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RESEARCH PAPER

Castration of piglets: the analgesic effects of intratesticular and intrafunicular lidocaine injection

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Abstract

Objective The aim of this study was to evaluate the analgesic effect of intratesticular and intrafunicular lidocaine for the surgical castration of piglets and to investigate the degree of nociception induced by lidocaine injection.

Study design Prospective controlled experimental study.

Animals Forty-seven male Norwegian landrace piglets with normal testicular anatomy, aged 22 (±2.6 SD) days and weighing 7.4 ± 1.4 kg.

Materials and methods Anaesthesia was induced and maintained using halothane delivered in oxygen. End-tidal halothane was stabilized at 1.3% for 20 minutes before mean arterial blood pressure (MAP) pulse rate and electroencephalography (EEG) monitoring began. After 5 minutes of data collection, scrotal skin was desensitized with lidocaine before either an intrafunicular (IF) ($n = 15$) or an intratesticular (IT) ($n = 16$) lidocaine injection was made. Pigs in the control group ($n = 16$) did not receive lidocaine. Ten minutes later, a scalpel and an emasculator were used to cut the *funiculus spermaticus*. The MAP, pulse rate and EEG were monitored continuously for 5 minutes after castration.

Results During castration, MAP increased significantly, while pulse rate and EEG theta power fell significantly more in control, compared with the IT or IF groups. EEG alpha power fell more in the control group than in the IF group. No significant differences were found between the IF and IT groups. EEG, MAP and pulse rate responses to castration in the control group were significantly larger than the response to lidocaine injection.

Conclusion/clinical relevance Injecting lidocaine into the *funiculus spermaticus* or into the testes is effective in reducing signs of nociception caused by castration. Lidocaine injection is less noxious than castration without local anaesthetic.

Keywords castration, electroencephalography, local anaesthesia, nociception, pain, piglets.

Introduction

Piglet castration is routinely performed in several countries in an attempt to prevent boar-tainting of meat. It is traditionally carried out at a young age without anaesthesia. The procedure was previously regarded as relatively innocuous because of its brevity and the popularly held misconception that the underdeveloped nervous systems of neonatal mammals limits their nociceptive abilities. Recent reports have challenged this; neonatal mammals may have increased pain perception and be predisposed to developing hypersensitivity (Fitzgerald & Beggs 2001). The castration of piglets induces pain-related behaviour during (Weary et al. 1998; Horn et al. 1999; Taylor & Weary 2000; Taylor et al.

2001) and after (McGlone & Hellman 1988; McGlone et al. 1993; Hay et al. 2003) surgery. Under current Norwegian law, castration may only be performed by a veterinarian using an anaesthetic on piglets less than 28 days old. The benefits of anaesthetizing piglets for surgical castration are also receiving attention in other European countries, and both local anaesthesia and general anaesthesia induced by injection or inhalation have been evaluated (McGlone & Hellman 1988; White et al. 1995; Kohler et al. 1998; Nyborg et al. 2000; Baumann & Bilkei 2002). An anaesthetic technique suitable for routine piglet castration should be quickly performed, cost-effective, induce minimal stress and provide post-operative analgesia. Rapid complete recovery is also desirable: piglets may be crushed by the sow and are prone to hypothermia. The use of local anaesthetic fulfils most of these criteria. Several studies have shown that local anaesthetic administered into the substance of the testicle (IT) or into the *funicular* (IF) or the *cavum vaginalis* reduces nociception induced by castration (McGlone & Hellman 1988; White et al. 1995; Nyborg et al. 2000). To our knowledge, a comparison of the nociceptive responses to different routes of local anaesthetic administration or the subsequent antinociceptive effects has not been made.

Nociceptive stimuli during general anaesthesia may induce changes in blood pressure, pulse rate or in the electroencephalogram (EEG) which may be used as indicators of nociception. The aim of this study was to use these indicators under halothane anaesthesia to evaluate the analgesic effect of IT or IF lidocaine injection during piglet castration. A second aim was to compare the nociception induced by IT lidocaine injection with injection into the *funiculus spermaticus*.

Materials and methods

Animals

Ten pregnant Norwegian landrace sows were housed at the research facility and fed a commercial diet (Format edel norm; Felleskjøpet, Kløfta, Norway). Each piglet was given iron dextran by subcutaneous injection, (200 mg Fe) (Idofer, Boehringer Ingelheim, København, Denmark) within 3 days of farrowing. From 3 days of age, the piglets were offered a commercial grain diet (Format Kvikk; Felleskjøpet, Norway) and in litters from sows with agalactia, a commercial milk-replacer (Pluss melkeerstatning; Felleskjøpet, Norway) was also offered. Forty-seven male piglets, from 10 different litters, with a mean age of 22 ± 2.6 (SD) days and a mean body mass of 7.4 ± 1.4 kg were included in the study. All animals had normal testicular anatomy and were judged to be healthy after clinical examination. All piglets were destroyed under anaesthesia at the end of the study. The protocol was approved by the National Animal Research Authority.

Anaesthesia

Anaesthesia was induced with halothane (Halothane; Halocarbon Laboratories, River Edge, NJ, USA) delivered in oxygen and administered by mask. When anaesthesia was judged to be adequate for endotracheal intubation, lidocaine (Xylocain 100 mg mL^{-1}; AstraZeneca, Oslo, Norway) was sprayed onto the larynx and the trachea was intubated. A paediatric circle anaesthesia system was immediately connected to the endotracheal tube and the pig was placed in left lateral recumbency on a hot water blanket before intermittent positive pressure ventilation was imposed.

Instrumentation

The pigs were connected to an anaesthetic monitor (AS/3, Datex Engström, Helsinki, Finland) for monitoring oxygen saturation, end-tidal CO_2 concentration, inspiratory and expiratory halothane concentration, rectal temperature and ECG. Gas was drawn to the monitor from the proximal end of the endotracheal tube. Lidocaine (0.3 mL SC) (Lidokain 10 mg mL^{-1}; Nycomed Pharma AS, Asker, Norway) was administered in proximity to the saphenous artery, which was then exposed through a skin incision. A 0.8 × 25 mm catheter (Venflon; Beckton Dickinson, Helsingborg, Sweden) was then introduced. Tubing filled with physiological saline was connected to the catheter and attached to an electronic transducer (PX-241; Edwards Lifesciences, Irvine, CA, USA) zeroed at the level of the thoracic inlet. To avoid biasing the results, the measured physiological variables were maintained within specified intervals. Rectal temperature was kept above 37.5 °C while mean arterial pressure (MAP) was maintained above 50 mmHg by infusing Ringer's acetate and dextran (Macrodex; Pharmalink, Upplands Väsby, Sweden) solution. Dobutamine (Dobutamine 2.0 mg mL^{-1}; Abbott Laboratories, Chicago, IL, USA) was infused using a syringe driver

