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Validating behavioral sampling techniques for lame sows administered flunixin meglumine and meloxicam

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ABSTRACT

Lameness poses a welfare challenge for pigs as it is associated with pain. Monitoring changes in behavior is a useful tool for recognizing illnesses in animals, including lameness. Lame sows spend more time lying down compared to non-lame animals, but there is currently no practical way of recording these changes in behavior. The objectives of this study were to determine if scan sampling could detect behavioral changes in sows induced lame, and detect changes in behavior associated with pain mitigation in sows induced lame. Lameness was induced in 12 multiparous, crossbred sows using a chemical synovitis model. Standing, sitting and lying behaviors were evaluated using continuous sampling, as well as 5, 10 and 15 min scans ('scan sampling') for 12 h/d (0600-1800) over a 5-day period. Three pain control treatments were evaluated: flunixin meglumine, meloxicam, and sterile saline administered approximately 28 and 52 h after lameness induction. No differences were found in lying and standing behavior in saline treated sows for all sampling methods ($P = 0.99$). Regardless of sampling method, standing time decreased in the days following lameness induction compared to the day before induction ($P < 0.01$). After treatment with flunixin meglumine, sows increased their standing behavior, but this change was only detected using the continuous sampling method ($P < 0.04$). All sampling methods were able to detect standing behavior changes among sows treated with meloxicam ($P < 0.01$). Results suggest that scan samples of 15 min or less are effective in detecting most behavioral deviations in sows treated with meloxicam or not treated at all.

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1. Introduction

The welfare of farm animals is a key issue for producers, consumers, researchers and veterinarians. Definitions of animal welfare usually incorporate aspects of good health, absence of negative affective states, and living conditions that promote natural behaviors (Farm Animal Welfare Council, 1979; Fraser et al., 1997). To ensure good animal welfare is achieved on farms, assessments and auditing programs have been used as an objective means to evaluate the quality of life of farm animals. Measurements for assessment include animal-, resource-, and protocol-based measures (Webster, 2005; Blokhuis, 2008). Although the inclusion of all three parameters provides a better-rounded understanding of farm animal welfare, animal-based measures are considered the only direct indicator of an animal's welfare.

Animal-based measures often include an evaluation of painful states. Animal pain is defined as an aversive sensory experience that changes the animal's physiology and behavior (Molony and Kent, 1997). Pain is a clinically important condition that adversely affects an animal's quality of life and, when left unmitigated, can result in distress and detrimental effects to the animal's physical health and overall welfare (Hellebrekers, 2000).

Lameness, defined as deviation in gait, may be a significant source of pain in sows, depending on the severity, chronicity and etiology of the lameness (Pairis-Garcia et al., 2015a). Pain associated with lameness is not only an animal welfare concern, but can also have severe economic impacts to the producer. Approximately 15% of the sow inventory is involuntary culled due to lameness (Schenk et al., 2010). Based on a total U.S. sow inventory at 5.98 million, approximately 897,000 sows are culled due to lameness resulting in ~$43 million industry loss per year ($87.14 per hundredweight).

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Lameness in swine has been most commonly evaluated on-farm using a 5-point subjective scoring system (D'Eath, 2012), though some studies have suggested using a more succinct scoring system to decrease observer variation and increase consistency over time (D'Eath, 2012). Recognizing that scoring systems can be subjective in nature, developing and validating objective tools for lameness assessment are still required. A non-invasive tool to assess lameness includes visual observation of sow behavior. Sows spend nearly 80% of their time lying down (Elmore et al., 2010; Tuyttens et al., 2008) and deviations in lying behavior may be a key indicator of discomfort or pain (Elmore et al., 2010). When lameness has been induced, sows spent less time standing and more time lying for up to 72 h after induction compared to non-lame sows (Pairis-Garcia et al., 2015a).

Behaviors can be observed and scored using several sampling and recording methodologies. Sampling methods include continuous (recording the animal constantly over time), and scan sampling (recording behavior at specific intervals). Although the continuous sampling method provides the most accurate behavioral repertoire of an individual, it is a labor intensive and time-consuming process. No research to our knowledge has determined if scan sampling methods can be used to detect changes in, behavior associated with lameness, nor if these methods are sensitive, enough to detect behavioral changes associated with pain mitigation. Therefore, the objectives of our study were to determine 1) the ability of three scan sampling methods to detect the same changes in standing, lying and sitting behaviors in sows induced lame compared to a continuous sampling method, and 2) evaluate the ability of three scan sampling methods to detect behavioral changes associated with pain mitigation in sows induced lame.

2. Materials and methods

The protocol for this study was approved by the Iowa State University Animal Care and Use Committee. The animals were cared for in accordance with the United States Animal Welfare Act and the Guide for the Care and Use of Laboratory Animals, 8th edition. This work was performed in a facility accredited by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) at Iowa State University College of Veterinary Medicine.

