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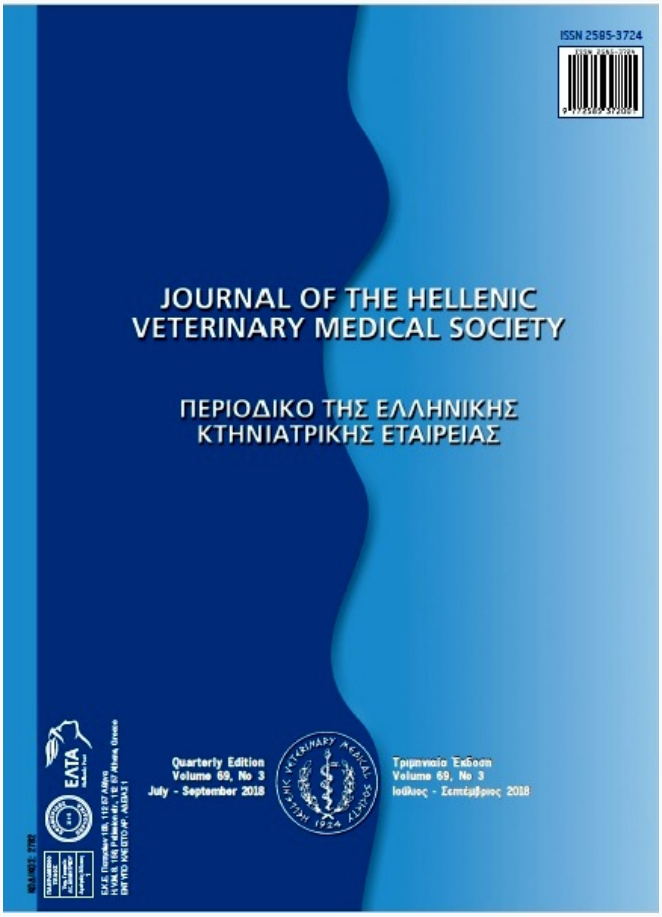

Effects of diazepam, ketamine HCl and sevoflurane anesthesia on vital and recovery values of nine long legged buzzards (Buteo rufinus) upon wing amputation

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Research article
Ερευνητικό άρθρο

Effects of diazepam, ketamine HCl and sevoflurane anesthesia on vital and recovery values of nine long legged buzzards (*Buteo rufinus*) upon wing amputation

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ABSTRACT. In this clinical study, effects of diazepam + ketamine HCl + sevoflurane anesthesia on vital functions and recovery duration and qualityofnine long legged buzzards were evaluated upon wing amputation. Operation was decided for long legged buzzards and heartand breathingrate, body temperature, and reflexes of long legged buzzards were evaluated before, during and after the anesthesia. Diazepam and ketamine HCl injection increased the heart rate whereas it was decreased by sevoflurane. Respiratory rate decreased upon sevoflurane application. Body temperature decreased during anesthesia. Recovery began in the 3rd minute after cessation of sevoflurane administration with return of eye reflexes and completedin the 35th minute. It was observed that although birdsrecovered from anesthesia, danger of hypothermia persisted for a long time.There was a significant difference between the respiratory and heart rates during the ketamine HCl and sevofluraneanesthesia from those in the preoperative period. However, there was no statistically significant difference between pre and post operative periods in terms of vital parameters. For the first time, effects of diazepam + ketamine HCl + sevoflurane anesthesia combination on vital parameters are evaluated in long legged buzzards in Turkey.

Keywords: long legged buzzard (*Buteorufinus*), wing amputation, diazepam, ketamine HCl, sevoflurane

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INTRODUCTION

In the literature, the reliability of anesthesia application to birds has been discussed. The advantages of injectable anesthetics are the ease of use, being economical and they ensure fast induction. Their disadvantages are inadequate muscle relaxation, necrosis at the injection site, maintenance dose risks and low recovery success. Diazepam, midazolam, xylazine or medetomidine in combination with ketamine is preferred for premedication (Durrani et al., 2009;Girling, 2009;Lierz and Korbel, 2012; Forbes, 2014; Lennox, 2015).

The dose of diazepam has been reported as 0,1-0,5 mg/kg (Girling, 2009). Ketamine ensures approximately 30 minutes surgical anesthesia when it is given intramuscularly (IM) at 4-10mg/kg (Forbes, 2014). Due to complications such as hyperthermia, tachycardia, and superficial respiration, it is not recommended to use alone ketamine HClin some birds e.g pigeons (Durrani et al.,2009).Isoflurane and sevofluranearepreferred for inhalation anesthesia(Mckeown and Hennigh, 2014).

In this study, it is aimed to evaluate effects of diazepam+ ketamine HCl + sevoflurane anesthesia on vital functions and recovery period before, during and after anesthesia in long legged buzzards upon wing amputation.

