

# Combined Epidural Lidocaine and Medetomidine-Ketamine-Isoflurane Anaesthesia for Management of Femoral Fracture in a Cheetah (*Acinonyx jubatus*)

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## ABSTRACT

A 17 kg adult female cheetah was presented with a history of lameness of the left hind limb sustained in the wild approximately a week earlier. The animal was anaesthetized for clinical examination by darting using medetomidine-ketamine cocktail. Palpation of the left mid-shaft femur revealed a firm swelling and crepitation. Radiography confirmed a complete transverse and overriding fracture of the left femur which required open reduction and internal fixation. Hematology revealed lymphocytosis while biochemistry showed hypoproteinemia, hypoglobulinemia and low alanine aminotransferase activity. Epidural lidocaine hydrochloride was administered in the lumbosacral region to supplement medetomidine-ketamine-isoflurane anaesthesia for the surgical procedure. Isoflurane concentration was maintained at 0.5-1.0% using a rebreathing anaesthesia machine throughout the surgery. Temperature and cardiopulmonary parameters remained stable intra-operatively. Hind limb paralysis extended for about seven hours post-operatively, suggestive of prolonged post-operative local anaesthesia. The successful management of this surgical procedure demonstrated the suitability of using the described anaesthesia protocol in surgical procedures of the hind limbs in wild felidae.

**Keywords:** Cheetah; Epidural Anaesthesia; Isoflurane; Sparing Effect; Analgesia.

## BACKGROUND

Epidural anaesthesia is a method of administering drugs in close proximity to their site of action either at the receptors in the dorsal horn of the spinal cord or at the nerves as they leave the spinal cord (1). This technique has been used in surgical patients as an adjunct to general anesthesia and with the aim of reducing the dose requirement for general anesthetic agents, especially inhalant anesthetics that cause a dose-dependent cardiopulmonary depression (1, 2). Reduction in the dose of anesthetic agents is of value particularly in general anesthesia of high risk patients (3). Furthermore, epidural anesthesia has been shown to provide excellent pre-operative,

intra-operative and post-operative analgesia (4, 5) which is of benefit to patients undergoing surgical procedures caudal to the umbilicus.

A number of experimental studies in domestic cats have reported on efficacy of epidural lidocaine (6, 7, 8, 9), xylazine (6), medetomidine (7), bupivacaine (9), ketamine (8), lidocaine-xylazine combination (10), lidocaine-bupivacaine combination (9) and lidocaine-ketamine combination (8). Studies have reported successful use of ketamine in combination with medetomidine (11, 12) or midazolam (12) in anaesthetizing cheetah either for clinical examination or surgical procedures. Tiletamine-zolazepam combination has also

been used successfully, either alone (13) or in combination with ketamine and xylazine (14), medetomidine (12, 15) or midazolam (12). One study has described the use of epidural morphine in combination with tiletamine–zolazepam in a cheetah undergoing total hip replacement (16). However, there is currently no report on the use of epidural lidocaine in cheetahs.

This study details a successful use of epidural lidocaine in an adult cheetah under a light plane of medetomidine–ketamine–isoflurane anesthesia during management of a femoral fracture. To the best knowledge of the authors this is the first publication describing epidural lidocaine anesthesia in a cheetah.

### CASE PRESENTATION

An adult female Cheetah weighing 17 Kg was presented to the Small Animal Clinic, University of Nairobi with a history of leg carrying lameness of the left hind limb sustained in the wild approximately a week earlier. Clinical examination under Medetomidine (50µg/Kg)–Ketamine (5mg/Kg) anaesthesia revealed slight dehydration and a firm swelling around the left femoral shaft region. Crepitation was present on manipulation and radiography confirmed a complete transverse and overriding fracture of the left femoral diaphysis with callus (Figure 1). A decision was taken to reduce and fix the fracture using a compression bone plate and screws. Presurgical hematological parameters revealed lymphocytosis



**Figure 1:** Radiography of left femur showing an overriding fracture and callus

(Table 1) while the biochemistry revealed hypoproteinemia, hypoglobulinemia and low alanine aminotransferase activity (Table 2).

