; article; brain cortex; brain depth stimulation; Brain Mapping*; controlled study; Diagnostic Imaging; Electrophysiology; Fingers/innervation; Fingers/physiology; imaging; Isoflurane; mechanoreceptor; nerve cell plasticity; nonhuman; optics; Physical Stimulation; Pressure; pressure sense; priority journal; Saimiri; slow adapting receptor; somatosensory cortex; Somatosensory Cortex/*anatomy & histology/cytology/*physiology; squirrel monkey; Thiopental; vibration

Chen, L. M., Friedman, R. M., & Roe, A. W. (2005). Optical imaging of SI topography in anesthetized and awake squirrel monkeys. *Journal of Neuroscience*, 25(33), 7648–7659. Scopus. <https://doi.org/10.1523/JNEUROSCI.1990-05.2005>

Keywords: Amplitude modulation; Anesthesia; Anesthesia*/methods; animal cell; animal experiment; animal tissue; article; Awake; brain electrophysiology; Brain Mapping; Brain Mapping/*methods; controlled study; diagnostic imaging; Electric Stimulation; Electric Stimulation/methods; electrostimulation; Male; membrane structure; nonhuman; Optical imaging; Optics; Optics and Photonics*; priority journal; Saimiri; signal noise ratio; skin stimulation; Somatosensory Cortex; Somatosensory Cortex/*physiology; squirrel monkey; tactile discrimination; Topography; Touch; Touch/physiology; Vibration; Wakefulness; Wakefulness/*physiology

Chen, L. M., Friedman, R. M., & Roe, A. W. (2009). Optical imaging of digit topography in individual awake and anesthetized squirrel monkeys. *Experimental Brain Research*, 196(3), 393–401. Scopus. <https://doi.org/10.1007/s00221-009-1861-y>

Keywords: *Anesthesia; *Brain Mapping; alertness; Anesthesia*; animal experiment; article; behavior; Brain Mapping*; controlled study; Cortical magnification; Diagnostic Imaging; Diagnostic Imaging/*methods; finger; Functional imaging; Hand; Image Processing, Computer-Assisted; Image Processing, Computer-Assisted/methods; Male; nonhuman; Optics and Photonics; Optics and Photonics/methods; Physical Stimulation; Physical Stimulation/methods; priority journal; Saimiri; Saimiri/*physiology; signal transduction; Somatosensory; somatosensory cortex; somatosensory stimulation; squirrel monkey; topography; Wakefulness; Wakefulness/*physiology

Cordeiro, J. F., Araújo, A. L., Tanikawa, A., Santos, J. R. S., Bragagnoli, A. L., Nóbrega Neto, P. I., & Menezes, D. J. A. (2015). Epidural anesthesia in capuchin monkeys (*Sapajus libidinosus*). *Journal of Medical Primatology*, 44(1), 12–17. Scopus. <https://doi.org/10.1111/jmp.12151>

Keywords: adult; anesthesia; Anesthesia, Epidural; Anesthesia, Epidural/*methods; anesthetic recovery; Anesthetics, Local; Anesthetics, Local/*adverse effects/metabolism; animal experiment; Article; blood pressure; breathing rate; Cebinae; Cebinae/*metabolism; Cebus; dermis; epidural anesthesia; epidural space; heart rate; hemoglobin; Lidocaine; Lidocaine/*adverse effects/metabolism; local anesthesia; local anesthetic agent; metabolism; muscle relaxation; nociception; nonhuman; normal value; oxygen saturation; pelvic girdle; perineum; priority journal; procedures; propofol; rectum temperature; Regional block; Sapajus libidinosus; skin sensation; skin sensitivity; tail; tiletamine plus zolazepam; Veterinary Pharmacology and Anaesthesiology

Cordeiro, J. F., Santos, J. R. S., Dantas, S. B. A., Fonseca, S. S., Dias, R. F. F., Medeiros, G. X., Neto, P. I. N., & Menezes, D. J. A. (2014). Anatomy of the medullary conus applied to the epidural route of administration of drugs in capuchin monkeys (*Sapajus libidinosus*). *Pesquisa Veterinaria Brasileira*, 34, 29–33. Scopus. <https://doi.org/10.1590/S0100-736X2014001300006>

Keywords: Anesthesiological procedure; animal experiment; anthropometry; Article; body height; capuchin monkeys; Cebus; cerebrospinal fluid; conus medullaris; dura mater; epidural drug administration; lumbar vertebra; myelography; neuroanatomy; nonhuman; sacral vertebra; topography

Costa e Silva, D. R., Ribeiro, C. F. dos S. de C., Soares, P. C., Lima, A. R. de, & Branco, É. (2019). Topography of the medullary cone of the feline night monkey: Clinical implications in epidural anesthesia. *Revista Brasileira de Ciência Veterinária*, 26(1), 17–20. CAB Abstracts. <https://doi.org/10.4322/rbcv.2019.004>

Keywords: America; Aotus (Mammalia); Aotus azarae; Brazil; Cebidae; Community of Portuguese Language Countries; conduction anesthesia; Developing Countries; epidural anaesthesia; Latin America; South America; Threshold Countries; Veterinary Pharmacology and Anaesthesiology

Crofoot, M. C., Norton, T. M., Lessnau, R. G., Viner, T. C., Chen, T. C., Mazzaro, L. M., & Yabsley, M. J. (2009). Field anesthesia and health assessment of free-ranging *Cebus capucinus* in Panama. *International Journal of Primatology*, 30(1), 125–141. Scopus. <https://doi.org/10.1007/s10764-009-9333-6>

Keywords: Anesthetic; assessment method; Barro Colorado Island; captive population; Cebidae; Cebus; Cebus capucinus; Central America; Chemical immobilization; Cytomegalovirus; Darting; Disease; field method; Gatun Lake; health status; health survey; Hematology; Herpesviridae; Panama [Central America]; Saimiriine herpesvirus 1; Serology; Telazol

de Almeida Balthazar, D., dos Santos Vasconcelos, M., Magalhães, B. S. N., Kagohara, A., Troccoli, F., Galhães, A., dos Santos Filho, M., & Paiva, J. P. (2020). Determination of echocardiographic parameters in spider monkey (*Ateles spp.*) collectives in captivity sedated with ketamine and midazolam. *Revista Brasileira de Medicina Veterinária*, 42(1). Scopus. <https://doi.org/10.29374/2527-2179.BJVM107120>

Keywords: abdominal mass; adult; America; anesthetic recovery; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); aortic diameter; arterial wall thickness; Article; Ateles; biochemical analysis; blood cell count; body weight; Brazil; cardiovascular disease; cardiovascular parameters; Cebidae; Chemical restraint; Community of Portuguese Language Countries; congestive cardiomyopathy; Developing Countries; Echocardiogram; echocardiography; electrocardiography; heart ejection fraction; heart left ventricle enddiastolic diameter; heart left ventricle enddiastolic volume; heart left ventricle endsystolic diameter; heart left ventricle endsystolic volume; heart output; heart rate; heart volume; human; ketamine; Latin America; left atrial diameter; left ventricular fractional shortening; midazolam; nonhuman; Parameters of normality; posterior wall curving fraction; sedation; single drug dose; South America; Spider monkey; thorax radiography; Threshold Countries; urinalysis; young adult

de La Salles, A. Y. F., Andrade, J. K., Lemos, K. K. A., Carreiro, A. D. N., de Souza, J. G., Costa, T. S. F., Reinaldo, M. P. O. S., de Souza, A. P., & de Menezes, D. J. A. (2019).

Electrocardiographic parameters of *Sapajus libidinosus* (SPIX, 1823) after chemical immobilization with tiletamine-zolazepam. *Journal of Medical Primatology*, 48(3), 154–160. Scopus. <https://doi.org/10.1111/jmp.12403>

Keywords: Adult; anesthesia; anesthetic agent; Anesthetics; animal experiment; Article; Cebinae; controlled study; Drug Combinations; electrical axis; electrocardiogram; Electrocardiography; heart rate; heart rhythm; Immobilization; Male; nonhuman; P wave; PR interval; priority journal; procedures; QRS complex; QT interval; R wave; Reference Values; Sapajus; Sapajus libidinosus; sedation; sinus rhythm; T wave; tachycardia; Tiletamine; tiletamine plus zolazepam; tiletamine, zolazepam drug combination; veterinary medicine; Zolazepam

de La Salles, A. Y. F., de Andrade, J. K., Cordeiro, J. F., Carreiro, A. D. N., Rodrigues Falcão, B. M., de Brito Freitas, K., & Menezes, D. J. A. (2021). Assessment of the technique of the anesthetic block of the Brachial Plexus by Supraclavicular approach in *Sapajus libidinosus* (SPIX, 1823). *Journal of Medical Primatology*, 50(1), 29–35. Scopus. <https://doi.org/10.1111/jmp.12492>

Keywords: adult; analgesia*; anesthesia*; Anesthetics, Local; Anesthetics, Local/*administration & dosage; animal experiment; animal model; Article; Biological Resources (Animal); Brachial Plexus; brachial plexus anesthesia; Brachial Plexus Block; Brachial Plexus Block/*methods; Brachial Plexus/*drug effects; Cebinae*; clinical effectiveness; controlled study; drug effect; *Electric Conductivity; Electric Stimulation Therapy/*methods; electrostimulation; hypnosis; Lidocaine; Lidocaine/*administration & dosage; limb movement; local anesthetic agent; Macaca fascicularis; Macaca mulatta; Male; Models, Animal; Nerve Block/*methods; Neural Conduction/*physiology; nociception; nonhuman; Peripheral Nerves/pathology/*physiopathology; Peripheral Nervous System Diseases/physiopathology/*therapy; Physiology and Biochemistry (Wild Animals); primate*; procedures; propofol; *regional block; regional block*; Sapajus; Sapajus libidinosus; sedation; skin sensitivity; thoracic limb; threatened species; tiletamine plus zolazepam; Veterinary Pharmacology and Anaesthesiology

De Souza, A. B., Rodrigues, R. P. S., Pessoa, G. T., Da Silva, A. B. S., Moura, L. S., Sousa, F. C. A., Da Silva, E. G., Diniz, A. N., Barbosa, M. A. P. S., Araújo, J. R., Santos, I. C., Guerra, P. C., Alves, J. J. R. P., Macedo, K. V., Diniz, B. L. M., Marques, D. C., & Alves, F. R. (2018). Standard Electrocardiographic Data from Capuchin Monkeys (*Cebus apella*, Linnaeus, 1758). *Journal of the American Association for Laboratory Animal Science*, 57(1), 13–17. Scopus.

