Impact of general injection anaesthesia and analgesia on post-castration behaviour and teat order of piglets

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Injection anaesthesia with a combination of ketamine and azaperone (K/A) is discussed as a painless alternative to commonly used non-anaesthetized castration. To protect anaesthetized piglets from being crushed, they have to be separated from the sow for 3 h following castration. The aim of this study was to test if this separation and the different treatments would affect short-term behaviour after castration (3 to 6 h after castration) as well as weight gain. Piglets were 5 to 7 days old. Treatment Group 1 received a combination of anaesthesia and analgesia (n = 29, ketamine: 25 mg/kg BW; azaperone: 2 mg/kg BW; meloxicam: 0.4 mg/kg BW), Group 2 received only analgesia (n = 24) and Group 3 received no medication (n = 29). Behaviour and suckling order were compared for a 3 h period the day before castration and after castration. A significantly higher number of teats used by anaesthetized piglets (P = 0.004) suggests a decrease in suckling order stability. There were significant treatment effects between all three groups in the time spent at the sow’s teat, with an increase in Group 2 (169%), decrease in Group 1 (228%), whereas the control Group 3 (12%) almost remained unchanged. The anaesthetized piglets showed an increase in the time spent active away from the sow after castration of almost 200% (Groups 2 and 3: 50%, P < 0.001). However, no significant treatment effect was seen for weight gain. The results suggest that analgesia has an effect on behaviour, perhaps due to less post-castration pain. This advantage is not apparent for animals receiving additional anaesthesia, probably because of impaired coordination. Although the behavioural changes did not affect weight gain significantly, a decrease in suckling order stability indicates a certain degree of stress due to fighting over teat positions as a consequence of separation. Thus, post-castration behaviour must be taken into account when evaluating alternative castration methods.

Keywords: anaesthesia, analgesia, teat order, piglet castration, animal welfare

Implications

Injection anaesthesia (ketamine/azaperone) and analgesia (meloxicam) during the castration of pigs is considered as a welfare friendly alternative to conventional castration without any anaesthesia and post-castration pain treatment. Our study suggests that this combination of injection anaesthesia and analgesia in particular impairs the short-term suckling behaviour and teat order of piglets. In contrast, analgesia treatment alone resulted in a higher suckling order stability with no changes to a lower (posterior) teat position and increased time spent at the teat after being reunited with the sow. The results suggest that analgesia treatment alone has an effect on post-castration behaviour, perhaps due to less post-castration pain.

Introduction

For animal welfare reasons, research on alternatives to common surgical castration without anaesthesia and analgesia has been demanded by scientists (European Food Safety Authority (EFSA), 2004), producer organizations (Declaration of Brussels, 2010) and the European Commission (2011). The need for specific research pertaining to general anaesthesia and analgesia has been recently expressed (von Borell et al., 2009; PIGCAS Report, 2009).

Research by Lahrmann et al. (2006 and 2008) show that neuroleptanalgesia (injection anaesthesia with ketamine and azaperone (K/A)) can reduce the defensive struggle during castration but cannot always prevent it. However, as an alternative to anaesthesia-free piglet castration, they refer to this method as practical and as in conformity with animal welfare legislation. A disadvantage of this type of general anaesthesia is the long post-operative sleeping phase.
ineligible for analysis. A Wilcoxon matched-pair test was used to assess significance of differences in the duration of time that piglets spent at the teat and away from the suckling area (standing, walking) was assessed in comparison to the time spent at the sow’s teat (massaging and milk intake with the snout at the teat while lying, sitting or standing). Two criteria were used to evaluate the consistency of the sucking position:

1. During the observation period before castration, the sucking position (1 to 7, cranial to caudal) in which a piglet spent most of its time (preferred teat position (PTP)) was determined, and this was compared with the position after castration/separation (change in direction to anterior = higher in rank, posterior = lower in rank).
2. The number of teats used (at which a piglet spent more than 2 min over a 3-h period) was measured and compared.

**Weight gain**

Each piglet was taken out of the crate once a day in the morning and weighed to compare the daily weight gain (g/day).

**Statistical analysis**

The duration of time that piglets spent at the teat and away from the suckling area of the sow was analysed using a linear mixed model in SAS 9.1 (2006). The treatment (three levels) and time period (two levels) were considered as fixed effects in the model. The individuals were clustered for each litter/sow (29 levels) and considered as random effect. Because the data were not normally distributed, data were ranked for analysis. A Wilcoxon matched pair test was used in a before/after comparison of the number of teats used. The change in PTP was evaluated using a logistical analysis of variance (ANOVA). In addition, a Spearman rank correlation coefficient was calculated for the teat positions. The weight gains were compared using unifactorial ANOVA.

