Veterinary Anaesthesia and Analgesia 2018, **xxx**, 1–6 https://doi.org/10.1016/j.vaa.2017.03.011

RESEARCH PAPER

Evaluation of butorphanol–azaperone–medetomidine (BAM) in captive blesbok immobilization (*Damaliscus pygargus phillipsi*)

Aleksandr Semjonov[a,b], Vladimir Andrianov[a], Jacobus P Raath[b,c], Toomas Orro[a], Liesel Laubscher[b,d], Silke Pfitzer[c] & Toomas Tiirats[a]

[a]Institute of Veterinary Medicine and Animal Sciences, Estonian University of Life Sciences, Kreutzwaldi 62, 51014 Tartu, Estonia

[b]Wildlife Pharmaceuticals South Africa (Pty) Ltd., White River 1240, South Africa

[c]Wildlifevets.com, Ngongoni Game Lodge, Mpumalanga, South Africa

[d]Department of Animal Sciences, Stellenbosh University, Matieland 7602, South Africa

Correspondence: Aleksandr Semjonov, Institute of Veterinary Medicine and Animal Sciences, Estonian University of Life Sciences, Kreutzwaldi 62, 51014, Tartu, Estonia. E-mail: aleksandr.semjonov@emu.ee

Abstract

Objective The fixed-dose combination of butorphanol, azaperone and medetomidine (BAM; 30, 12 and 12 mg mL^{-1}, respectively) with subsequent antagonism by naltrexone–atipamezole was evaluated for reversible immobilization of captive blesbok (*Damaliscus pygargus phillipsi*).

Study design Prospective, clinical trial.

Animals Sixteen blesbok (four males and twelve females), weighing 52.5–71.0 kg, were immobilized in South Africa.

Methods The total dose of BAM ranged from 0.5 to 0.7 mL for females and 0.7 to 0.9 mL for males. In seven animals chosen randomly, 8000 units of hyaluronidase was added to the dart. Physiologic variables were recorded every 5 minutes beginning at 10–20 minutes after darting. Arterial blood samples were collected three times at 20, 30 and 40 minutes after darting for analysis of blood acid-base status.

Results The mean administered doses of BAM were as follows: butorphanol (0.34 ± 0.08 mg kg^{-1}), azaperone (0.14 ± 0.03 mg kg^{-1}) and medetomidine (0.14 ± 0.03 mg kg^{-1}). The inductions were calm and smooth. The mean induction time was 9.6 ± 3.2 minutes with just BAM and 5.1 ± 0.8 minutes with BAM and hyaluronidase combination. Heart rate (45 ± 6 beats $minute^{-1}$) and respiratory frequency (38 ± 4 breaths $minute^{-1}$) were stable throughout immobilization. The mean arterial blood pressure for all animals was stable but elevated (137 ± 7 mmHg). Rectal temperature slightly increased over time but remained within an acceptable range. The recovery time after administering naltrexone and atipamezole was 4.8 ± 0.7 minutes.

Conclusion and clinical relevance The BAM combination proved to be reliable and effective in blesbok.

Keywords azaperone, BAM, blesbok, butorphanol, medetomidine.

Introduction

Blesbok (*Damaliscus pygargus phillipsi*) are gregarious medium-sized antelope that prefer the open grassland habitat of southern Africa. Ganhao et al. (1988) investigated the physiological responses of blesbok, eland (*Taurotragus oryx*) and red hartebeest (*Alcelaphus buselaphus*) to different capture methods, namely net capture, enclosure capture and chemical immobilization, and found that chemical immobilization elicited the lowest stress response. Chemical immobilization has become an essential part of research, in the treatment of sick or injured animals and during capture operations.

Etorphine is a widely used opioid for the chemical immobilization of blesbok (Williams & Riedesel 1987; Burroughs 1993; Kock & Burroughs 2012). Thiafentanil can also be used, and some users claim that a

Please cite this article in press as: Semjonov A, Andrianov V, Raath JP et al. Evaluation of butorphanol–azaperone–medetomidine (BAM) in captive blesbok immobilization (*Damaliscus pygargus phillipsi*), Veterinary Anaesthesia and Analgesia (2018), https://doi.org/10.1016/j.vaa.2017.03.011

mixture of etorphine and thiafentanil provides better induction than etorphine alone (Kock & Burroughs 2012). A number of sedatives and tranquilizers can also be included in the immobilizing mixture (Kock & Burroughs 2012).