Keywords: Age; animal experiment; Animal Health and Hygiene (General); Article; Cebidae; Cebus; Cebus apella; Diagnosis of Animal Diseases; Electrocardiography; Heart; ketamine; Laboratory Animal Science; 00; 86; midazolam; nonhuman; P wave; physiology; PR interval; QRS complex; QRS interval; QT interval; R wave amplitude; Reference Values; Sapajus apella; sex difference; sinus rhythm; species difference; Species Specificity; ST segment depression; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

Disarz, P., Adams, P. P., de Carvalho, A. L., Wu, S., de Lima, C. L., & Fukushima, F. B. (2019). General Anesthesia in Sapajus nigritus (black capuchin). *Acta Scientiae Veterinariae*, 47. <https://doi.org/10.22456/1679-9216.90023>

Keywords: Anesthesia; anesthesia induction; black capuchin monkey; body temperature; Cebidae; chemical restraint; dexmedetomidine; isoflurane; ketamine; lidocaine; physiologic alteration; propofol; Sapajus nigritus; systolic blood pressure; vasectomy

Dutton, C. J., Junge, R. E., & Louis, E. E. (2003). Biomedical evaluation of free-ranging ring-tailed lemurs (*Lemur catta*) in Tsimanampetsotsa Strict Nature Reserve, Madagascar. *Journal of Zoo and Wildlife Medicine*, 34(1), 16–24. Scopus. [https://doi.org/10.1638/1042-7260\(2003\)34\[0016:BEOFRL\]2.0.CO;2](https://doi.org/10.1638/1042-7260(2003)34[0016:BEOFRL]2.0.CO;2)

Keywords: Acari; ACP Countries; Africa; Africa South of Sahara; anesthesia; animal disease; animal parasitosis; Animal Physiology and Biochemistry (Excluding Nutrition); Animals, Wild; Antibodies, Protozoan; Antibodies, Viral; Apicomplexa; Arachnida; arthropods; article; Bacteria; Bacteria (microorganisms); bacterium; blood; blood analysis; Blood Chemical Analysis; blood examination; Communicable Diseases; Developing Countries; Disease; East Africa; Eucoccidiorida; Feces; Francophone Africa; Health; Hematologic Tests; immunology; Indian Ocean Islands; infestation; invertebrates; isolation and purification; Laelapidae; Least Developed Countries; Lemur; Lemur catta; Lemuridae; Madagascar; Masoala; microbiology; Mite Infestations; mites; Nematoda; nematode; Nutrition; parasitology; Pathogens, Parasites and Infectious Diseases (Wild Animals); Physiology and Biochemistry (Wild Animals); prosimian; Protozoa; Protozoan, Helminth, Mollusc and Arthropod Parasites of Animals; protozoon antibody; Red ruffed lemur; Reference Values; Ring-tailed lemur; Sarcocystidae; Strepsirhini; tiletamine; Toxoplasma; Toxoplasmosis, Animal; Varecia; Varecia rubra; Varecia variegata; virus antibody; wild animal; zolazepam

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Vasectomy; Vasectomy/instrumentation/*veterinary; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

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Flaiban, K. K. M. D. C., Spohr, K. A. H., Malanski, L. D. S., Svoboda, W. K., Shiozawa, M. M., Hilst, C. L. S., Aguiar, L. M., Ludwig, G., Passos, F. C., Navarro, I. T., Balarin, M. R. S., & Lisbôa, J. A. N. (2008). Hematologic values of free-ranging *Cebus cay* and *Cebus nigrinus* in Southern Brazil. *International Journal of Primatology*, 29(5), 1375–1382. Scopus. <https://doi.org/10.1007/s10764-008-9290-5>

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Keywords: Adolescent; Anesthesia; anesthesia level; Anesthesia Recovery Period; Anesthesia/*methods/veterinary; Anesthetics, Dissociative; Anesthetics, Dissociative/*administration & dosage; Animal Physiology and Biochemistry (Excluding Nutrition); Animal Surgery and Non-drug Therapy; Aotidae; Aotidae/*physiology; Aotus; Aotus (Mammalia); Aotus infulatus; arterial gas; arterial pressure; article; Blood Cell Count; Blood Cell Count/veterinary; Blood Chemical Analysis; Blood Chemical Analysis/veterinary; breathing rate; Cebidae; continuous infusion; controlled study; Drug Combinations; hanging; heart rate; infusion rate; Laboratory Animal Science; Lactate; lactic acid; mobilization; nonhuman; oxygen saturation; primate; priority journal; Propofol; Propofol/administration & dosage/*pharmacology; Recovery; rectum temperature; recumbency; Tiletamine; Tiletamine/*administration & dosage; tiletamine plus zolazepam; Total intravenous anesthesia; Veterinary Pharmacology and Anaesthesiology; Zolazepam; Zolazepam/*administration & dosage

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Keywords: alfaxalone; anaesthesia; Anesthesia, Intravenous; Anesthesia, Intravenous/*veterinary; anesthetic agent; Anesthetics; *Anesthetics/administration & dosage; Anesthetics, Combined; Anesthetics, Combined/*administration & dosage; animal model; Animal Reproduction and Embryology; Animal Science (General); Article; breathing rate; Butorphanol; Butorphanol/*administration & dosage; Cleaning, Grading, Handling, Storage and Transport Equipment; Deep Sedation; Deep Sedation/methods/*veterinary; Dexmedetomidine; Dexmedetomidine/*administration & dosage; endotracheal intubation; Farm and Horticultural Structures; hypersalivation; immobilization; Injections, Intramuscular; Injections, Intramuscular/veterinary; intramuscular drug administration; intravenous anesthesia; Intubation, Intratracheal; Intubation, Intratracheal/veterinary; Lemur catta; Lemur/*surgery; Lemuridae; lemurs; Male; Midazolam; Midazolam/*administration & dosage; nonhuman; observational study; Orchiectomy; Orchiectomy/veterinary; Pregnanediones; Pregnanediones*/administration & dosage; procedures; respiration depression; scoring system; surgery; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

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Keywords: Papio anubis: Trapping; Tagging, Global positioning system collaring; Sedation, Immobilization; Tracking techniques; Injuries; Mortality, Mortality rate; Kenya; Primates, Cercopithecidae; Systematics: Cercopithecidae, Chlorocebus pygerythrus; Cercopithecidae

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Keywords: Analgesics, Opioid; Anesthesia; anesthetic agent; Anesthetics, Combined; Anesthetics, Dissociative; Anesthetics, Intravenous; animal disease; Animal Physiology and Biochemistry (Excluding Nutrition); article; Blood Gas Analysis; Blood Pressure; Body Temperature; breathing; Butorphanol; Cercopithecidae; comparative study; drug effect; *Erythrocebus*; *Erythrocebus patas*; Heart Rate; hypnotic sedative agent; Hypnotics and Sedatives; intravenous anesthetic agent; Ketamine; Medetomidine; Midazolam; narcotic analgesic agent; Oximetry; Patas monkeys; physiology; Random Allocation; randomization; Respiration; time; Time Factors; Veterinary Pharmacology and Anaesthesiology; Zoo Animals

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Keywords: Analgesics, Opioid; Analgesics, Opioid/administration & dosage/pharmacology; anesthesia; anesthetic agent; Anesthetics; Anesthetics/administration & dosage/*pharmacology; Animal Nutrition (General); Animals, Wild; article; Butorphanol; Butorphanol/administration & dosage/*pharmacology; drug administration; Drug Administration Schedule; Drug Combinations; Drug Therapy, Combination; Feed Additives; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/administration & dosage/pharmacology; *Lemur; *Lemur catta*; Lemuridae; lemurs; Medetomidine; Medetomidine/administration & dosage/*pharmacology; narcotic analgesic agent; Ring-tailed lemur; Telazol; Tiletamine; tiletamine, zolazepam drug combination; Tiletamine/administration & dosage/*pharmacology; Veterinary Pharmacology and Anaesthesiology; wild animal; Zolazepam; Zolazepam/administration & dosage/*pharmacology

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narcotic analgesic agent; Ring-tailed lemur; Techniques and Methodology; Telazol; Veterinary Pharmacology and Anaesthesiology; wild animal

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Keywords: America; anesthetic agent; Anesthetics, Dissociative; Anesthetics, Dissociative/*pharmacology; animal disease; *Animals, Zoo; Animals, Zoo*; article; Brazil; cardiology; Cebidae; Cebus; Cebus/*physiology; Cebus apella; Community of Portuguese Language Countries; Developing Countries; Electrocardiography; Electrocardiography/*veterinary; Hominidae; Homo; Human Physiology and Biochemistry; Immobilization; Immobilization/*veterinary; Immobilization/methods; Immobilization/methods/*veterinary; Ketamine; Ketamine/*pharmacology; Latin America; man; methodology; Non-communicable Human Diseases and Injuries; Non-drug Therapy and Prophylaxis of Humans; physiology; South America; species difference; Species Specificity; Threshold Countries; Tufted capuchin; Veterinary Pharmacology and Anaesthesiology; Zoo Animals

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Keywords: America; Anatomy; anesthesia; Anesthesia, Epidural; anesthetics; Cebidae; cerebrum; Community of Portuguese Language Countries; Conus medullaris; Developing Countries; Epidural anaesthesia; Latin America; Physiology and Biochemistry (Wild Animals); Saimiri; Saimiri/*anatomy & histology; Saimiri sciureus; South America; Spinal Cord/*anatomy & histology; Threshold Countries; vertebrates; Veterinary Pharmacology and Anaesthesiology

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Keywords: Cebidae; conduction anesthesia; epidural anaesthesia; Sapajus apella; Veterinary Pharmacology and Anaesthesiology

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Keywords: *Cebus apella*; Sedation, Field anaesthesia, Evaluation of different anaesthetics; Madagascar, Beza Mahafaly Special Reserve; Treatment techniques, Pain management using oxymorphone, Pharmacokinetics; Sedation, Epidural anaesthesia, conus medullaris topography; Vertebral column, Vertebrae architecture; Sedation, Modified immobilization technique; Madagascar, Beza Mahafaly Special Reserve; Electrophysiological techniques, Electrocardiography, in captivity; Sedation, Ketamine anaesthesia; Heart beat; Brazil, Sao Paulo Zoo; Physical restraining techniques, Capture & restraint, first report, adult; Sedation, Anaesthesia; Physiological condition, Acute stress; Hormones, Adrenal & gonadal hormones; Handling techniques; Physical restraining techniques; Sedation, Anaesthetic drugs & dosages; Sedation, Epidural anaesthesia, adult; Physiological condition, Physiological parameters; Physical restraining techniques; Sedation, Anaesthetic drugs; Physiological condition, Stress; Haemodynamics, Blood pressure; Sedation, Anaesthesia; Eye, Ophthalmic parameters; Haemodynamics, Hemodynamic parameters; Sedation, Anaesthesia; Sedation, Anaesthetic drug combinations, Anaesthetic & cardiorespiratory effects; Haemodynamics, Blood pressure, Anaesthetic drug combinations effects; Heart beat; Respiratory function; Sedation, Medetomidine based anaesthetic protocols, Efficiency evaluation & cardiorespiratory effects; Circulatory system, Functions, medetomidine based anaesthetic protocols effects; Respiratory function; Trapping, Field capture & marking methods evaluation; Marking techniques; Sedation; Argentina, Formosa, east; Handling techniques, Chemical restraint, Physiological manifestations of associated stress in free-ranging juvenile & adult males; Trapping, Capture, Associated stress, physiological manifestations in free-ranging juveniles & adults; Sedation, Anaesthesia, Responses to restraint-associated stress in free-ranging juvenile & adult males; Weight, Adrenal gland weight, Responses to capture & restraint-associated stress in free-ranging juvenile & adult males; Physiological condition, Stress response, Capture & restraint-associated, physiological manifestations in free-ranging juvenile & adult males; Stomach, Stomach mucosa; Adrenal gland; Hormones, Serum cortisol & prolactin levels; Diseases and disorders, Stomach mucosal lesions; Kenya, Kibwezi, Physiological manifestations of capture & restraint-associated stress in wild juvenile & adult males; Handling techniques, Review; Physical restraining techniques; Sedation, Anaesthesia; Mammalian hosts, *Cebus capucinus*, Prevalence, host health assessment, intestinal parasitic taxa; Panama, Barro Colorado Island; Sonographic techniques, Ultrasonography; Sedation, Anaesthesia; Haemodynamics, Blood flow rate; Kidney, Anatomy & echographic measurements; Sex differences; Sedation, New balanced anaesthetic technique development, adult, female; Haemodynamics, Blood pressure; Heart beat, Pulse rate; Ventilation rate, Breathing rate; Sedation, Chemical restraint, Ketamine & dexmedetomidine; Body temperature, Rectal temperature; Haemodynamics, Systolic arterial pressure; Heart beat, Heart rate; Ventilation rate, Respiratory rate; Sedation, Chemical restraint; Heart beat, Electrocardiography; Sedation, Immobilization, adult male; Heart beat, Electrocardiographic parameters; Sedation, Anaesthesia drug effects, Comparative study; Oxygen consumption, Respiratory rate; Body temperature, Rectal temperature; Haemodynamics, Arterial blood

pressure; Heart beat, Pulse rate; Super Taxa: Animalia, Chordata, Vertebrata, Mammalia, Primates, Cebidae; Systematics: Cebidae, Cebus apella

