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Long-term weight gain and economic impact in pigs castrated under local anaesthesia

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ABSTRACT

Castration is a controversial practice in swine production because in some countries is still performed without anaesthesia, and therefore causes intense suffering and stress to animals. This study investigated the effect of pre-surgical administration of local anaesthesia (LA) on the growth performance of piglets until the end of the growth phase (102 days). Piglets aged 3 to 5 days were selected in pairs of similar weights and same age. They were originated from 22 litters. The groups were randomly assigned to one of two treatments. Castration was performed with (LA; $n = 45$) or without (NLA; $n = 45$) intra-testicular administration of 0.5 mL of 2% lidocaine plus adrenaline per testicle, administered by an automatic repeating vaccinator. Castration was performed 10 min later. Average daily weight gain and economic impact were evaluated between the intervals before castration until 21 (weaning phase), before castration until 60 (end of the initial nursery phase) and before castration until 102 (growth phase) days of age. Average daily weight gain data were analyzed by comparing the average daily weight gain between the weaning phase, 60 and 102 days of age versus the initial weight (pre-castration). At the end of the growing phase, animals treated with LA showed greater weight gain than animals castrated without anaesthesia. LA also showed improved cost:benefit ratio and theore might provide greater economic benefit under the conditions used in this study. Our findings have proved that castration with LA improves long-term weight gain of piglets.

1. Introduction

Castration avoids 'boar taint', caused by compounds such as androstenone and skatole, which give the meat an offensive odour. However, castration is one of the most controversial management practices in swine production, because it is usually performed without the use of perioperative anaesthetics and/or analgesics (McGlone & Hellman, 1988; Hansson, Lundeheim, Nyman, & Johansson, 2011; Kluivers-Poodt et al., 2012), and therefore causes intense suffering and stress to animals. Castration induces behavioral (Hansson et al., 2011, Kluivers-Poodt et al., 2012, Kluivers-Poodt, Zonderland, Verbraak, Lambooij, & Hellebrekers, 2013), biochemical and endocrine (Kluivers-Poodt et al., 2012; Sutherland, Davis, Brooks, & Coetzee, 2012) changes. Although these changes may be minimized by LA and analgesia (Hansson et al., 2011; Kluivers-Poodt et al., 2012, 2013), this is not yet a common practice worldwide.

Although intratesticular administration of local anaesthesia may cause a painful additional stimulus to castration, Haga and Ranheim (2005) have shown that administration of lidocaine intratesticularly or in the spermatic cord in piglets was effective in reducing the nociceptive effects caused by orchiectomy.

Over the years, many studies have been developed to reduce or prevent the stressful effects of surgical castration in pigs. However, the major obstacles to implementation of developed techniques in the industry are usually related to the economic impact or need of specialized technicians, which are not available in pig farms (De Roest, Montanari, Fowler, & Baltussen, 2009).

Although the current belief is that there is no difference in growth performance (i.e. weight gain) between pigs castrated with anaesthesia and those castrated without anaesthesia (McGlone & Hellman, 1988; Hansson et al., 2011; Kluivers-Poodt et al., 2012, 2013), the studies carried out to date have assessed this only for a short time, specifically for about 60 days (until the nursery production phase). It is not certain that use of LA would not improve weight gain in a later phase, therefore the novelty of this study is comparing the weight gain during the full growing phase of pigs castrated with or without anaesthesia, by proposing a practical and feasible technique under field circumstances.

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2. Material and methods

All of experimental procedures have been previously approved by the Animal Ethics Committee of this institution (CEUA), under protocol number 76/2013. The study was performed at a commercial farm. A total of 90 male commercial crossbreed (Landrace-Large White) piglets were divided into two groups of 45 piglets each. They were originated from 22 litters and piglets from each group were selected in pairs of similar weights and same age and maintained in the same pen. The number of piglets in each pen ranged from 4 to 8. After that, they were randomly assigned to one of the treatments. In the LA group, pigs underwent castration with LA, provided by intra-testicular administration of 0.5-mL of 2% lidocaine with adrenaline per testicle, administered by an automatic repeating vaccinator. The time for application of the anaesthetic was 25 s from the moment the animal was restrained to the moment it was released. Castration was performed 10 min later. In the NLA group, animals were castrated without LA. Animals were weighed immediately before surgery when piglets were between 3 and 5 days old, at weaning (21 days old), when they were 60 days old and at the end of growth phase (102 days old). The average daily weight gain (ADWG) was calculated according to: ADWG = [(Weight at weaning or at 60 days of age or at the end of growth phase)–(Weight before surgery)]/(days between weight measurements).