MATERIAL AND METHODS

Animals

In this study; raptors were injured with gun-pow and transported by rescue team for the treatment of Mustafa Kemal University, Faculty of Veterinary Medicine, and Department of Surgery in Hatay/ Turkey Of all 23 wild birdswhich were provided to the clinics in one year, 14 of them were determined as long legged buzzards. Upon clinical and radiological examinations of these animals, they were classified according to treatment processes. Nine of the long legged buzzards animals had infections as well as necrotic, open and comminuted fractures.According to the results of examinations, wing amputation was decided in 9 of the long legged buzzards

Clinicial examination

General health statuses of animals were assessed. Animals which had bad health statuses were orally administered antibiotics of Baytril %10 (1ml/1lt),A andB vitamins.Five cc of lactated Ringer's and 5% dextrose solutions were givento animals subcutaneously. During this process, antiseptic wound dressings and bandages were applied to the wings of the animals. Animals which were sufficiently healthy for surgical interventions were operated. Continuous ECG monitoring (Petas, KMA 800) was usedto follow heart and, respiration rates, body temperature before, during and after the operation. The number of normal heart, respiratory rate and body temperature are given in table 1.

Anesthetic procudures

Anesthesia induction was performed by using 0.5 mg/kg IM diazepam and 40 mg/kg IM ketamineHCl (alpha, Egevet) 10 minutes after diazepam application (Girling, 2009) at the muscles semimembranosous and semitendinosous. Patient was up on the anesthesia. During ketamine anesthesia is done preoperative procedure such as patients' feather collected, asepsia

Table 1: Change in Vital Parameters of Long Legged Buzzards (n=9)

Period	The heart rate (mean±SD)	Respiratory rate (mean±SD)	Body temperature (mean±SD)
Before the application	157±32^{a}	44±24	39,4±5,1^{*,d}
Diazepam	240±24^{b,d}	60±18^{a,c,d}	39,0±4,7^{a,b,c}
Ketamine HCL	286±46^{a,c,e}	56±13^{b}	38,2±3,8
Sevoflurane	118±15^{a,b,c}	30±9^{a,b,c}	36,0±4,1^{a,c,d}
20 minutes after waking up	134±22^{d,e}	38±13^{d}	36,4±2,1*^{,b}

^{*,a,b,c,d,e}When cells in the same column were evaluated between each other, there were significant differences between same letters ($p<0.05$).

and antisepsia. After then, upon induction, tracheal intubation (endotracheal tube, internal diameter 2.5) was applied 10 minute later and 100%O_2 and 1-4% concentrations of sevoflurane anesthesia were applied by a non-rebreathing system with spontaneous respiration. Operative interventions were finalized during the 80-90 minutes anesthesia process. During interventions, and vital parameters (body temperature, heart and respiratory rates) were continuously followed up (Table 1). Statuses of reflexes were controlled before and after the anesthesia (Table 2).

Table 2: Status of Long Legged Buzzards Before and After the Anesthesia (+: present, -: absent, min: minutes) (n=9)

Reflex/Anesthesia	Diazepam	KetamineHCl	Sevoflurane	Awakening
Eye Reflex	+	+	- (5±1,1 min)	+ (3±0,8 min)
Swallowing	+	+	- (6±1,7 min)	+ (5±1,1 min)
Foot Movement	+	-(5±2,1 min)	-	+ (9±1,8 min)
Wing beat	+	-(6±1,9 min)	-	+ (13±2,3 min)
Head Movement	+	-(7±2,1 min)	-	+ (18±5,1 min)
Full Recovery				+ (35±5,4 min)

Statistical methods

Statistical analyses were performed by using SPSS 17.0 program. Independent Samples T-Test was used to compare two independent groups and One-way ANOVA and Post-hoc Tukey tests were used to compare more than two groups. Values were represented as mean±standard deviation (mean±SD) and the statistical significance was accepted when p value was lower than 0.05 ($p<0.05$).

RESULTS

It was determined that diazepam led to decrease in reflexes but it did not eliminate any of the reflexes in long legged buzzards. It was observed that diazepam increased the hearth and respiratory rates whereas it did not change the body temperature. Ketamine HCl stopped coordination and convulsive reflexes. It increased the heart rate and prominently decreased the body temperature. It was determined that ketamine HCl did not influence significantly breathing, swallowing and eye reflexes. Even though animals had swallowing reflex, intubation was applied and there was no complication in*Buteo rufinus*.It was also shown that sevoflurane eliminated all reflexes from the 6th minute of its application.It decreased the hearth rate, and prominently reduced the respiratory rate and body temperature.

When the 3% sevoflurane inhalation anesthesia was applied, even though all conditions of the anesthesia were ensured, there were pain and leg motions in three animals during plucking of feathers. When 4% of sevoflurane was given, these reflexes were not observed and it was decided that the ideal starting concentration of sevoflurane was 4%. In the25th minute upon anesthesia, all patients were stabile when they were administered the 2% concentration sevoflurane anesthesiaand when 1% concentration anesthesia was given to patients in the 40th minute (during the suture applicationprocess).Upon suture application process, sevoflurane inhalation was stopped and observed the animals recovered (Table 2).

