Etorphine-Medetomidine Immobilization in 16 Captive Persian Fallow Deer (*Dama dama mesopotamica*)

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ABSTRACT

Sixteen captive Persian fallow deer (*Dama dama mesopotamica*) scheduled for translocation were immobilized with a combination of 30±5μg/kg etorphine and 3±0.6μg/kg medetomidine administered by a remote intramuscular injection. Induction and recovery times and physiologic parameters were recorded, and the quality of induction, immobilization and recovery were scored. Naltrexone and atipamezole were administered for recovery. Mean induction time was 4.9±3.1 minutes, and induction quality was considered very good. The quality of immobilization was fair, due to the light immobilization plane and constant limb movement. Severe hypoxemia was observed (oxygen saturation at 70%). Following reversal, mean recovery time was 3.8±2.4 minutes, and recovery quality was excellent. The combination of etorphine-medetomidine at the doses reported here did not result in optimal immobilization and is likely to produce severe hypoxemia, however, recovery is quick. Other anesthetic combinations should be investigated for immobilization of Persian fallow deer.

Keywords: *Dama dama mesopotamica*; Etorphine; Medetomidine; Immobilization; Persian Fallow Deer.

INTRODUCTION

The Israel Nature and Parks Authority (INPA) together with the Tisch Family Zoological Gardens in Jerusalem conducts breeding and reintroduction of the Persian fallow deer (*Dama dama mesopotamica*) back to Israeli fauna after complete extinction of this deer from this region, at the end of the 19th century (1). A reliable and safe immobilization, which will be quickly reversible, is required for translocation of the deer from breeding centers to the wild.

Various potent opioids have been reported for the capture of wild cervids (2), and were also reported in Persian fallow deer (3). α_2-adrenoreceptor agonists are used in combination with various drugs for wildlife immobilization. A combination of etorphine hydrochloride and acepromazine maleate (Large Animal Immobilon) with xylazine has been described for capture of free ranging Fallow deer (*Dama dama*) (4), although cardiopulmonary effects were not reported by the authors. Medetomidine is a potent and selective α_2-agonist (5), which is commonly used in combination with the dissociative ketamine for immobilization in deer species (2, 6-9), including Persian fallow deer (10). However, the combination of etorphine and medetomidine has not been reported in this species.

The goals of this report were to describe the effectiveness, physiological parameters, and complications of the combination etorphine-medetomidine in captive Persian fallow deer. Our hypothesis was that this combination would provide an effective immobilization, although, respiratory parameters

may be compromised, as was reported with other opioid-based combinations in this species (3).

MATERIALS AND METHODS

All procedures received approval from the (Israel National Park Authority) INPA and the Institutional Animal Care and Use Committee. The deer were housed at an outdoor enclosure of approximately 5,000 square meters, and were fed once a day. Deer were not fasted before immobilizations.

All immobilizations were performed in order to transport Persian fallow deer from the Jerusalem Zoo breeding center to Nahal Sorek nature reserve in the Jerusalem Mountains in Israel. Sixteen deer were immobilized using etorphine (Captivon 98, Wildlife Pharmaceuticals Ltd., White River, South Africa; 9.8 mg/mL; target dosage 30 µg/kg) combined with medetomidine (Domitor, Orion Corporation Orion Pharma, Espoo, Finland; 1 mg/mL; target dosage 3 µg/kg). An observer, blinded to the immobilization protocol used, evaluated the immobilization and monitored all deer during all capture events.

All immobilizations occurred during early morning, and the ambient temperature was recorded. The weight was estimated prior to drug administration, and the drugs were injected remotely (10-15 meters) with a dart gun (DAN-INJECT CO_2 Injection Rifle, Model J.M.SP. DAN-INJECT, Børkop, Denmark) into the hindquarter or shoulder muscles, using 1.5 mL dart syringes with 1.5x30 mm plain needles (DAN-INJECT, Børkop, Denmark). Darting was performed by the zoo chief veterinarian from a pedestrian bridge across the deer enclosure. If adequate immobilization was not achieved, then a lower dosage of the same combination was administered, based on the level of immobilization, and the time elapsed from the first dart. Following capture the deer were blindfolded, weighed, and placed in sternal recumbency. All deer were vaccinated against rabies, treated against ectoparasites, dewormed, and the presence of a microchip was verified, or placed if not present.

