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TILETAMINE-ZOLAZEPAM-XYLAZINE IMMOBILISATION IN WARTHOGS

(Phacochoerus aethiopicus)

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Key words: Warthog, Phacochoerus aethiopicus, immobilisation, Tiletamine, Zolazepam, Xylazine

Introduction
There is relatively little information available on the immobilisation of wild suids, especially of warthogs. Most of the references are based on individual field experiences and lack detailed measurements. The combination of Tiletamine/Zolazepam is frequently recommended for the immobilisation of different wild pig species in recent literature. A detailed investigation was carried out by Hauck (1991), who successfully used Tiletamine/Zolazepam immobilisation for European wild boar (sus scrofa). Van Rensburg (1993) described Tiletamine/Zolazepam as the drug of choice for the immobilisation of bushpigs (potamochoerus larvatus). Espie (1993) recommended this mixture as an ideal anaesthetic agent for warthogs and Burroughs (1993) also mentioned it for warthogs. Calle and Morris (1999) documented the successful use of Tiletamine/Zolazepam in warthogs as well, but they noticed hyperkinesia and hyperthermia in dosages above 3 mg/kg body weight and recommended the combination with an alpha-2-adrenoceptor agonist.

Material and Methods
With the permission of the Kenia Wildlife Service a population of 9 female and 3 male warthogs were captured in a suburb of Nairobi and brought into a holding area of about 1 hectare. Two months later they were again translocated and released as family groups into the Nairobi National Park. The age of the animals ranged from 6 month to approximately 6 years. The mean body weight was 69,8 kg ± 22,3 kg (x ± s), varying from 33,0 kg to 101,1 kg. The warthogs were immobilized with Tiletamine/Zolazepam at a dose of 3 mg/kg body weight in combination with Xylazine at a dose of 0,5 mg/kg body weight applied intramuscularly by means of a blowpipe. The anaesthetic phases were documented. Reflex activity, muscle relaxation, pain sensitivity, body temperature, heart rate, respiratory rate and peripheral oxygen saturation (pulse oximetry) were recorded every 5 minutes (15 min. – 75 min. after injection). Electrocardiogram and arterial blood pressure were monitored in 10 minutes intervals (10/15 min. – 70/75 min. post injectionem). Venous blood gas analysis including acid-base-state were carried out every 20 minutes (10/15 min. – 50/55 min. after injection).

Results
The mean induction time (x ± s) was 05:20 ± 02:08 [min:sec], the mean tolerance phase lasted 57:29 ± 14:06 [min:sec] and the mean recovery time was 1:36:13 ± 0:31:13 [h:min:sec]. The tolerance phase was marked by a good immobilisation although the reflex activity remained and the muscle tone was slightly reduced. The warthogs tolerated small veterinary procedures (taking blood samples, antibiotic injections) without defensive reaction. Untoward side effects did not occur.

The influence of the Tiletamine/Zolazepam-Xylazine immobilisation on cardiovascular, respiratory and metabolic parameters which are important for the assessment of the clinically suitability is shown in table 1.
During Tiletamine/Zolazepam-Xylazine immobilisation of warthogs the changes of clinical parameters are compensated by endogenous regulatory mechanisms, resulting in values which remain within the physiological limits. Electrocardiogram, peripheral oxygen saturation, venous oxygen and carbon dioxide partial pressure did not deviate from the normal range, despite a decrease of heart rate and blood pressure. The combination of Tiletamine/Zolazepam and Xylazine, in the dosage described above, leads to a safe and effective immobilisation in healthy warthogs, and is suitable for minor surgical and management procedures under field conditions.

References


Table 1: Influence of the Tiletamine/Zolazepam-Xylazine immobilisation in warthogs (Phacochoerus aethiopicus) on some cardiovascular, respiratory and metabolic parameters as mean values ± standard deviation (x ± s) and statistical significance.

