Anaesthesia in captive raccoons (Procyon lotor) during seasonal obesity

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ANAESTHESIA IN CAPTIVE RACCOONS (PROCYON LOTOR) DURING SEASONAL OBESITY

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Summary

In November 2008, 15.12 raccoons (Procyon lotor) were anesthetised using 0.05 mg/kg dexmedetomidine hydrochloride and 5 mg/kg ketamine hydrochloride. To achieve complete relaxation, up to 1 mg/kg alfaxalone were slowly applied intravenously prior to intubation. Anaesthesia was maintained using isoflurane in oxygen. Anaesthesia was monitored using rectal temperature, heart rate and respiratory rate. All animals were castrated according to the procedure described in dogs. The chosen anaesthesia protocol proved to be reliable for the use in raccoons. All animals had copious amounts of subcutaneous and intra-abdominal adipose tissue, which was considered adequate for the season. The induction and recovery periods were related to body mass, indicating an effect of adipose tissue on drug delivery and elimination.

Introduction

The raccoon (Procyon lotor) was originally a North and Central American species. Since its introduction to Europe in the 1930ies with subsequent releases and escapes there is a growing free-living population with approximately 300,000 to 500,000 living in Germany alone (HOHMANN and BARTUSSEK, 2001). Raccoons are also kept as zoo animals and their popularity as pets increases. A reproductive management, preferably by castration, is recommended to prevent fertile animals to escape into the wild, stabilise the population structure and reduce the risk of genital pathologies as described for in non-breeding female individuals (HERMES et al., 2004).

Raccoons do not hibernate, but can stay without food for several months at a time (HOHMANN and BARTUSSEK, 2001), due to the accumulation of subcutaneous and intra-abdominal fat as energy store that may account for up to 50% of their body mass in winter (STUEWER, 1943). Seasonally obese animals present a challenge to the clinician, as the uptake, distribution, and elimination of anaesthetic drugs is modified by body condition (MUIR, 2007). Additionally, the subcutaneous fat layer may act as a mechanical barrier and prevent effective injection into the muscle (CATTET and OBBARD, 2010).

Material and methods

In November 2008, 15.12 raccoons of the animal park “CUX-ART” in Beverstedt, Germany, were caught and anaesthetised for translocation into a larger outside enclosure and castrated prior to re-release. Most animals were between seven months and 4.5 years of age. The animals were kept in a well-structured outdoor enclosure with many hideaways in trees.
All raccoons, usually on a diet of cat food, eggs, chicklets, fruits and bread rolls, were fasted for at least 24 hours and then either caught in life traps (“cat trap” / “Katzenfalle”, Heiland Vet GmbH, Hamburg, Germany) or straight out of the trees with a self-closing loop (“dog catching loop” / “Hundefangstab”, Albrecht, Aulendorf, Germany) and transferred into transport boxes. After arrival at the clinic, the animals were weighed. Following the description by JALANKA and ROEKEN (1990) for the use of medetomidine and ketamine hydrochloride in procyonidae, an injection of 0.05 mg/kg dexmedetomidine (Dexdomitor®, Pfizer Tiergesundheit GmbH, Berlin, Germany) and 5 mg/kg ketamine hydrochloride (Ketavel®, Pfizer Tiergesundheit GmbH) was applied to the muscles of a hind leg manually. When the animals could be handled, an access to the Vena cephalica was established using a 22 G 1" venous catheter (Vasocan® Braunüle Luer Lock, B. Braun Melsungen AG, Melsungen, Germany) and up to 1 mg/kg alfaxalon (Alfaxan®, Vetoquinol, Ravensburg, Germany) was slowly applied until complete relaxation was achieved. For pain management, an additional 20 mg/kg (male) or 30 mg/kg (female) metamizol-Na (Novaminsulfon®, Animedica, Senden-Böensell, Germany) and 0.1 mg/kg meloxicam (Metacam®, Boehringer, Ingelheim, Germany) were given intravenously. All animals were intubated (cuffed endotracheal tubes size 3.5 to 4.5, Rüsch, Kernen i.R., Germany) and anaesthesia was maintained using 0.5 Vol-% (male) and 1.0 Vol-% (female) isoflurane (Isofluran CP® with 1 mL isoflurane/mL, CP-Pharma Handelsgesellschaft MbH, Burgdorf, Germany) and an oxygen flow rate of 0.7 L/min.

