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Isoflurane Anesthesia in the Octodon degus

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Inhalation anesthesia for **Octodon degus** using isoflurane in a nonrebreathing system is described. Ten laboratory raised degus were used to determine the optimum percentage of isoflurane to maintain surgical anesthesia. Time to loss of righting reflex, time to loss of toepinch reflex, duration of surgical anesthesia and time to standing unaided were recorded. Findings indicate that 2% isoflurane with 1.5 liters per minute of both nitrous oxide and oxygen provide surgical anesthesia.

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Introduction

The Octodon degus is a common rodent of central Chile. Like many of the South American rodents, it is a hystricomorph (Meunier and Fischer, 1985). The degu has shown some potential as a research subject in medical laboratories in the United States (Fulk, 1976). Also, it is moderately tolerant of heat stress. Thus, the degu may prove to be a new animal model that could be used in future studies of hearing loss, especially under field conditions. The current animal model for hearing loss studies at the U.S. Army Aeromedical Research Laboratory (USAARL) is the chinchilla. Since both the degu and the chinchilla are hystricomorph rodents, it is hoped that many similarities exist, especially in their audiograms. Here at USAARL, we have observed the degu to be a more prolific breeder than the chinchilla.

To accomplish auditory research, monauralizations and electrode implants are necessary. These techniques require a safe and satisfactory regimen of anesthesia. A search of the literature revealed the degu may be difficult to anesthetize (Letelier, Del Villar, and Sanchez, 1985; Letelier, Sanchez, and Del Villar, 1984; Paeile et al., 1984).

Isoflurane (Forane^{R}) has been shown to be a safe and effective anesthetic agent for chinchillas (Hargett and Record, 1989). The rapid induction of and rapid recovery from inhalation anesthesia, when compared with injectables used for surgical anesthesia in chinchillas, have been established (Hargett et al., 1988). Experience at USAARL has shown that 20 to 25 minutes of surgical anesthesia is sufficient for most procedures. For this reason, we have used inhalation anesthesia for most surgical procedures.

Isoflurane, a nonflammable liquid, is a new inhalation general anesthetic. Induction of and recovery from isoflurane are rapid. The level of anesthesia may be changed rapidly with isoflurane. Nitrous oxide reduces the inspiratory concentration of isoflurane required to reach a desired level of anesthesia and may reduce the arterial hypotension seen with isoflurane alone. Surgical levels of anesthesia may be sustained with a 1.0 - 2.5 percent concentration when nitrous oxide is used concomitantly. An additional 0.5 - 1.0 percent may be required when isoflurane is given using oxygen alone (Anaquest, 1987).

The present study was undertaken to evaluate the success of isoflurane in inducing surgical anesthesia in the degu. The inhalation anesthesia was delivered by mask using a nonrebreathing system.

Methods and materials

This study used 10 healthy 1- to 2- year old adult male and female degus, weighing from 192 grams to 298 grams, with a mean weight of 210 grams. These degus were from the USAARL issue colony and were housed in pairs in clear plastic cages with wire tops, approximately 43 X 23 X 21 cm (Figure 1). Bedding material lining these cages was ground corn cobs roughly 6 cm deep. They were provided with a commercial rodent ration* and water ad libitum.

The degus were not deprived of food or water before the experiment and were returned to their cages upon being able to stand unaided. Animals were assigned randomly to each of four conditions. Surgical depth was defined as the loss of righting reflex followed by the loss of toepinch reflex and was corroborated by subjectively evaluating the subject's general appearance and vital signs. The following data were gathered on each subject: Respiration rates, time to loss of righting reflex, time to loss of toepinch reflex, time from removing the anesthetic to return of toepinch reflex, and time from removing

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* See Appendix A

Figure 1. Degus shown in typical laboratory housing cage, with the top removed for better viewing.

the anesthetic to standing unaided. The time at surgical depth was limited to 20 minutes. This is neither a minimum nor maximum for the techniques tested, but merely a convenient benchmark. All times were taken with a stopwatch and rounded to the nearest 5 seconds.

Each degu was anesthetized using a nonrebreathing system employing a face mask. The degus were placed on a padded surface, and their heads were inserted into the mask (Figure 2). They were physically restrained until they lost their righting reflex. A setting of 5 percent isoflurane, with a flow rate of 2 liters per minute of nitrous oxide and 1 liter per minute of oxygen, was used for induction. When the toepinch reflex was no longer present, the degu was removed from the mask, its eyes were lubricated with Lubrifair® to prevent corneal drying, and it then was returned to the mask. The loss of toepinch reflex was taken to be the beginning of surgical anesthesia.

Each degu was maintained at surgical depth by using a 1.0, 1.5, 2.0, or 3.0 percent isoflurane setting, with a flow rate of 1.5 liters per minute of both nitrous oxide and oxygen (Figure 3). At the end of 20 minutes, the isoflurane and nitrous oxide were turned off (no flow) and the oxygen flow was maintained at 3 liters per minute. This allowed the degu to return to consciousness rapidly, without complications induced by nitrous oxide (Soma, 1971).

Figure 2. A degu being held in the mask at the time of induction of anesthesia.