<table>
<thead>
<tr>
<th>parameter/ time [min.]</th>
<th>10/15</th>
<th>30/35</th>
<th>50/55</th>
<th>70/75</th>
<th>statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>body temp. [°C]</td>
<td>38,8 ± 0,8</td>
<td>38,8 ± 0,7</td>
<td>38,3 ± 0,7</td>
<td>37,6 ± 0,4</td>
<td>p&lt;0,0001</td>
</tr>
<tr>
<td>heart rate [min.-1]</td>
<td>91 ± 15</td>
<td>72 ± 13</td>
<td>71 ± 15</td>
<td>65 ± 10</td>
<td>p&lt;0,0001</td>
</tr>
<tr>
<td>P_Amean [mm Hg]</td>
<td>106 ± 18</td>
<td>106 ± 20</td>
<td>100 ± 18</td>
<td>91 ± 11</td>
<td>p&lt;0,0001</td>
</tr>
<tr>
<td>respiratory rate [min.-1]</td>
<td>32 ± 11</td>
<td>29 ± 11</td>
<td>30 ± 13</td>
<td>30 ± 6</td>
<td>p=0,0406</td>
</tr>
<tr>
<td>S_AO2 [%]</td>
<td>88 ± 6</td>
<td>88 ± 5</td>
<td>91 ± 4</td>
<td>91 ± 4</td>
<td>p&lt;0,0001</td>
</tr>
<tr>
<td>pO2V [mm Hg]</td>
<td>61 ± 10</td>
<td>64 ± 6</td>
<td>67 ± 5</td>
<td>65 ± 1</td>
<td>p=0,0127</td>
</tr>
<tr>
<td>pCO2V [mm Hg]</td>
<td>43 ± 6</td>
<td>46 ± 6</td>
<td>43 ± 6</td>
<td>39 ± 4</td>
<td>p=0,0048</td>
</tr>
<tr>
<td>pHv</td>
<td>7,49 ± 0,03</td>
<td>7,50 ± 0,03</td>
<td>7,52 ± 0,03</td>
<td>7,56 ± 0,03</td>
<td>p&lt;0,0001</td>
</tr>
</tbody>
</table>
REVERSIBLE ANAESTHESIA OF FREE-RANGING LIONS (Panthera leo) IN ZIMBABWE

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Keywords: anaesthesia, lion, Panthera leo, medetomidine, tiletamine, zolazepam, atipamezole

Extended abstract
When anaesthetising free-ranging wildlife it is important to use reliable methods that expose the animals to minimal stress. Induction and recovery periods need to be rapid and smooth, and physiologic parameters should be stable throughout anaesthesia. The aim of this study was to evaluate the combination of medetomidine (M), zolazepam (Z), tiletamine (T), and atipamezole for reversible field anaesthesia of lions (Panthera leo). Eleven free-ranging lions (body weight 131-209 kg) were anaesthetised on 13 occasions for fitting of radio-collars and ear tags, or for tuberculosis testing. Medetomidine was given at a mean (range) dosage of 0.047 mg/kg (0.040-0.055) in combination with ZT at 0.80 mg/kg (0.52-1.38). The drug mixture was delivered i.m. using a dart syringe fired from a dart gun. Respiratory and heart rates, rectal temperature, and relative oxyhemoglobin saturation (SpO₂) were recorded every 15 min. For reversal of the anaesthesia, atipamezole at 0.20 mg/kg (0.10-0.28) was administered i.m. 86 min (46-140) after darting. The induction was smooth, and complete anaesthesia with excellent muscle relaxation occurred within 6 min (4-10) in all lions. No additional doses were required. Physiologic parameters ranged as follows: respiratory rate 14-38 breaths per minute, heart rate 40-75 beats per minute, rectal temperature 37.6-40.9°C, and SpO₂ 85-96%. Atipamezole effectively reversed the anaesthesia, and recovery was smooth in all animals. Time to first signs of recovery was 13 min (4-30) after reversal. The animals were walking within 31 min (15-69) after injection of atipamezole, when ZT dosages under 1 mg/kg was used (n=9). In conclusion, the combination of MZT reversed with atipamezole was a safe and effective anaesthesia protocol for free-ranging lions at the dosages used in this study.

Acknowledgements
Special thanks to the many members of the Department of National Parks and Wildlife Management in Zimbabwe, Hwange Lion Research, Malilangwe Trust, and the Wildlife Veterinary Unit for valuable assistance during preparations and field operations. We also wish to acknowledge Michael Forsgren’s Fund, Stiftelsen Svenska Kvinnors Djurskyddsförening, Orion Pharma Animal Health, Dansjö Medical, and Scandivet for their generous support.
CAPTURE AND FIELD ANAESTHESIA OF A FAST RUNNER –
THE MONGOLIAN WILD ASS (Equus hemionus)

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Keywords: Asiatic wild ass, Equus hemionus, Khulan, Dziggetai, capture, anaesthesia, Mongolia