2.1. Animals and housing

Twelve multiparous (mean parity 6.0; range 2.0–9.0), non-pregnant, crossbred Newsham maternal cull sows were obtained from a commercial farm in Iowa (BW 241.4 ± 15.5 kg; mean ± SD). All sows underwent a physical examination (i.e., an evaluation of integument, cardiovascular, and respiratory systems) and a lameness evaluation prior to enrollment in the study by a trained veterinarian with expertise in sow lameness (for a detailed description of this scoring system see Pairis-Garcia et al. (2014, 2015a)). Lameness was induced in each sow three times throughout the study; hence, the physical examination and walking lameness evaluation where each sow walked at her own pace over a non-slip mat measuring 4.3 m in length were conducted between each lameness induction. No sow was induced if she demonstrated any observable lameness from previous inductions; therefore, all sows had no observable signs of lameness at the start of the induction. No sow on trial demonstrated any observable residual lameness at the time of induction; therefore, all sows were induced lame three times.

To avoid confounding lameness with injury resulting from aggression, each sow was housed in an individual pen; however, sows could see, smell, hear and have nose-to-nose contact with other sows. Each pen measured 3.7 m length × 1.4 m width × 1.2 m height and had a solid concrete floor with a rubber mat (2.4 m length × 0.02 m height × 1.4 m width). Metal fences (1.2 m height × 0.76 m width) were affixed to the end of each pen. Each pen was provided with environmental enrichment including chains and/or plastic toys attached to the pen gates.

Sows were provided ad libitum access to water via one nipple and hand-fed a custom mixed diet of 14.8% crude protein total mixed ration composed of ground corn, soybeans, and nutrients formulated according to Swine National Research Council guidelines (NRC, 2012) to meet or exceed non-gestating sow nutrient requirements. Matrix® (FDA approved; 0.22% Altrenogest; Intervet/Schering-Plough, Milsboro, Delaware, United States of America- Dose: 6.8 ml to 15 mg) was added to one kg of feed daily to prevent estrus initiation.

2.2. Lameness induction

To induce sows, they were snared and then anesthetized intramuscularly using Xylazine (4.4 mg/kg) (Anased®, Lloyd Laboratories, Shenandoah, Iowa, United States of America), Ketamine HCl (2.2 mg/kg) (Ketaset®, Wyeth, Madison, New Jersey, United States of America), and Tiletamine HCl and Zolazepam HCl (4.4 mg/kg) used in combination (Telazol®, Wyeth, Madison, New Jersey, United States of America). Once anesthetized, the sow's claw was cleaned with mild soap and water, and then scrubbed for 5 min with iodine based surgical solution (Operand®, Aplicare Inc., Branford, Connecticut, United States of America) using 4 × 4 sterile gauze pads. To rinse, 70% isopropyl alcohol was used on the foot until no surgical solution remained. Approximately 10 min after anesthetized, sows were positioned in lateral recumbency and injected with 15 mg of amphotericin B (X-gen Pharmaceuticals, Inc., Big Flats, New York, United States of America) into the intraarticular space of the left or right rear medial distal interphalangeal joint (Karriker et al., 2013). During the first round, sows were randomly assigned to either the left or right rear leg. In the second round, the opposite rear leg was induced, and in the final round the original leg was re-induced (Pairis-Garcia et al., 2015a).

Every 15 min while anesthetized the heart rate, respiratory rate, and rectal temperature were monitored until sows returned to a sternal position unaided (Karriker et al., 2013).

2.3. Treatments

Twelve sows were randomly assigned to three blocks (4 sows per block), and within each block sows were randomly allocated to one of three treatments for round one: 1) Flunixin meglumine (FM; 2.2 mg/kg administered intramuscularly (IM) n = 12), 2) Meloxicam (M; 1.0 mg/kg by mouth (PO) administered in 8 g cookie dough; n = 12) or, 3) Saline (S; administered IM at an equivalent volume to flunixin meglumine; n = 12). In round two, sows were randomly assigned to one of the remaining two treatments. By the third round, sows received the treatment they had not been administered in round one or two (Pairis-Garcia et al., 2015a). The trial included three rounds, each lasting 312 h.

Flunixin meglumine treatments were administered 27.5 and 51.5 h post induction and meloxicam was administered 28.5 and 52.5 h post lameness induction. Drugs were administered twice during each round to ensure that the drug effect lasted for a sufficient enough time to allow for a full day's observation (based on previous data assessing drug concentration and elimination rates; Pairis-Garcia et al., 2013; 2015b). Half of the saline-treated sows had the saline administered at 27.5 and 51.5 h post lameness induction to match sows receiving flunixin meglumine; the remaining half of the saline-treated sows received saline at 28.5 and