Effects of tail fat on recovery times of anesthesia with isoflurane in fat-tailed Iranian Lori-Bakhtiyari lambs

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Abstract

In the present study, the effect of tail fat on recovery times in intact sheep and sheep with a ligated median sacral artery following similar anesthetic exposure with isoflurane was investigated. This study was performed using seven healthy fat-tailed Iranian Lori-Bakhtiyari ewe lambs. The lambs were anesthetized twice at two week intervals (the experiment was performed in two stages). After mask induction with isoflurane in 100% oxygen, sheep were intubated and anesthesia was maintained for 4 hr using a rebreathing system. Induction and extubation times and time to sternal recumbency and attempts to stand were recorded during anesthetic induction and recovery (Stage 1). Two weeks later, prior to the second anesthesia, the median sacral artery (MSA) was ligated under epidural anesthesia. All sheep were anesthetized as mentioned above (Stage 2). No significant differences were observed for the induction time between two stages (p > 0.05) but extubation, sternal recumbency and attempts to stand times were significantly longer in intact sheep (Stage 1) after 4 hr anesthesia with isoflurane (p < 0.05). Recovery time was decreased following MSA ligation in fat developed an animal model to investigate fat drug solubility of isoflurane gas. Therefore, using less-soluble in fat anesthetics is better than high-soluble anesthetics for prolonged anesthesia to decrease postoperative complication in obese patient.

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Introduction

Obesity is a growing challenge for anesthesiologists because of many problems including an increased incidence of intra- and postoperative atelectasis, difficulty in tracheal intubation, an increase in airway resistance that may resemble asthma, an increased capacity to metabolize anesthetics such as halothane or enflurane (but not apparently sevoflurane), a greater surgical demand for relaxation and decrease in functional residual capacity (FRC). The obese or overweight patient presents kinetic issues that may delay recovery, thereby, aspiration and develop acute upper airway obstruction after tracheal extubation that add to the risks of anesthesia. Rapid recovery is, therefore, desirable to ensure early efficient coughing and to decrease the rate of postoperative respiratory complications.

One of the elements that determine recovery from anesthesia is the clearance of anesthetic from the effect site. Several factors influence clearance. Anesthetic in tissue depots, the solubility of the anesthetic in blood (the blood/gas partition coefficient) and tissue/blood solubility coefficients will determine the rate of decrease of anesthetic in the arterial circulation during recovery from anesthesia because solubility determines the clearance of anesthetic at the lungs. If the fat solubility of the anesthetic is very small, most of the anesthetic will be cleared by ventilation and will thus not recirculate and delay recovery from anesthesia.

Most Iranian sheep have large, fat tails, which accounts for up to 14.5% of the cold carcass weight. The blood supply to the tail originates from the median sacral artery (MSA) which is a branch of the abdominal aorta. The objective of the study reported here was to evaluate effectiveness of body fat on recovery times in obese patients. Therefore, the recovery times of anesthesia by isoflurane in intact fat-tailed lambs and lambs with a ligated MSA was conducted.

Materials and Methods

Seven healthy, 8 to 10-month-old, fat-tailed Lori-Bakhtiyari ewe lambs, with a body condition score of 4 (on a scale of 0 to 5 units) and with a mean ± SD weight of 34.3 ± 1.2 kg, were used in the present study. The overall health of the sheep was monitored before and throughout the study. The animals were kept in barn and received anti-parasitic medications prior to the study and were acclimatized to the experimental conditions for 14 days. Body weight of the animals was recorded at arrival and before induction of the anesthesia. The animals had free access to hay and tap water throughout the study. Wool was clipped a week before the start of experiment.

Food was withheld for 20 hr before induction of the anesthesia and the procedure. However the animals had free access to water. All practical parts of the study, including the ligating of MSA, the induction of inhalation anesthesia, and the monitoring of the animals, intra-operative and recovery parameters were performed with the same author. Sheep were anesthetized twice in a two-week interval (the experiment was performed in two stages).

Stage 1. Sheep were anesthetized for 4 hr using isoflurane in oxygen. For induction of the anesthesia sheep were restrained gently and isoflurane in 100% oxygen (4 L min⁻¹) was delivered via a fitted facemask without using of sedatives or tranquilizers. Prior to anesthesia, the right jugular vein was catheterized for subsequent fluid administration. For induction of the anesthesia, the concentration of isoflurane was increased gradually (0.5% every 30 sec) until a vaporizer setting of 4.5% was reached.

Lidocaine 10% spray (Astra, Sodertalje, Sweden) was used to anesthetize the larynx prior to tracheal intubation. Following intubation, sheep were connected to a rebreathing system and a medium plane of anesthesia, as determined by palpebral and pedal reflexes, was maintained with isoflurane (2.0 to 2.5%) in oxygen (1.5 L min⁻¹).

Stage 2. Two weeks later, prior to the induction of anesthesia, the MSA of lambs was ligated under epidural analgesia. The level of the lumbosacral junction was prepared aseptically, and the needle placed correctly into the epidural space for injection of 4 to 5 mL of a 2% lidocaine solution (Farvet, Bladel, The Netherlands).

Following epidural anesthesia, sheep were positioned in dorsal recumbency to ligate the MSA. Using aseptic technique, a 4 cm midline incision was made at the base of the tail and after subcutaneous dissection the MSA was identified and ligated using No. 0 chromic catgut at its most proximal location (Figs. 1A and 1B). After careful hemostasis the subcutaneous tissue was closed with No. 0 chromic catgut and the skin with No. 1 polypropylene in a simple continuous pattern. An hour and half after epidural anesthesia, all sheep were anesthetized again as mentioned above.

Lactated Ringer’s solution (10 mL kg⁻¹ per hr) was administered during anesthesia in both stages.

Heart rate was obtained using a continuous electrophysiological monitor (Model RS-2000; Gmed Co., Seoul, Korea). Rectal temperature was measured at 1 hr intervals. Sheep were placed in left lateral recumbency on a padded surgical table during the maintenance of anesthesia. At the end of anesthesia, sheep were disconnected from the anesthetic circuit and were allowed to breathe room air. Induction time (time from the administration of isoflurane to tracheal intubation), extubation time (time from the discontinuation of isoflurane to swallowing reflex), time to sternal recumbency (time from the discontinuation of isoflurane to sternal recumbency) and attempts to stand (time from the discontinuation of isoflurane to time to standing) were recorded during anesthetic induction and recovery.