Abstract
In the Equid Action Plan, the status of the Gobi wild ass (Equus hemionus) – in Mongolian ‘Khulan’ or ‘Dziggetai’ - is qualified as “insufficiently known” and the species is listed as vulnerable (1). With an estimated 20,000 animals, southern Mongolia is one of the most important strongholds of the Asiatic wild ass. In spite of this relatively large population, very little data concerning movement patterns, habitat use and social behaviour has been collected. In the past, monitoring of the population and derived population estimates appear sketchy and vary considerably. Since 1953 the khulan is protected in Mongolia. However, due to human population growth in conjunction with severe winters in recent years, the occurrence of herder - khulan conflicts appear on the rise: (a) The presence of herders and their livestock at water points potentially interfere with khulan access to this vital resource (b) Khulan populations are believed to grow and herders increasingly view khulans as pasture competitors for livestock (c) Massive livestock losses during the past years have led to an increased poaching pressure on khulans for meat (3).

In June 2002 we initiated a khulan project within the frame of the Przewalski wild horse re-introduction endeavour by the International Takhi Group (ITG) in the Gobi-B Strictly Protected Area (SPA) in SW Mongolia. The Gobi desert of Mongolia is characterized by its remoteness and harsh climate. Hence, large ungulates inhabiting this ecosystem can be expected to cover large ranges in order to meet their dietary and water requirements. In order to monitor movement patterns and habitat use we captured and equipped seven free-ranging Asiatic wild asses with ARGOS satellite collars (2,3, see additional downloads at www.takhi.org).

The Mongolian khulan is extremely skittish – most probably due to poaching activities – and flees human presence at several kilometres distance. Three distinct techniques have been employed to capture this species in the wild: (a) In the summer 2002 we used a modified CO$_2$ dart gun (Daninject JM), from a pre-placed hide, 60-80 meters distant from a water point (b) 2003 we used a video-enabled remote controlled CO$_2$ gun (5) at several water points (c) a chase method where the khulan is darted from a moving jeep. Anaesthesia was induced with a single 3 ml dart containing a combination of 4.4 mg Ethorphine (M99, C-Vet Veterinary Products, Lancs, UK), 10 mg Detomidine–HCl (Domosedan, Orion Corp. Farmos Finland) and 10 mg Buthorphanol (Torbugesic, Fort Dodge Animal Health, Iowa, USA). Anaesthesia was reversed in all cases with an i.v. combination of 200 mg Naltrexone (Trexonil Wildlife Laboratories Inc., Fort Collins, Colorado, USA) and 20 mg Atipamezole (Antisedan, Orion Corp. Farmos Finland). Reversal was smooth and without signs of excitation. All animals were standing and alert approximately two minutes following administration of the antagonists Presently we have captured and out-fitted seven khulans in Mongolia. The jeep-chase method proved the most efficient in our primary study area. However; this method is not necessarily applicable to all other areas.
Acknowledgements
We thank N. Enksaikhaan and O. Ganbataar for their invaluable assistance during the capture events. Funding for the research on takhis, wolves and khulans is provided by the Austrian Science Foundation (FWF project P14992) through the Zoo Salzburg (Research for Conservation).

References

COMPARISON OF ANAESTHETIC PROTOCOLS FOR THE FIELD IMMOBILIZATION OF THE BLACK-BACKED JACKAL (*Canis mesomelas*)

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**Keywords:** Black backed jackal, *Canis mesomelas*, and anaesthesia

**Abstract**

The combination of dissociative anaesthetic agents and alpha-2 agonists has been widely used to immobilize free-living wild carnivores (1, 2, 3) although there are few reports as to their comparative efficacy. This project was completed in Namibia in 2002 and 2003, as part of a study on free-ranging black backed jackals. A short-term immobilization was required for blood sampling and biological studies. The suitability of the anaesthetic combinations medetomidine/ ketamine (MK), medetomidine/ketamine/diazepam (MKD), and medetomidine/tiletamine-zolazepam (MTZ) was investigated.

Forty-two jackals were captured using cage traps and foothold traps. Each animal was randomly assigned to receive MK (N=15), MKD (N=16), and MT-Z (N=11), delivered by intramuscular hand injection. Medetomidine was used at 0.04 -0.050mg/kg, ketamine at 3-5mg/kg, diazepam at 0.2-0.5mg/kg and tiletamine-zolazepam at 2-4mg/kg. Endotracheal intubation was attempted in all cases. Heart rate, respiratory rate, rectal temperature, and presence or absence of pedal and palpebral reflexes were recorded every five minutes. Anaesthesia was terminated by intramuscular hand injection of atipamezole (0.2-0.25mg/kg) in all animals, which were then observed throughout the recovery period until escape. A subjective score for the overall quality of anaesthesia was recorded for each animal.

