

Anesthesia and Analgesia in Rats

This is not intended to be an inclusive tutorial on all possible drug combinations that can be used in rats. The following guidelines are also general recommendations and consequently do not include reference to specific research-associated concerns. If you have questions about the use of anesthetics or analgesics for your particular situation, or if you have questions or comments about this document, please contact an IAS veterinarian.

*Anesthesia does not necessarily equate to analgesia.

Inhalational Anesthetics	Dosage	Comments
Isoflurane Recommended	3-5% for induction 1-3% for maintenance	300 µl in a 500 ml container- chamber induction for brief anesthesia. Maintenance requires use of a calibrated vaporizer.
Injectable Anesthetics	Dosage & Route	Comments
Dissociatives		
Ketamine + xylazine# Recommended	Ket 75-100 mg/kg IP + Xyl 5-10 mg/kg IP	Thermal support is crucial. To prolong anesthesia, supplement with 1/3 dose of ketamine only. Xylazine can be reversed with 1-2 mg/kg Yohimbine IP.
Ketamine + Acepromazine	Ket 75-80 mg/kg IP + Ace 1-2.5 mg/kg IP	Best for prolonged restraint, minor surgical procedures.
Ketamine + xylazine + acepromazine	Ket 40-80 mg/kg IP + Xyl 5-10 mg/kg IP + Ace 0.75-4 mg/kg IP	Provides a good surgical plane of anesthesia for most procedures at upper end of dose range. 60-120 min. sleep time
Ketamine + Midazolam	Ket 75-100 mg/kg IP Mid 4-5 mg/kg IP	Best for prolonged restraint, minor surgical procedures.
Ketamine + Dexmedetomidine#	Ket 75-100 mg/kg IP + Med 0.15 mg/kg IP	Provides a good surgical plane of anesthesia for most procedures.
Barbiturates		
Pentobarbital (Nembutal®)	40-50 mg/kg IP sedation 70-85 mg/kg IP anesthesia	Poor analgesic in rats. Narrow safety margin. Caution should be used to avoid overdoses.
Local Anesthetics		
Lidocaine 1%	4 mg/kg (0.4 ml/kg)	5 min onset of action
Bupivacaine 0.25%	Up to 2 mg/kg SC, intraincisional	30 min onset of action, can combine with lidocaine
Other		
Propofol (Diprivan®)	7.5-10 mg/kg IV for induction, then 44-55 mg/kg/hr continuous IV infusion	Titrate as needed
Urethane	1000 mg/kg IP	Caution! Prolonged anesthesia; terminal procedures only carcinogenic and mutagenic

Subcutaneous (SC), Intraperitoneal (IP), Intravenous (IV), oral (PO)

*Ketamine alone is not adequate for deep anesthesia or procedures that are painful. It is only to be used for immobilization.

#Reversal of α 2agonists such as xylazine and dexmedetomidine can be accomplished by giving atipamazole (Antisedan®) 1-2.5 mg/kg IM, IP, SC or IV

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Analgesics	Dose	Duration
Opioid		
Buprenorphine Recommended	0.01-0.05 mg/kg SC, IP	6-12 hr
Ethiqo XR® extended-release buprenorphine	0.65 mg/kg SC between the shoulder blades	72 hr
NSAID		
Meloxicam Recommended	1-2 mg/kg SC, PO	24 hr
Carprofen	5 mg/kg SC or 10 mg/kg PO	24 hr
Flunixin meglumine	2.5 mg/kg SC	12 hr (not commonly used)

Subcutaneous (SC), Intraperitoneal (IP), Intravenous (IV), oral (PO)

RAT Neonatal Anesthesia (mouse < 10 days of age)

Hypothermia- can only be performed in neonatal rodents < 6 days old and should not be used for procedures lasting longer than 30 minutes.