Anaesthesia was monitored by rectal temperature measurements and respiratory rate and heartbeats per minute were counted. Time was recorded for the different periods throughout the duration of anaesthesia, defined as time from application of pre-medication until first lifting of the head: (1) Induction period – application of pre-medication until relaxation of respective animal, (2) Preparation period – first handling of the animal until first incision, (3) Surgery period – first incision until last suture and (4) Recovery period – end of isoflurane application until first lifting of the head. Castration was performed on the basis of the description for the procedure in male and female dogs (BRASS, 1999; MATIS, 1999). Once the swallowing reflex was present again, the raccoons were extubated and transferred to recovery cages. The pre-medication was not antagonised to keep the animals sedated for the potentially stressful transport back to their enclosure. The animals were released into their new enclosure when able to lift their heads.

If not indicated otherwise, measurement values are given as median plus first and third quartile.

**Results**

The anaesthesia protocol was rated excellent with a smooth induction and recovery and a stable stage of surgical tolerance during surgery. All raccoons could be handled after an induction period of 15.0 minutes (10.0, 19.0; n = 10.9) after application of ketamine and dexmedetomidine. The heart rate was recorded as 78 bpm (73, 86; n = 14.13), the median respiratory rate as 24 breaths per minute (20, 26; n = 14.13). The rectal temperature measured at different time points during anesthesia was recorded with 38.2 °C (37.4, 38.5; n = 13.12). As expected, the values for rectal temperature measurements decreased over time with the first measurements always being higher than the last measurements resulting in a difference of 1.4 °C (1.2, 1.5; n = 6.9). The time between first and last measurement ranged between 24 and 113 minutes. Heart and respiratory rate increased when tension was applied to the gonadal ligaments, but remained within a limited range (heart rate: 46 - 130 bpm, heart rate 9 - 48 breaths/minute).

The swallowing reflex was regained in a median of 15.0 minutes (10.5, 20.0; n = 10.9) after the end of isoflurane application. The recovery period (21.0 minutes, quartiles: 14.5, 27.5; n = 4.3) showed large individual differences. Interestingly, there was a significant positive correlation (Spearman Correlation,
SPSS 18.0: $r = 0.405, p = 0.043; n = 10.9$) between body mass (median: 8.7 kg, quartiles: 7.1, 11.2; $n = 15.12$) and duration of induction period (Fig. 1) and between body mass and duration of recovery period ($r = 0.679, p = 0.047; n = 4.3$). There was also a significant negative correlation between the duration of isoflurane application (median: 41.0 minutes, quartiles: 23.8, 58.3; $n = 10.10$) and duration of the recovery period ($r = -0.786, p = 0.018; n = 4.3$). There was no significant difference in body mass between the sexes (male: median: 9.0 kg, quartiles: 7.8, 12.1, $n = 14$; female: median: 8.6 kg, quartiles: 6.9, 10.8, $n = 13$; Mann-Whitney-Test: $U = 75, p = 0.46; n = 14.13$). Surgery was uneventful and revealed a high volume of subcutaneous and intra-abdominal adipose tissue in all animals.

**Discussion**

The anaesthesia protocol used in the current study can be recommended for the use in raccoons, and recovery times in this study compare favourably to those measured in other studies in this species with different drug combinations and dosages (BELANT, 2004). The surgery was considered comparable to that in dogs. The high volume of subcutaneous and intra-abdominal adipose tissue was considered adequate for the season.

It could not be decided whether the adipose tissue in the animals of this study only delayed induction and elimination by acting as a drug reservoir, or whether it additionally also impeded efficient drug injection. It might have been useful to choose longer needles for the intra-muscular administration of anaesthetic drugs in this study. Also, hyaluronidase could be used to increase the absorption rate of the pre-anaesthetic drugs, as described for polar bears during their obese season (CATTET and OBBARD, 2010).

Obesity may modify the distribution and elimination of anaesthetics, influencing the pattern of induction and recovery (MUIR, 2007). This may lead to phenomena like the prolonged recovery period recorded for heavier raccoons: as the vast majority of isoflurane is eliminated via the lungs (PLUMB, 2005) and the ventilatory capacity is decreased in obese animals (GREENE and MARKS, 2007), the elimination of isoflurane should be prolonged in obese animals. The negative effect of the duration of the anaesthesia period on the duration of the recovery period may be explained by the storage of a higher amount of the pre-anaesthetic drugs in the fatty tissue and thus an ongoing redistribution by the end of inhalation anaesthesia. Especially in animals with a well-known predisposition for seasonal

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**Figure 1:** Influence of the body mass (kg) on the duration of the induction period (min) in 10.9 raccoons.
obesity, it may be favourable to plan, if possible, anaesthetic procedures for periods of the year when less adipose tissue can be expected and hence drug absorption and elimination may be faster.

References


