Effects of stocking rate on measures of efficacy and welfare during argon gas euthanasia of weaned 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 euthanasia of weaned pigs (Sus scrofa domesticus) with argon gas. Two hundred and thirty-three weaned pigs designated for euthanasia at a commercial production farm were randomly assigned to group sizes of one, two, or six pigs. Gas euthanasia of each piglet group was performed in an Euthanex® AgPro chamber. The chamber was filled with argon gas for 6 min in order to reduce the oxygen concentration to less than 2%. Pigs were then placed into the pre-filled chamber and gas flow was continued at a high rate to displace introduced air and re-establish a fatally low residual oxygen concentration. Pigs remained in the chamber for 10 min and were then removed to test for signs of sensibility and life. There was no significant evidence of an effect of stocking rate on focal pig latencies to onset of neuromuscular excitation or last movement, as scored from video recordings. Solitary pigs were more likely to pace and make righting attempts in the chamber than paired or grouped focal pigs, although pigs in higher stocking rate treatments tended to retain posture longer. The results of this study do not support seclusion during argon gas euthanasia as a method of improving animal welfare. The portable chamber did not facilitate a truly pre-filled atmosphere for euthanasia, although the procedure used in this study was consistently effective.

Keywords: animal welfare, argon, behaviour, euthanasia, pigs, stocking rate

Introduction
Argon has been proposed as a less-aversive alternative to carbon dioxide gas for stunning and euthanasia of swine and poultry (Raj & Gregory 1995; Mota-Rojas et al 2012). Like carbon dioxide, argon euthanasia enables producers to euthanise animals in groups, although such practice must take into consideration non-instantaneous loss of consciousness (Dalmau et al 2010) and the potential distress of hypoxia (American Veterinary Medical Association [AVMA] 2013). Argon exposure has been reported to increase vocalisation, righting attempts, and chamber escape attempts relative to either chamber confinement alone (Sadler 2013) or exposure to carbon dioxide (Sadler et al 2014b,c), and anoxia induces convulsions prior to brain death (Raj 2006; McKeegan et al 2007). Numerous studies of pigs (Sus scrofa domesticus) and other mammals have provided evidence that visual, auditory, and olfactory alarms can transmit fear and stress to conspecifics in proximity to an animal undergoing a distressing procedure (Vieulle-Thomas & Signore 1992; Talling et al 1996; Amory & Pearce 2000; Düpjan et al 2011). If loss of consciousness is asynchronous within a shared euthanasia chamber, there is potential for conscious pigs to be exposed to squealing and violent convulsions of conspecifics, to the possible detriment of welfare. Alternatively, euthanasia in small groups could provide a calming effect for social animals, like pigs, during the periods of loading and retained consciousness (Sharp et al 2003; Atkinson et al 2012; Mota-Rojas et al 2012), and prevent the isolation distress to which young pigs are susceptible (Fraser 1975; Kanitz et al 2009). Current AVMA Guidelines generally warn against performing individual euthanasia in the presence of sensitive conspecifics, but also advise administering inhaled agents “under conditions where animals are most comfortable (eg, […] for pigs, in small groups)” (2013; p 19). The AVMA recommendations for inhalant euthanasia agents include cautions that “[i]f animals need to be combined, they should be of the same species and compatible cohorts and, if needed, restrained or separated so that they will not hurt themselves or others. Chambers should not be overloaded” (2013; p 19). The document advises separation or restraint of animals to prevent injuries during euthanasia with carbon monoxide gas, although this suggestion is not made for argon. Canadian Council on Animal Care (CCAC) Guidelines (2010) also recommend sheltering conspecific bystanders from the euthanasia process, but advise euthanising groups of familiar animals together to avoid isolation of social species and buffer against stressors. Previous research by our group revealed that weaned solitary pigs displayed greater incidence of pacing and...