All jackals were successfully anaesthetised, sampled and released. Most were subsequently sighted several times in the area of the reserve. No anaesthetic complications or emergencies occurred with any drug combination. The average duration of the procedure (±SD) was 48.8±6.2 minutes. Recorded time from injection of atipamezole to standing position (±SD) was: 4.2±2.3 minutes for MK (N=13), 5.8±4.9 for MKD (N=15) and 9.3±6.9 for MTZ (N=9). Ataxia was observed in 53% of cases with MK, 18% with MKD and 91% with MTZ. Parametric data was compared by one-way ANOVA, and non-parametric data by means of Kruskal-Wallis test. A p value of <0.05 was considered significant.

All three protocols allowed a safe and effective immobilization. Animals anaesthetised with MK and MKD could be immediately released, whilst recovery cages had to be used for jackals that received MTZ, as marked ataxia and disorientation would have exposed them to attacks by predators or other accidents. MTZ therefore proved sub-optimal for the immobilization of black backed jackals in this type of field conditions.

**Acknowledgements**

References


* Domitor® 1mg/ml, Novartis South Africa (Pty) Ltd
* Anakes-V 100mg/ml, Bayer (Pty) Ltd. South Africa
* Tranject 10mg/2ml, SCP Pharmaceutical (Pty) Ltd. South Africa
* Zoletil 100, Virbac RSA (Pty) Ltd.
* Antisedan 5mg/ml, Novartis South Africa (Pty) Ltd.
* One-Way ANOVA, Graphpad Prism v3.0c GraphPad Software, Inc. San Diego, CA 92130 USA
ANAESTHESIA OF HOMEOTHERM AND HETEROThERM BAT SPECIES

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Abstract

The some thousand species belonging to the order of bats (Chiroptera) can be divided from
physiological point of view into two groups: homeotherm and heterotherm species. Their
protocol for anaesthesia and the monitoring during it is different. Among the injectable
narcotics the combination of ketamine plus medetomidine, among the inhalative ones
isoflurane proved to be the safest and the most trustworthy. However heterotherm species'
sleep is for the most part absolutely relaxed, even after small surgical interventions the
postoperative management is of considerable importance; for analgesia butorphanol is
recommended.

Key words: Chiroptera, anaesthesiology, homeothermy, heterothermy

Introduction

The order of bats (Chiroptera) includes two suborders: the true bats (Microchiroptera) and
the flying foxes (Megachiroptera). The suborder Microchiroptera comprises 782, and the
suborder Megachiroptera 175 species, currently.

There are two options for the heat (and energy) balance of bats. All megabats and the
majority of the tropical microbats can continuously maintain an optimal body temperature of
about 39ºC (during flight even higher) (homeothermy).

To avoid the sacrifice of the a large proportion of their energy intake to compensate for heat
loss, the small sized microbats living in the temperate zones and the members of some
tropical bat families have in varying degrees the ability to go into a state of torpor (diurnal
lethargy) or hibernation (heterothermy). These bats consume 90-240 times as much energy
at their active periods and even the metabolic rate of any drugs given to them depends on
the actual body temperature (13).

A big variety of dosages of anaesthetic agents used for bats and flying foxes is
recommended in the literature (Table 1). In the late 1960 the recommended method for
providing unconsciousness was the refrigerator; the surgical intervention should have been
carried out on the hypotermic bat (5).
### Table 1. Anaesthetic agents used and recommended in the literature for bats and flying foxes.