**Results**

With a difference of almost 200% (corresponding to 31 min/3 h), the anaesthetized animals (Group 1) spent a significantly

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**Material and methods**

The study took place at the Experimental Farm of the University and included 82 male piglets (5 to 7 days old, >2 kg, Hermitage × Piétrain) from 29 litters. In each litter, piglets were randomly assigned to three types of treatment and castrated in the morning within 5 min of each other: Group 1 (n = 29) received a combination of anaesthesia (K/A) and analgesia (meloxicam); Group 2 (n = 24) was only given analgesic medication; Group 3 (n = 29) served as control and was castrated without medication, but received the same sham handling before castration. Injections were applied behind the base of the ear. Group 1 received the anaesthesia behind one (K/A mixed in one syringe) and analgesia behind the base of the other ear. The drugs (ketamine: Ursotamin®, 25 mg/kg BW, Serumwerke Bernburg AG, Bernburg, Germany; azaperone: Stresnil®, 2 mg/kg BW, Janssen Animal Health, Neuss, Germany; meloxicam: Metacam®, 0.4 mg/kg BW, Boehringer, Ingelheim, Germany) were administered i.m. 10 min before castration. The absorption for meloxicam was reported to occur within 1 h following this route and dose of administration in pigs (Fosse et al., 2008; Keita et al., 2010). After surgery, all male piglets were separated from the sow by a board in their farrowing pen during a 3 h post-operative sleeping and recovery period to protect them from being crushed, whereas female piglets (that were equally represented in the litter as males) remained all the time with the sow. A second piglet nest with a piglet mat and heat lamp was set up behind the board to protect these pigs from hypothermia.

**Evaluation of animal behaviour**

Piglet behaviour was observed for 3 h on the day before castration and at the same time of the day for 3 h after castration (after being reunited with the sow and female piglets following a 3 h recovery period). A single observer who was unaware (‘blinded’) of the different treatments conducted focal animal observations from video. The duration of time that the animals spent active outside of the suckling area (standing, walking) was assessed in comparison to the time spent at the sow’s teat (massaging and milk intake with the snout at the teat while lying, sitting or standing). Two criteria were used to evaluate the consistency of the sucking position:

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**Results**

With a difference of almost 200% (corresponding to 31 min/3 h), the anaesthetized animals (Group 1) spent a significantly
longer time active away from the sow’s teat area (difference between before and after castration) than the other two treatments (Group 3: 49%, Group 2: 52%, P < 0.001). They showed a decrease of 27% in the duration of time spent at the teat (Figure 1). There was no difference in activity away from the sow’s teat area between animals with and without analgesic treatment. The piglets that underwent analgesic treatment spent 68% more time at the teat of the sow after separation, whereas the animals of the control group lost their PTP after 3 h of separation (χ² = 5.3, P = 0.07; Figure 3). The Spearman rank correlation coefficients of rs = 0.98, 0.88 and 0.90 revealed a highly significant relationship for the teat positions used before and after castration in all treatment groups.

The average weight was 2630, 2600 and 2520 g for Group 1 to 3 on castration day. From the day of castration to day 1 after castration, the piglets of Groups 1 and 3 experienced a slight decrease in weight gain compared with the previous day (before castration to castration day), whereas weight gain of Group 2 increased (Figure 4). However, these differences were not significant and already compensated for at day 2 after castration.

Discussion
The high correlation of rank before and after castration shows that the suckling order (3 to 6 h after castration) was not substantially influenced by the 3-h separation of male animals. Nonetheless, although not significant, nearly 30% of the anaesthetized piglets changed their PTP, which indicates a certain amount of disturbance after being reunited. Accordingly, for every treatment, there was a rise in the number of teats used and hence an increased change in position after reunification. This disturbance arising from the re-establishment of the suckling order could have a negative
effect on all members of the litter when leading to stressful fights over teat positions (Van Putten, 1990). Interestingly, it appeared easier for the piglets that had received analgesia alone to be re-integrated into the group. These animals exhibited the lowest proportion of changes and were not displaced into lower ranking positions. The analgesic treatment may give them an advantage in recovering their PTP. Accordingly, they spent significantly more time at the sow’s teat than the other treatment groups.

