Applied Animal Behaviour Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Evaluating environmental enrichment as a method to alleviate pain after castration and tail docking in pigs

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ARTICLE INFO

Keywords:
Enrichment
Pig
Castration
Tail docking
Pain
Stress

ABSTRACT

Castration and tail docking are common management practices performed on commercial swine farms in the US and around the world to reduce adverse behaviors and the occurrence of boar taint. However, these practices themselves are a welfare concern for the piglet because they cause acute pain. The provisions of environmental enrichment (EE) may reduce anxiety, protect from stressors, influence pain sensitivity, and improve the overall welfare of animals. Our objective was to determine if EE can reduce the physiological and behavioral stress response caused by castration and tail docking in piglets over time. Sows were randomly assigned to control farrowing stalls (CON; n = 9) or stalls enriched (ENRICH; n = 9) with newspaper, soil, ball and rope, so that EE was available to piglets upon birth. At 5 days old, ENRICH and CON piglets (n = 54 per treatment) were allocated to one of six piglet husbandry treatments; four boar piglets were randomly allocated to one of four treatments: 1) control handled (SHAM B), 2) tail docked (TAIL B), 3) castrated (CAST), or 4) castrated and tail docked (BOTH); and two gilt piglets were randomly allocated to one of two treatments: 5) control handled (SHAM G), or 6) tail docked (TAIL G). Live weight tended ($P < 0.10$) to be greater in all ENRICH pigs. Leukocytes and the neutrophil to lymphocyte ratio were decreased ($P < 0.05$) among ENRICH compared with CON piglets. ENRICH piglets were more active ($P < 0.05$) than CON piglets. Maintenance and play behaviors decreased ($P < 0.05$) 120 min after, but returned to baseline at 24 h. Cortisol was greater ($P < 0.05$) among CAST and BOTH piglets, but no differences were observed in cortisol concentrations between housing groups. Stress vocalizations were greater ($P < 0.05$) in CAST and BOTH compared with SHAM piglets, while all pig processing treatments displayed more ($P < 0.05$) pain behaviors than SHAM. The use of EE had no effect on reducing pain-induced stress of castration and tail docking. However, we found that pigs raised with EE were heavier and more active than pigs raised without enrichment. We also found that EE modulated the immune response in pigs. In conclusion, EE improved the overall welfare of pigs at an early age.

1. Introduction

At only a few days of life, male pigs are routinely castrated and tail docked to prevent behavioral problems (aggression and tail biting) and for meat quality issues (boar taint) in the US swine industry. These procedures cause behavioral and physiological changes indicative of acute pain and stress. Physiological indicators of stress including cortisol and adrenocorticotropic hormone (ACTH) secretion, lactate from plasma (Prunier et al., 2005), mean arterial blood pressure, electroencephalography (Haga and Ranheim, 2005), and heart rate (White et al., 1995) have been shown to change in response to management practices in piglets. Behavioral changes associated with castration include increased vocalization, and reduced activity and nursing (McGlone and Hellman, 1988; Taylor et al., 2001; Hay et al., 2003; Moya et al., 2008). Pain and stress share pathways and have a synergistic relationship. The hypothalamic-pituitary-adrenal (HPA) axis can be activated by nociceptive stimuli and glucocorticoids have been implicated in the pain response (Khasar et al., 2008).

The practice of performing painful husbandry procedures without pain mitigation is gaining increasing public concern. Therefore, researchers have looked at alternative methods (Marchant-Forde et al., 2009), as well as drug administration to alleviate the pain to castration (Sutherland et al., 2010; Sutherland et al., 2012) and tail docking (Sutherland et al., 2011). Some methods of anesthesia and analgesic require additional handling of pigs for administration, some drugs may be painful (e.g. lidocaine burns), injections cause small but measurable changes in behavior (McGlone et al., 2016), or a veterinarian may have to perform the procedure which may not be economically viable for the producer. Few studies have shown the effects of non-pharmacological, stress-reducing methods on nociceptive responses (Rossi and Neubert,

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https://doi.org/10.1016/j.applanim.2018.04.009
Received 28 August 2017; Received in revised form 10 April 2018; Accepted 11 April 2018

2008). Providing animals with enrichment can attenuate the HPA response to acute stress (review: Blackburn-Munro and Blackburn-Munro, 2001; Bolay and Moskowitz, 2002), and may be a novel approach to alleviating pain and stress to husbandry procedures.

Environmental enrichment (EE) is defined as the use of physical or social aspects to improve the quality of life of confined animals, and allows animals the opportunity to explore and interact with their environment, enhancing cognitive, sensorimotor and physical activity (Gabriel et al., 2010a; Fox et al., 2006). Environmental enrichment influences pain sensitivity and perception, and duration of pain. It has been shown to increase the rewarding effects of psychotropic drugs (Gameiro et al., 2005; Gameiro et al., 2006; Rivat et al., 2007; Smith et al., 2003), suggesting a relationship between enrichment and the analgesia regulating system (Tall, 2009).

Therefore, the objective of this study was to evaluate if EE could reduce stress reactivity, and therefore pain perception to husbandry practices in piglets. This approach may provide a practical method of pain-reduction that would require no additional handling or drug administration to piglets during on-farm management procedures. To our knowledge this is the first time EE has been tested as a method of pain mitigation in livestock species.