<table>
<thead>
<tr>
<th>Anaesthetic agent</th>
<th>Dose (mg/bwkg)</th>
<th>Route</th>
<th>Ref.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>120</td>
<td>SC</td>
<td>14</td>
<td>In small sized bats</td>
</tr>
<tr>
<td>Ketamine</td>
<td>5-15</td>
<td>IM</td>
<td>11</td>
<td>Use acepromazine to alleviate catatonia</td>
</tr>
<tr>
<td>Ketamine</td>
<td>120</td>
<td>SC</td>
<td>12</td>
<td>In Nyctalus noctula</td>
</tr>
<tr>
<td>Ketamine + xylazine</td>
<td>20</td>
<td>IM / SC</td>
<td>14</td>
<td>In Pteropus giganteus, Rousettus aegyptius, Carollia perspicillata add ketamine every 10 to 20 minutes</td>
</tr>
<tr>
<td>Ketamine + xylazine</td>
<td>50</td>
<td>IM</td>
<td>7</td>
<td>In Pteropus poliocephalus</td>
</tr>
<tr>
<td>Ketamine + xylazine</td>
<td>25</td>
<td>IP</td>
<td>6</td>
<td>In vampire bats; mixture of ketamine + xylazine (2:1)</td>
</tr>
<tr>
<td>Ketamine + acepromazine</td>
<td>11</td>
<td>NL</td>
<td>14</td>
<td>In Pteropus spp.</td>
</tr>
<tr>
<td>Ketamine + acepromazine</td>
<td>11</td>
<td>NL</td>
<td>2</td>
<td>In Pteropus giganteus</td>
</tr>
<tr>
<td>Pentobarbital</td>
<td>30-50</td>
<td>IP</td>
<td>11</td>
<td>In insectivorous bats</td>
</tr>
<tr>
<td>Pentobarbital</td>
<td>30</td>
<td>NL</td>
<td>4</td>
<td>In insectivorous bats</td>
</tr>
<tr>
<td>Pentobarbital</td>
<td>NL</td>
<td>NL</td>
<td>6</td>
<td>In vampire bats</td>
</tr>
<tr>
<td>Ether</td>
<td>NL</td>
<td>NL</td>
<td>1</td>
<td>In Pteropus p. parnelli</td>
</tr>
<tr>
<td>Ether</td>
<td>NL</td>
<td>NL</td>
<td>17</td>
<td>In vampire bats</td>
</tr>
<tr>
<td>Ether</td>
<td>NL</td>
<td>NL</td>
<td>4</td>
<td>In insectivorous bats</td>
</tr>
<tr>
<td>Halothane</td>
<td>NL</td>
<td>NL</td>
<td>6</td>
<td>In vampire bats</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>5 vol% (introduction)</td>
<td>by mask</td>
<td>10</td>
<td>In Myotis, P. pipistrellus, Nyctalus noctula</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>NL</td>
<td>NL</td>
<td>6</td>
<td>In vampire bats</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>NL</td>
<td>NL</td>
<td>1</td>
<td>In vampire bats</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>5 vol% (introduction)</td>
<td>by mask</td>
<td>9</td>
<td>In Pteropus hypomelanus add glycopyrrolate (0.01 mg/bwkg IM)</td>
</tr>
<tr>
<td>Methoxyflurane</td>
<td>NL</td>
<td>NL</td>
<td>16</td>
<td>In Pteronotus p. parnelli</td>
</tr>
<tr>
<td>Methoxyflurane</td>
<td>NL</td>
<td>NL</td>
<td>3</td>
<td>In Eptesicus fuscus</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>NL</td>
<td>NL</td>
<td>6</td>
<td>In vampire bats</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>NL</td>
<td>NL</td>
<td>15</td>
<td>In Rousettus aegypticus</td>
</tr>
</tbody>
</table>

**IM = intramuscular**  
**IP = intraperitoneal**  
**NL = not listed**  
**SC = subcutaneous**

**Material and methods**

The main part of the examinations and the surgeries were performed at the Department and Clinic for Internal Medicine, Faculty of Veterinary Medicine, Szent István University, Budapest.

In the last 8 years 68 insectivorous microbats of 9 species (*Eptesicus serotinus, Myotis bechsteinii, Myotis myotis, Nyctalus noctula, Pipistrellus kuhlii, Pipistrellus nathusii, Pipistrellus pipistrellus, Plecotus austriacus, Vespertilio murinus*) living in Hungary (temperate zone) were anaesthetised or sedated for a variety of diagnostic and/or surgical procedures. The most common reasons for the anaesthesia on microbats were osteosynthetic operations of broken forelimb bones and suturing of teared wings.
For minor interventions, such as radiography, no drugs but hypothermy (staying for half an hour in the refrigerator) was used in microbats.

In the last two years 6 specimens of two flying fox species (*Rousettus aegypticus*, *Pteropus lylei*) at the Budapest Zoo and Botanical Garden were anaesthetised for diagnostic reasons (radiography, computed tomography).

Table 2 contains anaesthetic agents, dosages and the reasons for anaesthesia in bats and flying foxes executed by ourselves. Homeotherm species are marked with a *.