Miller, D. S., Sauter, M. L., Hunter-Ishikawa, M., Fish, K., Culbertson, H., Cuozzo, F. P., Campbell, T. W., Andrews, G. A., Chavey, P. S., Nachreiner, R., Rumbeiha, W., Stacewicz-Sapuntzakis, M., & Lappin, M. R. (2007). Biomedical evaluation of free-ranging ring-tailed lemurs (*Lemur catta*) in three habitats at the Beza Mahafaly Special Reserve, Madagascar. *Journal of Zoo and Wildlife Medicine*, 38(2), 201–216. Scopus. [https://doi.org/10.1638/1042-7260\(2007\)038\[0201:BEOFRL\]2.0.CO;2](https://doi.org/10.1638/1042-7260(2007)038[0201:BEOFRL]2.0.CO;2)

Keywords: Anaplasma phagocytophilum; animal disease; animal parasitosis; Animals, Wild; article; Bacteria; bacterium; Bartonella; blood analysis; Blood Chemical Analysis; blood examination; Conservation of Natural Resources; Ehrlichia; environmental protection; Free-ranging; Gender; Habitat; Health; Hematologic Tests; isolation and purification; Lemur; Lemur catta; Lemuridae; Madagascar; microbiology; Neorickettsia risticii; Nutritional Status; Parasitic Diseases, Animal; parasitology; Physical Examination; physiology; prosimian; reference value; Reference Values; Ring-tailed lemur; sex difference; Sex Factors; Strepsirhini; Toxoplasma gondii; wild animal

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Keywords: anesthesia; anesthetics; Animal Physiology and Biochemistry (Excluding Nutrition); Article; Body Temperature; Cercopithecidae; Chlorocebus; Chlorocebus aethiops; Chlorocebus pygerythrus; clinical effectiveness; cold; Cold Temperature; correlational study; hypothermia; Male; measurement accuracy; microchip analysis; Microchip Analytical Procedures; nonhuman; physiology; priority journal; procedures; subcutaneous thermal sensor microchip; Techniques

and Methodology; temperature measurement; Thermometry; transponder; validation study; verification; veterinary medicine; Veterinary Pharmacology and Anaesthesiology

Ospina S., P. A., Li E., O., Tribeno H., D., & Cahua U., J. (2009). Haematological values in tufted capuchin (*Cebus apella*) reared in captivity. *Revista de Investigaciones Veterinarias Del Peru*, 20(1), 47–52.

Keywords: Anesthesia; blood sampling; *Cebus apella*; ketamine; tufted capuchin monkey; xylazine

Pinheiro, L. L., Lima, A. R., Muniz, J. A. P. C., Imbeloni, A., Fioreto, E. T., Fontes, R. F., Cabral, R., & Branco, E. (2012). Anatomy and morphometric aspects of the trachea of *Saimiri sciureus* Linnaeus, 1758: Knowledge for emergency procedures. *Anais Da Academia Brasileira de Ciencias*, 84(4), 973–977. Scopus. <https://doi.org/10.1590/S0001-37652012000400012>

Keywords: article; Emergencies; emergency; Emergency procedure; endotracheal intubation; histology; Intubation, Intratracheal; Laryngeal Masks; Morphology; Respiratory system; *Saimiri*; *Saimiri sciureus*; squirrel monkey; Trachea; Tracheostomy

Raposo, A. C. S., Ofri, R., Schaffer, D. P. H., Gomes Júnior, D. C., Libório, F. A., Martins Filho, E. F., & Oriá, A. P. (2015). Evaluation of ophthalmic and hemodynamic parameters in capuchin monkeys (*Sapajus* sp.) submitted to dissociative anesthetic protocols. *Journal of Medical Primatology*, 44(6), 381–389. Scopus. <https://doi.org/10.1111/jmp.12200>

Keywords: adult; Anesthesia; Anesthesia, General; Anesthesia, General/veterinary; Anesthesia/*veterinary; anesthetic agent; Anesthetics, Combined; Anesthetics, Combined/pharmacology; Anesthetics, Dissociative; Anesthetics, Dissociative/*pharmacology; animal experiment; arterial pressure; Article; Blood Pressure; Blood Pressure/*drug effects; Body Temperature; breathing; breathing rate; Cebidae; *Cebus*; *Cebus*/*physiology; controlled study; Dexmedetomidine; digital reflex; drug effects; eyeball; eyeball positioning; eyelid reflex; Female; general anesthesia; Heart Rate; Heart Rate/drug effects; hemodynamic parameters; Intraocular pressure; Intraocular Pressure/*drug effects; Ketamine; Laboratory Animal Science; lacrimal fluid; Lacrimal production; lacrimation; Midazolam; muscle relaxation; nonhuman; oxygen saturation; physiology; priority journal; pupil reflex; randomized controlled trial; rectum temperature; reflex; Respiration; Respiration/drug effects; *Sapajus*; Tears; Tears/*drug effects; tiletamine plus zolazepam; Tiletamine-zolazepam; veterinary; Veterinary Pharmacology and Anaesthesiology; visual system parameters; Xylazine; young adult

Rocha, V. J., Aguiar, L. M., Ludwig, G., Hilst, C. L. S., Teixeira, G. M., Svoboda, W. K., Shiozawa, M. M., Malanski, L. S., Navarro, I. T., Mariño, J. H. F., & Passos, F. C. (2007). Techniques and trap models for capturing wild tufted capuchins. *International Journal of Primatology*, 28(1), 231–243. Scopus. <https://doi.org/10.1007/s10764-006-9108-2>

Keywords: Anesthesia; bait; Brazil; capture method; Capture of mammals; Cebidae; *Cebus*; chemical restraint; conservation management; *Eira barbara*; Londrina; Management; *Nasua*;

Nasua nasua; Parana; Pecari tajacu; Porto Rico; sex ratio; South America; species conservation; Telemaco Borba; trap (equipment); Traps; vocalization; wildlife management; Zoetel

Roe, A. W., Healy, F. L., Friedman, R. M., Heider, B., & Chen, L. M. (2002). Differences in si topography between anesthetized and awake squirrel monkey as revealed by optical imaging. *Society for Neuroscience Abstract Viewer and Itinerary Planner, 2002*, Abstract No. 651.3-Abstract No. 651.3.

Keywords: Aceprozamine; anesthesia; Cebidae; local anesthetic drug; nervous system; optical imaging; pentothal; squirrel monkey; sedative/hypnotic drug; somatosensory cortex; topography

**Sanz-Cabañes, H., Navarro-Serra, A., & Otero-Abad, B. (2015). Study of an anaesthetic protocol for vasectomies in vervet monkey (*Chlorocebus pygerythrus*). In *Proceedings of the International Conference on Diseases of Zoo and Wild Animals, May 13th-16th, 2015, Barcelona, Spain*. (C. A. Szentiks & A. Schumann, Eds.; p. 205). Leibniz Institute for Zoo and Wildlife Research; CAB Abstracts.
<https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20153288983&site=ehost-live>**

Keywords: Africa; Africa South of Sahara; Anglophone Africa; Cercopithecidae; Chlorocebus; Chlorocebus pygerythrus; Commonwealth of Nations; Developing Countries; Southern Africa; Threshold Countries; Veterinary Pharmacology and Anaesthesiology

Schäffer, D. P. H., de Araujo, N. L. L. C., Otero, A. R., Dórea Neto, F. D. A., Barbosa, V. F., Martins Filho, E. F., & Oriá, A. P. (2017). Cardiorespiratory effects of epidural anesthesia using lidocaine with morphine or dexmedetomidine in capuchin monkeys (*Sapajus* sp.) undergoing bilateral tubal ligation surgery, anesthetized with isoflurane. *Journal of Medical Primatology, 46*(6), 311–319. Scopus. <https://doi.org/10.1111/jmp.12304>

Keywords: * $\alpha 2$ agonist; adult; analgesic agent; Analgesics, Non-Narcotic; Analgesics, Non-Narcotic/*adverse effects; Analgesics, Non-Narcotic/administration & dosage; Analgesics, Non-Narcotic/administration & dosage/*adverse effects; Analgesics, Opioid; Analgesics, Opioid/*adverse effects; Analgesics, Opioid/administration & dosage; Analgesics, Opioid/administration & dosage/*adverse effects; Anesthesia, Epidural; Anesthesia, Epidural/adverse effects; Anesthetics, Inhalation; Anesthetics, Inhalation/administration & dosage; Anesthetics, Local; Anesthetics, Local/*adverse effects; Anesthetics, Local/administration & dosage; Anesthetics, Local/administration & dosage/*adverse effects; animal experiment; Animal Surgery and Non-drug Therapy; Article; Blood Pressure; Blood Pressure/drug effects; Body Temperature; Cebidae; Cebinae; Cebinae/*physiology; Cebinae/*physiology/surgery; Cebinae/surgery; Cebus; controlled study; Dexmedetomidine; Dexmedetomidine/*adverse effects; Dexmedetomidine/administration & dosage; Dexmedetomidine/administration & dosage/*adverse effects; drug effect; electrocardiogram; epidural anesthesia; Female; Heart Rate; Heart Rate/drug effects; heart rhythm; hypotension; inhalation anesthetic agent; isofluorano; Isoflurane; Isoflurane/administration & dosage; Laboratory Animal Science; Lidocaine; Lidocaine/*adverse effects; Lidocaine/administration & dosage; Lidocaine/administration & dosage/*adverse effects; local anesthesia*; local anesthetic

agent; Lumbosacral Region; Lumbosacral Region/surgery; Morphine; Morphine/*adverse effects; Morphine/administration & dosage; Morphine/administration & dosage/*adverse effects; narcotic analgesic agent; nonhuman; opioid*; oxygen saturation; physiology; primate*; priority journal; QT prolongation; Random Allocation; randomization; rectum temperature; regional block; regional block*; Sapajus; side effect; Sterilization, Tubal; surgery; uterine tube ligation; uterine tube sterilization; Veterinary Pharmacology and Anaesthesiology; $\alpha 2$ agonist; $\alpha 2$ agonist*

Spina, F., Brizzi, L., Spattini, G., Faiola, F., & Biretoni, F. (2019). Ultrasonographic appearance and measurement of abdominal structures in healthy Capuchin monkeys (*Sapajus* spp.). *Journal of Medical Primatology*, 48(3), 166–170. Scopus. <https://doi.org/10.1111/jmp.12402>

Keywords: Abdomen; abdominal viscera; adult; anatomy and histology; anesthesia; Animal Anatomy and Morphology; animal experiment; article; body components; Capuchin monkeys; Cebidae; Diagnosis of Animal Diseases; diagnostic imaging; echography; growth, development and aging; Laboratory Animal Science; morphology; nonhuman; physical examination; Reference Values; Sapajus; Sapajus apella; screening tests; sonographer; statistics; topography; Ultrasonography; ultrasound; veterinary medicine; wild animals

Spolti, P., de Moraes, A. N., Tamanho, R. B., Gehrcke, M. I., Souza Junior, J. C., & Oleskovicz, N. (2013). Effects of tiletamine/zolazepam or S(+) ketamine/midazolam/tramadol for chemical contention in red howler monkeys (*Alouatta guariba clamitans*). *Pesquisa Veterinaria Brasileira*, 33(2), 236–240. <https://doi.org/10.1590/S0100-736X2013000200016>

Keywords: Alouatta guariba clamitans; anesthesiology; Anesthetic association; anesthesia; bispectral index; capillary refill time; capture; heart rate; hemoglobin oxygen saturation; midazolam; neuropharmacology; red howler monkeys; respiratory rate; S(+) ketamine; systolic arterial pressure; tiletamine; tramadol; wild animal sedation; zolazepam

Springer, A., Razafimanantsoa, L., Fichtel, C., & Kappeler, P. M. (2015). Comparison of three short-term immobilization regimes in wild Verreaux's sifakas (*Propithecus verreauxi*): ketamine-xylazine, ketamine-xylazine-atropine, and tiletamine-zolazepam. *Journal of Zoo and Wildlife Medicine : Official Publication of the American Association of Zoo Veterinarians*, 46(3), 482–490. <https://doi.org/10.1638/2014-0154.1>

