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CASE REPORT

Medetomidine-ketamine-isoflurane anaesthesia in pygmy hippopotami (*Choeropsis liberiensis*) – a case series

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Abstract

History Medical knowledge of pygmy hippopotami is limited. Anaesthesia has been considered a challenge because of the anatomy, semi-aquatic life style and aggressive behaviour. Polycystic kidney disease (PKD) has been described and can contribute to active kidney disease potentially affecting anaesthesia.

Physical examination and Management Fourteen pygmy hippopotami were anaesthetized for general health assessment and reproductive procedures. Animals (estimated bodyweight 250 kg) were darted intramuscularly with 0.08 mg kg^{-1} medetomidine and 1.2 mg kg^{-1} ketamine. After endotracheal intubation, anaesthesia was maintained with isoflurane delivered either by circle system (100% oxygen) or by Triservice apparatus (air or air/oxygen admixture). Heart rate (HR) respiratory rate (f_R), oxygen saturation (SpO_2) and end tidal CO_2 were recorded at 5-minute intervals. Atipamezole was administered intramuscularly (0.4 mg kg^{-1}) at the end of the procedure. Statistical analysis was performed using ANOVA ($p < 0.05$).

Most animals rapidly became recumbent although five hippopotami needed additional drugs to assure acceptable immobilization. There were no statistical differences in mean HR between animals with or without PKD (PKD: 34 ± 8 beats $minutes^{-1}$; no PKD: 33 ± 6 beats $minutes^{-1}$), f_R (PKD: 15 ± 7 breaths $minutes^{-1}$; no PKD; 12 ± 5 breaths $minutes^{-1}$) and end tidal CO_2 (PKD: 7.1 ± 1.3 kPa; no PKD: 7.8 ± 1.4 kPa). SpO_2 was higher in animals receiving 100% oxygen or air with oxygen (92 ± 8% and 91 ± 9% respectively) compared with animals receiving air only (77 ± 5%) ($p = 0.003$). Recovery was uneventful after atipamezole administration.

Follow-up There were no apparent adverse effects after anaesthesia during a 24-hour follow-up period.

Discussion and conclusions Medetomidine-ketamine-isoflurane induced satisfactory anaesthesia in this species. Incremental induction doses were related to remote injection and the animals' thick skin. There were no differences in anaesthetic parameters in animals with or without PKD. Supplemental oxygen should be mandatory during anaesthesia in this species.

Keywords atipamezole, *Hexaprotodon liberiensis*, isoflurane, ketamine, medetomidine, Triservice apparatus.

Introduction

Medical knowledge about pygmy hippopotami (*Choeropsis liberiensis*) remains scarce and is mainly

based on post-mortem findings (Raymond et al. 2000; Nees et al. 2009) or individual case reports. A female-biased sex ratio has been reported in captive populations (Zschokke 2002). Polycystic kidney disease (PKD) also occurs in captive populations (Raymond et al. 2000; Nees et al. 2009; Hermes et al. 2010). PKD has been considered to contribute to possibly life threatening renal complications in this species (Raymond et al. 2000; Nees et al. 2009).

Most case reports only provide a brief mention of the anaesthetic procedures (Franz et al.1978; Miller & Boever 1983; Flach et al. 1998; Johnston 2002; Bouts et al. 2009). Only three manuscripts have discussed anaesthesia in more detail (Jarofke & Klös 1982; Pearce et al. 1985; Weston et al. 1996). Similarly, only three secondary book references are available (Jarofke 1993; Miller 2003, 2007).

Anaesthesia of pygmy hippopotami remains a challenge for zoo and wildlife veterinarians. These animals are extremely territorial and aggressive and are capable of inducing fatal injuries mainly by their elongated canine teeth (Miller 2003). They are considered to be pseudo-ruminants since pygmy hippopotami have two diverticula at the end of the oesophagus lined by papillae, similar to the rumen (Schwarm et al. 2003). Consequently, fasting of at least 24 hours is recommended to reduce pressure of the gut on the diaphragm during recumbency. Since hippopotami head for water when frightened or aroused, anaesthesia should be carried out away from a pool to prevent accidental drowning. Pygmy hippopotami also have a very thick skin; recommended injection sites are either the medial or caudal aspect of the thigh or the area in the neck caudal to the ear (Miller 2003, 2007).

In the past, a survey of anaesthetic techniques used in pygmy hippopotami was performed in collaboration with more than 100 zoos (Jarofke & Klös 1982). In summary, all anaesthetic drugs were delivered intramuscularly (IM). Etorphine, either alone or in combination with acepromazine, azaperone, propionylpromazine or xylazine, was the most commonly used agent. Etorphine was successfully antagonized with diprenorphine. However, side effects including salivation, excitation and dog-sit position during induction often were reported with these combinations. Phencyclidine, a potent dissociative anaesthetic agent, was also administered in this species, either with acepromazine or propionylpromazine. Ketamine and xylazine combinations were used only sporadically (Jarofke & Klös 1982).

Pearce et al. (1985) reported twenty-one anaesthetic events using different drugs over a 1-year period in a single animal. Etorphine, either alone or combined with acepromazine, together with xylazine induced satisfactory sedation with only minor involuntary leg movements.

Intramuscular detomidine or medetomidine mixed with butorphanol has also been described but animals became aroused upon stimulation (Miller 2003, 2007). Midazolam-zolazepam-tiletamine caused mild sedation. Ketamine-butorphanol has been used for induction of anaesthesia but required supplemental drugs (Miller 2003, 2007). A case report mentioned the use of multiple injections of different drugs (atropine, ketamine, butorphanol, detomidine) for induction of anaesthesia in a single pygmy hippopotamus, followed by isoflurane after endotracheal intubation (Weston et al. 1996).

Ketamine (1–1.2 mg kg^{-1}) and medetomidine (0.08 mg kg^{-1}) have been used successfully for induction of anaesthesia in pygmy hippopotami. An endotracheal tube was placed and anaesthesia maintained with isoflurane. Dental procedures, general health examinations and a broncho-alveolar lavage were performed with this protocol (Johnston 2002; Bouts et al. 2009).

In order to investigate the presence of PKD and infertility problems combined with a distorted sex ratio at birth in this species, it was decided to initiate a health screening protocol in pygmy hippopotami across Europe. Zoos were asked to participate in this health screening which consisted of a full general examination including ultrasound of the reproductive organs and of the kidneys to diagnose PKD.

The present paper reports on the efficacy and safety of the combination of medetomidine and ketamine for induction of anaesthesia followed by isoflurane in a larger number of pygmy hippopotami, and describes subsequent antagonism with atipamezole. Furthermore, based on the renal ultrasound findings of the kidneys, a retrospective investigation was carried out to ascertain whether the presence or absence of PKD influenced the speed of onset or recovery from anaesthesia, the parameters measured intra-operatively, or resulted in any delayed adverse effects.

Case histories and management

Fourteen (eight PKD and six no PKD) pygmy hippopotami (ages 9–40 years; life span in captivity between 35 and 45 years) were anaesthetized for