### Table 2. Anaesthetic agents, dosages and reasons for anaesthesia in bats executed at the Szent István University, Budapest and at the Budapest Zoo.

<table>
<thead>
<tr>
<th>species</th>
<th>anaesthetic agent</th>
<th>dose (mg/bwkg)</th>
<th>reason for anaesthesia</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eptesicus serotinus</td>
<td>isoflurane</td>
<td>5 vol%</td>
<td>radiography</td>
<td>n = 2</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>isoflurane</td>
<td>5 to 2 vol%</td>
<td>osteosynthesis</td>
<td>n = 2</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>isoflurane</td>
<td>5 to 2 vol%</td>
<td>explorative laparotomy</td>
<td>n = 1</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>isoflurane</td>
<td>5 to 2.5 vol%</td>
<td>enucleation</td>
<td>n = 1</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>ketamine + diazepam</td>
<td>80 + 0.5</td>
<td>osteosynthesis</td>
<td>n = 2</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>ketamine</td>
<td>30</td>
<td>radiography</td>
<td>n = 1</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>ketamine + medetomidine</td>
<td>50 + 0.5</td>
<td>osteosynthesis</td>
<td>n = 2</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>ketamine + medetomidine</td>
<td>40 + 0.5</td>
<td>osteosynthesis</td>
<td>n = 1</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>ketamine + xylazin</td>
<td>40 + 2</td>
<td>osteosynthesis</td>
<td>n = 1</td>
</tr>
<tr>
<td>Eptesicus serotinus</td>
<td>ketamine + xylazin</td>
<td>50 + 2</td>
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<td>radiography</td>
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<td>5 to 1.2 vol%</td>
<td>contrast radiography</td>
<td>n = 4</td>
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<td>Nyctalus noctula</td>
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<td>osteosynthesis</td>
<td>n = 4</td>
</tr>
<tr>
<td>Nyctalus noctula</td>
<td>isoflurane</td>
<td>5 to 1.5 vol%</td>
<td>computed tomography, magnetic resonance imaging</td>
<td>n = 2</td>
</tr>
<tr>
<td>Nyctalus noctula</td>
<td>ketamine</td>
<td>30</td>
<td>radiography</td>
<td>n = 2</td>
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<tr>
<td>Nyctalus noctula</td>
<td>ketamine + diazepam</td>
<td>100 + 0.5</td>
<td>osteosynthesis</td>
<td>n = 2</td>
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<td>Nyctalus noctula</td>
<td>ketamine + medetomidine</td>
<td>25 + 0.5</td>
<td>experiment</td>
<td>n = 3</td>
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<td>Nyctalus noctula</td>
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<td>40 + 0.5</td>
<td>experiment</td>
<td>n = 3</td>
</tr>
<tr>
<td>Nyctalus noctula</td>
<td>ketamine + medetomidine</td>
<td>55 + 0.5</td>
<td>experiment</td>
<td>n = 3</td>
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<td>70 + 0.5</td>
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<td>n = 3</td>
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<td>Nyctalus noctula</td>
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<td>n = 2</td>
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<tr>
<td>Pipistrellus kuhlii</td>
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<td>5 to 2 vol%</td>
<td>osteosynthesis</td>
<td>n = 1</td>
</tr>
<tr>
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<td>isoflurane</td>
<td>5 vol%</td>
<td>radiography</td>
<td>n = 2</td>
</tr>
<tr>
<td>Pipistrellus nathusi</td>
<td>ketamine</td>
<td>50</td>
<td>washing the wing (paint)</td>
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<td>Pipistrellus pipistrellus</td>
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<td>5 vol%</td>
<td>radiography</td>
<td>n = 1</td>
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<tr>
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<td>120</td>
<td>osteosynthesis</td>
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<tr>
<td>Vesperilio murinus</td>
<td>isoflurane</td>
<td>5 to 2 vol%</td>
<td>osteosynthesis</td>
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<tr>
<td>Vesperilio murinus</td>
<td>ketamine</td>
<td>5 vol%</td>
<td>radiography</td>
<td>n = 1</td>
</tr>
<tr>
<td>Vesperilio murinus</td>
<td>ketamine</td>
<td>120</td>
<td>osteosynthesis</td>
<td>n = 1</td>
</tr>
<tr>
<td>Pteropus lylei</td>
<td>isoflurane</td>
<td>5 vol%</td>
<td>radiography</td>
<td>n = 1</td>
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<tr>
<td>Rousettus aegypticus</td>
<td>isoflurane</td>
<td>5 vol%</td>
<td>radiography</td>
<td>n = 1</td>
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<td>Rousettus aegypticus</td>
<td>isoflurane</td>
<td>5 to 2.2 vol%</td>
<td>osteosynthesis</td>
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<td>5 to 1.5 vol%</td>
<td>computed tomography, magnetic resonance imaging</td>
<td>n = 1</td>
</tr>
</tbody>
</table>

