

## Midazolam/ketamine induction and isoflurane maintenance of anaesthesia in a 2-month-old, hand-raised African buffalo (*Syncerus caffer*)

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### ABSTRACT

The use of a midazolam/ketamine combination for induction of anaesthesia in a 2-month-old, hand-raised buffalo calf (*Syncerus caffer*) is described to allow endotracheal intubation for the maintenance of anaesthesia with isoflurane and oxygen. Intraoperative complications were hypotension and hypothermia. For postoperative analgesia meloxicam and butorphanol was administered intramuscularly.

**Key words:** African buffalo, anaesthesia, butorphanol, ketamine, midazolam, *Syncerus caffer*.

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### INTRODUCTION

Adult African buffalo are dangerous to work with, and etorphine is commonly used for immobilisation or anaesthesia of this species<sup>1</sup>. In this instance the buffalo calf was accustomed to humans as it had been hand-raised, and as it could be restrained manually, the use of etorphine would not have been appropriate for anaesthesia. Diazepam in combination with detomidine and ketamine has been used in Asian buffalo for the intramuscular induction of anaesthesia<sup>5</sup> while a midazolam/ketamine combination has been used for induction of anaesthesia in a neonatal springbok<sup>9</sup>. The use of midazolam as an anaesthetic adjunct in combination with ketamine for the induction of anaesthesia in an African buffalo calf has not been reported previously. Midazolam belongs to a group of drugs named the imidazobenzodiazepines and is related to diazepam. This group of drugs are potent sedative-hypnotics, anxiolytic, muscle relaxant, anti-convulsogenic, and result in anterograde amnesia<sup>6</sup>. They have been used in combination with ketamine for the induction of anaesthesia in domestic animals such as cattle<sup>2</sup>. Respiratory depression from midazolam is a common adverse effect reported in humans<sup>11</sup> and in goats after the combined use of midazolam and ketamine for induction of anaesthesia<sup>7</sup>.

### ANAESTHETIC MANAGEMENT

Anaesthesia was required in a 2-month-old, hand-raised, male African buffalo calf (*Syncerus caffer*) for arthroscopic examination and surgical flushing of its left elbow, tarsal, and fetlock joints. Body weight was 80 kg. It suffered from a septic polyarthritis that was previously treated with florfenicol (Nuflor, Schering-Plough), and ramifenazone and phenylbutazone (Tomanol, Centaur). It was severely lame with visible swelling of the affected joints. Otherwise its physical condition was excellent and appetite and habitus were normal. Haematological analysis revealed a haemoglobin concentration of 93.6 g/l, haematocrit of 0.28 l/l, red blood cell count of  $12.2 \times 10^{12}/l$ , and a white cell count of  $54 \times 10^9/l$ . Rectal temperature was 39.5 °C. The animal was fasted overnight from food and water. The anaesthetic risk was considered to be minimal.

For venepuncture, the calf was manually restrained in lateral recumbency and a 20-G catheter (Jelco, Johnson & Johnson) introduced in the ear vein. Heart rate was 80 beats/minute, respiration rate 19 breaths/minute. For sedation, 8 mg midazolam (Dormicum, Roche) was administered intravenously. The calf remained conscious but within 2 minutes became relaxed as evidenced from the palpebral reflex that remained active and a generalised decrease in skeletal muscle tone. Jaw muscle tone was high with the oral reflex active. Heart and respiration rate increased respectively to 100 beats/minute and 24 breaths/minute. Anaesthesia

was induced after 3 minutes with 400 mg ketamine hydrochloride (Anaket, Centaur) intravenously. Endotracheal intubation was not possible as the oral and laryngeal reflex remained active. An additional 5 mg midazolam and 100 mg ketamine was injected intravenously to suppress the laryngeal reflex. The calf was judged to be in a medium plane of anaesthesia as the palpebral reflex was absent. The eyeball partially rotated down, the jaw muscle relaxed and the laryngeal reflex was absent. Heart rate decreased to 88 beats/minute and the respiration rate increased to 44 breaths/minute. With the aid of a laryngoscope, the calf was intubated with a 16 mm cuffed endotracheal tube. The endotracheal tube was connected to a circle anaesthetic machine, and anaesthesia maintained with isoflurane and oxygen. During inhalation anaesthesia, ventilation was maintained by positive pressure ventilation at a rate of 12 breaths/minute. Oxygen flow rate was set at 2 l/min and the vaporiser (Fortec 3, Ohmeda) set at 5 % isoflurane (Forane, Abbot) until the eyeball was rotated down. Thereafter the vaporizer setting was decreased to 3.5 % and the oxygen flow rate to 1 l/min. Blood volume was maintained with an intravenous infusion of a balanced electrolyte solution (Intramed Ringer Lactate Solution) at a rate of 10 ml/kg/min.

