Effects of stocking rate on measures of efficacy and welfare during carbon dioxide gas euthanasia of young pigs

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Abstract

The objective of this study was to evaluate the effects of chamber stocking rate on facets of animal welfare and efficacy during gas euthanasia of young pigs (Sus scrofa domesticus). Crossbred pigs (390 neonatal and 270 weaned) designated for euthanasia at production farms were randomly assigned to group sizes of one, two, four, or six pigs. Gas euthanasia of each piglet group was performed in a Euthanex® AgPro chamber. The chamber air was gradually displaced with CO₂ gas over 5 min to establish an in-chamber concentration of approximately 80% CO₂. Pigs remained in that atmosphere for an additional dwell period of at least 5 min. Higher stocking rates were associated with higher CO₂ concentrations after gradual fill for both age groups. While there was no evidence of an effect of stocking rate on latencies to loss of posture or last movement in neonatal pigs, there was evidence of an effect on all measured efficacy variables in weaned pigs, with grouped pigs faster to succumb than solitary pigs. This finding is consistent with expected consequences of higher CO₂ concentration at increased stocking densities. Aversive states and behaviours of focal pigs in the chamber were scored from video. Weaned solitary pigs displayed a high incidence of pacing and may have experienced isolation distress. Escape attempts were absent in neonates and not linearly affected by stocking rate in weaned pigs. Although the risk of hazardous interactions was correlated with group size, this study provided no evidence that isolation during gas euthanasia would benefit animal welfare.

Keywords: animal welfare, behaviour, carbon dioxide, euthanasia, pigs, stocking rate

Introduction

Exposure to carbon dioxide gas (CO₂) can be used as a method of euthanasia in which acute respiratory acidosis and hypoxia lead to rapid nervous system depression and eventual respiratory and cardiac arrest (Forslid 1987). Induced hypercapnia is commonly used as a single-step method of euthanasia for young pigs and as a method of pre-slaughter stunning for adult swine (Atkinson et al. 2012). Prolonged exposure to a concentration of 80–90% CO₂ in air is regarded by the American Veterinary Medical Association (AVMA) as an acceptable form of euthanasia for pigs (2013), although animal reactions to gas euthanasia appear to be closely tied to procedural details that vary widely within the industry and in published guidelines. Experimental comparison of physiological and behavioural indices of efficacy and welfare during procedural variations is needed to establish evidence-based recommendations for swine euthanasia.

Gas euthanasia methods are commonly chosen when large groups of animals need to be humanely and efficiently put to death, such as during disease outbreaks. Nevertheless, carbon dioxide gas does not provide instantaneous loss of consciousness and is believed to cause aversion and discomfort in animals, including pigs (Nowak et al. 2007; Dalmau et al. 2010; Mota-Rojas et al. 2012). While the capacity to euthanise animals in groups is a major advantage of gas methods (Atkinson et al. 2012), group euthanasia demands consideration of both direct and bystander effects. CO₂ exposure elevates stress hormones in swine (Gregory et al. 1987; Forslid & Augustinsson 1988; Kohler et al. 1998) and increases vocalisation, agitation, and chamber escape attempts (Raj 1999; Velarde et al. 2007; Rodríguez et al. 2008). Numerous studies of pigs and other mammals show that visual, auditory, and olfactory alarms can transmit fear and stress to conspecifics in proximity to an animal undergoing a distressing procedure (Vieuille-Thomas & Signoret 1992; Talling et al. 1996; Amory & Pearce 2000; Düpjan et al. 2011). Carbon dioxide exposure also causes periods of neuromuscular excitation with myoclonus, which can appear violent and sometimes results in bone fractures in poultry (Raj 2006; McKeegan et al. 2007). The onset of insensibility produced by CO₂ varies between pigs in unpredictable patterns that can only be ascribed to individual variation.