Keywords: Adjuvants, Anesthesia/administration & dosage/pharmacology; Anesthetics, Dissociative/administration & dosage/pharmacology; Anesthetics/administration & dosage/pharmacology; Animals, Wild; Atropine/administration & dosage/*pharmacology; Drug Combinations; Hypnotics and Sedatives/pharmacology; immobilization; Immobilization/*veterinary; ketamine; Ketamine/administration & dosage/*pharmacology; Propithecus verreauxi; tiletamine–zolazepam; *Strepsirhini; Tiletamine/administration & dosage/*pharmacology; Verreaux's sifaka; Xylazine/administration & dosage/*pharmacology; Zolazepam/administration & dosage/*pharmacology

Theriault, B. R., Reed, D. A., & Niekrasz, M. A. (2008). Reversible medetomidine/ketamine anesthesia in captive capuchin monkeys (*Cebus apella*). *Journal of Medical Primatology*, 37(SUPPL.1), 74–81. Scopus. <https://doi.org/10.1111/j.1600-0684.2007.00267.x>

Keywords: α 2-adrenergic receptor agonist; Anesthesia; Anesthesia/adverse effects/methods/*veterinary; anesthesiological techniques; Antisedan; atipamezole; Biomechanical Phenomena; Biomechanics; Cebidae; *Cebus; Cebus apella; combination chemotherapy; conference paper; controlled study; diet restriction; drug safety; food regurgitation; Imidazoles; Imidazoles/administration & dosage; Ketamine; Ketamine/*administration & dosage/adverse effects; Kinematics; Mastication; Mastication/physiology; Medetomidine; Medetomidine/*administration & dosage/adverse effects; monotherapy; N-methyl-D-aspartate; nausea; nonhuman; priority journal; reproducibility; Restraint, Physical; Restraint, Physical/veterinary; sedation; unclassified drug; vetaket; vomiting

Williams, C. V., Glenn, K. M., Horne, W. A., Baer, C. K., & Willette, M. M. (2001). Comparison of the anesthetic and cardiorespiratory effects of medetomidine-ketamine, medetomidine-butorphanol-ketamine, and medetomidine-butorphanol-midazolam in ring-tailed lemurs (*Lemur catta*). In *Proceedings American Association of Zoo Veterinarians American Association of Wildlife Veterinarians Association of Reptilian and Amphibian Veterinarians National Association of Zoo and Wildlife Veterinarians Joint Conference Orlando, Florida September 18-23, 2001*. (ZOOREC:ZOOR13800015019; pp. 165-168).

Keywords: Anaesthetic & cardiorespiratory effects; anaesthetic drug combinations; butorphanol; haemodynamics; heart beat; ketamine; Lemur catta; medetomidine; meeting paper; midazolam; respiratory functions; ring-tailed lemurs; sedation

Williams, C. V., Glenn, K. M., Levine, J. F., & Horne, W. A. (2003). Comparison of the efficacy and cardiorespiratory effects of medetomidine-based anesthetic protocols in ring-tailed lemurs (*Lemur catta*). *Journal of Zoo and Wildlife Medicine*, 34(2), 163–170. Scopus. [https://doi.org/10.1638/1042-7260\(2003\)034\[0163:COTEAC\]2.0.CO;2](https://doi.org/10.1638/1042-7260(2003)034[0163:COTEAC]2.0.CO;2)

Keywords: Anesthesia; anesthetic agent; Anesthetics, Combined; Anesthetics, Combined/*administration & dosage; Anesthetics, Dissociative; Anesthetics, Intravenous; animal disease; article; Blood Gas Analysis; Blood Gas Analysis/veterinary; Blood Pressure; Blood Pressure/*drug effects; breathing; Butorphanol; comparative study; dose response; Dose-Response Relationship, Drug; drug effect; Heart Rate; Heart Rate/*drug effects; hypnotic sedative agent; Hypnotics and Sedatives; Hypnotics and Sedatives/*administration & dosage; intravenous anesthetic agent; Ketamine; Lemur; Lemur/*physiology; Lemur catta; Lemuridae; lemurs; Medetomidine; Medetomidine/*administration & dosage; Midazolam; physiology; prosimian; Respiration; Respiration/*drug effects; Ring-tailed lemur; Strepsirhini; time; Time Factors; Treatment Outcome; Veterinary Pharmacology and Anaesthesiology

Williams, C. V., & Junge, R. E. (2007). Prosimians. In G. West, D. Heard, & N. Caulkett (Eds.), *Zoo animal and wildlife immobilization and anesthesia* (pp. 367–374). Blackwell Publishing; CAB Abstracts.

<https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20143309923&site=ehost-live>

Keywords: Anatomy and Morphology (Wild Animals); anesthesia; anesthetics; body components; Galagidae; Galago; inhaled anesthetics; intubation; lemurs; Loris; Lorisidae; Perodicticus; Perodicticus potto; Physiology and Biochemistry (Wild Animals); preanesthetic medication; Techniques and Methodology; vertebrates; Veterinary Pharmacology and Anaesthesiology

Williams, C. V., & Junge, R. E. (2014). Prosimians. In *Zoo Animal and Wildlife Immobilization and Anesthesia: Second Ed.* (pp. 551–559). Wiley Blackwell; Scopus. <https://doi.org/10.1002/9781118792919.ch37>

Keywords: Alpha-2 agonists; Benzodiazepines; Endotracheal intubation; Non-steroidal anti-inflammatory drugs (NSAIDs); Opioids; Prosimians

Wu, T.-L., Mishra, A., Wang, F., Yang, P.-F., Gore, J. C., & Chen, L. M. (2016). Effects of isoflurane anesthesia on resting-state fMRI signals and functional connectivity within primary somatosensory cortex of monkeys. *Brain and Behavior*, 6(12). Scopus. <https://doi.org/10.1002/brb3.591>

Keywords: adult; anesthesia; Anesthetics, Inhalation; animal experiment; Article; blood; BOLD signal; brain electrophysiology; controlled study; drug effects; fMRI; functional connectivity; functional magnetic resonance imaging; hand; Haplorhini; inhalation anesthetic agent; Isoflurane; Magnetic Resonance Imaging; nerve tract; Neural Pathways; nonhuman; nuclear magnetic resonance imaging; Oxygen; power analysis

Wu, T.-L., Wang, F., Anderson, A. W., Chen, L. M., Ding, Z., & Gore, J. C. (2016). Effects of anesthesia on resting state BOLD signals in white matter of non-human primates. *Magnetic Resonance Imaging*, 34(9), 1235–1241. Scopus. <https://doi.org/10.1016/j.mri.2016.07.001>

Keywords: adult; Anesthesia; Anesthetics, Inhalation; animal experiment; animal model; Article; BOLD signal; Brain Mapping; controlled study; diagnostic imaging; drug effects; fMRI; fractional anisotropy; fractional power; functional magnetic resonance imaging; functional tensor; gray matter; Humans; inhalation anesthetic agent; Isoflurane; Magnetic Resonance Imaging; Models, Animal; nerve cell; nervous system parameters; nonhuman; nuclear magnetic resonance imaging; physiology; priority journal; procedures; radiological parameters; Rest; Saimiri; squirrel monkey; White Matter

Yolles, J. N., & Lee-Stubbs, R. B. (2021). Comparison of Direct and Indirect Methods of Measuring Arterial Blood Pressure in Healthy, Anesthetized African Green Monkeys (*Chlorocebus aethiops*). *Journal of the American Association for Laboratory Animal Science*, 60(2), 229–237. Scopus. <https://doi.org/10.30802/AALAS-JAALAS-20-000054>

Keywords: ACVIM; adult; American College of Veterinary Internal Medicine; Anesthesia; Anesthesia/*veterinary; animal care; animal experiment; Animal Physiology and Biochemistry (Excluding Nutrition); animals; article; Blood Pressure; Blood Pressure Determination; Blood Pressure Determination/*veterinary; Blood Pressure Determination/methods; Blood Pressure Determination/methods/*veterinary; blood pressure measurement; blood pressure monitoring; Blood Pressure/*drug effects; BP; Cercopithecidae; Cercopithecus aethiops; Chlorocebus; Chlorocebus aethiops; Chlorocebus aethiops/*physiology; circulatory system; comparative study; controlled study; Diagnosis of Animal Diseases; DOP; drug effect; ECG; electrocardiogram; hemodynamics; IACUC; Institutional Animal Care and Use Committee; internal medicine; MAP; mean arterial pressure; methods; metrology; nonhuman; oscillometry; physiology; practice guideline; procedures; recommendations; Techniques and Methodology; ultrasonic Doppler; ultrasound; veterinary medicine

Analgesia

Description: This section features information on the use of analgesic drugs to treat postoperative or other pain for other nonhuman primates including Howler monkeys, Owl monkeys, Spider monkeys, Titi monkeys, Capuchin monkeys, Mangabeys, African green monkeys, Patas monkeys, Squirrel monkeys, Tarsiers, and Prosimians.

Results (6):

Ceccolini, M. E., Hedley, J., Chang, Y.-M., & Guthrie, A. (2021). A retrospective study of bite wound management in ring-tailed lemurs (*Lemur catta*) housed within five British zoos. *Journal of Zoo and Wildlife Medicine*, 52(4), 1263–1269. <https://doi.org/10.1638/2020-0160>

Keywords: Analgesia; bite wound; disease severity, infection; *Lemur catta*; Lemuridae; pain; wound dehiscence

Kelly, K. R., Pypendop, B., Grayson, K., Stanley, S., Christe, K., Summers, L., & Lerche, N. (2010). Pharmacokinetics and Pharmacodynamics of Oxymorphone in Titi Monkeys (*Callicebus* spp.) as Compared with Rhesus Macaques (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science*, 49(5), 686–687.

Keywords: Analgesics; behavioral difference; behavioral response; *Callicebus*; diastolic blood pressure; drug effect; heart rate; *Macaca mulatta*; neuropharmacology; oxymorphone; pain management; pharmacokinetics; physiologic response; physiologic parameter; primate medicine; pruritis; respiratory rate; rhesus macaques; serial collection; systolic blood pressure; Titi monkey

Kelly, K. R., Pypendop, B. H., Grayson, J. K., Stanley, S. D., Christe, K. L., Summers, L. M., & Lerche, N. W. (2011). Pharmacokinetics of Oxymorphone in Titi Monkeys (*Callicebus* spp.) and Rhesus Macaques (*Macaca mulatta*). *Journal of the American Association for Laboratory Animal Science*, 50(2), 212–220. Zoological Record.

Keywords: Male; animal behavior; behavior; Behavior, Animal; Species Specificity; Motor Activity; drug action; mechanism of drug action; pain killers; Laboratory Animal Science; Injections, Intravenous; oxymorphone; Macaca; Macaca mulatta; Pruritus; Veterinary Pharmacology and Anaesthesiology; Cercopithecidae; Cebidae; Macaca mulatta/blood/*physiology; Pain/drug therapy/*veterinary; Analgesics, Opioid/blood/*pharmacokinetics; Oxymorphone/blood/*pharmacokinetics; Pitheciidae/blood/*physiology; Callicebus

Withey, S. L., & Bergman, J. (2017). Effects of Cannabinoid Receptor Agonists on the Antinociceptive Effects of Oxycodone in Squirrel Monkeys. *FASEB Journal*, 31.

Keywords: Analgesics; antinociceptive effect; Cebidae; food-maintained behavior; neuropharmacology; oxycodone; pain; squirrel monkeys

Withey, S. L., & Bergman, J. (2018). Effects of the delta-Opioid Antagonist Naltrindole on the Antinociceptive and Behaviorally Disruptive Effects of Oxycodone in Squirrel Monkeys. *FASEB Journal*, 32(1).

