Case Report

Epidural Lidocaine and Medetomidine-Ketamine Anaesthesia in Feline Orthopedic Surgery

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ABSTRACT

A one-year old male domestic cat was presented due to leg-carrying lameness that had occurred following trauma, sustained two weeks before presentation. Clinical examination under medetomidine hydrochloride 0.08 mg/kg administered intramuscularly revealed swelling and crepitation over the right femur. Radiographic examination revealed a transverse diaphyseal femoral fracture that needed surgical intervention. Twenty-four hours later, atropine sulfate (0.04 mg/kg) and medetomidine hydrochloride (0.08 mg/kg) were administered for premedication while anaesthesia was induced using ketamine hydrochloride (5 mg/kg) each drug administered intramuscularly. Epidural lidocaine at 4mg/kg was injected 13 minutes after induction. The technique provided anaesthesia characterized by stable cardiopulmonary function, good muscle relaxation and post-operative analgesia. Despite painful manipulations, no additional anesthetics were required intraoperatively. Hind limb paralysis persisted for about one hour following the surgery. This anaesthesia protocol can therefore be used in cats undergoing hind limb fracture reduction and fixation more so in high anaesthetic risk patients or where inhalation anaesthesia is unavailable.

Key words: Cat, Medetomidine, Ketamine, Epidural Lidocaine, Analgesia, Muscle relaxation

INTRODUCTION

In epidural anaesthesia, drugs are administered in close proximity to their site of action which are either receptors and/or nerves emanating from the spinal cord (Torske and Dyson, 2000). As a result, small amounts of anaesthetics are used to achieve excellent analgesia adequate for most surgeries causal to umbilicus (Hendrix et al., 1996; Mwangi et al., 2013). This technique is therefore of value especially in high-risk surgical patients that are unable to tolerate general anaesthetic agents owing to their dose-dependent cardiopulmonary depression (Tendello et al., 1995; Torske and Dyson, 2000).

The effects of epidural lidocaine have been demonstrated in domestic cats in several experimental studies (Adentuji et al., 2002; Adentuji et al., 2003; De Rossi et al., 2009; Lawal and Adentuji, 2009). However, in clinical settings, literature has only one report describing effective use of epidural lidocaine-xylazine combination in cats undergoing castration and ovariohysterectomy (Sadegh et al., 2010). Another study demonstrates successful use of epidural morphine in a cheetah going through a total hip replacement (Pablo et al., 1995). A search through literature shows that currently, there is no study reporting on the use of epidural lidocaine in a domestic cat undergoing an orthopaedic procedure. These facts therefore warranted the current report that details the use of medetomidine-ketamine anaesthesia combined with epidural lidocaine in a cat undergoing surgical repair of a femoral fracture.

Case presentation and management

A one-year old 3.9 Kgs intact male domestic cat was brought to the Small Animal Hospital, University of Nairobi due to lameness of the right hind limb. The lameness was of leg carrying in nature and was reported to had occurred following trauma sustained 2 weeks earlier. Clinical examination under medetomidine sedation revealed a firm swelling and crepitation over the right femur. Radiography confirmed a complete transverse diaphyseal fracture of the right femur that needed surgical intervention (Figure 1). Additionally, there was callus deposition confirming that the fracture had been long standing. Apart from relative hyperglycemia (Glucose 136 mg/dl), other hemato-biochemical values were within the normal range. As part of patient preparation, the cat was fasted for 12 hours, but water was given ad libitum. In addition, 100 mg of phenybutazone (Butamic®, Microsules Laboratories, Uruguay) and 225 mg of amoxicillin trihydrate (Betamox® Norbrook Veterinary

Fig. 1: Radiograph showing a complete and overriding fracture of distal right femur (Yellow arrow).