*Eptesicus serotinus* (Serotine)  
*Pipistrellus pipistrellus* (Common pipistrelle)  
*Myotis bechsteini* (Bechstein’s bat)  
*Myotis myotis* (Mouse-eared bat)  
*Nyctalus noctula* (Noctule)  
*Rousettus aegypticus* (Egyptian flying fox)  
*Pipistrellus kuhlii* (Kuhl’s pipistrelle)  
*Pipistrellus nathusi* (Nathusius’s pipistrelle)  

For minor interventions, such as radiography, no drugs but hypothermy (staying for half an hour in the refrigerator) was used in microbats.
All of the specimens were weighing accurately and the calculated amount of drugs was administered.
The used drugs are listed in Table 3, the dosages were calculated on the basis of the reference cited and afterwards changed primarily empirically.

Table 3. Drugs used in bats and flying foxes at the Szent István University, Budapest and at the Budapest Zoo.

<table>
<thead>
<tr>
<th>generic name</th>
<th>trade name</th>
<th>concentration</th>
<th>manufacturer</th>
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</thead>
<tbody>
<tr>
<td>ketamine HCl</td>
<td>SBH Ketamin inj. A.U.V.</td>
<td>100 mg/ml</td>
<td>SelBruHa, Hungary</td>
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<tr>
<td>diazepam</td>
<td>Seduxen inj.</td>
<td>5 mg/ml</td>
<td>Richter Gedeon, Hungary</td>
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<tr>
<td>isoflurane</td>
<td>Forane sol. for inhal.</td>
<td>1 mg/ml</td>
<td>Abbott Laboratories, USA</td>
</tr>
<tr>
<td>medetomidin</td>
<td>Domitor inj. A.U.V.</td>
<td>20 mg/ml</td>
<td>Pfizer Animal Health, USA</td>
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</tbody>
</table>

Results and discussion

For minor painless (!) intervention, e.g. radiography, hypothermy is recommended in microbats. Even restless specimens can be examined after staying for half an hour in the refrigerator (at 4 to 5ºC). However even in state of torpor bats move their wings and legs slowly (it is an unintentional defence mechanism of the body) so to get a correct radiograph sedation is usually required. Either ketamin alone in a low dose (30 mg/bwkg) or with diazepam (0.5 mg/bwkg) proved to be safe. In flying foxes and in some of the tropical bat species, which are not able to go into a daily torpor or winter hibernation, it is absolutely prohibited to cool them because it can lead to pathological hypothermy. Beneath a body temperature of 30 to 32ºC degrees homeotherm mammals are not able to reach again their normal temperature by themselves.

Injectable anaesthesia in general requires accurate measuring of the weight of the small sized (4 g to 1.2 kg) bat species. The drugs can be administered usually intramuscular, only flying foxes more than 300 to 400 g in weight have veins (in the uropatagium or along the propatagium) which can admit the intravenous drugs. Drugs administered intramuscularly cause slow process and sometimes the required doses are even higher.

Ketamine alone (80 to 100 mg/bwkg) cause unconsciousness for minor surgeries but for painless state we need any combination of ketamine (50 mg/bwkg) plus medetomidin (0.5 mg/bwkg) or ketamine (40 to 50 mg/bwkg) plus xylazin (2 mg/bwkg) or ketamine (100 mg/bwkg) plus diazepam (0.5 mg/bwkg). We made a preliminary study with 4 times 3 healthy noctules to get a correct dose for ketamine plus medetomidin which combination has advantage that the effect of the medetomidin is reversible with atipamezol (Antisedan; Pfizer Animal Health, USA). They were anaesthetised always with medetomidin of 0.5 mg/bwkg, only the dose of the ketamine was different (25, 40, 55 to 70 mg/bwkg). By the lowest dose respond the animals for painful stimuli quite intensive, and also by the second dose were animals not absolutely painless. By the highest dose two of the three animals became for a longer time apnoetic and even one’s life could be rescued by (assisted) artificial respiration. By five further cases we decided to use a dose of 50 mg/bwkg ketamine and 0.5 mg/bwkg medetomidin and in one case 40 mg/bwkg ketamine and 0.5 mg/bwkg medetomidin which all worked well.

