Acta Scientiae Veterinariae, 2022. 50(Suppl 1): 826.

CASE REPORT
Pub. 826

ISSN 1679-9216

Dexmedetomidine for Chemical Restraint of a Brazilian Tapir (*Tapirus terrestris*)

Marllos Henrique Vieira Nunes[1], Eduardo Cavalcante das Neves[1], Elaine Christina Oliveira do Carmo[2], Danielle Saldanha de Souza Araújo[1], Cassio Toledo Messias[1] & Juliana Tessália Wagatsuma[1]

ABSTRACT

***Background*:** The Brazilian tapir (*Tapirus terrestris*), considered the largest land mammal in South America, is a vulnerable species in terms of its degree of conservation. In captivity, its health is evaluated through behavioral and physical observation and laboratory exams, and in some cases, chemical restraint, to reduce stress. Dissociative anesthetics and sedatives are used for the sedation of these animals, and few studies have reported the use of dexmedetomidine and its effects when associated with other drugs in chemical containment protocols; therefore, this work reports its use, in conjunction with ketamine and midazolam, in a young Brazilian tapir.

***Case*:** A male Brazilian tapir, male, weighing 89 kg, 1 and a half year old, housed at CETAS in Rio Branco, Acre, was chemically restrained with dexmedetomidine (7 µg/kg), ketamine (1.5 mg/kg), and midazolam (0.2 mg/kg) for venous blood collection, oral and rectal mucosal swabs, and microchipping. The protocol was administered intramuscularly to the right triceps brachii, after physical restraint. After 5 min of application, the animal assumed sternal recumbency and presented reflux. After 15 min, the patient was placed in the right lateral decubitus position. During collection, heart rate (48 ± 10 bpm), respiratory frequency (29 ± 1 mpm), rectal temperature (38.1 ± 0.18°C), oxyhemoglobin saturation (97 ± 1%), and electrocardiographic tracing were recorded. The tapir showed deep sedation, immobility, good muscle relaxation, discreet medial palpebral reflex, and bilateral rotation of the eyeball. After 40 min of protocol administration, sedative reversal was performed intramuscularly with 14 µg/kg atipamezole. Five min after administration, the tapir showed signs of mild sedation. After 10 min, he assumed the quadrupedal position, remained in this position for 8 min, and gently resumed the sternal decubitus. After only 20 min, he resumed the quadrupedal position, with mild ataxia and good muscular and conscious tone. After 50 min, the patient was discharged from anesthesia.

***Discussion*:** Domestic horses are phylogenetically close to tapirs, so the choice of drugs and doses of the protocol used was based on their use in horses, and on studies carried out with tapirs as well. Despite being docile and passive, the tapir was not conditioned and did not allow the manipulation and collection of samples collaboratively; therefore, it was chemically contained. The physical restraint performed did not generate satisfactory immobilization of the tapir, resulting in agitation and stress and causing the needle to break. The reflux presented by the tapir minutes after sedation and at recovery was induced by dexmedetomidine, and only the undigested banana pieces were offered to the animal. Reflux plus stress from extensive fasting and suboptimal physical restraint was responsible for the change in the tapir's eating behavior, with possible stress gastritis 24 h after chemical restraint. Only one study reported the use of dexmedetomidine in tapirs, associated with continuous infusions of ketamine, midazolam and guaiacol glyceryl ether for moderate to long-term field procedures. Sedative reversal of dexmedetomidine by atipamezole reduced the recovery time and the risk of death from cardiorespiratory depression. The anesthetic combination used was effective, promoting immobility, muscle relaxation, and stability of the physical parameters evaluated, with rapid and gentle induction and an adequate level of sedation for the objective, good sedative reversal, and anesthetic recovery.

Keywords: anesthesia, anesthetic management, wild animals, mammals, sedative.

