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CASE REPORT

Effect of Ketamine Hydrochloride Induced Anaesthesia on *Psammophis Sibilans*

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SUMMARY

This study sought to determine the actual dose of ketamine hydrochloride to be used to achieve surgical plane of anaesthesia in hissing sand snake (*Psammophis sibilans*). Ketamine hydrochloride was administered intravenously to the snakes at different doses based on their body weight, and some physiological parameters were monitored. Twelve snakes divided into four groups A, B, C and D were administered ketamine hydrochloride intravenously at 60 mg/kg, 46 mg/kg, 40 mg/kg, and 30 mg/kg respectively. With 40 mg/kg, a good plane of surgical anaesthesia was achieved in this species of snakes. The dose was able to achieve both anaesthesia and analgesia. Other dose recommended for anaesthesia was 30 mg/kg. It is concluded that dose higher than 46 mg/kg may cause the death of the animal. These result shows that ketamine hydrochloride is generally effective at 40 mg/kg in the *Psammophis sibilans*, with no wide individual variation in the time to onset (3.5±0.7 mins), duration of anaesthesia (23.5±9.19 mins), and time to recovery (36.5±25.1 mins).

Key words: Ketamine hydrochloride, *Psammophis sibilans,* righting reflex, anaesthesia.

INTRODUCTION

The domestication of reptiles as pets and for physiotherapy in some quarters is becoming more popular (Mariana *et al* 2011; Virata, 2014). This makes it increasingly important to understand handling and treatment of this species of animals (Bennet *et al.,* 1998). Reptiles generally pose a number of behavioural and handling issues when compared to other domestic species. For example, if reptiles are not restrained properly, they may constitute hazard to their handler, and careful selection of restraining technique and agent are required. The ideal agent for restraint should provide muscle relaxation, analgesia, easy control and should be safe for the personnel as well as the patient.

Ketamine hydrochloride is a dissociative anaesthetic agent and like other phencyclidines, it produces a trance-like state. This state results from an electrophysiological dissociation between limbic and higher cortical system (Lau and Zed, 2001; Petriollo *et al*., 2001; Allen and

Maized, 2005). In snakes, dosage of this agent depends on body temperature (Arena *et al.*, 1988). Recommended dosages range from 12 to 44 mg/kg for sedation and 55-88 mg/kg for surgical anaesthesia via intramuscular administration (Bouts and Gasthuys 2002). Patients anaesthetized with ketamine hydrochloride appear to have their awareness blocked from external stimuli, including auditory, visual or pain-related input (Glenn *et al.*, 1972). In snakes, intramuscular administration of ketamine hydrochloride has a disadvantage as it takes about seven days for the patient to recover (Bennet *et al.*, 1998) due to their slow metabolic rate. The effects of injectable anaesthetic agents that are excreted unchanged by the kidneys are diminished when injected into the caudal half of the snake body because of the renal portal system. There is paucity of information on the effect of anaesthetic agents on snakes via the caudal vein, and to our knowledge intravenous administration of ketamine hydrochloride in snakes has not been investigated.

MATERIALS AND METHODS

Twelve *Psammophis sibilans* snakes were collected around the Ahmadu Bello University dam. They were kept and allowed to acclimatize for two weeks in the herpetorium of the Department of Veterinary Pharmacology, Ahmadu Bello University where they were fed once a week with rats and water was provided *ad lib.*

The snakes were physically restrained using a snake tong. Pre-anaesthetic evaluation was done by sending blood and faecal samples of the snakes to appropriate laboratories for haemoparasite, ova and oocyst screening to ensure the animals were fit for the procedure. The snakes were treated appropriately based on the results obtained from the laboratories. Baseline values (length and circumference were measured using tape rule, weight was measured using a digital scale, cloaca and ambient temperatures, were monitored for each group using the veterinary multiparameter patients monitor G3L, Meidreich Medical Company, Hong Kong). By direct visual examination, the heart and respiratory rates were determined in each snake. Anaesthetic parameters evaluated were; onset of anaesthesia, duration of anaesthesia and recovery time. The evaluation was done based on the examination of righting reflex, following administration of ketamine hydrochloride.

The snakes were divided into four groups A, B, C and D with each group comprising of three snakes. The snakes were administered intravenously at 60 mg/kg, 46 mg/kg, 40 mg/kg and 30 mg/kg ketamine hydrochloride (Ketamin® Rotexmedica-Germany) to groups A, B, C, and D, respectively (Table 1). Each of them were weighed using digital weighing balance and their weight obtained in grams. The length of each snake was determined with a measuring tape. Visual assessment was done to determine the sex of the snakes by massaging the cloacal region to identify the presence or absence of hemipenis.