Pharmaceuticals, Nairobi-Kenya) were injected intramuscularly 2 hours prior to surgery. The day after the clinical examination, atropine sulfate (0.04 mg/kg) was administered intramuscularly and 10 minutes later the cat was premedicated using 1% medetomidine hydrochloride at 0.08 mg/kg (Domitor®, S5 Veterinary Medicine; Pfizer laboratories, Sandton- South Africa) administered intramuscularly. Fifteen minutes after premedication, anaesthesia was induced using ketamine hydrochloride 5mg/kg (Ketalar® 50 mg/ml, Pfizer Inc, New York-USA) administered intramuscularly and the cat intubated thereafter. Tetracycline eye drops were applied in the eyes to keep them moist. About 5 minutes post-induction, the lumbosacral area was prepared for an aseptic injection. Epidural injection was then performed following the procedure described by Skarda (1996) with some slight modification. These modifications included restraining of the patient on sternal recumbency and extending the hind limbs anteriorly in order to increase the lumbosacral space and hence facilitate an easy epidural injection. Secondly, the skin above the lumbosacral space was desensitized using 0.2 ml of 2% lidocaine so as to minimize pain during epidural puncture. Lastly, a gauge 23 hypodermic needle was used for the epidural injection and correct needle placement confirmed by lack of blood or cerebrospinal fluid on suction as well as lack of resistance upon injection of 1 ml air. Lidocaine (Lidocaine® B.P 2% with preservative, Mac Pharmaceuticals Limited, Nairobi- Kenya) at a dosage of 4mg/kg was then administered slowly for about 60 seconds. The epidural injection was performed 13 minutes after induction of anaesthesia. Following epidural injection, the cat was placed on right lateral recumbency. Thereafter, onset of analgesia was determined by evaluating pedal reflex every minute. Complete blockade of pedal reflex, hence onset of analgesia, was achieved within 4 minutes of epidural lidocaine. This was followed by positioning of the cat on left lateral recumbency and the fracture reduced and fixed using Kirshner-wires. Warm lactated Ringer’s solution was administered intravenously throughout the surgery at a rate of 10ml/kg/hr.

Outcome
An initial bradycardia was observed for 20 minutes following medetomidine injection and thereafter the heart rate started to rise gradually 5 minutes after ketamine injection and reached a peak of 110 bpm. Two minutes after epidural lidocaine, heart rate dropped linearly and reached the lowest value of 88 bpm, 40 minutes later. Thereafter, the heart rate increased to baseline value of 100 bpm and stabilized up to the end of surgery. The baseline respiratory rate was 56 breaths per minute and after epidural injection, respiration decreased to 28 breaths per minute and remained low up to the end of the surgery. Rectal temperature remained stable intra-operatively and oxygen saturation was between 86% and 98%. Changes in body temperature and cardiopulmonary parameters are illustrated in Figure 2 below. Excellent muscle relaxation was observed during surgery and this made reduction of the fractured fragment easier. The surgery took 72 minutes and the cat recovered from anaesthesia 20 minutes afterward with no untoward effects. Hind limb paralysis extended for 55 minutes after surgery signifying protracted motor and likely sensory blockade.

Fig. 2: Physiological parameters following medetomidine-ketamine anaesthesia and epidural lidocaine anaesthesia in a cat undergoing orthopedic surgery. Key: A: Premedication time; C: Time when surgery started; B: Epidural injection time D: Time when surgery ended.
DISCUSSION

Fracture management in feline presents a challenge in that while optimal perioperative analgesia is crucial, anaesthesia using inhalant agents results in severe dose-dependent cardiopulmonary depression (Pypendop et al., 2003) which might increase anaesthesia related morbidity and mortality. Further, long standing and unmanaged overriding fractures result in muscle contracture which necessitate an anaesthesia protocols that provide in addition to analgesia, excellent muscle relaxation to facilitate fracture reduction (Kimeli et al., 2014). In addition, patients suffering from chronic pain are considered anaesthetic risk since high doses of anaesthetics are required to induce and maintain a surgical plane of anaesthesia (Mwangi et al., 2014).

The patient in this case had suffered an unmanaged overriding fracture for 2 weeks and this had predisposed the patient to prolonged pain and stress as indicated by hyperglycemia. Hyperglycemia has previously been reported as a marker of stress in sick cats (Laluha et al., 2004). As the patient in this case was an anaesthetic risk, the choice and the dose of general anaesthetic agents had to be considered cautiously. As a practice in our hospital, cats are anaesthetised using either medetomidine + ketamine for short procedures or medetomidine + ketamine + isoflurane for longer surgeries. In this patients, the two options would have had some shortcomings. In the medetomidine + ketamine protocol, the concern was the need for high doses of anaesthetic agents required to sustain a surgical plane of anaesthesia intraoperatively. On the other hand, medetomidine + ketamine + isoflurane would have provided the necessary analgesia but with severe cardiopulmonary depression on an already physiologically compromised cat. As a result, it was decided that the patient be anaesthetized using half the calculated dose of medetomidine + ketamine and in addition administer epidural lidocaine at a dosage of 4mg/kg.