Keywords: Analgesics; behavior; Cebidae; oxycodone; naltrindole; pharmacology; squirrel monkey

Withey, S. L., Paronis, C. A., & Bergman, J. (2018). Concurrent Assessment of the Antinociceptive and Behaviorally Disruptive Effects of Opioids in Squirrel Monkeys. *Journal of Pain*, 19(7), 728–740. Scopus. <https://doi.org/10.1016/j.jpain.2018.02.003>

Keywords: Male; adult; animal experiment; animal model; nonhuman; Article; controlled study; animal behavior; Behavior, Animal; drug effect; buprenorphine; butorphanol; methadone; latent period; antinociception; diamorphine; Opioid; oxycodone; Analgesics, Opioid; narcotic analgesic agent; reinforcement; instrumental conditioning; nalbuphine; Behavior, Animal/*drug effects; Saimiri; Analgesics, Opioid/*pharmacology; naltrexone; drug antagonism; squirrel monkey; disruptive behavior; ED50; hot water; RBI; Saimiri sciureus; schedule-controlled behavior; tail flick latency; antinociception*; Opioid*; oxycodone*; schedule-controlled behavior*; squirrel monkey*

Adverse Effects

Description: This section contains citations about adverse effects of anesthetic or analgesic drugs on other nonhuman primates including Howler monkeys, Owl monkeys, Spider monkeys, Titi monkeys, Capuchin monkeys, Mangabeys, African green monkeys, Patas monkey, Squirrel monkeys, Tarsiers, and Prosimians.

Results (12):

Chinnadurai, S. K., Balko, J. A., & Williams, C. V. (2017). Minimum alveolar concentration and cardiopulmonary effects of isoflurane in ring-tailed lemurs (*Lemur*

catta). *Journal of the American Association for Laboratory Animal Science*, 56(4), 452–456. Scopus.

Keywords: adult; animal experiment; nonhuman; Article; controlled study; Blood Pressure; disease severity; drug effects; Isoflurane; Heart Rate/drug effects; Isoflurane/*administration & dosage; lung alveolus; diastolic blood pressure; mean arterial pressure; systolic blood pressure; Anesthetics, Inhalation; inhalation anesthetic agent; Heart Rate; Blood Pressure/drug effects; Anesthetics, Inhalation/*administration & dosage; Veterinary Pharmacology and Anaesthesiology; Lemuridae; Lemur catta; Lemur; minimum lung alveolus concentration; hypoventilation; Pulmonary Alveoli/drug effects; respiratory acidosis; *Lemur; cardiopulmonary hemodynamics; Pulmonary Alveoli; Lemur*

Chinnadurai, S. K., & Williams, C. (2016). The minimum alveolar concentration of sevoflurane in ring-tailed lemurs (*Lemur catta*) and aye-ayes (*Daubentonia madagascariensis*). *Veterinary Anaesthesia and Analgesia*, 43(1), 76–80. Scopus. <https://doi.org/10.1111/vaa.12266>

Keywords: Prospective Studies; physiology; prospective study; metabolism; clinical trial; veterinary; sevoflurane; lung alveolus; ether derivative; Anesthesia; Anesthesia, Inhalation; inhalation anesthesia; Anesthetics, Inhalation; inhalation anesthetic agent; Pulmonary Alveoli/*metabolism; Anesthetics, Inhalation/administration & dosage; Lemuridae; lemur; Lemur/*physiology; Lemur; minimum alveolar concentration; Anesthesia, Inhalation/*veterinary; Sevoflurane; Methyl Ethers; Anesthetics, Inhalation/administration & dosage/*pharmacokinetics; Methyl Ethers/administration & dosage/*pharmacokinetics; Pulmonary Alveoli; Aye-aye; Minimum alveolar concentration; Anesthetics, Inhalation/*pharmacokinetics; Methyl Ethers/*pharmacokinetics; Methyl Ethers/administration & dosage

Lahoz, M. M., Nagle, C. A., Porta, M., Farinati, Z., & Manzur, T. D. (2007). Cortisol response and ovarian hormones in juvenile and cycling female *Cebus* monkeys: Effect of stress and dexamethasone. *American Journal of Primatology*, 69(5), 551–561. Scopus. <https://doi.org/10.1002/ajp.20375>

Keywords: Female; adult; stress; article; physiology; animal disease; blood; Stress; Dexamethasone; Glucocorticoids; endocrine disruptor; physiological response; glucocorticoid; Progesterone; Cortisol; Hydrocortisone; steroid; environmental stress; juvenile; Estradiol; Cebus apella; estrogenic compound; Cebus; Cebidae; reproductive biology; menstrual cycle; androgen; Cebus monkey; Menstrual Cycle; Ovarian steroids

Long, C. T., Pacharinsak, C., Jampachaisri, K., McKeon, G. P., Howard, A. M., Albertelli, M. A., & Felt, S. A. (2011). Comparison of rectal and tympanic core body temperature measurement in adult Guyanese squirrel monkeys (*Saimiri sciureus sciureus*). *Journal of Medical Primatology*, 40(2), 135–141. <https://doi.org/10.1111/j.1600-0684.2010.00449.x>

Keywords: Anesthesia; adverse effects; Guyanese squirrel monkey; infrared; rectal core body temperature; Saimiri sciureus sciureus; thermometry; tympanic core body temperature

Monteiro, F. O. B., Koivisto, M. B. de, Vicente, W. R. R., Carvalho, R. de A., Whiteman, C. W., Castro, P. H. G., & Maia, C. E. (2006). Uterine evaluation and gestation diagnosis in owl monkey (*Aotus azarai infulatus*) using the B mode ultrasound. *Journal of Medical Primatology*, 35(3), 123–130. CAB Abstracts. <https://doi.org/10.1111/j.1600-0684.2006.00155.x>

Keywords: gestation; Developing Countries; America; Latin America; Threshold Countries; South America; Community of Portuguese Language Countries; Biological Resources (Animal); Non-Communicable Diseases and Injuries of Animals; Animal Reproduction and Embryology; Zoo Animals; Diagnosis of Animal Diseases; Animal Health and Hygiene (General); Aotus; Aotus azarai infulatus

Rodas-Martínez, A. Z., Canales, D., Brousset, D. M., Swanson, W. F., & Romano, M. C. (2013). Assessment of adrenocortical and gonadal hormones in male spider monkeys (*Ateles geoffroyi*) following capture, restraint and anesthesia. *Zoo Biology*, 32(6), 641–647. Scopus. <https://doi.org/10.1002/zoo.21101>

Keywords: Male; cortisol; stress; article; physiology; OECD Countries; Developing Countries; America; Latin America; Threshold Countries; blood; APEC countries; Corticosterone; physiological stress; Stress, Physiological; Stress; North America; testosterone; hydrocortisone; Cortisol; Hydrocortisone; Testosterone; aldosterone; Cleaning, Grading, Handling, Storage and Transport Equipment; Non-Communicable Diseases and Injuries of Animals; Veterinary Pharmacology and Anaesthesiology; Animal Reproduction and Embryology; Forests and Forest Trees (Biology and Ecology); Animal Physiology and Biochemistry (Excluding Nutrition); Zoo Animals; Pesticides and Drugs (General); monkeys; Cebidae; Ateles; Aldosterone; Ateles geoffroyi; Ateles sp.; Atelidae; Atelinae; New World primates

Rodrigues, M. A., Wittwer, D., & Kitchen, D. M. (2015). Measuring stress responses in female Geoffroy's spider monkeys: Validation and the influence of reproductive state. *American Journal of Primatology*, 77(9), 925–935. Scopus. <https://doi.org/10.1002/ajp.22421>

Keywords: female; feces; lactation; aggression; bioassay; Glucocorticoids; physiological response; concentration (composition); environmental stress; Estradiol; Non-Communicable Diseases and Injuries of Animals; Animal Reproduction and Embryology; Animal Behaviour; Animal Physiology and Biochemistry (Excluding Nutrition); captive population; estrogenic compound; infanticide; Cebidae; Ateles; wild population; reproductive biology; Ateles geoffroyi; Ateles sp.; Female reproductive state

Schäffer, D. P. H., de Araujo, N. L. L. C., Otero, A. R., Dórea Neto, F. D. A., Barbosa, V. F., Martins Filho, E. F., & Oriá, A. P. (2017). Cardiorespiratory effects of epidural anesthesia using lidocaine with morphine or dexmedetomidine in capuchin monkeys (*Sapajus* sp.) undergoing bilateral tubal ligation surgery, anesthetized with isoflurane. *Journal of Medical Primatology*, 46(6), 311–319. Scopus. <https://doi.org/10.1111/jmp.12304>

Keywords: $\alpha 2$ agonist*; Female; surgery; adult; animal experiment; nonhuman; priority journal; Article; controlled study; Blood Pressure; oxygen saturation; physiology; heart rate; Random Allocation; drug effect; randomization; Body Temperature; Isoflurane; analgesic agent; Lidocaine; Heart Rate/drug effects; morphine; hypotension; Analgesics, Non-Narcotic; dexmedetomidine; Laboratory Animal Science; local anesthesia; Analgesics, Opioid; narcotic analgesic agent; Anesthetics, Local; local anesthetic agent; Morphine; Anesthetics, Inhalation; inhalation anesthetic agent; Heart Rate; electrocardiogram; Dexmedetomidine; QT prolongation; Dexmedetomidine/administration & dosage; Analgesics, Non-Narcotic/administration & dosage; Blood Pressure/drug effects; Veterinary Pharmacology and Anaesthesiology; primate*; Animal Surgery and Non-drug Therapy; Anesthetics, Inhalation/administration & dosage; Isoflurane/administration & dosage; Cebus; rectum temperature; Cebidae; Sapajus; opioid; Lidocaine/administration & dosage; Analgesics, Opioid/administration & dosage; regional block; Anesthetics, Local/administration & dosage; *regional block; Morphine/*adverse effects; *local anesthesia; *opioid; * $\alpha 2$ agonist; Analgesics, Non-Narcotic/administration & dosage/*adverse effects; Analgesics, Opioid/administration & dosage/*adverse effects; Anesthesia, Epidural/adverse effects; Anesthetics, Local/administration & dosage/*adverse effects; Cebinae/*physiology/surgery; Dexmedetomidine/administration & dosage/*adverse effects; Lidocaine/administration & dosage/*adverse effects; Lumbosacral Region/surgery; Morphine/administration & dosage/*adverse effects; Sterilization, Tubal; Analgesics, Opioid/*adverse effects; Cebinae; side effect; Anesthesia, Epidural; epidural anesthesia; heart rhythm; isoflurane; lumbosacral region; Lumbosacral Region; uterine tube ligation; uterine tube sterilization; Anesthetics, Local/*adverse effects; Morphine/administration & dosage; regional block*; Analgesics, Non-Narcotic/*adverse effects; Cebinae/*physiology; Cebinae/surgery; Dexmedetomidine/*adverse effects; Lidocaine/*adverse effects; local anesthesia*; opioid*

Springer, D. A., & Baker, K. C. (2007). Effect of ketamine anesthesia on daily food intake in *Macaca mulatta* and *Cercopithecus aethiops*. *American Journal of Primatology*, 69(10), 1080–1092. <https://doi.org/10.1002/ajp.20421>

Keywords: Time Factors; Eating/*drug effects; **Macaca mulatta*; Ketamine/administration & dosage/*adverse effects; **Chlorocebus aethiops*; Anesthetics, Dissociative/administration & dosage/*adverse effects

Thompson, C. L., Donley, E. M., Stimpson, C. D., Horne, W. I., & Vinyard, C. J. (2011). The influence of experimental manipulations on chewing speed during in vivo laboratory research in tufted capuchins (*Cebus apella*). *American Journal of Physical Anthropology*, 145(3), 402–414. Scopus. <https://doi.org/10.1002/ajpa.21514>

Keywords: animal experiment; article; nonhuman; controlled study; comparative study; in vivo study; Feeding Behavior; Analysis of Variance; food; environment; Research Design; Animals, Laboratory; anesthesia; Awareness; laboratory; implantation; Research Design*; experimental test; Anesthesia; Animals, Wild; electrode; Food; Feeding Behavior/*physiology; mastication; mechanics; alertness; Electromyography; Cebus; Mastication; Cebus/*physiology; cebus apella; experimental conditions; platyrrhine; Feeding Behavior/classification; Mastication/*physiology

Volfova, M., Machovcova, Z., Schwarzenberger, F., Voslarova, E., Bedanova, I., & Vecerek, V. (2020). Non-invasive assessment of adrenocortical activity as a measure of stress in ring-tailed lemurs (*Lemur catta*). *Berliner und Munchener Tierarztliche Wochenschrift*, 133(1–2), 28–35. <https://doi.org/10.2376/0005-9366-18078>

Keywords: Biological validation; chemical restraint; enzyme immunoassay; faecal analysis; glucocorticoid metabolites; *Lemur catta*; ring-tailed lemur; sedation; stress; stress response

Case Studies

Description: Here are eleven case studies involving anesthesia or analgesia use in individual nonhuman primates, including Howler monkeys, Owl monkeys, Spider monkeys, Titi monkeys, Capuchin monkeys, Mangabeys, African green monkeys, Patas monkeys, Squirrel monkeys, Tarsiers, and Prosimians.