Arterial blood pressure was measured from a 20-G teflon catheter (Jelco, Johnson & Johnson) placed percutaneously in a palmar metacarpal artery and connected to a calibrated electronic pressure transducer and multifunction patient monitor (Cardiicap II, Datex). The mean (SD) heart rate and arterial blood pressure during anaesthesia were  $52.3 \pm 8.3$  beats/min and  $9.8 \pm 0.9$  kPa, respectively. End-tidal carbon dioxide and end-tidal isoflurane concentration was monitored with a respiratory gas monitor (Capnomac Ultima, Datex) and the sample line connected to the endotracheal tube. The mean end-tidal carbon dioxide was  $4.3 \pm 0.08$  kPa and end-tidal isoflurane concentration  $1.8 \pm 0.2$  % during anaesthesia. Intra-operative mean arterial blood pressure decreased to a minimum of 8.3 kPa

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with the end-tidal isoflurane concentration at 2.5 % after 60 min. of anaesthesia. The vaporiser setting was decreased to 1.5 % that resulted in an end-tidal isoflurane concentration of  $1.6 \pm$  and a mean arterial blood pressure of 11.3 kPa. Body temperature decreased to 37.7 °C at the end of anaesthesia. For analgesia, meloxicam (Mobic, Boehringer Ingelheim) at 0.2 mg/kg and butorphanol (Torbugesic, Fort Dodge) at a dose of 0.12 mg/kg were administered intramuscularly near completion of surgery.

## DISCUSSION

Except for the localised infection of the joints, the buffalo calf appeared healthy on clinical examination and haematological analysis that was within the normal range reported for the African buffalo<sup>3</sup>. As a dose for midazolam in buffalo was not available, an initial dose of 0.1 mg/kg was administered intravenously to evaluate its clinical effect. In adult domestic goats a total cumulative dose of 0.6 mg/kg administered intramuscularly was required to obtain clinical signs of sedation<sup>8</sup>. The sedative effect of the initial midazolam dose could not be evaluated as the buffalo calf was restrained in lateral recumbency after venepuncture. A wide range of doses has been reported for diazepam/ketamine anaesthesia in cattle. Kandpal and Kumar<sup>4</sup> reported a dose of 1 and 12 mg/kg for diazepam and ketamine, respectively, and Hall *et al.*<sup>2</sup> recommended a dose of 0.2 mg/kg and 5 mg/kg

for diazepam and ketamine, respectively. For the buffalo calf a total dose of 0.16 mg/kg midazolam and 6.3 mg/kg ketamine was required to obtain anaesthesia that was suitable for endotracheal intubation, and somewhat higher compared with the doses recommended by Hall *et al.*<sup>2</sup>. Ventilatory depression from midazolam/ketamine as evidenced by the absence of apnoea appeared not to be of clinical significance in this instance. Mean arterial blood pressure progressively decreased to a minimum of 8.3 kPa during anaesthesia, resulting in hypotension and was treated by decreasing the inspired concentration of isoflurane. The intraoperative decrease in body temperature may have contributed to the decrease in blood pressure as hypothermia decreases the minimum alveolar concentration of volatile anaesthetics, thus increasing the susceptibility to the volatile anaesthetic<sup>10</sup>. The administration of an analgesic such as butorphanol before the start of the arthroscopy, may also have reduced the dose of isoflurane required for anaesthesia and prevented the intraoperative hypotension. It is concluded that a midazolam/ketamine combination may be considered for the intravenous induction of anaesthesia in juvenile African buffalo accustomed to human handling. The recovery of the calf was uneventful.

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