In case of recovery parameters, eyelid motions started in the 3rd minute. Swallowing reflex, head movements to sides and pedal reflexes were observed in the 8th minute. The animal flapped its wings in the 18th minute and the full recovery was observed in the 35th minute. It took long time to have the ideal body temperature and it was observed that the danger of hypothermia continued for 2 hours after the recovery. There was no significant difference between pre and post operative periods in terms of vital parameters. On the other hand, there was a significant difference between the body temperature and preoperative sevoflurane anesthesia ($p<0,05$). Statistical differences were shown in Table 2.

When postoperative periods were assessed between each other, two animals died presumably due to hypothermia in 0to 6 hours and two animals died because of the stress and bad general condition on the 4th and 5th days. Full recovery and healing were observed in remaining animals and sutures were removed on the 10th day. Long legged buzzards which could not be left in their natural habitat due to amputated wings were delivered to Forestry and Water ministry officials. Then, healthy animals were given to Gaziantep Zoo.

DISCUSSION

The aim of the premedication is to decrease the salivation and mucus amount, but on the other side it may lead to the risk of airway obstruction by increasing the mucus viscosity (Paul-Murphy and Fialkowski, 2001). Ketamine + Diazepam combination is preferredin case of painfulprocedures in patients. The use of ketamine alone in birds is not recommended (Mahmud et al., 2014). Diazepam dose is 0.1-0.5mg/kg (IM) (Girling, 2009). Diazepam can lead to ataxia (Abou-Madi, 2001). In this study, preanesthetic induction was performed by giving 0.5mg/kg IM diazepam. It was determined that 0.5mg/kg diazepam diddecrease in reflexes but it did not eliminate, there was no ataxia and airway obstruction, the animal only become tranquilized, and did not allow the intubation. Diazepam slightly increased the heart and respiratory rates and it did not lead to prominent alteration in the body temperature (table 1.,2.).

Intubation can be hard due to laryngospasm (Şenel, 2008). Insufficient premedication and anesthesia led to complications of bronchospasm during the intubation in a study (Ünsaldı,2015). In wild poultries, 10mg/kg ketamine HCl ensures a short time anesthesia(Kibar and Bumin, 2006, Aslan et al., 2009, Forbes, 2014). In our study, 40mg/kg IM ketamine HCl was used. Although the swallowing reflex was present, intubation was slowly performed without complications. This dose of ketamine, although high enough, was accepted appropriate for sufficient anesthesia, and intubation without pain and complication. In poultries, when 20-50mg/kg ketamine alone is used, it can lead to both insufficient anesthesia and excitation and hypothermia can also be observed. There can also be low recovery success (Girling 2009). Dose of 60 mg/kg Ketamine HCl leads mild sedation and anesthesia. However, it should not be used alone also for its possible complications such as hypothermia, tachycardia and shallow breathing (Durrani 2009). In our study, higher doses of ketamine HCl were not required since the anesthesia was continued by using sevoflurane. 40mg/kg IM ketamine HCl was eliminated the wing and pedal reflexes, but eye and swallowing reflexes were still observed. Acceleration of the heart rate from awake state was statistical significant (table 1.,2.).

In both injectable and inhalational anesthesia applications, hypothermia is one of the important risks (Lierz and Korbel, 2012). Warming the body during the delivery of inhalants, and taking precautions for heating the body minimize the hypothermia until the end of the recovery process (Chan et al., 2013). In this study, it was observed that hypothermia occurred and the body temperature of the animal reduced to 36.4^{0}C, hypothermia led to deaths in the postoperative period and hypothermia risk continued even in case the full recovery was observed. Furthermore, it was determined that external heating precautions had vital roles during the 5 to 6 hours of the postoperative period.

It has been reported that use ofsevofluranehas been recently increasing despite its high costs; sevoflurane have faster inductionand reanimationand these drugs can be preferred in the inhalation anesthesia (Chan et al., 2013, Mckeown and Hennigh, 2014). Sevoflurane inhalation is stated that its induction dose is 5-6% and its maintaining dose is 3-4% (Girling 2009). In this study, the clinical importance and effects of sevoflurane in rapptorsare clearly shown.It was decided that the ideal starting concentration was 4% and the maintaining dose was 2%. No reflexes and pain sensations were observed when these concentrations were applied to animals.Two of our animals died due to hypothermia in the postoperative period. Even though the full recovery was seen, hypothermia continued for two hours. During the reanimation period, the standing position of the animal took 35±5,4 minutes, the eyelid motions were observed in the 3rd minute after the anesthesia was stopped. The full recovery was completed in totally 35±5,4 minutes.

For the first time in Turkey, effects of anesthetic combination Diazepam + ketamine HCl+ Sevoflurane on vital parameters of long legged buzzards were evaluated in this study. It was determined that 0,5mg/kg IM, 40mg/kg IM Ketamine HCl, %100 O_2 and %1-4 Sevoflurane anesthetic combination was acceptable for free living buzzards.

CONFLICT OF INTEREST STATEMENT

All the authors declares that there is no conflict of interest for the presented case repost.

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