2. Materials and methods

2.1. Ethical statement

All animal procedures were approved by the Texas Tech University Animal Care and Use Committee prior to initiating animal work. This study was conducted at the Texas Tech University swine research farm, Lubbock, Texas, USA. Pigs were PIC USA genetics using the Camborough-22 sow line. All pigs were from a herd free from Brucellosis, Pseudorabies (PRV), Porcine Reproductive and Respiratory Syndrome virus (PRRS).

2.2. Animals and husbandry

Sows were randomly assigned to one of two housing treatment groups before parturition for their piglets to be reared in; control standard farrowing environment (CON: n = 9 stalls) or environmentally enriched farrowing environment (ENRICH, n = 9 stalls). Both housing treatment groups were in standard (0.61 m x 2.03 m), metal flooring farrowing stalls. Piglets born and reared in the CON group (n = 54) had no additions in the farrowing crate. Piglets born and reared in the ENRICH treatment group (n = 54) had the addition of environmental enrichment tactile objects upon birth. Environmental enrichment included objects and substrates to root and chew; hanging rope, a whiffle ball, newspaper, and soil was provided in a rubber pan. Newspaper and soil were replenished daily, while the rope and ball were cleaned of any fecal matter daily. Enrichment was placed in the stall the day before sows were due to farrow, making it available for piglets upon birth. Sows had no access to the enrichment items, and were not the experimental animal. All sows were fed a diet which met or exceeded NRC nutrient requirements (NRC, 2012). Water was provided ad libitum to sows and piglets.

At 5 d of age, 6 piglets (4 boars, 2 gilts) from both housing treatment groups (CON and ENRICH) were removed from the sow and randomly assigned to one of six piglet treatment groups (n = 9 per housing treatment) for husbandry procedures as part of litter processing. Boars were either 1) control handled (SHAM B); 2) tail docked (TAIL B); 3) castrated (CAST); or 4) castrated and tail docked (BOTH). Gilts from the same litter were either 5) control handled (SHAM G); or 6) tail docked (TAIL G). Pigs in the SHAM treatment groups were control handled with pressure being applied approximately 30 s to the scrotal (boars) and tail area but with no cutting. TAIL pigs were restrained, and the tail cut leaving a tail length of 1.5 inches. Pigs in the CAST treatment group were restrained to expose the anogenital region. A scalpel was used to make an incision on each side of the scrotum, the testicles were freed from the surrounding tissue and removed. Male piglets in the BOTH treatment group, were both castrated and tail docked in the same manner as the TAIL and CAST piglets. All husbandry procedures performed as part of litter processing took no more than 30 s. Non-experimental piglets were processed at the end of the 24 h study. No mortality was observed due to experimental treatment.

2.3. Experimental measurements

Performance, physiology and behavior measurements were taken to assess the effect housing environment had on the pain and stress response to piglet husbandry procedures. All piglets were weighed before (baseline) and 24 h after piglet husbandry procedures. To measure leukocyte differentials and peak cortisol response, blood was taken before and 60 min after the husbandry procedures via jugular venipuncture into 4 mL vacutainers with EDTA. Whole blood was analyzed to determine white cell counts (wbc), differential leukocyte counts (Idexx ProCyte DX, Westbrook, Maine, USA), and the neutrophil to lymphocyte (N:L) ratio was calculated by dividing the percent of neutrophils by the percent of lymphocytes. Blood samples were centrifuged at 3000 × *g* at 4 °C for 10 min, and plasma collected and stored at −80 °C for analysis of cortisol using an enzyme immunoassay kit (Enzo Life Sciences, Farmingdale, NY, USA). Sixty minutes was chosen as previous studies in our lab (Sutherland et al., 2010, 2011, 2012) have found it to be the peak cortisol response to castration and tail docking.

During the husbandry treatment procedures, camcorders (DCR-SR85, Sony, NY, USA) were used to record vocalizations. Stress vocalizations were analyzed using an automatic stress call monitoring system that identified the percentage of stress vocalizations from all piglet calls excluding grunts (STREMODO, Forschungsinstitut für die Biologie landwirtschaftlicher Nutztiere, Dummerstorf, Germany). The percentage of stress vocalizations in response to piglet treatment procedure were analyzed for each housing and piglet treatment group.

Before litter processing piglets were individually ear tagged and marked with livestock paint for easy identification in the pen. One hour before (baseline) litter processing, up to 120 min after, and 24 h later for one-hour piglets were observed by 1 min scan samples for maintenance, play and pain behaviors (Table 1).

2.4. Statistical analysis

All data were tested for constant variance and departures from normal distribution using the univariate procedure (SAS Inst., Inc., Cary, NC, USA). Data lacking normality and transformed logarithmically included all behavioral data. Data were subjected to analysis of variance using the mixed, repeated measures model procedure of SAS. Multiple comparisons were calculated using the PDIFF option in SAS. Piglet was the experimental unit. The main fixed effects were housing treatment (CON and ENRICH), piglet treatment (SHAM B, TAIL B, CAST, BOTH, SHAM G, TAIL G) and time. Litter was a random effect. All interactions between housing treatment, piglet treatment and time were included in the model. Only piglets that underwent management procedures were included in the housing treatment (CON and ENRICH) analyses. Data displayed in the graphs, tables, and text are presented as least squares means ± SEM. Statistical significance was determined at $P < 0.05$ and trends determined at $P < 0.10$.

3. Results

3.1. Weight

We found a housing treatment x time interaction ($F_{(1,106)} = 5.34$; $P = 0.023$) with ENRICH pigs weighing more 24 h after processing than before, but body weight of CON pigs was similar before and 24 h post-treatment (Fig. 1). There was also a time effect ($F_{(1,106)} = 736.36$;