DOI: 10.22456/1679-9216.124863

Received: 30 May 2022 Accepted: 4 October 2022 Published: 30 October 2022

[1]Centro de Ciências Biológicas e da Natureza (CCBN), Universidade Federal do Acre (UFAC), Rio Branco, AC, Brazil. [2]Centro do Triagem de Animais Silvestres (CETAS/AC), Rio Branco. CORRESPONDENCE: M.H.V. Nunes [marllos.nunes@ufac.br] & J.T. Wagatsuma [jutessalia@yahoo.com.br]. Universidade Federal do Acre - UFAC. BR-364, km 04. CEP 69920-000 Rio Branco, AC, Brazil.

INTRODUCTION

The Brazilian tapir (*Tapirus terrestris*) is considered the largest terrestrial mammal in South America. It belongs to the order Perissodactyla and the family Tapiridae, and is a herbivore, ungulate, which mainly inhabits forested areas [13,17].

In captivity, health status is periodically evaluated through behavioral and physical observation, as well as through blood, urine, and feces tests, to diagnose infectious and zoonotic diseases [6,13,20,24].

Chemical restraint, composed mostly of sedatives and dissociative anesthetics, is recommended to reduce the stress of handling by physical restraint alone and to reduce the risk of accidents, such as bites, kicks, or escape reactions by the animal [24].

Among the sedatives used in the chemical restraint of tapirs, dexmedetomidine is the most selective (1:1620) and results in less cardiorespiratory depression when compared to xylazine or detomidine. Sedation facilitates handling during transport, and immobilization for minimally invasive procedures. It can be used in continuous infusions, along with ketamine, midazolam, and guaiacol glyceryl ether, for long procedures performed in the field [1].

Few studies have reported on the use of dexmedetomidine in tapirs and its effects when combined with other drugs in chemical containment protocols. In this study, we aimed to report the use of dexmedetomidine, combined with ketamine and midazolam, in a young Brazilian tapir (*Tapirus terrestris*), describing its benefits and possible adverse effects, the administered doses, latency time, anesthetic action and recovery, and important anesthetic management aspects to avoid complications resulting from improper handling of the animal.

CASE

A Brazilian tapir (*Tapirus terrestris*), male, weighing 89 kg, 1 and a half year old, living at the Rio Branco Wild Animal Screening Center at IBAMA in Acre (CETAS/AC), was chemically contained for venous blood collection, oral and rectal mucosal swabs, and microchipping, for scientific purposes of research on hemoparasites, endoparasites, and molecular biology tests for the diagnosis of possible viral diseases.

The tapir's temperament was considered docile and passive with a low level of stress to human contact, raised freely by people. However, before chemical restraint, physical examination and blood tests such as blood count and serum biochemical profile were not performed due to the unpredictable behavior of the species.

The recommended solid and water fasting time was 12 h, however, the total fasting time was 24 h at the time of administration of the anesthetic protocol, composed of dexmedetomidine[1] [Dexdomitor® - 0.5 mg/mL, dose of 7 μg/kg], associated with ketamine[2] [Quetamina® - 100 mg/mL, dose of 1.5 mg/kg] and midazolam[3] [DORmire® - 5 mg/mL, dose of 0.2 mg/kg].

Banana pieces were offered to the tapir to facilitate handling and its displacement from the original enclosure to a containment cage used for big cats for intramuscular administration of the anesthetic protocol.

Physical containment in the cage did not promote efficient and calm immobilization of the tapir, generating great stress, movement, and agitation during the transfer. Three attempts were made to administer the protocol intramuscularly on the side of the left pelvic limb at the gluteus and quadriceps levels. However, the animal was still able to move at the time of the injection. The tapir presented a high sensitivity to the introduction of the needle, in one of the attempts, the needle[4] (40 × 1.20 mm - 18G) introduced into the animal broke, thus leaving the metal rod in the animal.

New attempt at scalp administration of 19G (Descarpak®)[5] were performed on the muscles of the right forelimb (right triceps brachii), where the skin is thinner, with success.

