



Overdosage of Ketamine Anaesthetic Agent in Cats with Special Reference to Clinical Assessment



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THIS study aimed to evaluate clinically the anesthetic overdosage of ketamine in cats. 10 local adult cats from both sexes were used to conduct this study. High dose of ketamine (150 mg/kg) was administered intramuscularly in all cats. Measurement of heart rate and respiratory rate as well as checking of certain reflexes were performed at regular intervals for 6 hours. Sedation, analgesia and muscle relaxation were evaluated depending on certain scores. Critical levels or clinical signs of cyanosis were not observed following administration of this high dose of ketamine which was confirmed by the measured values. Deaths of the anesthetized cats were not reported due to ketamine overdosage. High extension of the recovery period was only the main noticed result of the increased dose level of ketamine without any improvement in the anesthetic effect of this drug. Excellent sedation, profound analgesia and moderated muscle relaxation were reported in almost all anesthetized cats. In conclusion, clinical signs of acute toxicity were not reported and severe misjudgments of the bodyweight resulting in high dose of ketamine or even accidental administration increased dose level would not result into fatal outcomes.

Keywords: Ketamine, Ketamine overdosage, Anaesthesia of cat, Cats.

Introduction

The evaluation of anesthetic complications was performed rarely in the veterinary studies [1]. The identification of factors which represent major risk of death associated with anesthesia may reduce complications rate. In cats, certain factors that are associated with perioperative mortality such as poor health status, xylazine administration, endotracheal intubation and lack of anaesthesia monitoring [2]. In cats, the mortality rate during or following anaesthesia is thought to be higher than other species. The exact frequency is unknown and only few data related to the causes of death are available [3]. Ketamine is an N-methyl D-aspartate (NMDA) antagonist which leads to dissociation between the thalamo-neocortical and limbic systems [4]. Ketamine can be administered intravenously, intramuscularly or buccally in cats [5]. Ketamine hydrochloride

is one of the dissociative anesthetics with central sympathomimetic activity. If ketamine is administered solely, it produces mild muscle relaxation and continual pain reflex as well as twitching of muscle, rigidity and centrally mediated seizures. Furthermore, Ketamine results in cardiac function depression which is dose dependent [6]. Ketamine is cheap, widely available, and low dose of ketamine results in less hemodynamic and respiratory adverse effects in comparison with opioids [7]. Ketamine is a common choice for the anesthetic protocol as it leads to a predictable effect such as supporting cardiovascular function and depression of respiratory function less than other anesthetic drugs. Typical doses (5–10 mg/kg) of ketamine are of low volume of injection and produce analgesic properties [8]. However, prolonged recoveries of cats are associated with ketamine where a range of emergence phenomena are displayed. These phenomena include increase

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of sensitivity to both touch and noise (tactile and auditory hyperesthesia), increase of motor activity and ataxia that may last several hours following administration. The emergence phenomena delay the return to normal function and interfere with assessment of pain [9]. Accurate pre-anesthetic evaluation of the hydration status, kind of the intended surgical operation and possible risky loss of blood and fluid must be regarded to necessity determination for the fluid therapy [10]. There are evidenced increased mortality rates caused by fluid therapy which are fourfold in comparison to cats not received fluid therapy. Cats are considered to be more susceptible when overhydrated than other animals like dogs because of lower total blood volume which is about (170 mL) for cat of 3 kg body weight. Measurement of central venous pressure or using infusion pumps (which is an important factor for accurate rate of fluid delivery) are not done [11]. In addition to cats, ketamine is used to anesthetize other animals such as dogs and rabbits for diagnostic and surgical purposes [12-14].

This study aimed to evaluate clinically the anesthetic overdosage of ketamine (150 mg/kg of body weight) in cats.

Material and Methods

This study was conducted on 10 adult healthy local cats from both sexes with a body weight ranged between 2.5 to 4 kg and aged 1 to 3 years. Indoor cats were used to perform the current study. Fasting of cats was performed 12 hours and were weighed by electronic scale prior to anesthesia. Physiological variables like rectal temperature, heart rate and respiratory rate were measured and recorded for individual cat in separated monitoring sheet. Each animal was administered intramuscularly with high dose of ketamine equivalent to 150 mg/kg of body weight. Induction time of anesthesia, time of elapsed stage, duration and recovery from anesthesia were recorded. Measurement of vital signs such as heart rate and respiratory rate as well as checking of certain reflexes were performed at regular intervals for 6 hours. Sedation, analgesia and muscle relaxation were evaluated depending on certain scores [15] as shown in (Table 1). Time of injection was considered as time 0, physiological parameters were collected every 15 minutes interval.

