Brief Communication

The effect of antiseptic compounds on umbilical cord healing in piglets in a commercial facility

Amanda L. Robinson; Jessie D. Colpoys, PhD; Glenn D. Robinson; Elizabeth A. Hines, MS; Leo L. Timms, PhD; Erika M. Edwards; Ken J. Stalder, PhD; Anna K. Johnson, PhD; Howard D. Tyler, PhD

Summary

Four hundred and seventy piglets were assigned to four treatment groups: iodine, trisodium citrate, a dry dip created using nisin with talc, and no treatment. No treatment differences were noted on change in diameter or incidence of infection of the umbilical cord during the first 48 hours ($P > .05$).

Keywords: swine, antiseptic, healing, newborn, umbilical cord

Received: December 20, 2015
Accepted: March 22, 2016

The umbilical cord serves as a channel for the blood supply between the fetus and the placenta throughout pregnancy. During the birthing process, the umbilical cord ruptures, leaving it open-ended. This umbilical cord may become a potential route for pathogen entry into the newborn, increasing the risk of septicemia. Nielsen et al. reported that 2.1% of live-born piglets died from septicemia, which may result from umbilical infections, although there are several other common causes of this condition in piglets. Subclinical umbilical infections may prevent the abdominal wall musculature from healing completely, increasing the risk for umbilical hernias during the growing phase. The prevalence rate of umbilical hernias in the swine industry is approximately 1%. Preventing infections of the umbilical stump at birth through the use of antiseptic compounds is the most common approach for producers to attempt to decrease the prevalence of umbilical hernias, and tincture of iodine is the most commonly used antiseptic for this purpose. In 2007, the Drug Enforcement Administration listed iodine under the Controlled Substances Act. This regulation has made it difficult to obtain anything greater than 2% tincture of iodine. Trisodium citrate is a component of a recently developed, commercially available umbilical dip (NavelShield Navel Dip; Zurex Pharmag LLC, Middleton, Wisconsin). It is a non-iodine formulation that provides a wide spectrum of germicidal activity. The nisin dry dip was developed in efforts to increase drying and healing time of umbilicus tissue. In pigs, nisin has effective antimicrobial activity against Streptococcus suis, a major worldwide swine pathogen associated with meningitis, arthritis, pneumonia, and septicaemia. The nisin compound was mixed in a talc base because talc is relatively biologically inert and absorbs moisture without caking. The objective of this project was to compare three antiseptics (2% iodine, 10% trisodium citrate, and a nisin-based product) to no antiseptic treatment and determine their impact on umbilical healing and 24- and 48-hour infection rates in piglets in a field trial.

Materials and methods

This study was approved by the Iowa State University IACUC committee. A total of 470 mixed-sex commercial piglets (PIC 1050 sow × Danbred 600 sire; average birth weight, 1.15 kg; standard error, 0.33 kg) from a breed-to-wean sow farm were enrolled in this study. Piglets received small ear tags that identified treatment groups. Sows were housed in farrowing stalls (2.1 m × 0.91 m). The piglet area was 0.6 m × 1.8 m on each side of the farrowing stall, with a heat lamp 0.7 m above the floor surface and one rubber mat on the floor underneath the lamp.

Piglets were randomly assigned by alternating the four treatments across birth order within a litter: 2% iodine (n = 116); 10% trisodium citrate (n = 119); a novel dry dip created using an antibacterial peptide (nisin) mixed with talc (formulation concentration = 3.105 g nisin per 100 g talc) on a weight per weight basis (n = 117); and no treatment (n = 118). Piglet umbilical cords were dipped within 1 hour of birth using a small disposable cup filled with the antiseptic. Treatments were applied to the umbilical cord tissue and the
Nisin is generally more active on gram-positive than on gram-negative bacteria, and its bactericidal effect is exerted at the cytoplasmic membrane. Nisin kills susceptible bacteria through a multi-step process that destabilizes the phospholipid bilayer of the cell and creates transient pores. Nisin is a small amphiphilic peptide that is cationic at neutral pH. It has been shown to adsorb to surfaces, maintain activity, and kill cells that have adhered in vitro. Nisin is a safe chemical to use for food-animal treatment according to the FDA Code of Federal Regulation listing nisin as a Generally Recognized As Safe (GRAS) substance. In addition, for the purposes of this trial, nisin was mixed with talc to absorb water and help increase the drying and necrosis time of the umbilical tissue, thus decreasing the availability of a potential route for pathogen entry.

