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Case Report

Chemical immobilisation of dhole (*Cuon alpinus*), Indian jackal (*Canis aureus indicus*) and Indian wolf (*Canis lupus pallipes*) with ketamine hydrochloride–xylazine hydrochloride

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Abstract

Maintaining wild animals in captivity often requires chemical immobilisation to achieve various diagnostic, surgical and management interventions. Four dholes, two Indian grey wolves and four Indian jackals were immobilised using ketamine–xylazine combination for either medical or management interventions. Based on the estimated body weight, canids were darted upon with 6–8 mg kg^{-1} ketamine and 0.7–1.14 mg kg^{-1} xylazine. Initial signs of drug effect included decreased mentation and progressive ataxia followed by recumbency. The mean ± SD of induction time was 14.25 ± 2.75 (range: 11–17 min), 11 ± 3.16 (range: 8–15 min) and 15.5 ± 3.54 (range: 13–18 min) in dhole, Indian jackal and Indian wolf, respectively. Hyperthermia was initially observed in all the jackals and dholes, whereas rectal temperature in wolves remained well within the normal range for canids. The mean duration of anaesthesia was 31 ± 8.83 (range: 23–43 min), 32.5 ± 5.32 (range: 26–39 min) and 30.5 ± 7.78 (range: 25–36 min) in dhole, Indian jackal and Indian wolf, respectively, with subsequent smooth and uneventful recovery in all the cases. The observations made during immobilisation procedures in this work suggest that chemical immobilisation of captive dhole, Indian wolf and Indian jackal with 6–8 mg kg^{-1} ketamine and 1 mg kg^{-1} xylazine is effective and safe for routine management and medical interventions in these species provided body temperature is closely monitored and corrected as appropriate.

Keywords: *Canis aureus indicus*, *Canis lupus pallipes*, *Cuon alpinus*, immobilisation, ketamine hydrochloride, xylazine hydrochloride.

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Introduction

Many procedures that are routinely accomplished in domestic animals with minimal restraint may require anaesthesia in wild animals, in order to ensure the welfare and safety of the animals and personnel involved. When appropriately used, chemical immobilisation can be employed to safely restrain and capture many species, thereby minimising stress and the risk of injuries associated with other restraint methods (West *et al.* 2008). Hence, it is of utmost importance for wildlife veterinarians to know the suitable anaesthetic drugs and the combinations and dosage that provide safe and satisfactory immobilisation for adequate periods of time in different species (Ferreras *et al.* 1994). Reports on doses of anaesthetic agents for safe and effective immobilisation of most wild species occurring in India are very limited (Belsare & Vanak 2013). Furthermore, chemical immobilisation is challenging in India because available field immobilising drugs are limited to xylazine hydrochloride and ketamine hydrochloride due to several legal restrictions. Hence, there is an urgent need to document existing safe immobilisation

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protocols for many species using this combination. This will facilitate management interventions in captivity and also serve as a baseline for research and medical interventions in wild counterparts.

Three wild canid species are commonly found in Indian zoos. Among them, Asiatic wild dogs or dholes (*Cuon alpinus*) are pack hunting social canids native to South and Southeast Asia. Due to various anthropogenic threats, this species is classified as endangered in IUCN Red list of Threatened species, version 2010.1. (Kamler *et al.* 2015). The captive management of this species therefore assumes importance for maintenance of an insurance population, as well as for possible reintroduction of surpluses in suitable habitats. Indian jackal (*Canis aureus indicus*), a subspecies of golden jackal, are present in all protected areas of India except for those in the high altitude regions of the Himalayas. The IUCN considers golden jackals as a 'species requiring no immediate protection' with the caution that the population throughout its range are likely declining (Jhala & Moehlman 2008). Despite having a large population in captivity that is maintained in almost all Indian zoos, there is a scarcity of reports on captive management of this species. The Indian grey wolf (*Canis lupus pallipes*), one of two wolf subspecies found in India, inhabit throughout the arid and semiarid plains of peninsular India. Present populations of this species are estimated to be close to 2000–3000 individuals (Jhala 2003). Even though this wolf species has been classified as a species of 'Least Concern' by the IUCN, the pallipes subspecies is protected under Schedule 1 of the Indian Wildlife (Protection) Act of 1972, which prohibits their hunting, trapping or killing. In the last few decades, wolf protection and conservation efforts were initiated by setting up Indian wildlife preserves and captive breeding programmes in zoological parks.

