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RESEARCH PAPER

Yohimbine antagonizes the anaesthetic effects of ketamine–xylazine in captive Indian wild felids

Sadanand D Sontakke MVSc, **Govindhaswamy Umapathy** MSc, PhD **& Sisinthy Shivaji** MSc, PhD
Laboratory for the Conservation of Endangered Species (LaCONES), Annexe I of Centre for Cellular and Molecular Biology, Hyderguda, Hyderabad, India

Correspondence: Sisinthy Shivaji, Centre for Cellular and Molecular Biology, Uppal Road, Hyderabad 500 007, India.
E-mail: shivas@ccmb.res.in

Abstract

Objective To determine the effectiveness of yohimbine as an antagonist of ketamine–xylazine anaesthesia in captive Asiatic lions (*Panthera leo persica*), tigers (*Panthera tigris*) and leopards (*Panthera pardus*).

Study design Prospective clinical trial.

Animals Fifty-two healthy adult lions, 55 adult leopards and 16 adult male tigers.

Methods Captive wild felids in Indian zoos were anaesthetized with a combination of ketamine (2.2–2.6 mg kg^{-1}) and xylazine (1.1–1.3 mg kg^{-1}) using a dart propelled from a blowpipe. Time to onset of anaesthesia, lateral recumbency and induction time were measured, and physiological variables (respiration, heart rate and rectal temperature) were recorded once after the onset of complete anaesthesia. Anaesthesia was antagonized at various time periods with an intravenous administration of either 0.1 or 0.15 mg kg^{-1} yohimbine. Onset of arousal and time to complete anaesthetic recovery were recorded.

Results A total of 123 immobilizations were conducted between 2000 and 2005. Anaesthetic induction was achieved in 15–25 minutes in all animals. Incidents of sudden recovery or life-threatening effects associated with immobilizations were not observed. Yohimbine effectively antagonized anaesthesia in all animals within 10 minutes without any excitatory behaviour compared to control animals. No adverse reactions/side effects to yohimbine were recorded except that a few leopards exhibited seizure-like signs for a short period immediately after yohimbine administration. The duration of anaesthesia had no significant effect on the recovery time in any of the animals.

Conclusion and clinical relevance Yohimbine antagonized the xylazine portion of ketamine–xylazine anaesthesia and thereby hastened recovery from anaesthesia in Asiatic lions, tigers and leopards.

Keywords Asiatic lion, ketamine–xylazine, leopard, reversal, tiger, wild felids, yohimbine.

Introduction

Chemical restraint is a valuable tool in wildlife research and management since it facilitates the handling of animals as and when required for medical procedures and experimentation (Kreeger et al. 1986). In recent years, various drug combinations, such as tiletamine–zolazepam, medetomidine–ketamine, ketamine–xylazine and phencyclidine–promazine have been used to immobilize wild carnivores (Herbst et al. 1985; Shivaji et al. 1998, 2003; Grassman et al. 2004; Jacquier et al. 2006). Amongst them, the dissociative anaesthetic ketamine hydrochloride (ketamine), in combination with an alpha-two adrenergic agonist, xylazine hydrochloride (xylazine), has been used effectively to immobilize several wild felids including lions, leopards and tigers (Herbst et al. 1985; Seal et al.

1987; Patil et al. 1998; Shivaji et al. 1998, 2003; Jayaprakash et al. 2001). This anaesthetic combination produces a smooth and rapid induction of anaesthesia with the pressor and cataleptic effects of ketamine being complemented by the sedative and myorelaxing effects of xylazine, thus counteracting the adverse effects of ketamine (Amend 1972). However, this combination is known to cause prolonged sedation, which has been attributed to the xylazine (Kreeger et al. 1986). Such uncontrollable recoveries because of prolonged sedation are a serious concern in wildlife research since the sedated free-ranging animals could be easily preyed upon. A few deaths have also been recorded in tigers because of profound respiratory depression following ketamine–xylazine anaesthesia (Seal et al. 1987).

It is therefore very important to determine a suitable antagonist for the speedy recovery of anaesthetized endangered wild felids. Alpha-two adrenergic antagonists such as yohimbine, tolazoline and atipamezole have been used effectively in ungulates for antagonizing the anaesthetic effects of ketamine–xylazine (Kreeger et al. 1986; Sontakke et al. 2007). However, to the best of our knowledge, little has been published on the antagonism of anaesthesia in wild felids (Seal et al. 1987; Miller et al. 2003; Jacquier et al. 2006). Studies in the domestic cat (Hsu & Lu 1984) and the Bengal tiger (Seal et al. 1987) have suggested that yohimbine could hasten the recovery of ketamine–xylazine anaesthesia. The present study was undertaken as a part of ongoing research on the conservation of endangered Indian wild animals with the aim to study the ability of yohimbine to antagonize the anaesthetic effects of ketamine–xylazine in three endangered Indian large felids (Asiatic lions, leopards and tigers).

Materials and methods

Study area and animals

Captive Asiatic lions (*Panthera leo persica*), leopards (*Panthera pardus*) and tigers *(Panthera tigris*) were anaesthetized for collection of blood for steroid hormone assay, for collection of semen by electroejaculation and for minor surgical manipulations (vasectomy, wound dressing, etc.). Animals of 3–12 years of age were anaesthetized as a part of the present study between 2000 and 2005 at various zoos in India. A total of 123 immobilizations were carried out on 52 lions (22 males and 30 females), 55 leopards (32 males and 23 females) and 16 tigers (all males) during 2000–2005. All the animals were in the breeding age-group (about 3–12 years) and were apparently healthy without any detectable illness. The mean body weight (mean ± SD) of the animals were as follows: male lions 163.7 ± 9.3 kg (range 140–180 kg), female lions 151.2 ± 7.1 kg (range 140–175 kg), male leopards 75.9 ± 9.3 kg (range 60–101 kg), female leopards 68.6 ± 7.1 kg (range 55–85 kg) and male tigers 183.3 ± 11.3 kg (range 165–210 kg). The details of the number of animals used and their sexes are given in Table 1. All animals were housed individually in indoor concrete pens (2.75 × 1.8 m) during the night and were allowed in an open exercise area (surrounded by a moat) during daytime with an exposure to a natural photoperiod. Each animal was fed with 6–10 kg of beef supplemented with calcium and vitamins once a day for 6 days week^{-1}. The animals had free access to clean

Table 1 Number of captive Asiatic lions, leopards and tigers (3–12 years) used for immobilization trials (2000–2005) from various zoos in India

	Lion		Leopard		Tiger
Zoo	**Male**	**Female**	**Male**	**Female**	**Male**
Nehru Zoological Park, Hyderabad, Andhra Pradesh	6	10	10	9	5
Sri Venkateswara Zoological Park, Tirupati, Andhra Pradesh	3	3	3	4	4
Indira Gandhi Zoological Park, Vishakhapatnam, Andhra Pradesh	5	5	–	–	–
Sakkarbaug Zoological Garden, Junagadh, Gujarat	4	5	13	6	1
Nandankanan Zoolgical Park, Bhubaneshwar, Orissa	2	4	3	4	–
Bannerghatta Biological Park, Bangalore, Karnataka	2	3	3	–	6