Immobilization of Baird's Tapir (*Tapirus bairdii*) Using Thiafenthanil Oxalate (A-3080) in Combination with Xylazine and Ketamine

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Abstract

A wide variety of drug combinations have been used to immobilize captive and free ranging tapirs. Most of these anesthetic procedures combine opioids with alpha 2 agonists, cyclohexamines or neuroleptic agents. Thiafentanil oxalate (A3080) is a synthetic opioid that has been used in several species of non-domestic hoofstock. It´s effects have not been previously described on Baird´s Tapir (*Tapirus bairdii*). This study reports the use of a combination of thiafentanil oxalate (1 mg/100 kg), xylazine (1 mg/kg) and ketamine (0.5 mg/kg) (TXK) in two adult tapirs, and a combination of thiafentanil (1 mg/100 kg) and xylazine (0.70 mg/kg) (TX) in another adult tapir. The individuals receiving TXK were reversed with naltrexone (10 mg/mg thiafentanil) and yohimbine (0.125 mg/kg), while those receiving TX was reversed with naltrexone (10 mg/mg thiafentanil) and atipamezole (1 mg/10 mg xylazine). The induction time was 3-5 min, the recovery time was 4-5 min and the total time of anesthesia was 40-120 min. Physiological parameters are similar to those reported in studies that include opioids in the anesthetic protocol. The TX combination produced low oxygen saturation values that recquired suplemmentary oxygen. In conclusion, TXK and TX provided a fast and smooth induction and recovery time. Additionally TXK is an effective and safe option to immobilize wild and captive animals with poor body condition.

Keywords: A-3080, immobilization, opioids, Baird´s tapir, thiafentanil.

Introduction

Since 1960´s opioids have been used for immobilizing large and heavy animals. The three most commonly used in wildlife medicine are fentanyl, etorphine and carfentanil (Kreeger, 1997). These drugs have been combined with alpha-two agonists, butyrophenones, benzodiazepines, phenotiazines and cyclohexamines in order to reduce adverse effects (Caulkett *et al*., 2000; Ramdohr *et al*., 2001; Roffe *et al*., 2001; Miller *et al*., 2003; Lance, 2012). In the last 20 years thiafentanil oxalate (A-3080), a highly potent opioid, has demonstrated its efficacy to immobilize non-domestic hoofed species such as nyala (*Nyala angasii*; Cooper *et al*., 2005), impala (*Aepyceros melampus*; Janssen *et al*.,1991), greater kudu (*Tragelaphus strepsiceros*), African buffalo (*Syncerus caffer*), klipspringer (*Oreotragus oreotragus*), eland (*Taurotragus oryx*), waterbuck (*Kobus ellipsiprymnus*), elk (*Cervus canadiensis*), oribi (*Ourebia ourebi*), reedbuck (*Redunca sp*; Lance and Kenny, 2012), pronghorn (*Antilocapra americana*; Kreeger *et al*., 2001), Uganda kob (*Kobus kob thomasi*; Caulkett *et al*., 2006), mule deer (*Odocoileus hemionus*; Caulkett *et al*., 2006; Wolfe *et al*., 2004), Tibetan yak (*Bos grunniens*; Alcantar *et al*., 2007), Roan antelope (*Hippotragus equinus*; Citino *et al*., 2001), giraffe (*Giraffa camelopardalis*; Citino *et al*., 2006), gemsbok (*Oryx gazella*; Grobler *et al*., 2001), axis deer (*Axis axis*; Smith *et al*., 2005), Rocky Mountain elk (*Cervus elaphus nelsoni*; Stanley *et al*., 1988), rhebok (*Pelea caoreolus*; Howard *et al*., 2004), gaur (*Bos gaurus*; Napier *et al*., 2007) and Lichtenstein's hartebeest (*Sigmoceros lichtensteinii*; Citino *et al*., 2002).

The shortened induction time and the larger safety margin are the principal advantages of thiafentanil compared to other opiods (Lance and Kenny, 2012; Wolfe *et al*., 2004). However, when it is used as the sole agent, thiafentanil can induce muscle rigidity (Grobler *et al*., 2001). The combination of thiafentanil with alpha-two agonists and ketamine induces a good quality anesthesia with minimal disturbance of physiologic parameters, and improves muscle relaxation and analgesia (Grobler *et al*., 2001; Cittino *et al*, 2006). Although Lance (2012) mentioned that Perissodactyla remain refractory to this drug, the immobilization of rhinoceros in the field is becoming more common in Africa. In the case of tapirs, the effects of thiafentanil have

not been previously described, and most anesthetic protocols for these species are based on opioids such as etorphine (Parás *et al.*, 1996; Kreeger, 1997; Lambethh, 1998) carfentanil (Miller-Edge and Ansel, 1994), and butorphanol (Trim *et al.*, 1998; Foerster *et al.*, 2000; Velastin, 2004; Hernandez-Divers *et al.*, 2005; Tobler *et al.*, 2006; Bernal *et al.*, 2008). The anesthetic protocol preferred may depend on where the animal is going to be capture, drug availability and the experience of the personnel who perform the immobilization. Here, we report data from four immobilizations of Baird´s tapir in Mexico using thiafentanil.