Time from injection of the anesthetic drugs to becoming recumbent was designated as the induction time, and time from injection of the antagonist/s to standing was designated as the recovery time. The quality of induction, immobilization, and recovery were scored on a 1-5 scale: 1=poor, 2=fair, 3=good, 4=very good and 5=excellent, as described formerly (10).

Table 1: Data and drug doses (mean and standard deviation; range) administered intramuscularly to 16 captive Persian fallow deer immobilized for translocation with etorphine-medetomidine and reversed with atipamezole and naltrexone.

Fallow deer data	Etorphine-medetomidine
Number of males/females	9/7
Age (years)	1.2±0.6 (0.9-3.5)
Weight (kg)	51.3±10.0 (39.2-67)
Ambient temperatures (°C)	19.4±4.0 (11-23)
Etorphine IM (µg/kg)	30±5 (22-37)
Medetomidine IM (µg/kg)	3±0.6 (2.2-3.8)
Atipamezole IM (µg/kg)	15±3 (11-19)
Naltrexone IV (µg/kg)	150±30 (110-190)
Naltrexone IM (µg/kg)	75±15 (50-100)

During immobilization, cardiopulmonary parameters were recorded every 5 minutes until antagonist administration. Heart rate (HR) and rhythm was measured with a stethoscope over the heart. Respiratory rate (RR) and pattern were determined by observing thoracic excursions. Rectal temperature (RT) was measured with a digital thermometer. Oxygen saturation (SpO_2) using a lingual probe, monitored with a multiparameter monitor (MEC-1200Vet, Sehnzhen Mindray Bio-Medical Electronics Co., Ltd., Shenzhen 518057, P.R. China).

When all treatments were completed, the deer were placed inside a padded transport box (the transport box was constructed according to the guidelines of the International Air Transport Association; IATA, Live Animals Regulation), and antagonist was administered. Naltrexone (Trexonil, Kyron Laboratories, Johannesburg, South Africa; 50 mg/mL) 7.5 times the etorphine dose was divided into 2/3 injected intravenously and 1/3 injected intramuscularly and atipamezole (Atipam, Eurovet Animal Health, Bladel, Netherlands; 5mg/mL) 5 times the medetomidine dose was injected intramuscularly.

The deer were transported to acclimatization enclosures at the Nahal Sorek nature reserve and were observed closely for at least a month following translocation. Then they were free to leave the enclosure.

RESULTS

Deer data and drug doses determined after the deer were weighed are presented in Table 1. Mean and standard de-

Table 2: Physiologic variables (mean and standard deviation; range) of 16 Persian fallow deer during immobilization with etorphine-medetomidine.

Physiologic variables	Etorphine-medetomidine
HR (bpm)	73±30 (48-158)
RR (rpm)	36±21 (5-80)
RT (°C)	38.7±0.8 (37.0-39.8)
SpO_2 (%)	70±0 (70)[#]

HR, heart rate; bpm, beats per minute; RR, respiratory rate; rpm, respirations per minute; RT, rectal temperature; SpO_2, hemoglobin oxygen saturation.

[#] Only a few available measurements were available.

viation induction time was 4.9±3.1 minutes and median induction quality was very good (all deer were scored 4). Immobilization was characterized by continuous movements, tremors, and muscle rigidity. This was expressed in the immobilization scores that were determined to be fair (median of 2; range 1-2).

Mean and standard deviation of physiologic variables recorded during the immobilization are presented in Table 2. There were technical problems in obtaining measurements of SpO_2 in many of the deer due to the continuous movements under immobilization. Mean and standard deviation recovery time was 3.8±2.4 minutes and median recovery quality was excellent (median of 5; range 3-5). All deer recovered successfully and were translocated. No morbidities or mortalities were recorded at least a month following immobilization.

DISCUSSION

The dose of etorphine used in the present report was based on the dose of etorphine in Large Animal Immobilon that was reported for Persian fallow deer (3). It was thought that the addition of low dosage medetomidine to etorphine would be sufficient to produce immobilization, therefore only 3 μg/kg of medetomidine were used in this combination. In retrospect, a higher dose of medetomidine might produce better immobilization, and further investigation of this combination is recommended.

Induction time with the etorphine-medetomidine combination was shorter (approximately half) than induction times using a combination of α_2-agonists and dissociatives. Xylazine and tilatemine-zolazepam was reported to produce induction within approximately 8 minutes in fallow deer (11), and medetomidine-ketamine or medetomidine-midazolam were reported to produce induction in Persian fallow deer within 9±4 and 10±4 minutes, respectively (10). But, induction time was the same when compared with etorphine-acepromazine in this species (4.8±2.8 minutes) (3). Induction time is an important factor during wildlife immobilizations. Shorter induction times are preferred in order to reduce stress, injury to the animals, or capture myopathy. In addition, shorter induction time will ensure that immobilized animals can be found quicker, treated, and monitored as soon as possible (2, 4). Therefore, when quick induction time is a priority, such as with wild deer captured, the use of etorphine in the combination seems to be superior.

