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Incidence and severity of *Arcanobacterium pyogenes* injection site abscesses with needle or needle-free injection methods

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Incidence and Severity of *Arcanobacterium pyogenes* Injection Site Abscesses with Needle or Needle-Free Injection Methods¹

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Summary

A total of 198 nursery age pigs were used to evaluate the difference in the occurrence of injection site abscesses between needle-free jet injection and conventional needle-and-syringe injection systems. Pigs were fed for 21 d prior to treatment administration to acclimate the pigs to the environment of the Kansas State University Segregated Early Weaning Unit. On d 21, each pig received 4 injections of aluminum hydroxide adjuvant, 1 in the neck and 1 in the ham by needle-free jet injection (Pulse Needle-Free Systems, Lenexa, KS) on 1 side and 1 in the neck and 1 in the ham on the opposite side by conventional needle-and-syringe injection. Immediately prior to injection, the external surface of the injection sites was contaminated with an inoculum of *Arcanobacterium pyogenes*. The pigs were then fed for a period of 27 and 28 d. On d 27 and 28, the pigs were humanely euthanized and sent to the Kansas State University Veterinary Diagnostics Laboratory, where necropsies were performed and the injection sites underwent histopathological evaluation. The needle-free jet injection system was associated with more injection site abscesses than the conventional needle-and-syringe injection method for both the neck ($P = 0.06$) and ham ($P = 0.03$) injection sites. Twelve abscesses were found at needle-free injection sites, whereas only 1 abscess was found where a conventional needle injection method was used. Five abscesses were found at the neck injection sites, and 8 abscesses were observed at the ham injection sites. Of the 13 abscesses found, 10 developed on the left side of the animal, and only 3 were on the right side. In summary, the implementation of needle-free jet injection systems in market hog production will be beneficial by eliminating the potential for needles and needle fragments in meat products, but it may increase the occurrence of injection site abscesses in pork carcasses that will need to be trimmed in pork processing plants.

Key words: abscess, *Arcanobacterium pyogenes*, needle-free injection

Introduction

According to the 1994 Pork Chain Quality Audit (NPPC, 1994⁴), 8% of pork carcasses have abscesses present. As a result, abscesses are a very costly problem for commercial pork harvesting plants in the United States because carcasses exhibiting abscesses require trimming and may even be condemned. The presence of abscesses contributes to carcass trimming on 7.4% of all pork carcasses (NPPC, 1994).

¹ Appreciation is expressed to the National Pork Board for funding this project.

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⁴ NPPC (1994). Pork Chain Quality Audit (Progress Report – April 6, 1994). National Pork Producers Council, Des Moines, Iowa.

Another dilemma facing the pork packing industry is the potential for broken needles or needle fragments in pork products. This is of great concern to the industry because it presents a significant safety hazard to consumers. Even though metal detection systems are commonplace in packing plants, the alloys that these needles are made of and the size of the needle fragments can allow these metal pieces to go undetected (Sundberg, 2000⁵).

Needle-free air-powered vaccine injection systems are currently being used in the commercial swine industry. These injection systems are capable of serological responses similar to those of conventional needle injection devices with the added benefit of no broken needles (Houser et al., 2004⁶). Additionally, needle-free injection methods have shown potential for reducing lateral transmission of diseases when large numbers of animals are vaccinated (Reinbold et al., in press⁷). However, there has been no research investigating the relationship between injection types and abscess occurrence. Thus, the objective of this study was to investigate whether different injection types have different effects on the development of injection site abscesses when pigs are inoculated with *Arcanobacterium pyogenes*.

Procedures

The Kansas State University (K-State) Institutional Animal Care and Use Committee approved protocols used in this experiment. Pigs were housed at the K-State Segregated Early Weaning Unit.

A total of 198 nursery-age pigs were used in this 49-d study. The pigs were allowed a 21-d conditioning period to become acclimated with their environment before treatments were administered. On d 0 of the trial, each pig received a total of 4 intramuscular injections of a 2 mL dose of aluminum hydroxide vaccine adjuvant. On one side of the animal, a conventional needle-and-syringe injection method using a disposable 18 gauge $\times$ $\frac{3}{4}$ in. needle was used to administer an injection in the neck and ham, and needles were changed after every 25 animals. On the opposite side of the animal, a Pulse 250 needle-free jet injector (Pulse Needle-Free Systems, Lenexa, KS) set at 45 psi was used to administer injections in the neck and ham. A random number generator was used to randomize which side of the animal received each type of injection. Immediately prior to injection, the skin over the injection site was contaminated with an inoculum of *A. pyogenes*, a bacterium commonly associated with abscesses in swine, which was prepared by the K-State Veterinary Diagnostic Laboratory. The injection devices were not decontaminated or disinfected between injections.