Twenty four hours later, anesthesia was induced using 50µg/Kg of Medetomidine Hcl (Domitor; S5 Veterinary Medicine; Pfizer laboratories, Sandton-South Africa) and 5mg/Kg of Ketamine Hcl (Ketalar 50 mg/ml, Pfizer Inc, New York-USA) combination by darting using a blowgun to allow preparation for aseptic surgery and endotracheal intubation. To facilitate intubation, 2 ml of 2% lidocaine was splashed in the larynx to minimize laryngeal spasm and intubation was achieved using a size 8.0 mm endotracheal tube.

About 30 minutes after induction of general anesthesia, the lumbosacral region was shaved, washed and disinfected with 70% ethyl alcohol in preparation for aseptic epidural injection. The patient was restrained on a table in left lateral recumbency, with its pelvic limbs extended cranially to

**Table 1:** Hematological parameters of the cheetah before the surgery

Hematology parameters	Values	Normal range (Domestic cat)
WBC (X10 <sup>3</sup> /µL)	15.24	5.0-18.0
Lymphocytes (%)	38.1	5.0-30.0
Monocytes (%)	2.1	2.0-6.0
Granulocytes (%)	59.8	40-80
RBC (X10 <sup>6</sup> /µL)	8.14	4.0-9.0
MCV (fl)	53.8	35.5-55.0
Hct (%)	43.7	24.0-45.0
MCH (pg)	19.2	16.0-24.0
MCHC (g/dL)	35.9	28.0-40.0
RDW	13.9	8.0-12.0
Hb (g/dL)	15.7	9.5-15.0
THR (X10 <sup>3</sup> /µL)	411	120-500
MPV (fl)	9.4	4.0-7.0
Pct (%)	0.39	–
PDW	6.9	8.0-12.0

**Table 2:** Biochemistry parameters of the cheetah before the surgery

Biochemistry parameters	Values	Normal range (Domestic cat)
BUN mg/dL	23.9	19-34
Creatinine mg/dL	1.9	0.9-2.2
Total protein mg/dL	3.5	6-7.9
Albumin mg/dL	3.2	2.5-3.9
Globulin mg/dL	0.2	2.6-5.1
Phosphorus mg/dL	4.2	3.0-6.1
AST (IU)	12.2	7-38
ALT (IU)	18	25-97

maximally separate the lumbar vertebrae. The lumbosacral (between L7 and S1) space was then located as described by Skarda (17). The injection site was infiltrated subcutaneously with 1.0 ml of 2% lidocaine hydrochloride (Lidocaine, Mac Pharmaceuticals Limited, Nairobi-Kenya) to minimize the pain of epidural puncture.

A sterile 21-gauge hypodermic needle was inserted percutaneously in the midline at the prepared site into the epidural space. An empty sterile 5ml syringe was attached to the needle and suction applied to confirm correct needle placement by absence of blood or cerebrospinal fluid (CSF) aspirate. This was followed by injection of about 1 ml of air to ascertain absence of resistance to injection, which was further proof of correct needle placement. Four ml of 2% lidocaine hydrochloride (Lidocaine, Mac Pharmaceuticals Limited, Nairobi, Kenya) was injected into the epidural space slowly over a period of 60 seconds. Thereafter, the pedal reflex was assessed every 2 minutes by clamping the inter-digital tissue with an Allis tissue forceps to determine the onset of analgesia. Complete analgesia of the limb was achieved within 6 minutes of epidural lidocaine administration as ascertained by complete loss of the pedal reflex.

Anesthesia was maintained with isoflurane (Forane, Aesica, Queenborough Ltd., Kent, United Kingdom) vaporized in oxygen using a rebreathing circuit anesthetic machine. The maintenance concentration of isoflurane ranged between 0.5 and 1.0%, throughout the procedure. An intravenous catheter (G21) was inserted in the cephalic vein and warm lactated Ringer's solution (10 ml/kg/hr) was administered intravenously throughout the surgery. Mild hypothermia was observed but cardiopulmonary parameters remained stable intra-operatively. Rectal temperature ranged between 34.3°C and 37.9°C, heart rate between 69 and 98 beats/minute, respiratory rate between 12 and 19 breaths/minute and blood oxygen saturation between 84% and 98%. Excellent muscle relaxation of the hind limbs was also observed intra-operatively.