Evaluation of parameters

Ambient and cloacal temperatures were measured using the multi-parameter monitoring machine. The probe of the machine was disinfected using chlorhexidine and inserted into the cloacae. A masking tape was used to keep the probe in position throughout the experiment. The respiratory rate was assessed visually and counting of the number of inspiratory and expiratory movements of the body. It was difficult to count the respiratory rate because the respiratory rate was shallow due to basal metabolism. Muscle relaxation was observed by observing the movement of the tail of the snake. Complete loss of righting reflex denoted onset of anaesthesia, while recovery time was determined by observing the elicitation of righting reflex and analgesia by loss of response to tail pricking.

Table 1: Experimental grouping of the snakes induced with ketamine

Groups	Number of snakes	Dosage (mg/kg)
A	3	60
B	3	46
C	3	40
D	3	30

Table 2: Baseline values of length, circumference and weight in *Psammophis sibilans*

Groups	Length(cm)	Circumference(cm)	Weight(g)
A	108 ± 6.02	5.0 ± 0.2	220 ± 18.00
B	120 ± 0.2	7.9 ± 0.5	200 ± 10.32
C	112.5 ± 12.02	7.5 ± 0.7	229.2 ± 61.09
D	119 ± 18.38	6.5 ± 0.6	247.75 ± 17.32

Mean ± SPEM, n=3

Table 3: Fluctuations in cloacal and ambient temperatures of snakes following ketamine hydrochloride-induced anaesthesia (Mean ± SEM, n = 3)

Time	A (60mg/kg)	B (46mg/kg)	C (40mg/kg)	D (30mg/kg)	Ambient temperature
10	29.85 ± 2.61	28.3 ± 3.50^{a}	29.85 ± 2.61^{a}	27.9 ± 0.64^{ab}	27.8 ± 1.61
20	27.9 ± 0.64	28.2 ± 2.33^{a}	29.80 ± 2.54^{b}	27.9 ± 0.64^{bc}	27.2 ± 1.38
30	-	28.9 ± 3.11^{a}	29.25 ± 3.04^{b}	27.9 ± 0.64^{a}	27.6 ± 1.27
40	-	29.1 ± 2.89^{a}	29.30 ± 2.68^{b}	27.5 ± 0.0^{b}	27.6 ± 1.15
50	-	29.2 ± 2.75^{b}	29.05 ± 27.5^{ab}	27.4 ± 0.07^{bc}	28.3 ± 0.63
60	-	28.9 ± 2.75^{b}	29.35 ± 2.33^{ab}	27.4 ± 0.07^{bc}	28.1 ± 1.21
70	-	31.0 ± 0.0^{a}	29.60 ± 2.40^{a}	27.4 ± 0.07^{bc}	27.4 ± 0.00
80	-	30.0 ± 0.0^{a}	27.90 ± 0.28^{a}	27.5 ± 0.07^{a}	27.3 ± 0.00

Different superscripts in a row indicate significant difference at P<0.05

RESULTS

Result of samples sent to the laboratory shows ova of Strongyloides spp in all the animals. Ketamine was found to be effective at 40 mg/kg in the Psammophis sibilans. There was no wide individual variation in the degree of restraint, time to onset, and time to recovery. The results in groups A, B, C, and D for length of the snakes (108 ± 6.0, 120.0 ± 0.2, 112.5 ± 12.0 and 119.0 ± 18.4), circumference (5.0 ± 0.2, 7.9 ± 0.5, 7.5 ± 0.7 and 6.5 ± 0.6) and weight (220. ± 18.0, 200.0 ± 10.3, 229.2 ± 61.1 and 247.8 ± 17.3) respectively were as recorded in table 2. There were no anaesthetic complications in snakes that were administered ketamine at 46 mg/kg and below. The snakes recovered from anaesthesia, except those in Group A that were administered with 60 mg/kg of ketamine hydrochloride, which died shortly (20 minute) after ketamine injection. The peak effect of sedation and analgesia were observed in Group C, which had an onset of action of 3.5 ± 0.7 minute at an ambient temperature of 30.3 ± 2.1 ºC, cloaca temperature of 29.8 ± 2.5ºC and duration of anaesthesia of 23.5 ± 9.2 minute (Table 3). The snakes remain sedated for 36.5 ± 26.1 minute. At 38 mg/kg, muscular tone was maintained, and the snakes continually