Figure 1. Intramuscular administration of the antagonists in the second immobilization at Payo Obispo zoo. Photo: Payo Obispo zoo

Materials and methods

The study was conducted at three different sites in Mexico. The first two immobilizations were realized at Payo Obispo Zoo in Chetumal, Quintana Roo (18º 31' 17.72" N and 88º 18' 9.73"W). An adult male (Total Body Weight, TBW= 161 kg) rescued from a fire in the locality of Nuevo Tabasco was brought to the facilities of the zoo for a clinical evaluation. The specimen was anesthetized twice in six months (June-December 2011). The third immobilization was done in the village of Emiliano Zapata, near Calakmul Biosphere Reserve (CBR), Campeche (18º 31' 16.92" N and 89º 40' 32.94" W). An adult male tied by the villagers (estimated weight 150kg) was translocated to the core area of the reserve. The last immobilization was made at Africam Safari zoo in Puebla (18º 56' 8.94" N and 98º 7' 59.69" W). An adult female (TBW= 212 kg) was immobilized for clinical examination.

The first three immobilizations were performed with a combination of thiafentanil A-3080 (1 mg/100 kg; Thianil, Wildlife Pharmaceuticals Inc., Fort Collins, Colorado,USA), xylazine (1 mg/kg; Cervizine, Wildlife Pharmaceuticals Inc., Fort Collins, Colorado,USA) and ketamine (0.5 mg/kg; various sources). This cocktail was delivered intramuscularly (IM) via single use, 3 ml darts shot from a CO2-powered rifle (Dan Inject). In all applications, A-3080 was antagonized with the use of naltrexone HCl (IM; 10 mg to every one mg of thiafentanil delivered; trexonil, Wildlife Pharmaceuticals Inc., Fort Collins, Colorado,USA), and xylazine was antagonized with yohimbine (IM; 0.125mg/kg; various sources).

For the last anesthethic procedure we used a combination of A-3080 (1 mg/100 kg) and xylazine (0.70 mg/kg; Procin Equus, Laboratorios PISA farmaceutica, Mexico). A-3080 was antagonized with the same dose of naltrexone used for the three previous cases, while xylazine was antagonized with atipamezole (1 mg to every 10 mg of xylazine delivered; Antisedan, Pfizer). The drugs were delivered IM, with a 3ml dart shot from a CO2-powered blow pipe (Dan Inject). We recorded induction time (period elapsed between injection and sternal recumbency), recovery

Table 1. Basic anesthetic parameters of four immobilizations of *Tapirus bairdii* with TXK and TX
T=Thiafentanil; X=Xylazine; K=Ketamine; M=Male; F=Female

Average values	Payo Obispo (M) 1st Immobilization TXK	Payo Obispo (M) 2nd Immobilization TXK	Zapata (M) TXK	Africam Safari (F) TX
Induction time (min)	4	5	4	3
Total time of anesthesia (min)	106	94	120	40
Recovery time (min)	5	5	5	4
Body temperature (ºC)	36.9-37.9	36.2	33.4-37.8	37- 37.2
Respiration rate (bpm)	13-19	20-24	45536	43374
Heart Rate (bpm)	33-75	51-84	86-128	54-101
Oxygen saturation (%)	80-90	86-94	-	49-89

Table 2. Comparison of anesthetic parameters of different immobilizations using opioids T=Thiafentanil; X=Xylazine; K=Ketamine; C=Carfentanil; E=Etorphine; A=Acetylpromazine; D=Detomidine; AM= Acepromazine maleate; B=Butorphanol.

Average values	This study TXK	Miller *et al.*, 1994 CXK	Parás *et al.*, 1996 EA	Hernandez-Divers *et al.*,1998 BX	Pollock, 2003 DC	Lira *et al.*, 2008 EAM
Number of individuals (n)	3	6	5	16	1	4
Induction time (min)	3-5	5.5	3-6	5-34	3.5-18.35	3
Total time of immobilization (min)	40-120	106.3	40.5	13-60	10-20	60
Recovery time (min)	4-5	4.3	4	0-26	2-5	-
Body temperature (ºC)	36.2-37.9	-	37-37.4	35.5-38.6	36.4-37.2	-
Respiration rate (bpm)	10-24	13	12-27.5	8-50	12-15	-
Heart rate (bpm)	33-101	82.5	-	28-108	40-55	-

time (period elapsed between the administration of the antagonists and stand up), heart rate, respiration rate, rectal temperature and oxygen saturation.