After 5 min of application, sternal recumbency with a spontaneous eyelid reflex was assumed. The animal was positioned in the right lateral decubitus position, 15 min after administration. A cloth was placed under the eyes and lubricated with 0.9% saline solution, while another cloth was positioned below the head to avoid direct contact of the animal's right face with the ground. During this time, the animal had no spontaneous palpebral reflex and appeared to have intense muscle relaxation and a degree of sedation and immobility. Additionally, it regurgitated the banana pieces offered for it to enter the containment cage.

A face mask for oxygen delivery 100% (3 L/min) was attached to the tapir's proboscis and remained until the beginning of anesthetic recovery. The multiparameter monitor pulse oximeter sensor (DL 1000 Delta Life®)[6] was positioned on the animal's tongue, and the electrocardiogram electrodes of the same monitor were

positioned above the olecranon (thoracic) and inguinal fold (pelvic) of the tapir (Figure 1).

Blood was collected through puncture of the left lateral saphenous vein (8 mL) using a sterile needle and syringe. Samples of the oral and rectal mucosa were collected using a sterile swab and microchipping with the aid of a needle-punched applicator (Animall TAG®, microchip 2 × 12 mm, needle 2.6 mm × 3.0 cm)[7] in the subcutaneous dorsocranial midline of the withers.

During collections and microchipping, the tapir was monitored every 5 min for heart rate (48 ± 10 beats per minute [bpm]) and respiratory rate (29 ± 1 movements per minute [mpm]) through stethoscopy (3MTM Littmann®)[8]; rectal temperature (38.1 ± 0.18°C) using a clinical digital thermometer[9]; and oxyhemoglobin saturation (97 ± 1%), and electrocardiographic tracing with a multiparametric monitor [DL 1000 Delta Life®][6].

The tapir remained immobile during monitoring, with the degree of sedation and muscle relaxation considered deep, presenting a discreet medial eyelid reflex, without nystagmus, with bilateral rotation of the eyeball, unresponsive to manipulation during venipuncture, microchipping, and rectal, oral swabs, without requiring additional sedative doses.

Forty minutes after administration of the anesthetic, the animal began to present with a degree of superficial sedation, with slight movements of the limbs (thoracic and pelvic), nystagmus, and a strong medial palpebral reflex in the left eye. At this time, sedative reversal was performed by administering atipamezole [Antisedan® 5.0 mg/mL][1] at a dose of 14 µg/kg intramuscularly in the triceps of the left forelimb.

Five min after the administration of atipamezole, frequent movements of the forelimbs and pelvic limbs of the tapir, spontaneous swallowing reflex, mild nystagmus, and strong medial eyelid reflex were observed. At 10 min, the tapir tried to assume the quadrupedal position, regaining consciousness satisfactorily, and getting up abruptly and agitatedly, with moderate ataxia.

For 8 min, the tapir remained in the quadrupedal position, slightly moving the head and neck, and walking around the enclosure in an ataxic way with slow steps, however, it resumed sternal recumbency smoothly, without a sudden fall, and, after 20 min, it resumed smoothly. The quadrupedal position with mild ataxia, muscle tone recovered, and a degree of alert consciousness was observed through the offer of food (Figure 2).

Thirty-eight h after chemical restraint of the tapir, the handler observed that the tapir was more apathetic, avoiding walking and spending more time in the decubitus position than normal, with possible lameness and hyporexia. The following day, the anesthetic team returned to the CETAS/AC to evaluate the animal and perform an ultrasound scan of the left pelvic limb musculature to locate the needle that broke during the introduction, and thus assess whether it was causing discomfort to the animal.

On ultrasound imaging, the needle was found in the subcutaneous tissue in a "lying" position, close to the superficial musculature of the thigh approximately 0.7 cm deep and distant the sciatic nerve, not cause pain. However, possible stress gastritis was considered as a result of conducting the collections and the long fasting period. Management with oral administration of omeprazole was indicated. The following day, the tapir walked, interacted, and fed normally, with no further medical complaints.

