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Induction of a Transient Chemically Induced Lameness in the Sow. Detection Using Live Scoring and the GAITFour Sensor System

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Summary and Implications

There are no approved drug treatments for analgesia use in lame swine, and the identification and validation of robust, repeatable pain measurements is fundamental for the development of effective analgesic drug regimens and management strategies for use in lame pigs. Induction of lameness allows for controlled evaluation of lameness pain in animals because pre- and post lameness measurements can be taken from the same animal, thereby reducing the confounding effects of individual differences. The objective of this study was to determine if a transient clinical lameness could be produced in sows using a distal interphalangeal joint space injection of Amphotericin B. Six clinically normal crossbred sows weighing approximately 171 kg were purchased from a commercial producer in Iowa and housed in individual pens at Iowa State University.

Sows were randomly allotted to one of three treatments, two sows received 1 ml sterile saline control (CO), two sows received 10 mg amphotericin B in a 1 ml volume (LO) and two sows received 15 mg amphotericin B in a 1ml volume (HI). Sows were assessed for lameness while walking and standing based on a five point and data was collected using a GAITFour[®] gait analysis walkway system. Data will be presented descriptively. All sows were scored as 0 at the onset of the trial for lameness. At 24 h post injection, the average lameness scores were 2.75, 2.00, and 0.50 for the HI, LO and CO sows respectively. The CO sows' average returned to 0 at 72 h post injection, HI sows' average returned to 0 at 144 h, and LO sows' average score returned to 0 at 192 h post injection

On the GAITFour system, the total number of sensors activated (SEN) decreased for the amphotericin treated feet suggesting a smaller footprint and pressure was shifted to the non-treated foot at 48 h post injection. These changes resolved by 144 h post injection. It was demonstrated using this "proof of concept" pilot study that injection of 10 or 15 mg of amphotericin B in the distal interphalangeal joint of the medial claw of the rear foot causes clinical lameness in sows that is distinguishable from their pre-treatment gait by observational lameness score, and objective GAITFour

measurement. Additionally, this lameness spontaneously resolved in this study by 192 h post injection.

Introduction

Lameness has a significant impact on animal welfare and is therefore considered one of the most important causes of culling for sows in the United States. Furthermore, gilts and sows that exit the breeding herd prior to return on their economic inputs result in a net monetary loss for the farm. Science-based guidance for the industry on optimal housing, management and treatment of lame pigs is deficient. There are no approved drug treatments for analgesia use in lame swine, and the identification and validation of objective, repeatable pain measurements is fundamental for the development of effective analgesic drug regimens and management strategies for use in lame pigs (AVMA; 2010; FDA, 2010). Research to address the limited knowledge in this area is essential to formulating science-based recommendations for pig producers. This will become especially important if legislative actions succeed in preventing downed animals from entering the human food chain (Prevention of Farm Animal Cruelty Act and the Healthy School Meals Act) regardless of etiology. Most research has focused on behavioral or physiological changes associated with acute pain (Anil et al., 2002; Ting et al., 2003; Stilwell et al., 2008), but these changes can be complex, with natural variation between animals complicating the differentiation of pain from other factors such as stress (Anderson and Muir, 2005). Induction of lameness allows for controlled evaluation of lameness pain in animals because pre- and post lameness measurements can be taken from the same animal, thereby reducing the confounding effects of individual differences. This approach has been published by Kotschwar et al., (2009). The authors concluded that the amphotericin B-induced synovitis-arthritis model was a useful tool for studying changes associated with lameness in cattle through the use of pressure mats, heart rate and visual scoring of lameness. Therefore, the objective of this study was to determine if a transient clinical lameness could be produced in sows using a distal interphalangeal joint space injection of Amphotericin B.

Materials and Methods

This project was approved by the ISU Animal Care and Use committee.