TABLE 1. The criteria which were used to assess clinically the anesthetic effect of ketamine

Criteria	Score	Observation
Sedation score (evaluation based on degree of immobilization, calmness, reflexes disappearance and loss of consciousness)	0	No sedation (animal moves around and all reflexes are preserved)
	1	Mild sedation (sternal recumbency but animal is alert and all reflexes are preserved)
	2	Moderate sedation (sternal recumbency, dropped head, salivation, vomiting without response to stimuli)
	3	Profound sedation (animal laid easily on lateral recumbency, without movement and no response to stimuli)
Analgesia score (evaluation made by needle break over all body and particularly at sensitive areas such as interdigital space and scrotum)	0	No or poor analgesia (animal refuses handling and is completely aroused)
	1	Mild analgesia (violent response to stimuli)
	2	Moderate analgesia (there is only response to pin break stimuli on highly sensitive areas)
	3	Profound analgesia (excellent) (no response to pin break stimuli at whole body)
Muscle relaxation score (evaluation based on easiness degree of mouth opening and flexion degree of hind limb)	0	Mouth cannot be opened
	1	Mouth can be opened with resistance
	2	Mouth can be opened with little effort
	3	Mouth can be opened and limbs are moved without resistance.

Results

The current study showed that high dose of ketamine resulted in adequate immobilization characterized by rapid induction and long recovery without deaths of the anesthetized cats. Following intramuscular administration of cats with ketamine, dissociative anaesthesia were manifested by signs such as opened eye, dilation of eye pupil, movement of mouth and nose licking. Induction was rapid in all animals and cats became laterally recumbent within 1 to 2 minutes and there was an apnea for few seconds in some animals. Long duration of anaesthesia which lasted for 6 hours approximately in all cats was reported. The current study showed that high dose of ketamine resulted in adequate immobilization characterized by rapid induction and long recovery. Increased heart rate and respiratory rate were observed particularly at the beginning of the anaesthesia and decreased gradually to reach normal physiological boundaries at the end of anaesthesia. Furthermore, the high dose of ketamine resulted in excellent sedation, profound analgesia and moderated muscle relaxation in almost all anesthetized cats (table 2). Recovery from anesthesia was characterized by slow eye movements, ear twitching and trials were made to raise head and recumbent on sternum. There was excited recovery which required restraint to keep the cats safe. Cat suffered from loss of coordination and the animals stood up on their legs difficultly several attempts with conspicuous ataxia.

Discussion

In cats, death risk is approximately 10 times higher than that reported in human (0.02–0.05%) which is caused by anaesthesia [16]. The relatively small sizes of cats which are characterized by large surface area to volume ratio, make cats more susceptible to both hypothermia and drug overdosage than other large species. The small airways as well as more sensitive larynx predispose cat to the complications of the upper airway reflecting different standards of anaesthesia due to major element of the higher risk [17]. The results of the current study showed that there were no fatal results and high extension of recovery period following ketamine overdosage of 150 mg/kg. These outcomes were in consistency with Arnbjerg, 1979 who reported that the administration of ketamine at high dose (100 mg/kg) in cats was not associated with acute toxicity and subsequent anaesthesia

related deaths but relatively long period of recovery was observed [15]. The increased odds of death associated to anaesthesia include several factors such as poor health status, increased age, overweight, endotracheal intubation, fluid therapy and increased procedural urgency and complexity. On the other hands, pulse monitoring and oximetry were related to decreased complications [19]. In the current study, there were no reported dead cases in cats anesthetized with overdose of ketamine which could be attributed to using injectable form of anesthesia as the inhalation anesthesia was associated with high rate of mortality. This result was in agreement with Brodbelt, 2010 who reported that cats have small and highly sensitive airway to trauma, spasm, and edema in comparison to other animals such as dog and horse and therefore, the process of improper intubation is thought to be associated with increased complications. There were more dead cases of cats which were intubated following procedures than those that did not intubated (63% of dead cats after procedures having endotracheal intubation in comparison with 48% of cats without intubation), indicating that laryngeal trauma, spasm, or edema could be considered as the most common factors causing death other than obstruction of the endotracheal tube [19]. 70% of the risk of anesthetic-related death was decreased by monitoring of the peripheral pulse and in combination with the use of pulse oximetry, the risk was decreased by 80%. It should be mentioned that more than 60% of deaths reported during the immediate postoperative period (first 3 hours following the termination of the procedure). The cause of death was unknown in 20% of the cases indicating that there was no close monitoring of the patients. Furthermore, over 63% of all deaths were caused by cardiovascular or cardiopulmonary problems [20]. A need is necessitated to improve the quality of both anesthetic care and the monitoring level of the feline patients during the period of general anesthetic period as well as the recovery from anaesthesia [21]. In relation to patient weight, cats under 2 kg are approximately 16 times more likely to die during or after anesthesia and cats weighing 6 kg or more are nearly 3 times more likely to die than those of 2-6 kg body weight. Unlike patient weight, there was no association between breed and death related to anaesthesia in cats [22]. The relation of a drug or technique to either respiratory or cardiac arrest does not reflect cause and effect. The quite complex causes