It was observed that this anaesthesia protocol provided adequate analgesia, good muscle relaxation and acceptable cardiopulmonary functions. This attributes are associated with local anaesthetics ability to block both motor and sensory nerve (Day and Skarda, 1991). In addition to sensory nerve blockade by epidural lidocaine, there is analgesia attributed to the synergistic action of systemic medetomidine, an α-2 adrenocceptor blocker and ketamine that is a N-Methyl-D-aspartate (NMDA) receptor blocker. Onset of analgesia in this case was 4 minutes and is comparable to the time reported in other studies done in cat (De Rossi et al., 2009). Although the duration of analgesia was not assessed postoperatively, the prolonged hind limb paralysis suggested possible motor and sensory nerve blockade.

The observed excellent muscle relaxation is attributed to the motor nerve blockade by epidural lidocaine as has previously been reported in dogs (Mwangi et al., 2013). Due to the overriding nature of the fracture and the fact that the fracture was unmanaged for 2 weeks, the thigh muscles in the right hind limb had atrophied and contracted. Muscle relaxation provided by this anaesthesia protocol was therefore very vital for proper reduction and realignment of the fracture fragments.

Despite painful surgical manipulation elicited by the orthopedic procedure, there was no indication for top up of either ketamine or medetomidine. Based on our previous experience, while using medetomidine-ketamine anaesthesia for orthopedic surgery in cats, one or more top up dose(s) is always warranted. Reducing the dose of general anesthetic agents is valuable especially in high risk patients as it minimizes the likelihood of anaesthesia related complications (Jones, 2001). Local blocks have been shown to have a sparing effect on isoflurane anaesthesia in cats (Mosing et al., 2010), cheetah (Kimeli et al., 2014), sheep (Ghadirian and Vesal, 2013) and pigs (Tendeloo et al., 1995). In the current report, we postulate that the supplemental analgesia provided by epidural lidocaine and pre-emptive phenylbutazone kept the patient comfortable despite the painful stimuli elicited by tissue trauma, muscular manipulation as well as drilling K-wires through the bone.

In this study, epidural lidocaine produced minimal changes in heart rate and rectal temperature. This finding agrees with previous experimental studies involving epidural lidocaine in cats and dogs (Adentiu et al., 2001; Lawal and Adentiu, 2009). The initial depression in heart rate seen in the current case was likely due to medetomidine, a potent α-2 adrenoceptor agonist which causes a dose dependent bradycardia associated with reduced sympathetic tone, increase in peripheral resistance and blood pressure (Sinclair, 2003). After an intramuscular ketamine injection, heart rate increased by 22% to reach a peak value of 110 beats/minute. This ketamine associated tachycardia has been observed before in dogs (Martin et al., 1997; Somsak, 2003) and goats (Kinjavdekar, 1998) and is attributed to increased sympathetic tone, heightened norepinephrine release as a sequel to desensitization of arterial baroreceptors (Appel et al., 1979), vagal block and reduced norepinephrine uptake by the sympathetic nerve terminals (White et al., 1982). The subsequent, bradycardia observed following epidural lidocaine was likely due to the fact that upon lumbosacral injection, lidocaine diffuses rapidly in the cerebrospinal fluid to the brain and cause depression of the cardiovascular center making it less responsive to baroreceptors signal of hypotension caused by neural blockade (Cruz et al., 1997). Following additional ketamine, a subsequent tachycardia was observed and heart rate stabilized at 100 bpm up to the end of surgery. This observation may be attributed to ketamine that seems to have a positive chronotropic effect. However, this ketamine induced bradycardia has been shown to increase myocardial oxygen consumption (Patschke et al., 1975) and this might have contributed to the observed hypoxia in this case. The observed drop in respiratory rate is attributed to medetomidine although epidural lidocaine could have contributed to respiratory depression due to sympathetic nerve blockade. Hypoxia in this case could have been as a result of the observed respiratory depression and it’s advisable that oxygen supplementation be provided in such circumstances (Sinclair, 2003).

Findings from this case suggest that light general anesthesia using medetomidine-ketamine in combination with epidural lidocaine can offer adequate perioperative analgesia and excellent muscle relaxation in cats undergoing fracture reduction of the hind limb. However, cardiopulmonary depression should be anticipated when this anaesthesia protocol is used. Devoted monitoring and oxygen supplementation are therefore warranted.
REFERENCES