DISCUSSION

Owing to their phylogenetic proximity to domestic Equidae, the choice of drugs and doses of the protocol used was based on the proven beneficial use in this species and through the work conducted in tapirs [1,7,10,12,15,20].

Despite the docile and passive temperament, the tapir was not conditioned to the point of allowing the manipulation and collection of samples collaboratively, which resulted in the need for the tapir to be chemically contained. This conditioning must be routine, especially in captive tapirs through scratching and rubbing the neck or abdomen, which can lead to recumbency, aiming at handling with less stress and risk of accidents. [2,11,12].

The anesthetic protocol could have been administered in the tapir of this report intramuscularly in the region of the neck plate or the posterior or gluteal musculature, with the region of the neck plate being an easier place for the injection because of the thinner skin compared to the skin of the gluteal region [22].

The use of tranquilizer darts and blowguns for the remote administration of anesthetic or sedative drugs is recommended for the chemical restraint of captive wild animals [4,24]. The use of a dart for

Figure 1. Brazilian tapir (*Tapirus terrestris*), male, young, in the right lateral decubitus position, after chemical restraint with dexmedetomidine, ketamine and midazolam, with face mask supplying 100% oxygen attached to the proboscis, pulse oximeter sensor on the tongue, and electrocardiogram electrodes.

Figure 2. Brazilian tapir (*Tapirus terrestris*), male, young, in quadrupedal position, after sedative reversal, during anesthetic recovery.

anesthetic administration was not performed in this report because of a lack of material and equipment. Shooting darts with inadequate equipment or with an inexperienced operator increases the risk of erroneous perforations in the abdomen and thorax, which can be potentially lethal [4].

A combination of dexmedetomidine, ketamine, and midazolam was used for chemical restraint of the tapir. Alpha-2 agonist agents are often associated with dissociative anesthetics and benzodiazepines in chemical containment protocols for free-living and captive tapirs, promoting a satisfactory degree of sedation, safety for animal handling, collection of biological samples, transport, or capture [1,8,10,12,18,24].

Opioids, such as butorphanol and methadone, can also be part of chemical restraint protocols for tapirs, in association with alpha-2 agonist sedatives and ketamine. In a study that used 0.15 mg/kg of butorphanol, combined with 0.012 mg/kg of medetomidine and 0.6 mg/kg of ketamine in free-ranging Brazilian tapirs captured in box traps or pitfalls, it was possible to observe an average time of ten to 12 min for the tapirs to assume lateral or sternal recumbency after intramuscular administration [19]. There are similarities between the latency time of this report and another wherein Brazilian tapirs were sedated with methadone (0.15 mg/kg), detomidine (0.05 mg/kg) and ketamine (1-2 mg/kg) [22]. The protocols mentioned in this report promoted good muscle relaxation and could be used in captive tapirs.

After the administration of chemical containment protocols for an average of 4 a 6 min, tapirs begin to show mild ataxia and tend to sit. After approximately ten to 12 min, moderate muscle relaxation can be observed; then, the animals assume lateral or sternal recumbency, remaining immobilized for 30 to 40 min [22]. The tapir in this report was positioned in the left lateral decubitus position by the anesthetic team 15 min after administration of the drugs, presenting a degree of deep sedation without requiring additional doses.

It is important to remember that additional doses of ketamine contribute to an increase in anesthetic recovery time and may induce excessive salivation and respiratory secretions, in which case the use of atropine is indicated (0.03 mg/kg, intramuscularly) to reduce effects; however, the use of atropine can also lead to tachycardia owing to its positive chronopositive effect [19]. The tapir in this report did not require additional doses of ketamine after receiving chemical restraint and did not present with respiratory secretions during the period in which she was sedated or during recovery from anesthesia.

A study that reported the use of the tiletamine-zolazepam (1.25 mg/kg) in association with medetomidine (0.006 mg/kg) and ketamine (0.6 mg/kg) for the capture of 12 *Tapirus terrestris* and 2 *T. pinchaque*, administered with the aid of a distance dart, reported an average induction time of 2 to 3 min and immobilization for 30 to 40 min with stable heart rate and respiratory rate [14].