Immobilization quality of the etorphine-medetomidine combination was inferior to other medetomidine-based combinations. Potent opioids, including etorphine, were reported to produce muscle tremors and rigidity in many ungulates (12-15), including Persian fallow deer (3). Medetomidine produces muscle relaxation via central α_2-adrenergeic-agonism (16), and studies using medetomidine-based combinations in deer species reported good immobilization quality (6, 9, 10). Therefore, addition of an α_2-agonist, such as medetomidine, to a potent opioid is likely to reduce muscle rigidity and increase muscle relaxation during immobilization (13, 17). Although in the present study medetomidine was added to etorphine, movement, muscle rigidity and tremors were very common with this combination. It was considered that medetomidine dose may have been probably too low to overcome these side effects of etorphine. A higher dose of medetomidine may be indicated to produce better quality immobilizations in Persian fallow deer.

The mean HR of Persian fallow deer immobilized with etorphine or thiafentanil based combinations was 60-67 beats per minute (3), which is comparable to the mean HR observed in the present study. In comparison, the use of medetomidine-ketamine or medetomidine-midazolam combinations in Persian fallow deer resulted in lower HR; 50±11 and 47±13 beats per minute, respectively (10). This difference can be attributed to the higher dose of medetomidine used in these combinations compared with the etorphine-medetomidine used in the present study (approximately 25 times greater), as medetomidine produces hypertension and significant reflex bradycardia (5).

The RR reported here was higher than the RR following medetomidine-based combinations in Persian fallow deer (approximately 10 respirations per minute) (10), and was

also higher than the RR reported for Persian fallow deer immobilized with etorphine-acepromazine or thiafentanil-based combinations (10-20 respirations per minute) (3). The higher RR in the present study may be a result of the light immobilization plane observed. Respiratory depression and hypoxemia are common complications of ungulate immobilization (2), and were recently reported in Persian fallow deer during opioid-based immobilizations (67-77%) (3). In the present report, low SpO_2 was observed as well, therefore, it is recommended to supply oxygen during immobilization in wild cervids (8, 18, 19).

Although the deer had continuous movements and tremors in the present study, hyperthermia, defined as RT≥40.6˚C (13), was not observed in any deer. Because hyperthermia was reported in cervids and in Persian fallow deer following opioid-based immobilizations (2, 3, 13), it is recommended that temperature should be monitored during capture events.

In the present report, etorphine-medetomidine provided quick and smooth recoveries. Recovery time was similar or a little longer than other opioid-based combinations reported in Persian fallow deer. A study investigating the use of etorphine-acepromazine, thiafentanil or thiafentanil-azaperone reported mean recovery times of 0.5-2.3 minutes (3). However, following medetomidine-midazolam or medetomidine-ketamine, recovery times were longer (more than double); 13±6 and 14±7 minutes, respectively. This difference is probably because in the present report both etorphine and medetomidine were antagonized, while only medetomidine was antagonized in the medetomidine-based study (10).

It is important to note that the use of potent opioids is strictly regulated in Israel as well as in other parts of the world (20, 21). Another disadvantage of using potent opioids is the risk to people. An accidental human exposure can lead to severe respiratory depression and death, unless an antidote is administered (22).

Limitations to this report include the small number of deer evaluated, the fact that only one dose of medetomidine was evaluated and the missing measurements of oxygen saturation because of the poor immobilization produced. Additionally, although pulse oximetry is an important monitoring tool, it can be affected by many factors, and blood gas analysis, which was not available in the present investigation, was reported to be more accurate in deer (23).

In conclusion, at the doses administered, the etorphine-medetomidine combination produced fair immobilization quality, but induction and recovery were quick and smooth. Therefore, if shorter induction and recovery times are required, as is often with free-ranging immobilizations, then this combination can be used, although, doses should be increased. It is likely that using a higher dose of medetomidine (10-30 µg/kg) in this combination would provide better immobilization, however, the cardiopulmonary effects of the increased dose are unknown. As decreased SpO_2 was observed with the reported doses, oxygen supplementation should be available.

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