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RESEARCH PAPER

Does systemic lidocaine reduce ketamine requirements for endotracheal intubation in calves?

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Abstract

Objective To investigate whether an intravenous (IV) lidocaine bolus in calves premedicated with xylazine-butorphanol reduces the amount of ketamine required to allow endotracheal intubation.

Study design .

Animals In total, 41 calves were scheduled for elective umbilical surgery.

Methods Calves were randomly assigned to one of the two groups (L: lidocaine or S: saline). They were administered xylazine (0.07 mg kg^{-1}) and butorphanol (0.1 mg kg^{-1}) intramuscularly and 10 minutes later lidocaine (2 mg kg^{-1}; group L) or saline (group S) IV over 1 minute. After 2 minutes, ketamine (2.5 mg kg^{-1}) was injected IV. If the depth of anaesthesia was insufficient for intubation, additional ketamine (1 mg kg^{-1}) was administered every minute until intubation was successful. The amount of ketamine required for intubation, respiratory rate, pulse rate, arterial pressures, the depth of sedation and conditions of endotracheal intubation after induction of anaesthesia were compared between the two groups.

Results The calves in group L were sedated more deeply than those in group S; however, neither the median (range) amount of ketamine required for intubation, 3.5 (2.5–4.5) mg kg^{-1} and 3.5 (2.5–3.5) mg kg^{-1}, respectively, nor the induction quality differed significantly between the groups.

Conclusion and clinical relevance A bolus of lidocaine (2 mg kg^{-1}) administered 10 minutes after xylazine-butorphanol in calves deepened the degree of sedation but did not decrease the requirement of ketamine for endotracheal intubation. No adverse effects were recorded in the physiological variables measured.

Keywords anaesthesia induction, calves, ketamine, lidocaine, physiological variables.

Introduction

General anaesthesia in calves is commonly induced intravenously (IV) with ketamine following premedication with α_2-agonists, typically xylazine. After induction with ketamine, calves may show insufficient muscle relaxation, tonic-clonic movements and stiffness (Carroll & Hartsfield 1996). Inadequate relaxation may also complicate endotracheal intubation and potentially lead to laryngospasm. Xylazine is administered to improve muscle relaxation but can be responsible for bradyarrhythmias, hypotension and respiratory depression (Campbell et al. 1979; Rioja et al. 2008), and increasing the dose to improve muscle relaxation may worsen these undesired side effects. In the authors' experience, application of topical lidocaine on the larynx may not facilitate endotracheal intubation in large calves. Therefore, protocols to improve induction of anaesthesia and laryngeal relaxation for endotracheal intubation are needed.

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Lidocaine has been used IV as an adjuvant for the induction of anaesthesia in humans for this purpose and to attenuate the haemodynamic response to endotracheal intubation (Lev & Rosen 1994; Aouad et al. 2003; Baik et al. 2009; McKenna 2011). However, the benefits of lidocaine administration during endotracheal intubation are controversial and not well defined. Administration of lidocaine (1 mg kg^{-1}) IV in unpremedicated dogs just before induction with propofol had no effect on the cough response during endotracheal intubation (Jolliffe et al. 2007).

The hypothesis of the present study was that lidocaine administered IV 2 minutes before the induction of general anaesthesia with ketamine would reduce the amount of ketamine required to allow endotracheal intubation. Furthermore, it was investigated whether a bolus of lidocaine could improve the quality of anaesthesia induction in premedicated calves.

Materials and methods

Animals

This study protocol was approved by the Ethics Committee for Animal Experimentation of the Canton of Berne, Switzerland (no. 108/11). A written informed owner consent was obtained for all the animals included in the study.

The ketamine dose required to perform endotracheal intubation was defined as the primary outcome measure. To detect a significant difference between groups of 1 mg kg^{-1} ketamine, with a standard deviation of 1 mg kg^{-1}, at least 16 animals per group were required ($p \leq 0.05$, power ≥ 0.8). In order to account for animals that may be excluded during the study, a total of 41 animals were recruited. Female calves aged > 4 weeks and weighing < 150 kg were admitted to the Clinic for Ruminants of the Vetsuisse Faculty, University of Berne, for elective surgery on the ventral abdomen (umbilical hernia, abdominal hernia, omphalitis, omphalourachitis, omphaloarteritis and omphalophlebitis). A complete physical examination of all the organ systems as well as an ultrasonographic evaluation of the umbilical structures were performed. Calves were excluded if an American Society of Anesthesiologists physical status classification > 2 was assigned or a disease other than the surgical indications previously listed was present. Food was withheld for a minimum of 8 hours prior to anaesthesia, but the animals had free access to water.

Randomization of animals and blinding of the investigators

Each calf was randomly assigned to one of the two groups by drawing a lot out of an envelope initially containing 22 lots for each group. Calves in group L were administered lidocaine and those in group S were administered 0.9% sodium chloride. Anaesthesia was administered by one of the two anaesthetists (VM, DC). One clinician (JL), who was unaware of group allocation, was responsible for evaluation of the scores, administration of additional drugs and endotracheal intubation.

Anaesthetic technique

A 16 gauge, 8 cm cannula (BD Angiocath; Becton Dickinson, Sweden) was aseptically placed in an external jugular vein. Flunixin meglumine (2.2 mg kg^{-1}; Fluniximin, Dr. E. Graeub AG, Switzerland) and oxytetracycline (10 mg kg^{-1}; Oxysentin 100, Novartis Tiergesundheit AG, Switzerland) were administered IV 30 minutes before premedication. The calves were premedicated with intramuscular (IM) xylazine (0.07 mg kg^{-1}; Xylazine Streuli; Streuli Pharma AG, Switzerland) and butorphanol (0.1 mg kg^{-1}; Morphasol-10; Streuli Pharma AG, Switzerland) mixed together in one syringe and injected in the deltoid muscle. Next, 10 minutes after premedication, group L ($n = 21$) was administered lidocaine (2 mg kg^{-1}; Lidocaine 2%; Streuli Pharma AG, Switzerland) diluted to 20 mL in saline, and group S ($n = 20$) was administered an equivalent volume of 0.9% sodium chloride (NaCl 0.9%; Dr G Bichsel AG, Switzerland), injected IV by hand over 1 minute. After 2 minutes, ketamine (2.5 mg kg^{-1}; Ketanarkon 100; Streuli Pharma AG, Switzerland) was administered IV over approximately 10 seconds. Further 2 minutes later, the calves were positioned in sternal recumbency and endotracheal intubation was attempted, facilitated by a laryngoscope. If intubation was not possible within 10 seconds as a result of an inability to open the mouth or excessive chewing, active swallowing and strong coughing, an additional bolus of ketamine (1 mg kg^{-1}) was injected IV and endotracheal intubation was attempted 1 minute later. This procedure was repeated until successful intubation was achieved. The total dose of ketamine (mg kg^{-1}) administered to perform successful intubation was recorded. Animals were then placed on the surgery table in dorsal recumbency, and the endotracheal tube was connected to a rebreathing system (Fabius CE; Dräger AG, Germany) delivering isoflurane (Isoflurane ad us. vet.;

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