Animals and housing: To avoid aggression, 6 clinically normal crossbred sows weighing approximately 171 kg

were purchased from a commercial producer in Iowa and housed in individual pens at Iowa State University. Each pen measured 3.7 m length x 1.4 m width x 1.2 m height. A rubber mat (2.5 m length x 2 cm height x 1.4 m width) was provided for sow comfort. Sows had *ad libitum* access to water via one nipple waterer that was positioned over a grate. Metal fences (1.9 m height x 76 cm width) were affixed at the end of each home pen and lights were on a 12:12 light dark cycle (light hours were between 0600 and 1800).

Treatments: Sows were randomly allotted to one of three treatments, two sows received 1 ml sterile saline control (CO), two sows received 10 mg amphotericin B in a 1 ml volume (LO) and two sows received 15 mg amphotericin B in a 1 ml volume (HI). All injections were administered in the distal interphalangeal joint of the medial claw of the rear foot while sows were anesthetized with Xylazine (2.2 mg/kg), Ketamine (1.1 mg/kg), and Tiletamine (2.2 mg/kg) administered intramuscularly. Sows were monitored constantly post anesthesia until they returned to standing.

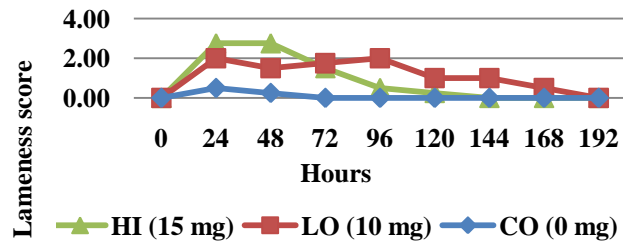
Measures: At 24-h intervals, starting immediately prior to injection and anesthesia (Time 0), sows were assessed for lameness while walking and standing based on a five point scale (0 = animal moves freely and uses all four limbs/feet evenly to 4 = animal non-weight bearing on the affected limb when either standing or walking). Observations were made by two observers blinded to treatment and averaged at each timepoint. Additionally, sows were assessed using a GAITFour® gait analysis walkway system and associated hardware. The GAITFour system is a high resolution, 4.3 m long, pressure sensitive mat originally designed for gait analysis in humans and later validated for dogs. It contains a

matrix of 32,256 pressure sensors. These activities continued for 216 h post injection. Data will be presented descriptively.

Results

All sows were scored as 0 at the onset of the trial for lameness. At 24 h post injection, the average lameness scores were 2.75, 2.00, and 0.50 for the HI, LO and CO sows respectively. The CO sows’ average returned to 0 at 72 h post injection, HI sows’ average returned to 0 at 144 h, and LO sows’ average score returned to 0 at 192 h post injection (Figure 1).

Figure 1. Average lameness scores by hours post injection and dose in sows injected intra-articularly with amphotericin B.



On the GAITFour system, the total number of sensors activated (SEN) decreased for the amphotericin treated feet suggesting a smaller footprint and pressure was shifted to the non-treated foot at 48 h post injection as indicated in a change in DIFF max which was calculated as the difference in max pressure between the treated and untreated rear feet. These changes resolved by 144 h post injection (Table 1).

Conclusions

It was demonstrated using this “proof of concept” pilot study that injection of 10 or 15 mg of amphotericin B in the distal interphalangeal joint of the medial claw of the rear foot causes clinical lameness in sows that is distinguishable from their pre-treatment gait by observational lameness score, and objective GAITFour measurement. Additionally, this lameness spontaneously resolved in this study by 192 h post injection.

Acknowledgements

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Table 1. Objective Gait Analysis Parameters Means for the Investigation of Amphotericin B Induced Lameness in Sows (HI and LO treatments combined).

	HPI**		
	0	48	144
SEN count	30.6	26.9	29.7
DIFF Max	8.16	-11.02	11.06

**HPI = Hours Post Injection.

SEN = number of sensors activated by amphotericin Treated foot on the pressure mat.

DIFF = calculated difference between the MAX pressure of treated versus untreated rear feet.