Results (11):

Backues, K. A., Hoover, J. P., Bahr, R. J., Confer, A. W., Chalman, J. A., & Larry, M. L. (2001). Multifocal pyogranulomatous osteomyelitis resembling chronic recurrent multifocal osteomyelitis in a lemur. *Journal of the American Veterinary Medical Association*, 218(2), 250-253+213. Scopus. <https://doi.org/10.2460/javma.2001.218.250>

Keywords: Male; article; nonhuman; human; osteomyelitis; corticosteroid; isoflurane; gamma interferon; Chronic Disease; Radiography; clinical feature; nonsteroid antiinflammatory agent; Recurrence; recurrent disease; amoxicillin plus clavulanic acid; immunomodulating agent; differential diagnosis; Anti-Inflammatory Agents, Non-Steroidal/therapeutic use; prosimian; radiodiagnosis; *Lemur; Aspirin/therapeutic use; Biopsy, Needle/veterinary; Femur/diagnostic imaging/pathology; Forelimb/diagnostic imaging/*pathology; Hindlimb/diagnostic imaging/*pathology; Histocytochemistry/veterinary; Lameness, Animal/diagnosis/drug therapy/pathology; Osteomyelitis/diagnosis/drug therapy/pathology/*veterinary; Radius/diagnostic imaging/pathology; Tibia/diagnostic imaging/pathology; Ulna/diagnostic imaging/pathology

Bagardi, M., Bassi, J., Stranieri, A., Rabbogliatti, V., Gioeni, D., Magnone, W., & Pigoli, C. (2021). Chylopericardium effusion in a Lac Alaotra bamboo lemur (*Haplemur alaotrensis*). *Animals*, 11(2), 1–10. Scopus. <https://doi.org/10.3390/ani11020536>

Keywords: Animal experiment; animal tissue; nonhuman; Article; computer assisted tomography; ketamine; female; meloxicam; histopathology; hypotension; propofol; dexmedetomidine; triacylglycerol; methadone; cardiomegaly; echography; echocardiography; anorexia; tachypnea; contrast medium; enrofloxacin; adult respiratory distress syndrome; coughing; thorax radiography; Zoo animals; atelectasis; Chylopericardium; computed tomographic angiography; contrast-enhanced ultrasound; hepatomegaly; lymphedema; LymphoCT; lymphocytopenia; pericardial effusion; pericardiocentesis; prednisolone; semfortan; thoracocentesis

da Silva, A. M., dos Santos, D. M., da Luz Flores, C. P., Machado, M. P., & Tome Melo, A. L. (2021). Anesthesia and Hematological and Electrocardiographic Changes in the Emergency Care of a Hooded Capuchin (*Sapajus cay*). *Acta Scientiae Veterinariae*, 49. <https://doi.org/10.22456/1679-9216.105088>

Keywords: Anesthesia; anesthesiology; capuchin monkey; chemical restraint; emergency care; electrocardiogram; hooded capuchin monkey; ketamine; Sapajus cay

Kohl, M., Bourgeois, A., Petit, T., Papaxanthos, M., Louvet, A., Duconseille, A. C., Lemberger, K., Hano, C., & Chain, N. (2015). Dentigerous cyst in the nares of a juvenile white crowned mangabey (*Cercocebus atys lunulatus*) treated successfully by minimal invasive surgery. In *Proceedings of the International Conference on Diseases of Zoo and Wild Animals, May 13th-16th, 2015, Barcelona, Spain* (C. A. Szentiks & A. Schumann, Eds.; p. 50). Leibniz Institute for Zoo and Wildlife Research; CAB Abstracts. <https://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20153289016&site=ehost-live>

Keywords: Developed Countries; Europe; European Union Countries; Mediterranean Region; OECD Countries; Western Europe; anesthesia; clinical picture; cancers; Non-Communicable Diseases and Injuries of Animals; Veterinary Pharmacology and Anaesthesiology; Diagnosis of Animal Diseases; 86; Animal Surgery and Non-drug Therapy; *Cercocebus atys lunulatus*

Merlin, T., & Veres-Nyéki, K. (2017). The use of atracurium in an anaesthetized ring-tailed lemur (*Lemur catta*). *Veterinary Anaesthesia and Analgesia*, 44(6), 1403–1405. Scopus. <https://doi.org/10.1016/j.vaa.2017.05.006>

Keywords: Female; nonhuman; saphenous vein; veterinary medicine; body temperature; buprenorphine; anesthesia induction; midazolam; medetomidine; sevoflurane; blood pressure measurement; Letter; Corneal Injuries; general anesthesia; artificial ventilation; incision; electrocardiography; endotracheal intubation; pulse oximetry; neuromuscular blocking agent; Neuromuscular Nondepolarizing Agents; end tidal carbon dioxide tension; case report; Lemuridae; Lemur; Lemur catta; extubation; foreign body; muscle contraction; atracurium besilate; oxygen supply; Atracurium; blepharospasm; cornea injury; cornea surgery; Eye Foreign Bodies; intraocular foreign body; maximal inspiratory pressure; nerve stimulation

Ozawa, S., Guzman, D. S.-M., Palm, C. A., Robertson, J., Norvall, A., Choi, E., Roy, M., Paul-Murphy, J., & Culp, W. T. N. (2021). Neoureterocystostomy and urethral stent placement in a black-handed spider monkey (*Ateles geoffroyi*). *Journal of Zoo and Wildlife Medicine*, 52(2), 843–848. Scopus. <https://doi.org/10.1638/2020-0131>

Keywords: Female; animal experiment; nonhuman; Article; autopsy; computer assisted tomography; pathology; ketamine; procedures; laparotomy; fluoroscopy; veterinary medicine; buprenorphine; meloxicam; isoflurane; histopathology; midazolam; oxygen; creatinine; protein; vomiting; operation duration; urinary tract infection; body weight loss; catheterization; echography; general anesthesia; Stents; blood cell count; proteinuria; Animals, Zoo; hematuria; laparoscopy; maropitant; urea nitrogen blood level; amoxicillin plus clavulanic acid; case report;

zoo animal; Monkey Diseases; abdominal radiography; lethargy; leukocytosis; monocytosis; extubation; Cystotomy; dysuria; abdominal distension; acidemia; *Ateles geoffroyi*; clavulanate potassium; crystalloid; cystostomy; extravasation; hyperkalemia; hyperphosphatemia; hypochloremia; iopamidol; neoureterocystostomy; nitinol; prazosin; pyelonephritis; spider monkey; uremia; Ureter; urethrography

Pentsou, K., & Huuskonen, V. (2020a). Combination of intramuscular alfaxalone, butorphanol, and midazolam as a novel immobilization protocol in 3 ring-tailed lemurs (*Lemur catta*). *Irish Veterinary Journal*, 73(1). Scopus. <https://doi.org/10.1186/s13620-020-00163-1>

Keywords: Immobilization; animal experiment; nonhuman; Article; computer assisted tomography; male; limb amputation; wound healing; follow up; lidocaine; paracetamol; midazolam; bradycardia; hypotension; hypothermia; sevoflurane; butorphanol; Alfaxalone; Immobilization; hospitalization; arterial pressure; general anesthesia; artificial ventilation; endotracheal intubation; Biological Resources (Animal); PP710; Veterinary Pharmacology and Anaesthesiology; Physiology and Biochemistry (Wild Animals); YY400; Animal Surgery and Non-drug Therapy; Lemuridae; lemurs; *Lemur catta*; alfaxalone; Midazolam; flumazenil; Butorphanol; premedication; hypercapnia; hypoventilation; degloving injury; glycopyrronium; oxygen supply; Ring-tailed lemur

Pentsou, K., & Huuskonen, V. (2020b). Correction to: Combination of intramuscular alfaxalone, butorphanol, and midazolam as a novel immobilization protocol in 3 ring-tailed lemurs (*Lemur catta*) (*Irish Veterinary Journal*, (2020), 73, 1, (9). *Irish Veterinary Journal*, 73(1). Scopus. <https://doi.org/10.1186/s13620-020-00180-0>

Perez, J., Ramirez, M., & Hernandez, C. A. (2008). Surgical intervention for removing intestinal *Prosthenoorchis* sp in a captive white-footed tamarin (*Saguinus leucopus*). *Revista Colombiana de Ciencias Pecuarias*, 21(4), 608–613.

Keywords: Acanthocephala parasites; anesthesia in primates; enterotomy in primates; *Saguinus leucopus*; white-footed tamarin

Portier, K., Viguier, E., & Quintard, B. (2016). The anaesthetic management of a lemur (*Prolemur simus*) undergoing craniotomy for brain tumour resection. *Veterinary Record Case Reports*, 4(1), e000332. CAB Abstracts. <https://doi.org/10.1136/vetreccr-2016-000332>

Keywords: Hemorrhage; bleeding; anesthesia; cerebrum; critical care; cancers; Other Wildlife Diseases; Veterinary Pharmacology and Anaesthesiology; Zoology of Wild Animals (Vertebrates and Invertebrates) (General); Pathogen, Pest, Parasite and Weed Management (General); Lemuridae; bamboo; lemurs; brain disorders; *Prolemur simus*
Vnuk, D., Musulin, A., Kreszinger, M., Pećin, M., Bata, I., Žubčić, D., & Lemo, N. (2009). Balanced anesthesia in the capuchin monkey (*Cebus capucinus*)—A case report. *Veterinarski Arhiv*, 79(4), 421–428. Scopus.

Keywords: Developed Countries; Europe; European Union Countries; Mediterranean Region; Anesthesia; Fentanyl; Southern Europe; Veterinary Pharmacology and Anaesthesiology; Animal Surgery and Non-drug Therapy; Cebus; Cebidae; Balkans; Capuchin monkey; *Cebus capucinus*

Human Pain and Nociception Research, Pharmacology, and Drug Development

Description: These articles describe using other species of nonhuman primates as models for studying pain and nociception in humans as well as for drug development, pharmacokinetics, and pharmacodynamics. Primate models covered in this section include Howler monkeys, Owl monkeys, Spider monkeys, Titi monkeys, Capuchin monkeys, Mangabeys, African green monkeys, Patas monkeys, Squirrel monkeys, Tarsiers, and Prosimians.

Results (14):

Allen, R., Granger, A., & Dykstra, L. (2001). LY235959 potentiates the antinociceptive effects morphine, 1-methadone, levorphanol, butorphanol, and buprenorphine in a primate titration procedure. *FASEB Journal*, 15(5), A910–A910.

Keywords: Analgesics; antinociceptive effects; buprenorphine; butorphanol; Cebidae; levorphanol; l-methadone; meeting abstract; morphine; non-specific motor effects; pharmacology; shock; squirrel monkey

Allen, R. M., & Dykstra, L. A. (2001). N-methyl-D-aspartate receptor antagonist potentiate the antinociceptive effects of morphine in squirrel monkeys. *Journal of Pharmacology and Experimental Therapeutics*, 298(1), 288–297. Scopus.