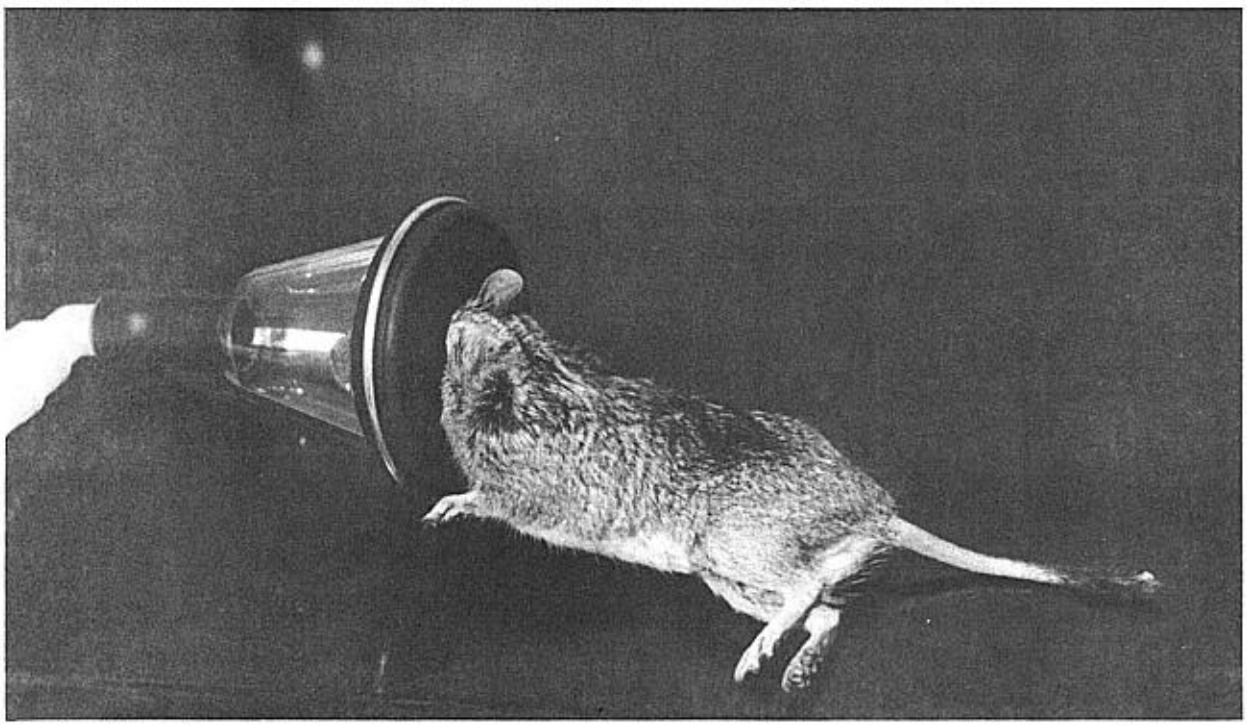

Figure 3. A degu being maintained at surgical anesthesia.

Results and discussion

All 10 degus were masked and induced in the same manner. After loss of toepinch reflex, each subject was maintained at the respective isoflurane flow rate for 20 minutes. Subject 1020 was maintained at 1.0 percent isoflurane which resulted in a return of the toepinch reflex, but not the righting reflex, during the 20 minutes of anesthetic flow. Time to standing unaided for this subject was the fastest for any degu in this study. See Table 1 for complete summary of results.

Table 1.
Isoflurane anesthesia by rates of flow

Subject	Dose	(1)	(2)	(3)	(4)
1048	2.0%	0:30	0:60	1:30	6:30
480	2.0%	0:30	0:45	1:30	4:00
493	2.0%	0:30	0:45	1:15	6:30
1034	2.0%	0:30	0:45	1:45	4:35
D-4	2.0%	0:30	0:45	1:15	3:30
D-2	2.0%	0:30	0:45	1:15	4:35
	Mean	0:30	0:47.5	1:25	4:57
1032	1.5%	0:40	0:40	1:30	6:25
1014	1.5%	0:40	1:00	NA	7:00
1020	1.0%	0:35	1:05	NA	2:45
483	3.0%	0:30	0:30	2:15	6:50

(1) Time to loss of righting reflex
(2) Time to loss of toepinch reflex
(3) Time to return of toepinch reflex
(4) Time to standing unaided
NA = Toepinch returned during time subject was on isoflurane

Subjects 1014 and 1032 were maintained at 1.5 percent isoflurane. Toepinch reflex returned during the 20 minutes on subject 1014, but not on 1032. Both subjects were able to stand unaided between 6 and 7 minutes.

Six subjects were maintained at 2.0 percent isoflurane. These degus had an average induction time of 30 seconds. Consult Table 1 for details. Average time to loss of toepinch reflex was 47.5 seconds. Average time to return of righting reflex was 1 minute and 25 seconds. Average time to standing unaided was 4 minutes and 57 seconds.

Subject 483 was maintained at 3.0 percent isoflurane. This degu remained at surgical anesthesia the entire 20 minutes and regained consciousness and stood unaided with no problems about 7 minutes after the end of anesthetic flow.

Conclusions

The induction rate of 5.0 percent with a flow rate of 2 liters per minute of nitrous oxide and 1 liter of oxygen allows for a rapid induction. Two percent isoflurane with a flow rate of 1.5 liters per minute of both nitrous oxide and oxygen provides excellent results as a maintenance dose, allows a quick recovery for the subject, and is safe for the subjects and personnel involved in administering anesthesia.

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Appendix A

List of manufacturers

BOC Health Care
Anaquest
Madison, WI 53713
(Forane)

Ralston Purina Company
Checkerboard Square
St. Louis, MO 63164
(Purina Laboratory Rodent Chow)

Pharmafair, Incorporated
110 Kennedy Drive
Hauppauge, NY 11788
(Lubrifair)