Ketamine–xylazine (KX) combinations have been widely used for immobilisation of wild canids (Kotwol 1981; Fuller & Kuehn 1983; Grassman *et al.* 2006; Gerardo *et al.* 2010; Belsare & Vanak 2013). Ketamine is a dissociative anaesthetic that is used either as a sole anaesthetic agent or in combination with α-2 adrenergic agonists like xylazine and medetomidine. Xylazine is a potent α-2 central nervous system depressant with anxiolytic, muscle relaxant and analgesic properties that help counteract the undesirable side-effects of ketamine such as convulsions and catalepsy. This manuscript reports safe and effective use of KX in three wild Indian canid species under captive conditions.

Methods

Four dholes (three males and one female), two Indian grey wolves (two males) and four Indian jackals (one male and three females) held in captivity in an Indian zoo were immobilised for either medical or management interventions. Based on estimated body weight, each animal was injected, using a pressurised plastic dart (3 cc or 5 cc dart syringe, DAN-INJECT ApS Sellerup Skovvej 116DK, Børkop, Denmark), with an intended dose of 8 mg kg^{-1} ketamine (Ketamil, 100 mg mL^{-1}; Troy Laboratories Private Ltd., Smithfield, NSW, Australia) and 1 mg kg^{-1} xylazine (Xylaxin, 20 mg mL^{-1}; Stanex Drugs & Chemicals Private Ltd., Hyderabad, India), projected using a CO_2 powered dart projector (Rifle Model IM, DAN-INJECT).

Only the animal attendant and veterinarian were allowed to approach canids for visual estimation of the body weight prior to immobilisation, as a means of minimising excitement prior to drug administration. The induction time (time between administration of immobilising agents and attainment of nonresponsive state for safe handling) was recorded for each canid. The actual body weight was measured immediately after immobilisation with an electronic digital scale (Model CS-PF, Canon Services, Bangalore, India) followed by the intended procedure. Ophthalmic solution (CIPLOX D®, Cipla Ltd., Mumbai, India) was applied to keep the eyes moist, and canids were blindfolded to cease visual stimuli. Catheters were placed in lateral saphenous veins for administration of emergency medication or additional doses of ketamine as needed.

The heart rate and the respiratory rate were monitored manually by a chest auscultation and chest excursions. The rectal temperature was monitored via patient monitoring units (MEC-1200 Patient Monitor; MINDRAY, Shenzhen, China).

Physiological parameters were monitored immediately after induction, and thereafter at 10 min intervals. The total duration of anaesthesia (time from when the animal became motionless until the first voluntary movement) was also recorded. The range and mean ± SD were calculated for all the data recorded, using Microsoft office Excel version 2007 (Microsoft, Redmond, Washington, USA).

Results

As accurate body weights could not be obtained before drug administration, the mean administered dosages were calculated after obtaining actual body weights, as tabulated in Table 1. Induction of anaesthesia was rapid and smooth in all the animals, with the induction time ranging from 8 to 18 min. Initial signs of drug effect included decreased mentation and progressive ataxia followed by recumbency. Hyperthermia was initially observed in all the jackals and dholes, whereas the rectal temperature in both the wolves remained well within the normal range for canines during the entire procedure (Malmsten 2007). The mean with SD and range of physiological parameters observed are tabulated in Table 2. Hyperthermia was successfully treated by spraying ethanol on groin, abdomen region and foot pads. In case of persistent hyperthermia (≥39°C, 20 min post initiation of procedures) as observed in three dholes, 10 mL kg^{-1} i.v. bolus dose of lactated ringers' solution was administered following cold water rectal enema, after which body temperature started decreasing gradually. Seizures were not seen in any canids. The duration of anaesthesia ranged from 23 to 43 min. No supplemental ketamine was given to any animal, as the intended procedures were carried out well within this period. All recoveries were smooth and uneventful. All canids took more than 45 min to completely recover from the effects of the anaesthetic agents.