1. Place neonates either on a latex covered bed of crushed ice, in a cut off finger of a latex glove and place in ice water (animal's head must be held above water to prevent water aspiration and death) or a paper lined test tube and placing in crushed ice/ice water.
2. Animals have reached proper plane of anesthesia when pedal reflex is lost (animal does not respond to toe pinch).
3. Once proper plane is reached, remove pups from ice bath and placed on a chilled cold pack or bed of ice.
4. Use fiber optic light during procedure because incandescent bulbs can warm surgical field.
5. Following anesthesia, pups should be rewarmed slowly. Rapid warming can cause tissue damage. Pups can be rewarmed on a circulating water heating pad (40°C) or in an incubator (33°C).
6. Pups can be returned to dam once they are able to crawl.

Ketamine/Xylazine Dilution for Rodents

Ketamine (Ketaset®) 100 mg/ml

Xylazine (Rompun®, Anased®) 20 mg/ml *Be careful to verify that it is 20 mg/ml & not 100 mg/ml.

Diluent: 5% Dextrose (D5W) or normal saline (0.9% NaCl)

Stability: stable for 28 days stored under ambient conditions and at 4°C, protected from light (amber bottle).

Rat Anesthetic Dose

Ketamine 75 mg/kg + Xylazine 10 mg/kg

3.75 ml Ketamine (100 mg/ml) + 2.5 ml xylazine (20 mg/ml) + 3.75 ml D5W or normal saline for injection
Rats receive 0.2 ml/100 g body weight

Ketamine and xylazine diluted as above with D5W (5% dextrose) or normal saline are chemically and physically stable after storage for 28 days under ambient conditions of 4°C protected from light.

Ketamine + Xylazine + Acepromazine

Ketamine 50 mg/kg + Xylazine 5 mg/kg + Acepromazine 1 mg/kg

5 ml Ketamine (100 mg/ml) + 2.5 ml Xylazine (20 mg/ml) + 1 ml Acepromazine (10 mg/ml)+1.5 ml D5W or normal saline for injection
Rats receive 0.1 ml/100 g body weight

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Buprenorphine Dilution and Dosage Chart

Buprenorphine (Buprenex®) 0.3 mg/ml in boxes of 5 1 ml vials

Dilution for Rat: 0.5 ml Buprenorphine (0.3 mg buprenorphine/ml) + 9.5 D5W (5% dextrose in water) for injection to make a final concentration of 0.015 mg/ml. Using this dilution, dose rats according to the following chart. Buprenorphine is **light sensitive** so prepare dilution in an **amber bottle** or cover bottle with **foil**.

Rat	Dosage	
Weight	0.01 mg/kg	0.05 mg/kg
100 g	0.07 ml	0.33 ml
150 g	0.1 ml	0.5 ml
200 g	0.13 ml	0.67 ml
250 g	0.17 ml	0.83 ml
300 g	0.20 ml	1.0 ml

Stable for up to 30 d at 21°C or 4°C- Jappinen A, Kokki H, Naaranlahti TJ, Rasi AS. Stability of buprenorphine, haloperidol and glycopyrrolate mixture in 0.9% sodium chloride solution. Pharm World Sci. 1999; 21(6): 272-4.

NSAID DILUTIONS FOR RATS

Meloxicam dilution based on dose of 5 mg/kg for stock solution 50 mg/ml

1.0 ml Meloxicam (50 mg/ml) + 9.0 ml sterile water or 0.9% sterile saline=0.5 mg/ml

Carprofen dilution based on dose of 5 mg/kg for stock solution 50 mg/ml

1.0 ml Carprofen (50 mg/ml) + 9.0 ml sterile water or 0.9% sterile saline=0.5 mg/ml

RAT	Dosage	
Weight	Meloxicam 2 mg/kg	Carprofen 5 mg/kg
100 g	0.4 ml	1.0 ml
150 g	0.6 ml	1.5 ml
200 g	0.8 ml	2.0 ml
250 g	1.0 ml	2.5 ml
300 g	1.2 ml	3.0 ml

Please refer to **IACUC Policy 035 Use of Non-Pharmaceutical Grade Compounds in Animal Research**
Non-pharmaceutical grade chemical compounds, eg urethane, may be used for scientific investigation when scientific justification is provided. Acceptable reasons for use of non-pharmaceutical or chemical grade agents may be:

1. Scientific necessity.
2. Non-availability of an acceptable veterinary or human pharmaceutical-grade product.