The current study also evaluated a potentially novel technique for assessing early signs of infection using the surface temperature of the umbilicus area compared to the sternal temperature (as determined using infrared technology). An increase in umbilical stump temperature when compared to the sternal temperature, combined with a tender umbilical stump, may indicate the presence of an infection. Similar approaches using infrared technology have been used to diagnose infection in human medical applications.

The application of this technology has the potential to be used in detecting subclinical umbilical infections, but could not be vali-
214

Table 1: Treatment effects on umbilical parameters in piglets during the first 48 hours*

<table>
<thead>
<tr>
<th>Measure</th>
<th>2% iodine</th>
<th>10% trisodium citrate</th>
<th>Nisin dry dip</th>
<th>No treatment</th>
<th>Treatment effect†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbilical diameter at birth (mm)</td>
<td>6.4 ± 1.3</td>
<td>6.8 ± 1.3</td>
<td>6.7 ± 1.2</td>
<td>6.6 ± 1.1</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Umbilical diameter at 24 hours (mm)</td>
<td>3.2 ± 1.2</td>
<td>3.4 ± 1.2</td>
<td>3.1 ± 1.2</td>
<td>3.3 ± 1.1</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Stump temperature at birth (°C)</td>
<td>28.9 ± 3.1</td>
<td>29.1 ± 3.0</td>
<td>29.0 ± 3.0</td>
<td>29.1 ± 3.0</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sternal temperature at birth (°C)</td>
<td>30.1 ± 3.3</td>
<td>30.4 ± 3.1</td>
<td>30.1 ± 3.0</td>
<td>30.3 ± 3.3</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Stump temperature at 24 hours (°C)</td>
<td>32.2 ± 2.8</td>
<td>32.5 ± 2.5</td>
<td>32.4 ± 2.6</td>
<td>32.4 ± 2.0</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sternal temperature at 24 hours (°C)</td>
<td>33.2 ± 2.0</td>
<td>33.4 ± 2.0</td>
<td>33.2 ± 2.0</td>
<td>33.2 ± 1.8</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Stump temperature at 48 hours (°C)</td>
<td>35.0 ± 2.2</td>
<td>35.1 ± 1.9</td>
<td>34.6 ± 2.6</td>
<td>35.1 ± 2.3</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sternal temperature at 48 hours (°C)</td>
<td>35.4 ± 2.3</td>
<td>35.7 ± 1.8</td>
<td>35.3 ± 2.4</td>
<td>35.7 ± 2.4</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

* 470 piglets were assigned to four antiseptic treatment groups: iodine, trisodium citrate, a dry dip created using an antibacterial peptide (nisin) with talc, and no treatment. Piglet umbilical cords were dipped within 1 hour of birth, with treatments applied to the umbilical cord tissue and stump for 5 seconds. Diameter of the widest part of the umbilical cord, just distal to the abdomen, was determined using digital calipers at birth and 24 ± 1 hours of age. Surface temperature of the umbilical stump was measured at birth, at 24 ± 1 hours of age, and at approximately 48 hours of age using a dual laser infrared thermometer. Redness and swelling of the umbilical stump were evaluated visually at 24 and 48 hours.

† All data were analyzed using mixed linear regression and orthogonal contrasts. Significance was declared for values of P < .05.

Implication

Under the conditions of this study, none of the three dips tested differ from no treatment in preventing umbilical infections and permitting healing of the umbilical cord when used within 1 hour of birth.

Acknowledgements

We would like to thank Zurex Pharmagra (Middleton, Wisconsin) and the Immucell Corporation (Portland, Maine) for donation of product, and the Iowa production unit that allowed us access to their facility and animals for this project.

Disclaimer

Scientific manuscripts published in the Journal of Swine Health and Production are peer reviewed. However, information on medications, feed, and management techniques may be specific to the research or commercial situation presented in the manuscript. It is the responsibility of the reader to use information responsibly and in accordance with the rules and regulations governing research or the practice of veterinary medicine in their country or region.

References


* Non-refereed references.