One of the biggest problems with the use of powerful opioids in chemical immobilization mixtures is that they need to be highly controlled in terms of their handling, storage and record-keeping. Furthermore, these substances are not always easily accessible. Beyond these practical considerations, opioids such as thiafentanil have also been reported to be associated with hyperthermia, respiratory depression, poor muscle relaxation and capture myopathy (Mich et al. 2008).

The use of butorphanol, azaperone and medetomidine as a sedative combination provides a potentially useful alternative (Wolfe et al. 2008). Butorphanol is a synthetic opioid analgesic agent (partial agonist—antagonist), three to five times more potent than morphine. It can be combined with alpha$_2$-adrenergic agonists to produce profound sedation or light general anaesthesia (Neiffer et al. 2005). Azaperone is a short-acting neuroleptic sedative belonging to the class of butyrophenones that is often used in combination with opioids and alpha$_2$-agonists to reduce the stress from capture and handling (Kock & Burroughs 2012). Medetomidine is a potent alpha$_2$-agonist with sedative and analgesic properties that, in combination with butorphanol, provides smooth induction and good muscle relaxation. The combination of these three agents has been reported to provide safe and reversible immobilization in white-tailed deer (*Odocoileus virginianus*) (Mich et al. 2008; Miller et al. 2009; Siegal-Willott et al. 2009), rocky mountain elk (*Cervus elaphus nelsoni*) (Wolfe et al. 2014), Nubian ibex (*Capra nubiana*) (Lapid & Shilo-Benjamini 2015), black bears (*Ursus americanus*) (Wolfe et al. 2008) and African lions (Semjonov et al. 2017). Hyaluronidase is proteolytic enzyme. The effect of hyaluronidase is via enzymatic breakdown of the interstitial barrier between cells which in turn breaks down the intercellular matrix (responsible for tissue integrity) and allows drugs to reach the central compartment much faster. As a result, the rate of drug absorption is enhanced, thereby accelerating immobilization (Watson 1993; Schulenburg et al. 2007; Dittberner 2011).

The aims of this study were to evaluate the effectiveness and physiological responses of captive blesbok to BAM administered intramuscularly (IM) with and without hyaluronidase.

Material and methods

Sixteen blesbok (four males and twelve females) that required clinical examination, deworming, blood collection and genetic material collection were recruited for this study. They were housed together in enclosures on the Ngongoni private game farm at an altitude of 900 m above sea level in Mpumalanga, South Africa, and were immobilized in September 2015.

The butorphanol—azaperone—medetomideine fixed-dose combination (BAM), as used in this study, was produced by Wildlife Pharmaceuticals South Africa (Pty) Ltd. Each animal was darted with BAM. The individual dose was estimated based on animal size, and small, medium and large females were administered 0.5, 0.6 and 0.7 mL, and small, medium and large males 0.7, 0.8 and 0.9 mL, respectively. Each millilitre of the solution contained 30 mg butorphanol, 12 mg azaperone and 12 mg medetomidine. In seven randomly chosen animals of both sexes, 8000 units of hyaluronidase (Hyaluronidase Type I-S from Bovine Teste; Sigma-Aldrich, MO, USA) was added to the dart. All animals were darted between 5:00 and 12:00 or 15:00 and 17:00 hours to avoid the high, midday environmental temperatures.

A gas-powered dart gun Pneu-Dart X-Caliber (Pneu-Dart Inc., PA, USA) was used to deliver the drugs. Darts with a 2 mL capacity combined with a 19 mm long, 14 gauge needle with wire barb (Wildlife Pharmaceuticals (Pty) Ltd., South Africa) were used. Remote darting was performed in a 6 × 8 m enclosure from an upper deck of the wall at distances ranging from 5 to 12 m. All injections were administered into the femoral muscles.

To antagonize the effect of the medetomidine and butorphanol, atipamezole (Antisedan 5 mg mL^{-1}; Orion Pharma, Finland) at five times the medetomidine dose in milligrams and naltrexone hydrochloride (Trexonil 50 mg mL^{-1}; Wildlife Pharmaceuticals (Pty) Ltd., South Africa) at one time (mg to mg), the actual butorphanol dose was administered to reverse medetomidine and butorphanol, respectively. All injections were administered IM.

Monitoring and manipulations of animals

Two stages of induction were timed: stage I — from time of the darting until the first signs of sedation,

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