Protocol variations using tiletamine-zolazepam (1.25 mg/kg) in association with detomidine (0.06 mg/kg) or romifidine (0.05 mg/kg), with and without the addition of ketamine (0.6 mg/kg), were evaluated.

These showed good results in terms of immobilization capacity and latency time of 3 to 5 min in tapir capture, however, short episodes of apnea were observed when detomidine was used [15,21].

Studies in Brazilian tapirs sedated with tiletamine-zolazepam showed that the use of these drugs was associated with recoveries with agitation, pedaling movements, apnea, and ataxia, suggesting the use of additional doses of midazolam (0.03 mg/kg, intramuscularly) 30 min after administration to reduce the undesirable effects generated by tiletamine and to supplement insufficient muscle relaxation promoted by zolazepam, due to its faster metabolism than tiletamine. The use of midazolam results in smoother but longer recoveries [15,16].

Only one study in the researched literature, reported the use of dexmedetomidine in *Tapirus terrestris*. It was used with continuous infusions of ketamine, midazolam, and glyceryl guaiacol ether for field procedures of moderate to long duration; longer sedation time was observed when using an intramuscular dose of 0.007 mg/kg than when using detomidine (0.04 mg/kg) associated with continuous infusions of ketamine, midazolam, and guaiacol glyceryl ether. When evaluating the effects on heart rate, mean arterial pressure, and respiratory rate, dexmedetomidine had less of an influence on these parameters [1].

Dexmedetomidine is the most selective alpha-2 agonist (1:1,620); therefore, it has better sedative effects than xylazine and detomidine. However, tapirs sedated with detomidine or dexmedetomidine may have oxyhemoglobin saturation values below 90%, due to the decrease in respiratory rate and minute volume, which in addition to the lateral decubitus contributed to the increase in the partial pressure of carbon dioxide in the arterial blood ($PaCO_2$) and reduction of arterial oxygen partial pressure (PaO_2). This is similarly observed in horses, with oxygen therapy or ventilatory support being recommended to prevent hypoxia [3,6].

The use of alpha-2 agonists in tapirs promotes sedation with effects similar to those observed in horses, such as lowering of the head, lip, and eyelid ptosis; tongue protrusion; penile relaxation; urination; and mild ataxia, but can also induce drooling and reflux of gastric contents [1,6,11,23]. The reflux presented by the tapir in this report minutes after sedation and the recovery period was induced by dexmedetomidine, and the content was only the undigested banana pieces offered to the animal in the absence of other gastric contents.

Reflux of gastric contents was observed during anesthesia in 6 tapirs, 1 of which died 3 days after the administration of the second anesthesia dose, and the necropsy results were conclusive for the diagnosis of aspiration pneumonia [6]. The reflux, added to the stress of the long fasting time and the physical restraint below the ideal, was a possible factor responsible for the behavioral and dietary changes in the tapir, with possible stress gastritis, 38 h after chemical restraint.

Changes in the stomach mucosa that lead to gastritis may occur because of stress in several species of wild and domestic animals, such as working horses or athletes. This may happen after long periods of training or intense exercise. Stress stimulates the hypothalamic-pituitary-adrenal axis, leading to an increase in the production of hydrochloric acid and pepsin. This can generate changes in the gastric mucosa by compromising the epithelial cells and the protective barrier formed by glycoproteins, predisposing the formation of ulcers [5,25].

In wild animals, in addition to these gastric changes, acute stress can trigger harmful effects, such as the excessive release of catecholamines,increased cortisol production and eating disorders [22].

In the literature, there are no studies that point to reference values for physical parameters in non-sedated tapirs, with some mean values of heart rate (75 bpm), respiratory rate (26 mpm), body temperature (37°C), and oxyhemoglobin saturation (88%), considered as "normal or standard" under different anesthesia protocols [22].