After injections were administered, the pigs were housed in their originally assigned pens for 27 and 28 d and monitored daily with feed additions weighed and recorded.

⁵ Sundberg, P. (2000). Detectability of needle fragments in pork under packing plant conditions. Pages 317-320 in Proceedings of the American Association of Veterinary Practitioners Preconference Workshops.

⁶ Houser, T. A., J. G. Sebranek, B. J. Thacker, T. J. Baas, D. Nilubol, E. L. Thacker, and F. Kruse. 2004. Effectiveness of transdermal, needle-free injections for reducing pork carcass defects. Meat Sci. 68:329-332.

⁷ Reinbold, J. B., J. F. Coetzee, L. C. Hollis, J. S. Nickell, C. Reigel, J. Huff, and R. R. Ganta. Comparison of *Anaplasma marginale* disease transmission with needle-free versus needle injection. Accepted for publication (Aug. 31). American J. of Veterinary Research – 09-07-0279.

On d 27 and 28, the pigs were humanely euthanized via jugular injection of 6 mL of Fatal Plus, 390 mg/mL pentobarbital. The euthanized pigs were then sent to the K-State Veterinary Diagnostic Laboratory, where externally palpable lesions were measured through the skin with calipers. Necropsies were then performed on all animals, and abscessed areas were harvested, measured, and weighed. Representative portions of the reactive tissue surrounding the injection sites were placed in 10% neutral buffered formalin for histopathological evaluation. A score of “0” was given to tissue from injection sites that were normal when viewed under a microscope. A score of “1” was given to tissue that contained groups of swollen macrophages with some granulation surrounding them that were due to a reaction to the adjuvant. A score of “2” was given to tissue that had abscesses and granulation visible microscopically.

The FREQ procedure of SAS (SAS Institute Inc., Cary, NC) was used, and injection site served as the experimental unit. The paired binary data were then analyzed using McNemar’s test.

Results and Discussion

Of a total of 792 injection sites, only 13 abscesses were found by gross and histological evaluation. There were 11 individual pigs that had injection site abscesses, with 1 individual having 3 abscesses. There was a greater amount of abscesses from the use of the needle-free jet injection system than from the conventional needle-and-syringe injection system for both the neck ($P = 0.0625$) and the ham ($P = 0.0313$) injection locations (Table 1). Of the 13 observed abscesses, 12 occurred at needle-free injection sites, and only 1 developed at a conventional needle-and-syringe injection site. Additionally, no statistical difference ($P > 0.05$) was observed when comparing abscess occurrence and injection site; neck injection sites had 5 abscesses, whereas 8 abscesses were observed at ham injection sites. There was not a significant difference in occurrence of abscesses between right and left sides. Of the 13 abscesses found, 10 developed on the left side of the animal, and 3 were on the right side.

Our findings contradict results by Houser et al. (2004), who found no difference in abscess formation between needle-free and conventional needle injection. This difference might be caused by the inoculum used in this study because no inoculum was used in their study.

Previous audit data has shown that abscesses occur at a relatively low rate in the commercial slaughter hog population (NPPC, 1994). This is in agreement with our data because only 5.6% of the pigs used in the present trial were positive for abscess formation. This is somewhat surprising because we purposely contaminated the exterior of the skin with a pathogen known to be found in abscesses on pork carcasses.

There is no question that the use of needle-free jet injection systems will benefit the pork industry by eliminating the potential for needles and needle fragments in meat products. However, these results suggest that implementing needle-free jet injection systems into commercial swine production may increase the amount of injection site abscesses as a result of *A. pyogenes* contamination. Additional research is needed to further understand the relationship between the occurrences of abscesses with different injection types.

Table 1. Pigs with histological injection site abscesses after vaccination¹

Item	Needle-and-Syringe	Needle-Free ²	<i>P</i> -value
Neck			
Total	198	198	----
Positive	0	5	0.06
Negative	198	193	----
Ham			
Total	198	198	----
Positive	1	7	0.0313
Negative	197	191	----

¹ A total of 198 pigs were injected twice by needle-free injection on 1 side (neck and ham) and twice by needle-and-syringe injection on the opposite side (neck and ham). Pigs were euthanized 27 or 28 d later, and injections sites were evaluated for abscess formation.

² Pulse Needle-Free Systems, Lenexa, KS.