Veterinary Anaesthesia and Analgesia, 2005, **32**, 48–52

RESEARCH PAPER

High rectal temperature indicates an increased risk of unexpected recovery in anaesthetized badgers

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Abstract

Objective To identify factors associated with sudden early recovery (SER) from anaesthesia in badgers (*Meles meles*).

Study design Experimental trial.

Animals Ninety-three adult wild badgers.

Methods Animals were randomly assigned to receive one of four anaesthetics based on medetomidine (M) ketamine (K) and butorphanol (B) combined in different ratios: (i) MKB 20:40:80 μg kg^{-1}; (ii) MKB 20:40:60 μg kg^{-1}; (iii) MKB 20:60:40 μg kg^{-1}; and (iv) ketamine alone 0.2 mg kg^{-1}. For each animal, induction time was measured and physiological variables (heart rate, respiratory rate and rectal temperature) were recorded at 5-minute intervals during anaesthesia. Cases of SER were recorded and binary logistic regression applied to identify predictive factors.

Results Fourteen animals (15%) exhibited SER. Rectal temperature was the only variable that was a significant predictor of SER. Animals showing SER had significantly higher rectal temperatures which, in contrast to other cases, did not fall during the first 10 minutes of anaesthesia, which was when most SERs occurred.

Conclusion and clinical relevance We recommend that (i) rectal temperature is closely monitored during wild badger anaesthesia and (ii) that animals with higher than expected temperatures are treated with additional caution.

Keywords anaesthesia, animal welfare, badgers, early recovery, temperature.

Introduction

There are few studies examining complications and problems in wild mammal anaesthesia, despite their significance for animal welfare and for workers in the field. Wild mammals present a particular challenge in anaesthesia because of wide variation in health status and pre-anaesthetic stress; many will have been trapped beforehand. For example, capture methodology affects body temperature during anaesthesia in free-ranging white-tailed deer (*Odocoileus virginianus*; DelGiudice et al. 2001) while age and body condition affect recovery times in anaesthetized elephant seals (*Mirounga leonine*; Field et al. 2002). Seasonal differences may also be

important: reindeer (*Rangifer tarandus tarandus*) more effectively metabolize medetomidine in autumn than in winter, resulting in shorter recovery times during this season (Soveri et al. 1999). A further factor in wild mammal anaesthesia is the imperative that the anaesthetics used allow animals to recover and be returned to their natural habitat as quickly as is possible.

In this paper, we report the incidence and factors associated with a potentially serious problem that can occur when wild mammals are anaesthetized by injectable agents, which we have called sudden early recovery (SER). In cases of SER, the animal under anaesthesia recovers unexpectedly and without obvious pre-monitory signs, requiring restraint, and either termination of the procedure or the administration of more anaesthetic.

Sudden early recovery has been reported in polar bears (*Ursus maritimus*) anaesthetized with medetomidine/ketamine (Cattet et al. 1999) and several reports have emphasized the need for further injections to maintain anaesthesia (Agoramoorthy & Rudran 1994; Fernandez-Moran et al. 2001). However, the incidence of this problem and the factors responsible are unknown.

Sudden early recovery during anaesthesia presents a welfare problem for both animals and handlers. Risks are increased when large or potentially dangerous wild mammal species are involved. It may create serious physical risks for handlers, while increasing animal pain and distress. In the current study we aimed at establishing reliable predictors of SER that could be used to predict the need for further anaesthetic injections in inadequately anaesthetized animals (Wolfensohn & Lloyd 1998) and provide an extra measure of safety for handlers. In this paper we examine the occurrence and factors associated with SER in European badgers (*Meles meles*), anaesthetized with ketamine (Hunt 1976) or ketamine/medetomidine/butorphanol combinations.

Materials and methods

Ninety-three adult badgers were caught in peanut-baited cage traps set in Wytham Woods, Oxfordshire between 3 and 17 June 2001 as part of a long-term population study (for details see Macdonald & Newman 2002). Work was carried out under English Nature Licences 1991537 and Home Office Licence PPL 30/1826. Anaesthetic monitoring was part of our continuing refinement of practice.

Trapped badgers were transferred to individual holding cages, and then transported to a central processing site where, still caged, they were weighed to the nearest 0.1 kg. The animal's mass was then calculated by subtracting the cage's mass from the total. The aim of our anaesthetic technique was to provide restraint and sufficient anaesthesia for minor procedures which were body size measurements, fur-clip marking, blood sampling (<5 mL by jugular venepuncture), recording of reproductive status and body condition (based on subcutaneous fat depot estimation). Anaesthetic doses were selected on the basis of previous experience at Wytham. As part of an ongoing anaesthesia trial, four different anaesthetic techniques based on medetomidine (Domitor; Pfizer Animal health, New York, NY, USA), ketamine (Vetalar; Pharmacia and Upjohn Limited, Kalamazoo MI, USA) and butorphanol (Torbugesic; Fort Dodge Animal Health, Madison, WI, USA) were used. The ratios of M, K and B varied with each combination: (i) MKB 20:40:80 μg kg^{-1}; (ii) MKB 20:40:60 μg kg^{-1}; (iii) MKB 20:60:40 μg kg^{-1}; and (iv) ketamine alone (0.2 mg kg^{-1}). All anaesthetics were administered by intramuscular (IM) injection in the thigh muscles and antagonists were not used. Cubs were not involved in the study.

After injection, the presence of righting reflexes was determined by gently rolling the handling cage onto its side and when these were absent, the animal was removed. Induction time was measured as the time between injection and loss of righting reflexes. Heart rate (measured by palpation of the femoral artery), rectal temperature [measured using a Vicks V900 digital thermometer (Procter & Gamble Company, Cincinnati, OH, USA)] and the presence of pedal reflexes (elicited by pinching interdigital skin of the forelimbs) were measured as soon as the badger had been un-caged (initial measurements) and weighed (to confirm initial calculated mass). Measurements were repeated every 5 minutes until the badger had been marked with a fur clip, measured, sampled and returned to its cage. It was anticipated that these steps combined would require up to 20 minutes anaesthesia time, although this was an overestimate in most cases.

Sudden early recovery was characterized by a premature recovery from anaesthesia, unheralded by obvious signs such as muscle stiffening or twitching, and which necessitated considerable physical restraint. Animals experiencing SER were either given a further injection of the anaesthetic