

Letter to the Editor on the surgical castration of piglets

Dear Editor,

We would like to raise a number of concerns with regard to the recent paper by Gerritzen *et al.*, entitled 'Castration of piglets under CO₂-gas anaesthesia' (*Animal*, 2008, 2(11), 1666–1673).

While we endorse the motivation of the authors in addressing the welfare problems created by castration of piglets without anaesthesia, especially in light of recent Dutch legislation, we believe that taking the approach outlined in this paper will not ameliorate the problems but will, in fact, compound them. Their aim was to 'examine whether or not CO₂ gas is capable of inducing an *acceptable anaesthetic state* during which castration can be performed' (abstract – emphasis added); this was determined by the piglet being rendered 'insensible and unconscious' through inhalation of 70% CO₂ + 30% O₂ as a putative anaesthetic agent.

The requirements of balanced anaesthesia are widely accepted by medical and veterinary authorities. Thurman and Short (2007) states that a general anaesthetic must relax muscles, induce hypnosis and provide analgesia. While CO₂ provides muscle relaxation and hypnosis at high doses, its effect on nociception may be immediate amplification, rather than reduction or cessation, even with concurrent hyperoxygenation (Dripps and Comroe, 1947; McArdle, 1959).

Inhalation of CO₂ in mammals elicits high levels of mucosal discomfort due to acidification (Anton *et al.*, 1992) and has been used in models of acute stress (Barbaccia *et al.*, 1996) and pain (Anton *et al.*, 1992). Leach *et al.* (2002) conclude that CO₂, either alone or in combination with argon, cannot be used humanely as a euthanasia agent, at any concentration. The systemic damage caused by elevated CO₂ is reported to include pulmonary oedema, emphysema, oedema of perivascular connective tissue in the lungs and myocardial tissue degeneration; these effects have been observed in a variety of species at concentrations as low as 50% (Conlee *et al.*, 2005). This physical damage, which contravenes the ethical principle of non-maleficence, may cause lasting negative health effects and leave the animal prone to conditions such as respiratory disease. These chronic effects of CO₂ inhalation suggest that the authors' proposed method of inducing anaesthesia in piglets requires further study to determine lasting negative effects.

We also have significant concerns about other aspects of this research, which suggest that using inhalation of 70% CO₂ + 30% O₂ to anaesthetise piglets is unacceptable. First, gasping is a response to an aversive stimulus, which

indicates distress, suffocation or respiratory arrest (Becerril-Herrera *et al.*, 2009). This concentration of CO₂ would induce a sensation of unachievable respiratory satiation akin to asphyxia. Second, all animals convulsed following loss of posture but, critically, convulsions occurred prior to unconsciousness; this is not a feature of an acceptable anaesthetic agent and is a physical sign that would exclude the use of this mixture as an euthanasia inhalant (American Veterinary Medical Association, 2004). These convulsions could be explained as voluntary escape attempts (Raj and Gregory, 1995 and 1996), perhaps associated with decreasing levels of consciousness or they may be due to fear, pain and suffering (European Food Safety Authority, 2004). Third, the lactic acidosis, hyperglycaemia and elevated PCO₂ observed in all piglets have been used as measures of physiological stress (Pollard *et al.*, 2002). Fourth, a mortality rate of 50% (data ambiguous in the paper) and a high morbidity were reported; up to 10% of the piglets undergoing the procedure may still have remained conscious according to the electroencephalography data. Finally, an electrocardiograph measures electrical activity of the heart and does not always correlate with heart function as stated.

We find it hard to accept that rendering an animal unconscious in a stressful and highly noxious manner, that may be effective in only 90% of animals, has a dangerously high morbidity and mortality rate, provides no post-operative analgesia and with known immediate aversive effects and unknown long-term effects, is an improvement upon conscious castration. The authors' claim that this method offers a humane alternative to testicular local anaesthesia has not been justified, in our opinion. We also suggest that the authors should use the standardised veterinary criteria before attempting to demonstrate the efficacy of a potential anaesthetic.

Yours sincerely,

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