Brazilian tapirs sedated with dexmedetomidine presented smaller variations in heart rate and mean arterial pressure than tapirs that received detomidine. Such effects were due to the selectivity of dexmedetomidine for alpha-2 agonist receptors [1].

Hyperthermia was not observed (above 41°C) in the tapir, and chemical restraint was done in the late afternoon, when the temperature of the environment and the city was milder, thus preventing the occurrence of hyperthermia and thermal stress [9], because the stress generated during physical restraint and protocol administration could also be a predisposing factor for this condition.

The sedative effect of dexmedetomidine was reversed by atipamezole, an alpha-2 adrenergic antagonist, contributing to a shorter recovery time and reduced risk of death from cardiorespiratory depression during recovery. There are reports on the use of

atipamezole for the sedative reversion of tapirs at doses of 0.05 to 0.06 mg/kg and doses that are higher than the one used in the reversion of the reported animal, which was 14 µg/kg. This is efficient and provides more savings to the protocol because of the lower volume administered [15,19,22].

Movement of the forelimbs and pelvic limbs and swallowing reflex were the first signs of tapir recovery seen 5 min after administration of the antagonist. In a study that used intramuscular atipamezole (0.06 mg/kg) to promote sedative reversal of anesthetized tapirs with medetomidine (0.006 mg/kg), tiletamine-zolazepam (1.25 mg/kg), and ketamine (0.6 mg/kg), there was a smooth recovery in 2 to 3 min [22].

The moderate ataxia and agitation observed during the tapir's anesthetic recovery were possibly caused by residual effects of ketamine and midazolam, and the escape instinct, as occurs in horses during recovery from anesthesia, especially when doses above 3 mg/kg of ketamine or 0.5 mg/kg of midazolam are used [7]. The doses of ketamine (1.5 mg/kg) and midazolam (0.2 mg/kg) used in the animal in this report were lower, however, the tapir presented with moderate ataxia in the first minutes of recovery, more than 40 min after the administration of sedation, when it assumed the quadrupedal position after reversal of dexmedetomidine due to the greater sensitivity of the species to benzodiazepines and dissociative anesthetics, in terms of half-life and residual action.

Recovery reports with periods in season and falls with head movement, something expected for tapirs, were published. Studies in Brazilian tapirs (*Tapirus terrestris*) chemically contained with tiletamine-zolazepam (4.11 mg/kg) and medetomidine (0.01 mg/kg) or romifidine (0.11 mg/kg) or xylazine (0.56 mg/kg) and reversed with atipamezole (0.05 mg/kg) intramuscularly, were also conducted [19,22].

Considering the above results, we conclude that the anesthetic combination used for chemical containment was effective for a young Brazilian tapir in captivity, promoting immobility, muscle relaxation, and stability of the evaluated physical parameters. This combination presented with deep sedation with rapid and gentle induction, and with the possibility of sedative reversal and good anesthetic recovery. The sedation and anesthetic recovery were similar to those seen in other reports and articles. However, the doses of the drugs used for anesthesia and the reversal in this report were lower than those found in the literature, also demonstrating anesthetic and reversal in this species.

MANUFACTURERS

[1]Zoetis Indústria de Produtos Veterinários Ltda. Campinas, SP, Brazil.
[2]Vetnil Indústria e Comércio de Produtos Veterinários Ltda. Louveira, SP, Brazil.
[3]Cristália Indústria Farmacêutica. Itapira, SP, Brazil.
[4]Solidor. São Paulo, SP, Brazil.
[5]Descarpack. Ilhota, SC, Brazil.
[6]Delta Life. São José dos Campos, SP, Brazil.
[7]AnimallTAG Tecnologia em Identificação - Brasil. São Carlos, SP, Brazil.
[8]3M do Brasil. Cidade Moções, SP, Brazil.
[9]Incoterm Indústria de Termômetros Ltda. Porto Alegre, RS, Brazil.

Acknowledgements. This work was possible thanks to the authorization granted by the Wild Animal Triage Center, Rio Branco, Acre (CETAS/AC).

Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of paper.

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