Discussion

In general, KX combination exhibited smooth and rapid induction and induced adequate plane of anaesthesia, safe enough to perform intended procedures in all the animals. Effective doses of the KX used in dholes by us were less than those recommended for free-ranging dholes (Grassman *et al.* 2006; Acharya *et al.* 2010). We could not compare the results with similar work on captive dholes as pursual of literature did not yield any such study. KX

Table 1. Mean drug dosages, induction time and recovery time ± SD used in dholes (*Cuon alpinus*), Indian Jackals (*Canis aureus indicus*) and Indian grey wolves (*Canis lupus pallipes*)

Species	Actual weight (kg)	Ketamine (mg kg^{-1})	Xylazine (mg kg^{-1})	Induction time (min)	Recovery time (min)
Dhole (n = 4)	13.4 ± 1.34	8.68 ± 0.42	1.08 ± 0.05	14.25 ± 2.75	31 ± 8.83
Indian jackal (n = 4)	7.38 ± 0.93	8.18 ± 0.97	1.02 ± 0.12	11 ± 3.16	32.5 ± 5.32
Indian wolf (n = 2)	26.5 ± 1.13	6.8 ± 0.78	0.8 ± 0.09	15.5 ± 3.54	30.5 ± 7.78

Table 2. Mean ± SD and range for physiological parameters observed in dholes (*Cuon alpinus*), Indian Jackals (*Canis aureus indicus*) and Indian grey wolves (*Canis lupus pallipes*) chemically immobilised with ketamine and xylazine

Species	Temperature (°C)		Respiration (breaths min^{-1})		Heart rate (beats min^{-1})	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
Dhole (n = 4)	39.61 ± 0.64	38.77–40.66	24.88 ± 7.54	15–37	67.69 ± 18.76	42–96
Indian Jackal (n = 4)	39.27 ± 0.49	38.55–40.16	32.06 ± 6.15	21–40	98.94 ± 12.27	80–116
Indian wolf (n = 2)	38.34 ± 0.90	37.22–39.66	15.25 ± 2.49	12–19	83.38 ± 10.77	69–98

was also very effective and safe in immobilising jackals, although the doses we used were higher than those mentioned in literature for captive jackals (Senthilkumar *et al.* 2011). Effective doses of the KX used in wolves here were same as those recommended for wolves in captivity (Larsen & Kreeger 2007). The dosage used provided good muscular relaxation and sufficient analgesia for management procedures with adequate handling time and acceptable recovery time in all three species.

Stress and overheating are always the major concerns when capturing large canids. We believe that the hyperthermia that was initially documented in all dholes and jackals was due to the animal's state of excitation at the time of darting. Most canids dissipate heat through panting, but this is often compromised during immobilisation (Larsen & Kreeger 2007). Additionally, canids immobilised with KX have been frequently observed to have poor thermoregulatory ability (Fuller & Kuehn 1983; Larsen & Kreeger 2007). As there was no holding house for dholes and jackals, they had to be darted in a large open enclosure. In contrast, Indian wolves were confined inside a small holding house and quickly darted without development of excitement. It is thus recommended to encourage captive canids to run into a den or other confined area, such as a holding house, wherein they can be darted upon without much excitation. Further, materials to deal with hyperthermia, such as cool water, wet towels, ice packs, ethanol and lactated ringers' solution, should be kept handy, before attempting immobilisation in canids.

Prolonged and rough recoveries have been reported as disadvantages of KX immobilisation in canids due to residual ketamine effects. Consequently, reversal of xylazine and other α-2 adrenergic agents with administration of antagonists is not advised until 45 min after the last injection of ketamine (Larsen & Kreeger 2007). Adherence to this recommendation minimises the odds of rigidity, excitement and other adverse residual ketamine-related signs during recovery. As all procedures and recovery were completed within 45 min of initial administration of ketamine, reversal of xylazine with use of yohimbine hydrochloride was not necessary.

