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METHOXYFLURANE ANESTHESIA IN MULE DEER *(Odocoileus hemionus)* FAWNS [1]

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Abstract: Methoxyflurane inhalation was used a total of 58 times to anesthetize 23 hand-reared mule deer *(Odocoileus hemionus)* fawns ranging from 25 to 85 days of age. Induction, maintenance, and recovery times were recorded for 28 anesthetizations. Induction time was unrelated to age and averaged 3 ± 1 min ($\overline{X} \pm SD$). Recovery time was longest in the youngest fawns and varied with the depth but not with the length of anesthesia. Induction and recovery were smooth, the depth of anesthesia was easily controlled, and analgesia and muscle relaxation was excellent. No adverse effects or complications were encountered.

INTRODUCTION

Physical exam, diagnostic, surgical and treatment procedures in animals may be quite difficult or impossible without the animal's cooperation. Physical restraint, accompanied by use of local anesthesia when necessary, is often sufficient for many of these procedures in domestic animals. However, physical restraint of wild ungulates frequently is ineffective and may cause stress induced death[6] or exertion myopathy.[2,3,5] Immobilization, tranquilization, or anesthesia may be necessary in these instances. General anesthesia may permit procedures to be conducted in a more precise and thorough manner.

A multitude of different injectable drugs and drug combinations have been used in mature animals.[4,7,8] However, many of these agents produce undesirable side effects, such as long recovery time and loss of the ability to regulate body temperature.[7] In addition, there are many species differences and the dosages may be quite critical with narrow margins of safety.[1] These disadvantages are further magnified in fawns because of: (1) the lack of information on acceptable dosages, and (2) the decreased ability of the neonate to metabolize and excrete drugs.[1]

Inhalant anesthetics obviate many of the disadvantages of injectable anesthetics. They have wider margins of safety, rapid recovery times, and decreased metabolic requirements for their removal from the body.[1] A major disadvantage is that anesthetic equipment is necessary for proper administration of inhalant anesthetics. A number of different inhalant anesthetics are available. Methoxyflurane[2] was chosen because it has a wide margin of safety, yet produces excellent analgesia and muscle relaxation.[1] In addition, it is not flammable at ordinary ambient temperatures.[1]

MATERIALS AND METHODS

Twenty-three mule deer fawns were removed from their dams 48 hrs. after birth, "bottle-fed" until weaned, and allowed to imprint on their human handlers. The management of these fawns is described elsewhere.[9]

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[2] MetofaneR. Pitman-Moore Inc., Washington Crossing, New Jersey 08560, USA

A standard Heibrink[1] in-circuit wick vaporizer gas anesthesia machine, equipped with a one liter bag, a canine mask, and 2 cylinders of oxygen, was used for all anesthetic procedures. The mask opening was decreased in size using electrician's tape to provide a snug fit around the fawn's muzzle. Methoxyflurane was placed in the vaporizer jar in an amount sufficient to allow full saturation of the wick.

All anesthetic administrations were conducted using 100% oxygen. On this machine the amount of anesthetic agent volatilized is based on a scale of 1 to 10. The highest setting, and an oxygen flow of one 1/min., were used for induction. The setting was then decreased to 2 and the oxygen flow to 700 ml/min. During surgical procedures the setting of the Heibrink vaporizer was varied from 1 to 4 as needed to maintain the level of anesthesia desired.

Two people are generally needed to conduct anesthesia in the easiest and most efficient manner. One holds the mask snuggly over the fawn's muzzle while the other restricts the fawn's movement. It is important that the fawn be allowed to stand during induction. Excitement and stress are greatly increased when this is not done; if allowed to stand there is only minor objection and resistance to the procedure.

Induction time was considered as the time from the application of the mask, until the fawns were no longer able to stand. The fawns were then placed in lateral recumbency and the anesthetic gas flow was reduced. Length and depth of anesthesia varied, depending upon the procedure being conducted. Recovery time was considered as the time from removal of the mask until the fawns were able to stand.

RESULTS

Methoxyflurane anesthesia was administered a total of 58 times to 23 fawns ranging from 25 to 85 days of age. No complications were encountered. The time necessary for induction, duration of anesthesia, and recovery was recorded in 28 of these anesthetic procedures (Table 1). There was no correlation between age and induction time ($r = 0.02$). Induction time averaged 3 ± 1 min. ($\overline{X} \pm SD$), recovery time 28 ± 18 min., and duration of anesthesia 16 ± 6 min. Recovery time appeared to be unrelated to duration of anesthesia, but did appear to be related to the depth of anesthesia induced.

DISCUSSION

Fawns accepted the mask and odor of methoxyflurane with little excitement or struggling, provided they were allowed to remain standing during induction. Repeated administration of the anesthetic were as well tolerated as the first. One fawn was anesthetized five times for the treatment of dog bites.

Methoxyflurane provided a rapid, smooth induction, excellent analgesia, and muscle relaxation, as well as a rapid, smooth recovery. The margin of safety appeared to be wide.

The depth of anesthesia was easily controlled to obtain the level desired for the specific technique being conducted. Fawns less than 70 days of age were subjected to skin biopsies and sutures which required only light anesthesia. A deeper depth of anesthesia was used in the older animals to prevent movement of the hind legs during castration. The difference in level of anesthesia is reflected by the longer recovery times in the older age group (Table 1). The longer recovery times in the younger animals may be related to a more prolonged depression of the central nervous system. This effect

[1] Heibrink Kinet-O-Meter, Model 685A, Ohio Chemical and Surgical Equipment Co., Madison, Wisconsin, 53700, USA

TABLE 1. Length of time for induction, duration of anesthesia, and recovery of mule deer fawns using methoxyflurane inhalation.*

Age (days)	Number of Fawns	Induction (minutes)	Duration of Anesthesia (minutes)	Recovery (minutes)
25	8	3 ± 1** (2-3)	15 ± 3 (11-21)	42 ± 25 (10-87)
42-43	12	3 ± 1 (2-5)	21 ± 4 (15-29)	21 ± 9 (9-38)
59-69	6	3 ± 1 (2-5)***	12 ± 5 (6-19)	21 ± 8 (14-32)
75-85	3	3 ± 1 (2-3)	9 ± 3 (5-11)	41 ± 18 (20-52)

*The level of anesthesia induced was similar and light in fawns less than 70 days of age, but was deeper in the oldest group.

**$\overline{X} \pm$ SD (range)

***Induction time in one animal in this group was 9 minutes.

lengthens the period of sleep after surgery and is not related to depth of anesthesia[1] (Table 1).

During maintenance of anesthesia salivation was minimal, and respiration as well as heart rate remained unaffected. Body temperature decreased 0.5 to 1 degree centigrade in most of the fawns. It is, therefore, advisable to keep the animal warm during anesthesia and recovery so as to maintain the body temperature within the normal range. Recovery time can be accelerated by discontinuing the administration of the anesthetic a few minutes ahead of completion of the surgical procedure.

This procedure of anesthesia was also successfully used for the castration of three hand-raised Bighorn Sheep 4 and 5 months of age.

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