

Response to the Letter to the Editor on the surgical castration of piglets

Dear Editor,

We would like to respond to the concerns of Angela J Wright, Martin Whiting and Alan Taylor with regard to our paper entitled 'Castration of piglets under CO₂-gas anaesthesia' (*Animal*, 2008, 2(11), 1666–1673).

As stated by Wright, Whiting and Taylor, a balanced anaesthesia has three requirements: hypnosis, analgesia and relaxation. It is evident, based on our results, that CO₂-anaesthesia provides these three components and that it is therefore suitable as an anaesthetic agent. These findings are confirmed in earlier research (Lauer *et al.*, 1994; Körte, 1996; Kohler *et al.*, 1998; Steenblock, 2002). Apart from the anaesthetic properties of CO₂, there is discussion about the aversiveness of inhaling a high concentration of CO₂. Ambrose *et al.* (2000) mention several signs as indicative of stress: increased locomotion, rearing, defecation, urination. In our study we found none of these behaviours in the piglets during the induction phase. There were also no vocalisations. This absence of indicators of distress was also reported by Martoft *et al.* (2002). We agree that the induction of anaesthesia with CO₂ induces stress; this is not different from induction of anaesthesia with other volatile anaesthetics. However, the limited reduction of animal welfare during the induction of anaesthesia with CO₂ is judged to be far lower than the gain achieved by a painless castration. The increased breathing and sometimes gasping is not induced by hypoxia, but by an increase in PCO₂ in the blood. Whether this is accompanied by a sensation of suffocation remains unknown. As stated in the paper, convulsions occurred after loss of consciousness, based on electroencephalograph recordings. This justifies the conclusion that these have no negative impact on the welfare of the piglets. It is well known that exposure to CO₂ leads to an increase of CO₂ in the blood and thus to a lowering of the pH in blood and cerebrospinal fluid; this induces the unconsciousness. The decreased pH will sooner or later lead to acidification, which might result in muscle pain. In this research as well as in later tests, no signs of reduced or affected muscle activity were registered that could be related to acidification. A possible explanation might be that the anaesthetic period of 1 to 2 min is likely to be too short to induce muscle acidification. After recovery from the CO₂-anaesthesia, piglets regained their normal behaviour very quickly. Although not measured, it is assumed that CO₂-anaesthesia provides no postoperative

pain relief. In general, anaesthesia does not provide any long-term pain relief. Mischler *et al.* (1994), however, report a prolonged mild antinociception after CO₂-induced anaesthesia. In general, local as well as general anaesthesia should be supplemented with postoperative pain relief. It cannot be concluded from this research that CO₂-anaesthesia leads to a mortality of 50%. Based on the results of Svendsen (2006), a pilot safety study was performed. In this pilot it became clear that a safe exposure to 70% CO₂ and 30% O₂ is time-limited; mortality was deemed unacceptable and thus experiments ended at the death of a maximum of two piglets. Further extensive studies (not published) showed that exposure with a maximum of 2 min is safe. Long-term effects of CO₂ inhalation for the given time of 2 min are unlikely to occur in practice. The piglets of the presented research and extensive additional studies did not show any long-term effects; no respiratory diseases or other abnormalities were observed or reported.

In conclusion, we agree that anaesthesia and thus CO₂-anaesthesia will account for a certain amount of stress during induction. It provides, however, an excellent anaesthetic state for a short-lasting surgical procedure such as castration. Additionally, CO₂ is an anaesthesia that can be used at a farm level and can easily be integrated in common farm practice, as extensive experience in The Netherlands has shown by now. To complete the improvement of welfare, this anaesthesia should be supplemented with long-term postoperative pain relief.

We acknowledge the concerns of the correspondents and thank you for the opportunity to respond to their comments.

Yours sincerely,

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