of both anesthetic complications and mortality where multiple factors are involved and the preexisting clinical disease or organ dysfunction is an important factor in morbidity and mortality [23]. ketamine is advocated to anesthetize high risk cardiac patient as ketamine does not cause profound cardiovascular depression [24]. The limited use of ketamine as a sole anesthetic could be attributed to muscle hypertonicity, myoclonus, violent recovery and occasionally convulsions [25]. On the other hand, the results of the present study revealed that the using of high dose of ketamine as a sole agent produced anesthesia with moderate muscle relaxation. In this study, high levels of ketamine resulted in rapid onset of

action, long duration of anesthesia up to 6 hours and increased heart rate in all cats. This result was in accordance with Pascoe *et al.*, 2007 who concluded that high doses of ketamine could lead to increased duration of anesthesia up to 6 hours or more. Ketamine causes an increase in the heart rate and affects the sympathetic activity. Ketamine is a commonly used injectable anesthetic that causes central catecholamine stimulation when given on its own. This stimulation may increase cardiac output, blood pressure, and heart rate in cats [26]. Rapid onset of action, maintenance of laryngeal reflex and stimulation of the heart are considered to be benefits of ketamine [27].

TABLE 2. Shows the results scores of clinical evaluation of the anesthetized cats

Animal	Sedation score	Analgesia score	Muscle relaxation score
1	3	3	3
2	3	2	2
3	3	3	3
4	3	3	3
5	3	2	2
6	3	3	3
7	3	3	2
8	3	3	3
9	3	3	3
10	3	3	3

Conclusion

High dose of ketamine (150 mg/kg) resulted in rapid induction of anesthesia, long duration and recovery. No death was reported following administration of high dose of ketamine. It can be concluded that even wrong calculation of dosages or accidental injection of ketamine at high dosage in cats would not result into fatal outcomes.

Conflict of interest

The authors state that they have no conflicts of interest.

Ethical approve

The present study has been given approval by the Institutional Animal Care and Use committee of the College of Veterinary Medicine, University of Mosul (UM.VET.2022.045).

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Authors Contribution

The authors each contributed equally.

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التقييم السريري لجرعة زائدة من مخدر الكيتامين في القطط

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الملخص

تهدف هذه الدراسة إلى التقييم السريري للجرعة الزائدة من مخدر الكيتامين في القطط. تم استخدام 10 قطة محلية بالغة من كلا الجنسين لإجراء هذه الدراسة. تم إعطاء جرعة عالية من الكيتامين (150 ملغم / كغم) في العضل في جميع القطط. تم قياس معدل ضربات القلب ومعدل التنفس وكذلك فحص بعض المنعكسات على فترات منتظمة لمدة 6 ساعات. تم تقييم التخدير والتسكين واسترخاء العضلات اعتماداً على درجات معينة. لم يتم ملاحظة المستويات الحرجة أو العلامات السريرية للازرقاق بعد تناول هذه الجرعة العالية من الكيتامين من خلال القيم المقاسة. لم تحدث أي وفاة القطط المخدرة بسبب الجرعة الزائدة من الكيتامين. كانت زيادة مدة الإفاقة هي النتيجة الرئيسية الملحوظة لزيادة مستوى جرعة الكيتامين دون أي تحسن في التأثير المخدر لهذا الدواء. تمت ملاحظة حدوث تخدير ممتاز وتسكين عميق واسترخاء عضلي معتدل في جميع القطط المخدرة تقريباً. يمكن الاستنتاج عن عدم حدوث علامات سريرية للسمية الحادة، كما أن سوء التقدير الشديد لوزن الجسم الذي يؤدي إلى إعطاء جرعة عالية من الكيتامين أو حتى حقن عرضي لجرعة زائدة من الكيتامين لن يؤدي إلى نتائج مميتة في القطط.

الكلمات المفتاحية: الكيتامين، جرعة زائدة من الكيتامين، تخدير القطط، القطط.