2.1. Statistical analysis

Average daily weight gain data were analyzed by comparing the average daily weight gain between the weaning phase, 60 and 102 days of age (final weights) versus the initial weight (pre-castration). Data were submitted to the PROC MIXED of SAS statistical package, using the RANDOM command to analyze the effects of random and REPEATED for the analysis of repeated measures. The following effects were considered: the effects of treatment, litter and phases (time point), as well as interactions between treatments and litters, treatments and phases, and litters and phases, depending on the daily weight gain response variable. Statistical significance was set as $P < 0.05$.

2.2. Economic impact

The economic impact was analyzed by a profit indicator (Mishan & Quah, 2007), based on the cost/benefit calculation, where cost was the value of the anaesthetic used for each animal plus the additional cost to pay the extra labour time for administration of lidocaine and benefit was the difference on weight (kg) between two groups, multiplied by the value of the pig weight (kg) in our region. Therefore, the result was obtained by the formula:

$$\text{Cost–benefit ratio} = \frac{\textit{Weight difference between groups x Value of1 kg of live pig*}}{\textit{Costs}}$$

The price of one kilogram of pig was obtained at the Center for Advanced Studies in Applied Economics–CEPEA ESALQ (2016).

In this mathematical model, when the ratio is > 1, there is benefit; when the ratio = 1, the cost and benefit are the same; and when the ratio is < 1, the cost outweighs the benefit.

3. Results

There was a significant difference between two treatment groups at repeated measures for ADWG ($p = 0.0155$). Based on slice analysis the ADWG between 102 days and before surgery was greater in LA group than in the NLA group ($p = 0.0014$) (Table 1). The cost/benefit index considering the period before and 102 days was 11.05, indicating that implementation of this practice would be economically advantageous in our region.

Table 1
Average daily weigth gain with (LA) or without (NLA) local anaesthesia before and 21, 60 and 102 days of age.

	Mean (kg)		SEM	*p* value
	LA	NLA		
Time Point				
Before-21 days	0.191[a]	0.174[a]	0.0026	0.1040
21–60 days	0.319[a]	0.310[a]	0.0048	0.0972
60–102 days	0.549[a]	0.529[b]	0.0049	0.0354

SEM: Standard error of mean.
Mean values with same letter (line) are not significantly separated ($p > 0.01$).

4. Discussion

This study demonstrates that use of local anaesthetic (LA) prior to castration appears to have positive effects on long-term weight gain of pigs, indicating that technique has both welfare for pigs and economic benefits for producers.

In the current study, long-term weight gain was improved when piglets at young age were castrated with LA. Although previous studies have reported that weight gain did not differ when castration was performed with LA, those studies evaluated weight gain only for a short period, and therefore did not address the long-term influence of pain due to castration (McGlone & Hellman, 1988; Hansson et al., 2011), which needs to be taken into account, given the productive cycle of animals. We did not observe any significant differences in weight gain until the end of nursery phase, when piglets were 60-day-old, as previously reported (Hansson et al., 2011; Kluivers-Poodt et al., 2012, 2013).

It has been widely reported that there is compensatory weight gain in pigs undergoing stress-induced feed restriction (Kristensen et al., 2002). Thus, it could be expected that a similar finding would be observed in pigs undergoing stress-induced castration; however, this was not the case in the current study. Thus, we believe that the pain induced by castration might elicit long-term neurophysiological changes, such as allodynia, hyperesthesia, hyperalgesia, paresthesia, or hyperpathia and possibly peripheral and/or central sensitization, which would have negative effects on weight gain, besides that, the results have indicated that these effects were reduced by LA (Prunier et al., 2006; Kluivers-Poodt, Hopster, & Spoolder, 2007). Although the expected anaesthetic effect of lidocaine with epinephrine in our study would be between 1- and 2-hour (White et al., 1995; Haga & Ranheim, 2005; Kluivers-Poodt et al., 2012), based on previous studies in men (Giannoni, White, Enneking, & Morey, 2001; Nguyen et al., 2001; Ong, Lirk, Seymour, & Jenkins, 2005; Katz & McCartney, 2005), we have hypothesized that the LA would produce a preventive analgesia and avoid peripheral and central sensitization, contributing to improve weight gain (Prunier et al., 2006).

Several systematic reviews and meta-analysis have defined and addressed the advantages of preventive analgesia in men (Ong et al., 2005; Katz & McCartney, 2005) and could explain our results. Pre-operative analgesic treatment, when compared to placebo, reduces pain for a longer time than the duration effect of analgesics as widely reported (Giannoni et al., 2001; Nguyen et al., 2001). The peritonsillar infiltration of ropivacaine reduced tonsillectomy pain for up to 5 days post-operatively. In another study, local wound infiltration of ropivacaine, but not saline, decreased pain scores for 24-h after craniotomy (Nguyen et al., 2001). These and other studies have evidenced that preventive analgesia may diminish peripheral and central sensitization, originated from a noxious transoperative and postoperative input and reduce primary and secondary hyperalgesia (Lavand'Homme, 2006).

Numerous studies have examined the behavioral, biochemical and