The surgery took 2 hours 40 minutes and immediately after surgery isoflurane was switched off leaving the animal inhaling 100% oxygen for 10 minutes. Thereafter, atipamezole (Antisedan, 5 mg/mL; Pfizer laboratories, Sandton, South Africa) at 1mg/kg was injected intramuscularly and immediately the animal was extubated. The patient was awake 7 minutes after atipamezole injection and completely recovered from anaesthesia 12 minutes later however she could not

stand due to hind limb paralysis. The observed hind limb paralysis extended for 7 hours post-operatively suggesting prolonged motor and possible sensory blockade.

## DISCUSSION

To the best of the researchers' knowledge, this is the first case documenting the use of epidural lidocaine in supplementing general anesthesia in order to facilitate hind limb surgery in an adult cheetah.

Patients that suffer untreated pain for a prolonged period pose a major anesthetic risk intra-operatively as high doses of anesthetic drugs are required to produce a surgical plane of anesthesia (18). The use of local anesthetic blocks in such patients allows the dose of anesthetic drugs to be tapered while providing excellent peri-operative analgesia and minimizing anesthesia related morbidity and mortality (18).

The patient in the current case was deemed an anesthetic risk due to lymphocytosis, impaired liver function, hypoproteinemia, slight dehydration and the long standing pain. To minimize the doses of medetomidine and ketamine and at the same time produce a safe surgical plane of anesthesia, epidural lidocaine was administered at 5 mg/kg BW (80 mg) in the lumbosacral space. The technique provided anesthesia of superior quality characterized by excellent muscle relaxation, rapid onset and prolonged duration of analgesia. This was attributed to the fact that local anesthetic agents indiscriminately block motor, sensory, and sympathetic fibers when administered epidurally (19).

The dose of isoflurane used for maintenance of anesthesia was reduced to 0.5-1.0% throughout the surgery, and this was adequate, as the animal did not respond to deep surgical stimuli elicited by an orthopedic procedure. A similar isoflurane-sparing effect of epidural lidocaine has been reported in pigs (2). Minimizing the concentration of inhalant anesthetics is of great value as these agents can cause a dose dependant cardiopulmonary depression (1).

The cardiopulmonary function remained stable intra-operatively. This observation was in agreement with studies carried out in dogs which have shown that epidural lidocaine has no significant changes on heart rate, mean arterial pressure and respiratory rate (20, 21). The maintenance of stable blood oxygen saturation was an additional proof of well maintained cardiac and respiratory functions. However, it is worth noting that when high volume of epidural lidocaine is

administered, the drug may extend cranially into the thoracic region and block the nerves innervating intercostal muscles as well as the sympathetic nerve fibers (1). Consequently, this results into depression of respiration and vasodilation of the dural blood vessels causing hypotension and bradycardia as well as hypothermia due to increased surface area for heat loss (17).

The observed mild hypothermia may be attributed to decrease in metabolic rate, muscle relaxation and CNS depression caused by the action of anesthetic drugs and adjunct. In addition, pre-surgical preparation of the surgical site with cold scrubbing fluids as well as the prolonged and invasive nature of the surgical procedure could have contributed to hypothermia. This is despite the draping of the surgical site.

Epidural lidocaine provides analgesia of about 1-4 hours in domestic cats. Notably, hind limb paralysis in this case extended for 7 hours post-operatively. This might be attributed to the observed hepatic insufficiency and hypoproteinemia. Lidocaine is metabolized in the liver by the P450 isoenzyme CYP 3A4 system (22) which may be impaired during hepatic damage resulting into prolonged duration of action as was observed in this case. Further, hypoproteinemia might have contributed to prolonged duration of action since 64% of lidocaine in circulation is bound by plasma proteins (23). In addition, Thomasy *et al.* (24) demonstrated that isoflurane anesthesia in domestic cats is associated with decreased clearance and elimination half-life of lidocaine mainly due to decrease hepatic blood flow. However, in view of this case prolonged postoperative analgesia was beneficial as it helped to mitigate immediate postoperative pain and therefore enhance healing.

## CONCLUSION

The use of epidural lidocaine with a light plane of general anesthesia for management of femoral fracture in an adult cheetah proved successful. This protocol provided good quality anesthesia characterized by excellent muscle relaxation, rapid onset and long duration of analgesia. Epidural lidocaine had a sparing effect on Isoflurane as evidenced by the concentration used for maintenance of anesthesia and the stability of the cardiopulmonary function. Recovery was smooth and uneventful. This anesthesia protocol is therefore recommended for surgical procedures of the hind limb in wild felidae.

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