Inhalation anaesthesia is always induced via face mask and by long term procedures tracheal tube is placed. Because of the sensitivity of the mucous membrane of the trachea and the small body (and lung) size only Cole tracheal tubes are used. Using a tracheal tube instead of the face mask is more economical because of a use up of lower amount of anaesthetic gas. Furthermore in some cases, e.g. in pneumothorax, it is the only way to solve the problem. For ultrashort term interventions, such as radiography, 5 vol% isoflurane is given via face mask. The maintenance dose for isoflurane lies between 1.8 to 2.5 vol%; at some procedures, e.g. enucleation, also during the operation is change of the dose needed.
However heterotherm species’ sleep is for the most part absolutely relaxed, even after small surgical interventions the postoperative management is of considerable importance; for analgesia is butorphanol recommended.

Acknowledgements
The authors would like to thank Ms Éva Orbán, Central Library of the Faculty of Veterinary Medicine, Szent István University, for her technical help in the preparation of this paper. Thanks are also due to a large number of volunteers for the careful nursing of the saved injured bats and to the keepers of the two flying fox species at the Budapest Zoo.

References
USE OF TRANQUILLISERS TO MODERATE AGGRESSION AND FACILITATE INTRODUCTIONS IN A MALE GORILLA.

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Keywords: gorilla, tranquilliser, aggression, introduction

Extended abstract
A 20-year-old male western lowland gorilla (Gorilla gorilla gorilla) with a previous history of attacking female gorillas was relocated to Bristol Zoo Gardens to live with two female gorillas; a 27-year-old multiparous female and a 23-year-old nulliparous female. Initially, various management practices were attempted to integrate the male with the two females from day 8. During the previous days the male had been in visual and olfactory contact but was physically separated from the females. The females were together all night and only mixed with the male under supervision during the day. Such mixes varied from 15 minutes to 6 hours, depending upon whether inappropriate aggressive behaviour, including physical attacks, was displayed by the male. After 35 days, following severe injuries sustained by the older female from the male (on day 8, day 19, day 35), an attempt to moderate his aggression using medication was initiated. A few regimes using tranquillisers were trialed; including diazepam (100mg) alone, haloperidol (20mg once daily) plus thioridazine (100-300mg twice daily), then risperidone (6-12mg once daily) only. Fights and agitated behaviour occurred using these regimes, or high doses considered likely to risk side effects if continued for long periods, were required. The agitation of the male was increased at time of oestrus in the younger female; therefore at these times the older female was isolated from the male. The final successful regime was Sulpiride (200-400mg twice daily) and haloperidol (40-60mg once daily) that has been used for 135 days (and is continuing) from day 76 after initial introduction. Agitated behaviour i.e. sweating, ‘raspberry’ blowing, has been vastly reduced to almost zero using this combination. The male mated the younger female on day 83. Mating of the older female was observed on day 94; this was her first oestrus period observed since introducing the new male, this gap was presumably due to her elevated stress levels during that period. The male attacked the older female again on day 99 resulting in a fractured foot; this is the last attack to date. The haloperidol was tapered to zero over 20 days from day 140. Mating of both females continued during their respective oestrus periods. The younger, nulliparous female conceived on day 184 and is 28 days pregnant at the time of writing. From day 173 after initial introductions, all three animals were left together all day and all night. The Sulpiride dose was reduced from day 198 from 400mg twice daily to 200mg in the morning, 400mg in the afternoon until day 211 (time of writing).

Acknowledgments
My thanks for the skill and dedication of the animal staff at Bristol Zoo Gardens, particularly those looking after the gorilla (M. Gage, C. Kibbey, C Ogbourne, A. Moore), and for the support of Dr B Carroll, D Bolton, J Partridge, K Wyatt in working with these animals.

Drugs referred to in text.
Thiothiazine 100mg/5ml suspension; ‘Melleril suspension’
Sulpiride 200mg tablets; ‘Sulpitil’
Risperidone 2mg and 4mg tablets; ‘Risperdal’
Diazepam tablets BP 10mg (APS Ltd, Leeds,
Haloperidol tablets BP 20mg (APS Ltd, Leeds,