

Oral presentation

Local anaesthesia for pigs subject to castration

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Introduction

The legislation in Norway requires that anaesthesia and analgesia must be used when piglets are castrated. The procedure must also be performed by a qualified veterinarian [1]. Since anaesthesia became mandatory in 2002, the injection of the local anaesthetic lidocaine into the testicle has been the preferred anaesthetic method among veterinary practitioners in Norway [2]. The method has been controversial as it has been claimed that the injection in itself was as painful as the castration procedure and that the local anaesthesia did not produce sufficient anaesthesia for surgical castration. This presentation will focus on the published work where the effect of local anaesthesia on piglets during castration was studied.

Pharmacology of local anaesthetics

Local anaesthetics block the initiation and propagation of action potentials in nerve cells by preventing the voltage-dependent increase in Na⁺ conductance. Chemically, local anaesthesia molecules consist of an aromatic part linked by an amide or ester bond to a basic side chain. The ester containing compounds, e.g. procaine, are inactivated by plasma and tissue esterases. The amides are more stable, and these drugs, e.g. lidocaine, have longer half-lives and duration of effects. The addition of a vasoconstrictor such as adrenaline prolongs the effects and reduces the systemic absorption rate, thereby reducing the risks of systemic toxicity [3].

Procaine has been assessed by the European Medicines Agency (EMA) as a local anaesthetic which can be used without an established maximum residue limit (MRL) in production animals. Procaine was previously widely used, but has been replaced by other local anaesthetics such as lidocaine, which has a faster onset and longer duration. In

addition, lidocaine causes fewer side-effects and spreads more easily in the tissues. Lidocaine has been placed in Annex II for horses by the EMA. Used in other production animals, the withdrawal time for meat and milk are therefore 28 and 7 days, respectively [4].

Effects of local anaesthetics in piglets subject to castration

Research on the effects of castration and various anaesthetic techniques in piglets has been published since the late 1980's. McGlone and Hellmann found that local anaesthetics restored nursing activity and maintenance behaviors such as lying and nursing of castrated 10- to 14-day old piglets to the level of uncastrated, unanaesthetized pigs. This effect was not evident in 7-week old pigs [5] In another experiment, McGlone *et al*, did not find that the analgesics butorphanol or aspirin affected behaviors after castration without local anaesthesia in 8-week old pigs [6].

It is well known that pigs express their discomfort through vocalization. White *et al* found that pigs castrated without local anaesthesia had an increased heart rate and gave more high energy frequency (HEF) calls than pigs not given an anaesthetic irrespective of age at castration [7]. A few studies have also been conducted where the different procedural sources of pain have been described. The cutting and severing of the spermatic cord seems to be the procedure which induces the most consistent alterations in behaviors such as vocalization [8,9].

Noxious stimuli induce expression of the protein c-Fos in neurons in the dorsal horn.

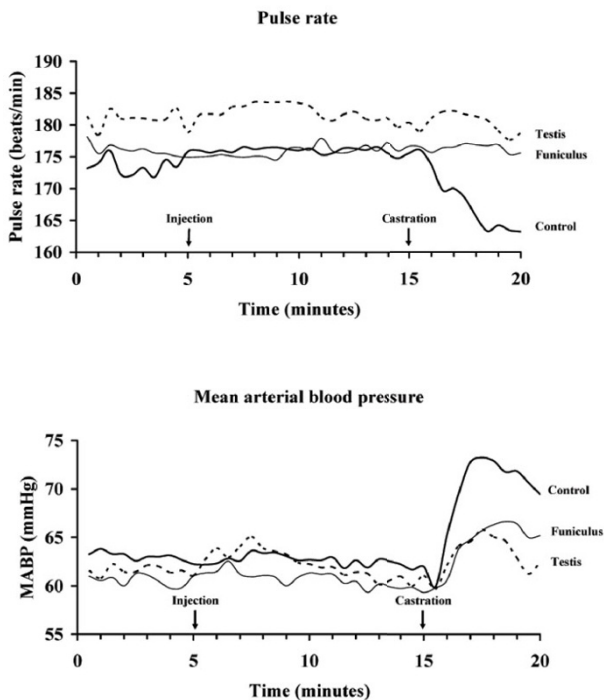


Figure 1
 a. Mean MAP (mmHg) before, during and after lidocaine injection and castration. The three curves illustrate the control group where no lidocaine was administered, the funiculus group where lidocaine was injected into the funiculus spermaticus and the testis group where intratesticular lidocaine was used. b. Mean pulse rate (beats/minute) before, during and after lidocaine injection and castration. The three curves illustrate the control group where no lidocaine was administered, the funiculus group where lidocaine was injected into the funiculus spermaticus and the testis group where intratesticular lidocaine was used. Reprinted from [11] with permission from Blackwell Publishing Group.

In a study published by Nyborg *et al.* the expression of c-Fos positive neurons in the dorsal horn of the spinal cord was compared in pigs castrated with or without local anaesthesia. In unanaesthetized pigs the numbers of c-Fos positive neurons were significantly higher than in pigs which received local anaesthesia intrafunicularly [10].