McGlone et al. (1993) and Hay et al. (2003) demonstrated that castrated piglets spent less time nursing (massaging and suckling) and were less active than non-castrated animals. Langhoff et al. (2009) confirmed a tendency towards a reduction in teat stimulation in the first hours after castration for piglets without analgesic treatment and the contrasting positive effect of meloxicam on suckling behaviour. In the present study, the animals that received analgesic treatment spent more time suckling 3 to 6 h after castration than before, whereas this duration almost remained unchanged in the control group (Figure 1).

The results obtained by Llamas Moya et al. (2008) demonstrated that piglets ‘in pain’ (castrated) were less active after surgery than animals ‘without pain’ (non-castrated). In our study, there was no difference in activity away from the sow’s teat area between animals with and without analgesic treatment (meloxicam), thus preventing the conclusion that the animals were ‘pain-free’ (Figure 1, away from sow). However, ‘time spent at sow’s teat’ also includes active behaviour (e.g. standing with teat in snout). It increased after castration in piglets that received analgesia, but stayed similar in control piglets. Therefore, this result might still fit to the finding of Llamas Moya et al. (2008) stated above.

The strong increase in activity away from the sow’s teat area of the anaesthetized animals (combination) after castration probably arises from impaired coordination. They moved about within the pen apparently disoriented and restless, whereas piglets that underwent the other treatments searched for a teat or rested more quickly after reuniﬁcation.

This impaired orientation could also have contributed to the decreased suckling time.

In earlier studies, K/A anaesthesia has been described as being ‘practical and in conformity with animal welfare laws’ with reference to the reduction of pain during surgery (Lahrmann et al., 2006 and 2008). On the basis of our results, it is however doubtful that the animal’s post-operative well-being is improved by this method, because the additional handling, recovery from anaesthesia (von Borell et al., 2009) and long post-operative sleeping and hunger phase are also stressful for the animals and, furthermore, may lead to a signiﬁcant loss of energy (Prunier et al., 2006). Separating piglets by a board in the pen is stressful for both piglets and sow, since they both hear each other’s vocalizations but cannot reach each other for 3 h. However, it would be impractical to separate the piglets by removing them from the pen owing to reasons of lack in space under on-farm conditions.

Neonatal animals are sensitive to hypothermia and their metabolic and excretory functions may still be too underdeveloped to completely process drugs (Prunier et al., 2006). According to the EFSA report (2004), an animal’s behaviour should be inﬂuenced as little as possible after surgery. However, our results show that especially anaesthetized piglets exhibit signiﬁcant behavioural changes during an observation period of up to 6 h after castration compared with the observation period one day before castration. In the ﬁrst days after birth, in particular, separating and reuniting the male animals could be a stress factor for the entire litter as the suckling hierarchy is established during this period (Newberry and Wood-Gush, 1985; Sambraus and Porzig, 1991). Reducing the stability of the suckling order can trigger ﬁghts between piglets (Van Putten, 1990). If the milk intake is also reduced as a consequence, this can be particularly critical for young pigs (De Passillé et al., 1988). According to Evbank (1976), a stable suckling hierarchy is the basis for a calm, ‘satisﬁed’ and productive group of piglets.

The weight comparisons in this study, however, showed that separation for 3 h and re-establishing the suckling order do not signiﬁcantly affect the piglets’ weight increases. Daily live weight gain up to weaning was also reported to be unaffected by analgesic treatment (Keita et al., 2010).

Another alternative to injection anaesthesia such as inhalation anaesthesia using isoflurane, halothane or CO2 (carbon dioxide) exists. Although these methods are associated with their own disadvantages (von Borell et al., 2009; PIGCAS Report, 2009), the short post-operative sleeping phase should be considered advantageous in comparison to K/A injection anaesthesia because it presumably has less of an effect on piglet post-castration behaviour.

In conclusion, our study suggests that analgesia treatment alone could have a beneﬁcial effect on post-castration behaviour, perhaps due to less post-castration pain. However, the combination of K/A injection anaesthesia and analgesia with associated separation seems to inﬂuence piglet behaviour negatively and may cause a stressfull post-castration disturbance to the litter.

Figure 4 Daily weight gain (g/day) of piglets from the day before castration to castration day, as well as from castration day to the following 4 days (± s.e.). Differences were not signiﬁcant (P > 0.05).
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