Even though the complete recovery period was relatively prolonged, it was smooth and uneventful in all canids. No immobilisation-related mortality occurred during or within one month after the immobilisation procedure. Observations made during chemical immobilisation procedures suggest that immobilisation protocols followed in present study are effective and safe for carrying out routine management procedures and medical interventions in captive dhole, Indian wolf and Indian jackal provided body temperature is closely monitored and corrected as appropriate.

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Conflicts of interest

The authors disclose no conflict of interest.

Contributions

SKM and AAS conceived and designed the procedures. SKM, AAS, PK, LA, HC and NJ carried out the work and compiled data. SK conducted the statistical analysis. SK and AAS prepared the draft manuscript. All authors reviewed and agreed the content of the final manuscript.

References

Acharya B.B., Johnsingh A.J.T. & Sankar K. (2010) Dhole telemetry studies in Pench Tiger Reserve, Central India. *Telemerty in Wildlife Science* **13**, 69–79.

Belsare A.V. & Vanak A.T. (2013) Use of xylazine hydrochloride–ketamine hydrochloride for immobilization of Indian fox (*Vulpes bengalensis*) in field situations. *Journal of Zoo and Wildlife Medicine* **44**, 753–755.

Ferreras P., Aldama J.J., Beltrán J.F. & Delibes M. (1994) Immobilization of the endangered Iberian Lynx with xylazine and ketamine hydrochloride. *Journal of Wildlife Diseases* **30**, 65–68.

Fuller T.K. & Kuehn D.W. (1983) Immobilization of wolves using ketamine in combination with xylazine or promazine. *Journal of Wildlife Diseases* **19**, 69–72.

Gerardo A.J., Francisca A.A. & Andrew A.C. (2010) Comparison of chemical immobilization methods in wild foxes (*Pseudalopex griseus* and *Pseudalopex culpaeus*) in Chile. *Journal of Wildlife Diseases* **46**, 1204–1213.

Grassman L.I. Jr, Janecka J.E., Austin S.C. *et al.* (2006) Chemical immobilization of free-ranging dhole (*Cuon alpines*), binturong (*Arctictis binturong*), and yellow throated marten (*Martes flavigula*) in Thailand. *European Journal of Wildlife Research* **52**, 297–300.

Jhala Y.V. (2003) Status, ecology and conservation of the Indian wolf *Canis lupus pallipes* Sykes. *Journal of Bombay Natural History Society* **100**, 293–307.

Jhala Y.V., Moehlman P.D. (2008) *Canis aureus. The IUCN Red List of Threatened Species*. Version 2014.3. www.iucnredlist.org (Accessed 27 May 2015).

Kamler J.F., Songsasen N., Jenks K., Srivathsa A., Sheng L. & Kunkel K. (2015) *Cuon alpinus. The IUCN Red List of Threatened Species*. http://dx.doi.org/10.2305/IUCN.UK.20154.RLTS.T5953A72477893.en (Accessed 17 December 2015)..

Kotwol P.C. (1981) Tranquilisation of Indian wild dog (*Cuon alpines Pallas*). *Cheetal* **23**, 34–35.

Larsen R.S. & Kreeger T.J. (2007) Canids. In: *Zoo Animal and Wildlife Immobilization and Anesthesia*. 1st edn, (eds G. West, D. Heard & N. Caulkett), pp 395–407. Blackwell Publishing: Iowa.

Malmsten J. (2007) *Blood pressure in free-ranging gray wolves* (Canis lupus) *immobilized with tiletamine and zolazepam* (dissertation). Swedish University of Agricultural Sciences.

Senthilkumar K., Jayathangaraj M.G. & Thirumurugan R. (2011) Chemical immobilization of golden jackal (*Cuon aureus*). *Tamilnadu Journal of Veterinary & Animal Sciences* **7**, 256–257.

West G., Heard D. & Caulkett N. (eds.) (2008) *Zoo Animal and Wildlife Immobilization and Anesthesia*. Blackwell Publishing Ltd: Oxford.