Table 4: Evaluation of anaesthetic indices in snakes

Parameters	Group A	Group B	Group C	Group D
Onset of anaesthesia (minutes)	1.0 ± 0.0	2.0 ± 0.0	3.5 ± 0.70	15 ± 0.0
Duration of anaesthesia (minute)	-	14.0 ± 0.0	23.5 ± 9.19	61 ± 49.5
Recovery time (minutes)	-	26.0 ± 0.0	36.5 ± 26.1	19 ± 7.07

exhibited slow righting movement along their length whilst handled. However, at 60 mg/kg all the animals in that group died. Animals that were administered with 30 mg/kg were sedated, but head and tail reflex were not abolished.

DISCUSSION

Earlier reports indicated that surgical plane of anaesthesia could be achieved using ketamine hydrochloride to induce anaesthesia following intramuscular administration of between 55 and 80mg/kg (Bennet *et al*., 1998; Bouts and Gasthuys 2002). In this study, surgical plane of anaesthesia was achieved between 40 mg/kg to 46 mg/kg by intravenous administration of ketamine hydrochloride. The period of anaesthesia could be extended by injecting additional ketamine hydrochloride once the snake start responding to painful stimuli, but it proved unwise to administer more than a total dose of 46 mg/kg.

The major objective of using ketamine hydrochloride intravenously was to compare it anaesthetic effect to that induced following intramuscular administration. This agent is preferred because at anaesthetic dosages, it causes minimal cardio-pulmonary depression (Arena *et al.*, 1988).

The onset of anaesthesia was 15 minutes for ketamine hydrochloride at 30 mg/kg, 3.5miute at 40 mg/kg, and 2 minute at 46 mg/kg. At 60 mg/kg, no useful result was obtained. The animals were observed by monitoring the time at which head and tail reflexes were lost following the use of ketamine hydrochloride. Loss of head reflex was observed at about the same time as the onset of anaesthesia (Table 4). However, for snakes administered with 30 mg/kg sedation and tail and head reflexes were intact throughout the duration of the experiment. Therefore, 30mg/kg was adequate to achieve good sedation in this species of snakes. The respiratory rate of animals in the group was 6 cycles per minute prior to induction, and maintained at 3 cycles per minute all through. ketamine causes respiratory depression (Matt *et al*., 2004). This was not so with animals in the group administered with 40 mg/kg, in which induction, was accompanied with an increase in respiratory rate. After 10 minute of induction the respiratory rate was maintained at 2 cycles per minute and the later value became 1 cycle per minute after another 10 minute. On recovery, respiratory rate returned to 2 cycles per minute. For other groups (46mg/kg and 60mg/kg), respiratory rate was 6 cycles per minute prior to induction, 2 cycles per minute at onset of anaesthesia, and was maintained at this value all through the duration of anaesthesia. The result showed that the respiratory rate of *Psammophis sibilans* under anaesthesia was 2 cycle per minute.

The mean durations of anaesthesia are 14.0 ± 0.0, 23.5± 9.19, 61 ± 49.5 minute for group B, C and D, respectively, and the anaesthesia was accompanied by a complete loss of body reflexes. This result showed that ketamine hydrochloride at 30 mg/kg is effective to achieve a good surgical plane of anaesthesia as evidenced by the long duration of action, compared to the dose administered in other groups. However, snakes in this group (30 mg/kg) were only sedated, the analgesic property of ketamine hydrochloride was not observed, as reflexes

were maintained all through. The complete loss of reflex in the group administered with ketamine at the dose rate of 40mg/kg showed that the agent exerted analgesic and sedative properties.

Recovery period was observed by monitoring the time at which head and tail reflexes were regained. This finding was observed at 26.0 ± 0.0, 36.5 ± 26.1 and 19 ± 7.07 for snakes administered with 46 mg/kg, 40 mg/kg and 30 mg/kg ketamine hydrochloride respectively. Thus the use of intravenous ketamine hydrochloride has an advantage because the animals recovered in less than an hour, compared to those given via intramuscular. This is in contrast to previous findings by Bennet et al., (1998), who proposed that ketamine administration is disadvantageous in reptiles as it takes about seven days for this species of animal to fully recover due to the body metabolism.

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