Keywords: Male; animal experiment; animal model; article; nonhuman; priority journal; controlled study; shock; Dose-Response Relationship, Drug; dose response; Drug Therapy, Combination; Pain Measurement; Analgesics; antinociception; Analgesics/*pharmacology; Analgesics, Opioid; Receptors, N-Methyl-D-Aspartate; Morphine; Saimiri; n methyl dextro aspartic acid receptor blocking agent; dizocilpine; Dizocilpine Maleate; Excitatory Amino Acid Antagonists; drug potentiation; Drug Synergism; Analgesics, Opioid/*pharmacology; squirrel monkey; Excitatory Amino Acid Antagonists/*pharmacology; Morphine/*pharmacology; Dizocilpine Maleate/pharmacology; morphine derivative; Isoquinolines; 3 amino 1 hydroxy 2 pyrrolidinone; decahydro 6 phosphonomethyl 3 isoquinolinecarboxylic acid; glycine receptor antagonist; Isoquinolines/pharmacology; Receptors, N-Methyl-D-Aspartate/*antagonists & inhibitors; Pain Measurement/*drug effects; Receptors, N-Methyl-D-Aspartate/physiology

Allen, R. M., Granger, A. L., & Dykstra, L. A. (2002). Dextromethorphan potentiates the antinociceptive effects of morphine and the δ -opioid agonist SNC80 in squirrel monkeys. *Journal of Pharmacology and Experimental Therapeutics*, 300(2), 435–441. Scopus.
<https://doi.org/10.1124/jpet.300.2.435>

Keywords: Male; animal experiment; article; nonhuman; priority journal; controlled study; shock; motor activity; Pain Measurement; morphine; antinociception; Analgesics, Opioid; Electroshock; n methyl dextro aspartic acid receptor; Receptors, N-Methyl-D-Aspartate; Morphine; Conditioning, Operant; Saimiri; drug tolerance; Dizocilpine Maleate; Excitatory Amino Acid Antagonists; drug potentiation; Drug Synergism; Analgesics, Opioid/*pharmacology; Piperazines; squirrel monkey; mu opiate receptor; dose time effect relation; Pain Measurement/drug effects; Morphine/*pharmacology; Dizocilpine Maleate/pharmacology; 4 [alpha (4 allyl 2,5 dimethyl 1 piperazinyl) 3 methoxybenzyl] n,n diethylbenzamide; Benzamides; Receptors, Opioid, delta; Antitussive Agents; dextromethorphan; Dextromethorphan; Isoquinolines; Pyrrolidinones; Isoquinolines/pharmacology; Excitatory Amino Acid Antagonists/pharmacology; Piperazines/*pharmacology; Conditioning, Operant/drug effects; Benzamides/*pharmacology; Antitussive Agents/*pharmacology; Dextromethorphan/*pharmacology; Pyrrolidinones/pharmacology; Receptors, N-Methyl-D-Aspartate/*antagonists & inhibitors; Receptors, Opioid, delta/*agonists

Carey, G. J., & Bergman, J. (2001). Enadoline discrimination in squirrel monkeys: Effects of opioid agonists and antagonists. *Journal of Pharmacology and Experimental Therapeutics*, 297(1), 215–223. Scopus.

Keywords: Male; animal experiment; article; nonhuman; priority journal; controlled study; drug efficacy; Dose-Response Relationship, Drug; unclassified drug; dose response; drug effect; reliability; drug receptor binding; nalbuphine; Narcotic Antagonists; Saimiri; opiate agonist; opiate antagonist; paired associate learning; enantiomer; Discrimination Learning; Naltrexone; squirrel monkey; Receptors, Opioid, mu; 3,4 dichloro n methyl n [2 (1 pyrrolidinyl)cyclohexyl]benzeneacetamide; Pyrrolidines; nalorphine; Thiophenes; mu opiate receptor antagonist; kappa opiate receptor agonist; drug selectivity; norbinaltorphimine; bremazocine; Receptors, Opioid, kappa; discriminative stimulus; Nalbuphine; drug discrimination; 2 amino n [2 (3 hydroxy 1 pyrrolidinyl) 1 phenylethyl] n methylphenylacetamide; 3 [1 (3,4 dichloro n methylphenylacetamido) 2 (1 pyrrolidinyl)ethyl]phenoxyacetic acid; 4 [alpha (4 allyl 2,5 dimethyl 1 piperazinyl) 3 hydroxybenzyl] n,n diethylbenzamide; asimadoline; Benzofurans; beta funaltrexamine; enadoline; ethylketazocine; gr 89686a; gr 89696a; n methyl n [2 (1 pyrrolidinyl)cyclohexyl]benzo[b]thiophene 4 acetamide; opiate receptor affecting agent; pd 129829; Pyrroles; quadazocine; spiradoline

de La Salles, A. Y. F., de Andrade, J. K., Cordeiro, J. F., Carreiro, A. D. N., Rodrigues Falcão, B. M., de Brito Freitas, K., & Menezes, D. J. A. (2021). Assessment of the technique of the anesthetic block of the Brachial Plexus by Supraclavicular approach in *Sapajus libidinosus* (SPIX, 1823). *Journal of Medical Primatology*, 50(1), 29–35. Scopus. <https://doi.org/10.1111/jmp.12492>

Keywords: Male; adult; animal experiment; animal model; nonhuman; Article; controlled study; procedures; Models, Animal; drug effect; nociception; analgesia*; Lidocaine; anesthesia*; propofol; sedation; brachial plexus; Anesthetics, Local; Anesthetics, Local/*administration & dosage; Macaca fascicularis; skin sensitivity; local anesthetic agent; Macaca mulatta; clinical

effectiveness; *Electric Conductivity; electrostimulation; Biological Resources (Animal); Veterinary Pharmacology and Anaesthesiology; Physiology and Biochemistry (Wild Animals); *primate; limb movement; Sapajus; Sapajus libidinosus; threatened species; Lidocaine/*administration & dosage; *anesthesia; tiletamine plus zolazepam; Brachial Plexus Block; Brachial Plexus Block/*methods; regional block; *Cebinae; *regional block; Brachial Plexus/*drug effects; Electric Stimulation Therapy/*methods; Nerve Block/*methods; Neural Conduction/*physiology; Peripheral Nerves/pathology/*physiopathology; Peripheral Nervous System Diseases/physiopathology/*therapy; Brachial Plexus; brachial plexus anesthesia; hypnosis; thoracic limb; analgesia*; regional block*

Dykstra, L. A., Granger, A. L., Allen, R. M., Zhang, X., & Rice, K. C. (2002). Antinociceptive effects of the selective delta opioid agonist SNC80 alone and in combination with mu opioids in the squirrel monkey titration procedure. *Psychopharmacology*, 163(3–4), 420–429. Scopus. <https://doi.org/10.1007/s00213-002-1100-8>

Keywords: Male; Time Factors; time; animal experiment; article; nonhuman; priority journal; controlled study; shock; Behavior, Animal; Dose-Response Relationship, Drug; drug effect; Buprenorphine; Analgesics; morphine; butorphanol; sedation; Drug Interactions; Antinociception; Behavior, Animal/drug effects; Analgesics/*pharmacology; drug response; tail; Electroshock; Morphine; motor dysfunction; Narcotics; Saimiri; drug potentiation; Buprenorphine/pharmacology; Piperazines; squirrel monkey; Receptors, Opioid, mu; Butorphanol; Butorphanol/pharmacology; Morphine/pharmacology; Receptors, Opioid, mu/*agonists; opiate receptor; 4 [alpha (4 allyl 2,5 dimethyl 1 piperazinyl) 3 methoxybenzyl] n,n diethylbenzamide; Benzamides; drug selectivity; Receptors, Opioid, delta; Delta opioids; Mu opioids; SNC80; titrimetry; Piperazines/*pharmacology; Benzamides/*pharmacology; Narcotics/pharmacology; Receptors, Opioid, delta/agonists

Gomes, L. M., Moysés, D. A., Nascimento, H. F. S., Mota, T. C., Bonfim, L. T., Cardoso, P. C. S., Burbano, R. M. R., & Bahia, M. O. (2021). Genotoxic and cytotoxic effects of the drug dipyrone sodium in African green monkey kidney (Vero) cell line exposed in vitro. *Naunyn-Schmiedeberg's Archives of Pharmacology*, 394(7), 1529–1535. Scopus. <https://doi.org/10.1007/s00210-021-02078-2>

Keywords: African green monkey; Nonhuman; Article; in vitro study; cell viability; unclassified drug; oxidative stress; cell death; reactive oxygen metabolite; apoptosis; Reactive oxygen species; comet assay; DNA damage; genotoxicity; Cytotoxicity; fluorescent dye; Genotoxicity; dipyrone; MTT assay; Vero cell line; cytotoxic agent; dichlorodihydrofluorescein diacetate; Dipyrone; dipyrone sodium

Laćan, G., De Salles, A. A. F., Gorgulho, A. A., Krah, S. E., Frighetto, L., Behnke, E. J., & Melega, W. P. (2008). Modulation of food intake following deep brain stimulation of the ventromedial hypothalamus in the vervet monkey: Laboratory investigation. *Journal of Neurosurgery*, 108(2), 336–342. Scopus. <https://doi.org/10.3171/JNS/2008/108/2/0336>

Keywords: Male; animal experiment; article; nonhuman; priority journal; controlled study; Blood Pressure; Models, Animal; animal behavior; Feeding Behavior; food intake; Eating;

histology; immunohistochemistry; anesthesia; autonomic nervous system; Feasibility Studies; statistical significance; brain function; Heart Rate; electrode; Electrodes, Implanted; feeding behavior; Obesity; Glial Fibrillary Acidic Protein; Cercopithecus aethiops; brain depth stimulation; stereotactic procedure; Stereotaxic Techniques; Anorexia nervosa; Deep Brain Stimulation; eating disorder; Feeding behavior; Hypothalamus, Middle; Ventromedial Hypothalamic Nucleus; zona incerta; vervet monkey

Neri, C., Guarna, M., Bianchi, E., Sonetti, D., Matteucci, G., & Stefano, G. B. (2004). Endogenous morphine and codeine in the brain of non human primate. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, 10(6), MS1-5.

Keywords: Male; Brain/drug effects/metabolism; Gas Chromatography-Mass Spectrometry; *Brain Chemistry/drug effects; Cercopithecus/*metabolism; Codeine/*analysis/metabolism/pharmacology; Morphine/*analysis/metabolism/pharmacology

Roe, A. W., Healy, F. L., Friedman, R. M., Heider, B., & Chen, L. M. (2002). Differences in si topography between anesthetized and awake squirrel monkey as revealed by optical imaging. *Society for Neuroscience Abstract Viewer and Itinerary Planner*, 2002, Abstract No. 651.3-Abstract No. 651.3.