Results

The first two immobilizations were performed in the same animal with the combination of TXK and reverted with naltrexone and yohimbine. The first time the individual was skinny, dehydrated, debilitated and not responsive. A clinical examination was necessary to determine the health status of the tapir. For the second immobilization the animal had gained 20 kg (TBW=170 kg), and the procedure was shorter (first 106 min and second 94 min). The induction time of the two events was 4-5 min, and the recovery time 5 min. Physiologic values were stable and no suplemmentary drugs were needed (Table 1).

Figure 2. Placing the pulse oximeter to monitor oxygen saturation and pulse from an immobilized tapir with TXK at Payo Obispo zoo. Photo: Payo Obispo zoo

The tapir immobilized at Emiliano Zapata presented a poor body condition and had been under a prologend period of stress (tied for 20 hrs), was anesthetised and reverted with the same doses described before. The induction time was 4 min and the recovery time 5 min. In this case the total elapsed time was longer (120 min), due to the translocation of the individual from the village to the core area of the Calakmul Biosphere Reserve (30 km in straight line). During the final minutes the animal began to make slight movements of the head. Once the reversal agents were administered, the individual stood up and walked away through the jungle, after 8 days of the immobilization, the radiocollared tapir was observed a few kilometers from the release point exhibiting normal behaviour.

In all the cases, TXK produced a safe and effective immobilization with minimum alterations of physiological parameters (heart rate, respiration rate and body temperature). For the last anesthethic procedure we used a TX combination. The induction time (3 min) and recovery time (4 min) were shorter than the other anesthetic events. Physiologic values were generally stable, although low oxygen saturation values sometimes occurred (49% to 89%; Table 1). After two hours of observation the individual behaviour was normal, no alterations or health problems were observed in subsequent eight weeks. Both anesthetic protocols allowed morphometric measures to be taken, as well as blood samples, swabs for microbiological analysis, tissue samples, fecal samples, collect ectoparasites and in the case of the translocated tapir, we also placed a radiocollar.

Discussion

One objective of this study was to evaluate the physiologic effects of this cocktail in Baird´s tapir. The combination of TXK shows to be effective for immobilizing captive and free-ranging tapirs. Compared with previous studies the combination of thiafentanil with an alpha 2 agonist and ketamine produced a

good quality anesthesia with minimal disturbance of physiologic parameters (Citino *et al*., 2001; Grobler *et al*., 2001). Induction time was similar to those already reported when opioids were used in tapirs (Miller *et al*., 1994; Parás *et al*.,1996; Lira *et al*., 2008)(Table 2). This is one of the principal advantages that narcotics have in comparison to the combination of butorphanol with an alpha-2-adrenergic, and the combination of tiletamina-zolazepam with an alpha-2-adrenergic and atropine in which induction time is of 15 to 20 minutes (Foerster *et al*., 2000; Velastin *et al*., 2004; Hernandez-Divers *et al*., 2007). This characteristic is desirable in the anesthesia of free-ranging animals where habitat conditions are dangerous. In comparison with other protocols that present premature arousals and need the administration of supplementary drugs like ketamine (Foerster *et al*., 2000; Hernandez-Divers *et al*., 2007) this combination could be used for short and long immobilizations (total time of anesthesia 40-120 min) without the addition of supplementary drugs.

Lance and Kenny (2012) reported spontaneous recovery in Elk in 27 to 106 minutes from an initial dose of thiafentanil oxalate without the use of an antagonist. In the case of the tapir immobilized in Zapata, after 100 minutes of being administered the cocktail, the animal started to move its head and be more alert. This is likely due to a low dosage and the rapid absorption and fast metabolism of the components.

Recovery was quick and uneventful in all animals. The shorter recovery time (3 min) was associated with the use of atipamezole which is more potent and more selective than yohimbine (Kreeger *et al*., 1997). This is an important consideration when we are designing the anesthethic protocol for immobilizing tapirs in risky habitats, in our experience the combination of butorphanol and xylazine have a prolonged recovery time (15 min), which increases the risk of drowning, injury or predation. There are few reports on the immobilization of cachectic and underweight tapirs (Hernandez-Divers *et al*., 2005). In this study two animals presented poor physical condition, however immobilization produced by TXK demonstrated to be safe and adequate in these cases.

The use of opioids to immobilize free-ranging animals is common, they produce rapid induction, are fully reversible and have minimal disturbance of physiologic parameteres. In tapirs it´s use is controversial, Janssen (2003) mentioned that the poor oxygen saturation and the risk to personnel were the principal reasons for the decrease in the use of these narcotics. The combination of thiafentanil with other drugs appears to be an alternative for captive and free ranging tapirs, further studies are necessary to know all the physiologic effects of thiafentanil in all Perissodactyls.

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