Most of these studies revealed that castration is a painful procedure in piglets, regardless of age, which induces both physiological and behavioral alterations in the animals. However, these studies did not address to what extent the administration of local anaesthetics in itself was stressful or painful for the piglets or whether administration intratesticular or into the spermatic cord gives better analgesic effect. In addition, it would be of interest to determine to which extent the local anaesthetic reduces physiological responses induced by nociceptive/surgical stimuli, and to study the distribution of the local anaesthesia when injected into the testicle, as it was claimed that such administration would not result in sufficient concentrations in the spermatic cord where the greatest effect was needed. Therefore two studies were performed at the Norwegian College of Veterinary Medicine.

In the first study the aim was to evaluate the analgesic effect of intratesticular or intrafunicular lidocaine for the surgical castration of piglets. It was of particular interest to investigate the degree of nociception induced by the lidocaine injection in the tissues. Anaesthesia was induced and maintained using halothane, during anaesthesia mean arterial pressure (MAP), pulse rate and electroencephalography (EEG) were monitored. Lidocaine with adrenaline was injected into the testicle (n = 16) or into the spermatic cord (n = 15). The control group (n = 16) did not receive local anaesthesia

During castration, MAP increased significantly, while pulse rate and EEG theta power fell significantly more in

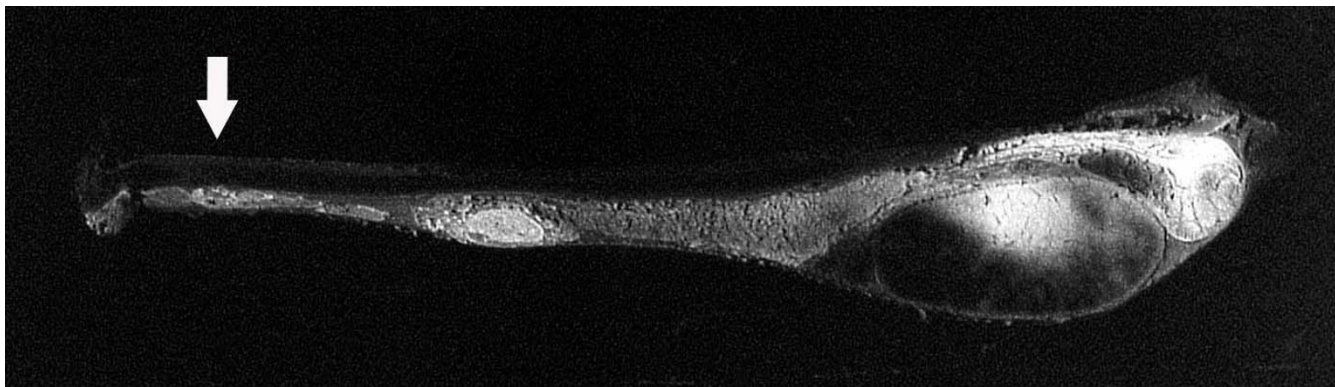


Figure 2
 Autoradiogram from a representative piglet which was injected with radiolabelled lidocaine into the testicle. The piglet was killed 3 minutes after the injection. White areas correspond to high concentration of radioactivity. The arrow indicates the location of the Cremaster muscle.

the control group, compared to groups in which pigs received lidocaine into the testicle or into the spermatic cord. The blood pressure response to castration was significantly larger in the control group than the response to lidocaine injection in the treatment groups (Fig. 1a,b) [11], indicating that the injection of lidocaine is less painful than castration without local anaesthesia. No difference was found in analgesic effect between intratesticular injection and injection into the spermatic cord.

To study the distribution of lidocaine administered intratesticularly, radiolabelled lidocaine with adrenaline was injected into the testicles and subcutaneously (SC) in the scrotum of 12 piglets [12]. The animals were euthanized at 3, 10, 20 and 40 minutes, respectively, after the injection. The testicles and spermatic cords were immediately removed and frozen. Autoradiograms were subsequently produced and tissue was subjected to liquid scintillation counting to quantify the amount of radioactivity within the different structures.

Quantification of radioactivity in the spermatic cord and testicle showed that the highest concentration of radiolabelled lidocaine was found in the spermatic cord 3 minutes after the injection into the testicle. Autoradiograms produced in this study verified that lidocaine injected into the testicle was transported rapidly into the spermatic cord. The autoradiograms also showed that lidocaine does not readily diffuse through the tunica vaginalis and into the cremaster muscle (Fig. 2). This might explain the nociceptive response which is elicited during the castration procedure performed under local anaesthesia, as this procedure also involve the cutting and/or tearing of the cremaster muscle.

Conclusion

Injection of local anaesthesia into the testicle before castration in piglets reduces the physiological and behavioral responses associated with the surgical stimulus. Although these responses are not completely abolished, it is reasonable to assume that local anaesthesia improves animal welfare for piglets subject to castration.

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