Keywords: acepromazine; anesthesia; Cebidae; imaging and microscopy techniques; laboratory techniques; local anesthetic-drug; neuropharmacology; optical imaging; pentothal; psychopharmacology; sedative/hypnotic-drug; squirrel monkey

Slovik, M., Rosin, B., Moshel, S., Mitelman, R., Schechtman, E., Eitan, R., Raz, A., & Bergman, H. (2017). Ketamine induced converged synchronous gamma oscillations in the cortico-basal ganglia network of nonhuman primates. *Journal of Neurophysiology*, 118(2), 917–931. <https://doi.org/10.1152/jn.00765.2016>

Keywords: Female; Dose-Response Relationship, Drug; Chlorocebus aethiops; Microelectrodes; Neural Pathways/drug effects/physiology; Ketamine/*pharmacology; *ketamine; Excitatory Amino Acid Antagonists/*pharmacology; *basal ganglia; *gamma oscillations; *NMDA antagonist; *PCP; Cortical Synchronization/drug effects/physiology; Gamma Rhythm/*drug effects/physiology; Globus Pallidus/*drug effects/physiology; Motor Cortex/*drug effects/physiology; Phencyclidine/pharmacology; Receptors, N-Methyl-D-Aspartate/*antagonists & inhibitors/metabolism; Signal Processing, Computer-Assisted

Ward, K. W., Coon, D. J., Magiera, D., Bhadresa, S., Nisbett, E., & Lawrence, M. S. (2008). Exploration of the African green monkey as a preclinical pharmacokinetic model: Intravenous pharmacokinetic parameters. *Drug Metabolism and Disposition*, 36(4), 715–720. Scopus. <https://doi.org/10.1124/dmd.107.019315>

Keywords: Humans; Rats; Male; animal experiment; animal model; article; nonhuman; priority journal; controlled study; comparative study; Models, Animal; ciprofloxacin; methodology; Species Specificity; species difference; *Models, Animal; Primates; quantitative analysis;

algorithm; Lidocaine; Models, Animal*; Pharmacokinetics; Injections, Intravenous; Tissue Distribution; Dogs; mass spectrometry; high performance liquid chromatography; Drug Evaluation, Preclinical/*methods; *Pharmacokinetics; Drug Evaluation, Preclinical; Chromatography, High Pressure Liquid; accuracy; propranolol; drug blood level; pharmacokinetics; drug screening; Pharmaceutical Preparations; Macaca fascicularis; diclofenac; verapamil; dog; drug bioavailability; drug clearance; Infusions, Intravenous; Mass Spectrometry; Canis familiaris; Rattus; Pharmacokinetics*; ketoconazole; rhesus monkey; Macaca mulatta; Pharmacokinetic; Bioavailability; distribution volume; heterocyclic compound; Ciprofloxacin; drug potentiation; Erythromycin; body size; phenytoin; Fluoroquinolones; Cercopithecidae; quinoline derivative; Quinolines; Cercopithecus; Cercopithecus aethiops; Lidocaine/pharmacokinetics; Prednisolone; *Chlorocebus aethiops; African green monkey; Propranolol/pharmacokinetics; Aza Compounds/pharmacokinetics; Ciprofloxacin/pharmacokinetics; Erythromycin/pharmacokinetics; Moxifloxacin; Phenytoin/pharmacokinetics; Prednisolone/pharmacokinetics; Quinolines/pharmacokinetics; prednisolone; Aza Compounds; metoprolol; moxifloxacin; Phenytoin; Propranolol; Vervet; liver blood flow; prednisone; quinidine

Wu, R., Wang, F., Yang, P.-F., & Chen, L. M. (2017). High-resolution functional MRI identified distinct global intrinsic functional networks of nociceptive posterior insula and S2 regions in squirrel monkey brain. *NeuroImage*, 155, 147–158. Scopus.
<https://doi.org/10.1016/j.neuroimage.2017.04.067>

Keywords: Male; adult; animal tissue; nonhuman; Article; controlled study; physiology; procedures; heat; nociception; Pain; nuclear magnetic resonance imaging; image analysis; thalamus; Magnetic Resonance Imaging; functional magnetic resonance imaging; Neuroimaging; hemisphere; brain region; brain function; nerve cell network; Saimiri; primary

Zeng, Z., McDonald, T. P., Wang, R., Liu, Q., & Austin, C. P. (2002). Studies on the expression of NPFF2 receptor in the spinal cord and brainstem of African green monkey by immunohistochemistry and autoradiography. *Society for Neuroscience Abstract Viewer and Itinerary Planner*, 2002, Abstract No. 258.7-Abstract No. 258.7.

Keywords: African green monkey; algesia modulation; analgesia; Cercopithecidae; [iodine-125]]Dme) neuropeptide FF; neuropeptide FF; nociception regulation; NPFF1 receptor; NPFF2 receptor

Web Resources

General Resources:

Choosing An Anesthetic Learning Module, National Centre for the Replacement, Refinement, and Reduction of Animals in Research (NC3Rs),
<https://module.researchanimaltraining.com/nc3rs/21-2/#/>

Description: The NC3Rs offers online e-learning modules for laboratory animal professionals including this course which covers the principles of anesthesia for all laboratory species. The module covers such topics as choosing an inhalation or injectable anesthetic and balanced anesthesia.

National Research Council. (2011). *Guide for the Care and Use of Laboratory Animals: Eighth Edition*. Washington, DC: National Academies Press. <https://doi.org/10.17226/12910>

Description: The *Guide* is the standard in the United States for care and husbandry of laboratory animal species. Eighth edition also available in Japanese and Thai.

IPS Captive Care Committee (2007). *IPS International Guidelines for the Acquisition, Care and Breeding of Nonhuman Primates, Second Edition*. International Primatological Society. <http://www.internationalprimatologicalsociety.org/policy-statements-and-guidelines/>

Description: These guidelines, prepared by the Captive Care and Breeding Committee, aim to promote good practice in the acquisition, care and breeding of primates and the enhancement of welfare. Includes translated editions into French, Spanish, Chinese, Japanese, and Thai.

Primate Info Net. Wisconsin National Primate Research Center. <https://primate.wisc.edu/primate-info-net/>

Description: Primate Info Net (PIN) is designed to cover the broad field of primatology, providing original content and links to resources about non-human primates in research, education and conservation. Through e-mail lists, Google Groups and other resources, PIN also supports an informal “primate information network” comprised of thousands of individuals around the world working with non-human primates.

Organizations

Academy of Veterinary Technicians in Anesthesia & Analgesia (AVTAA). <https://www.avtaa-vts.org/index.pml>.

Description: The Academy of Veterinary Technicians in Anesthesia and Analgesia (AVTAA) exists to promote interest in the discipline of veterinary anesthesia. The Academy provides a process by which a veterinary technician may become credentialed as a Veterinary Technician Specialist (Anesthesia & Analgesia). The Academy provides the opportunity for members to enhance their knowledge and skills in the field of veterinary anesthesia. Includes a free online library of resources on veterinary anesthesia.

American Board of Veterinary Specialties (American Veterinary Medical Association). <https://www.avma.org/education/veterinary-specialties>.

Description: There are 22 AVMA-Recognized Veterinary Specialty Organizations™ comprising 46 distinct AVMA-Recognized Veterinary Specialties™. More than 16,500 veterinarians have

been awarded Diplomate status in one or more of these specialty organizations after completing rigorous postgraduate training, education, and examination requirements. Board-certified veterinary specialists serve animals and the public through collaboration and teamwork with primary care veterinarians, human medical professionals, research scientists, and public health officials.

American College of Laboratory Animal Medicine (ACLAM). <https://www.aclam.org/>

Description: The American College of Laboratory Animal Medicine advances the humane care and responsible use of laboratory animals through certification of veterinary specialists, professional development, education and research. ACLAM produces publications about laboratory animal medicine, including *Nonhuman Primates in Biomedical Research* (2012) which has a chapter on Anesthesia and Analgesia in Nonhuman Primates.

American College of Veterinary Anesthesia and Analgesia (ACVAA). <https://acvaa.org/>

Description: The American College of Veterinary Anesthesia and Analgesia exists to promote the highest standards of clinical practice of veterinary anesthesia and analgesia and defines criteria for designating veterinarians with advanced training as specialists in the clinical practice of veterinary anesthesiology. The ACVAA issues certificates to those meeting these criteria, maintains a list of such veterinarians, and advances scientific research and education in veterinary anesthesiology and analgesia.

American Society of Primatologists (ASP). <https://www.asp.org/>

Description: The American Society of Primatologists is an educational and scientific organization whose purpose is to promote the discovery and exchange of information regarding primates, including all aspects of their anatomy, behavior, development, ecology, evolution, genetics, nutrition, physiology, reproduction, systematics, conservation, husbandry, and use in biomedical research. ASP's website features pages on animal training, social housing, and environmental enrichment. The society also publishes the peer-reviewed journal, *American Journal of Primatology*.

Association of British Wild Animal Keepers (ABWAK). <https://abwak.org>

Description: ABWAK is a non-profit organization specializing in improving cooperation among wild animal keepers. The site has links to information about the journal *Ratel*, training and professional development, and job openings.

Association of Primate Veterinarians (APV). <https://www.primatevets.org>

Description: The members of the APV are veterinarians working with nonhuman primates in zoos and research settings as well as breeders.

Association of Veterinary Anesthetists (AVA). <https://ava.eu.com/>

Description: A group of veterinary surgeons and others (e.g. researchers, technicians, pharmacologists) who share an interest in animal anaesthesia, analgesia and animal welfare. AVA holds meetings twice a year at various venues in Europe which are open to all those who share common interest. The association brings together over 450 veterinary professionals working in more than 35 countries.

Association of Zoos and Aquariums (AZA). <https://www.aza.org/>

Description: Formerly called the American Zoo and Aquarium Association, AZA is a nonprofit organization dedicated to the advancement of zoos and aquariums in the areas of conservation, education, science, and recreation. The AZA Office of Conservation and Science coordinates Taxon Advisory Groups (TAG) which monitor the status of particular species in captivity and provide recommendations on species management in captivity and with respect to conservation efforts. Primate TAGs include New World Primate, Old World Monkey, and Prosimian. TAGs prepare animal care manuals which are available for free download. Committees, such as the Behavior and Husbandry Advisory Committee, specialize in broad scientific areas and are coordinated to serve in advisory capacities for TAGs. The AZA holds regional and annual conferences at which environmental enrichment at zoos is often discussed. Services are geared towards member institutions, but anyone may contact members of these groups for information. There are fees for AZA membership, published membership directories, reports, and conference proceedings.

EUPRIM-Net Project. <https://www.euprim-net.eu/>

Description: An EU funded project that networks eight European primate centers and is aimed at advancing knowledge and competence in biological and biomedical research, animal keeping and breeding. The project objectives focus on animal welfare, the standardization of procedures and methods, the enhanced availability of non-human primates and training for those working with primates.

International Primatological Society (IPS). <http://www.internationalprimatologicalsociety.org/>

Description: The International Primatological Society was created to encourage all areas of non-human primatological scientific research, to facilitate cooperation among scientists of all nationalities engaged in primate research, and to promote the conservation of all primate species. The Society is organized exclusively for scientific, educational and charitable purposes.

North American Veterinary Anesthesia Society (NAVAS). <https://www.mynavas.org/>.

Description: The North American Veterinary Anesthesia Society (NAVAS) helps veterinary professionals and caregivers advance and improve the safe administration of anesthesia and analgesia to all animals. Includes resources section with practice guidelines, drug information and formularies, and pain assessment tools and scales.

U.S. National Primate Centers

National Primate Research Centers. <https://www.nprcresearch.org/primate/>. Public website: <https://nprc.org/>

Description: There are seven National Primate Research Centers (NPRCs) that are specialized facilities for research using nonhuman primates (NHP). Staffed with experienced research and support personnel, each center provides the appropriate research environment to foster the development of NHP models of human health and disease for biomedical investigations. The NPRCs are affiliated with academic institutions and are accessible to eligible biomedical and behavioral investigators supported by research project grants from the NIH and other sources. The National Primate Research Centers were formerly called Regional Primate Research Centers. The name was changed in April 2002 to reflect the expanded role of the centers. The NPRC website maintains online bibliography on Health and welfare research in captive and wild primates (2000 to present).

- California National Primate Research Center, University of California-Davis, <https://cnprc.ucdavis.edu/>
- Oregon National Primate Research Center, Oregon Health and Science University, <https://www.ohsu.edu/onprc>
- Southwest National Primate Research Center, Texas Biomedical Research Institute, <https://snprc.org/>
- Tulane National Primate Research Center, Tulane University, <https://tnprc.tulane.edu/>
- Washington National Primate Research Center, University of Washington, <https://wanprc.uw.edu/>
- Wisconsin National Primate Research Center, University of Wisconsin-Madison, <https://primate.wisc.edu/>
- Yerkes National Primate Research Center, Emory University, <http://www.yerkes.emory.edu/>

Additional Primate Centers and Animal Colonies

Caribbean Primate Research Center, University of Puerto Rico, <http://cprc.rcm.upr.edu/>

Duke Lemur Center, Duke University, <https://lemur.duke.edu/>

Living Links: Center for the Advanced Study of Human and Ape Evolution (part of Yerkes National Primate Research Center, Emory University), https://www.emory.edu/LIVING_LINKS/