PRELIMINARY STUDY REPORT: To Assess Second-Degree Burn Wound Treatment with Water-Jel®

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OBJECTIVE

To determine the effect of Water-Jel® dressing on burn temperature, progression and debridement.

MATERIALS AND METHODS

Experimental Animals

Four young specific pathogen free (SPF) pigs weighing 20-25 kg were conditioned for two weeks prior to experimentation. Three animals were used for these studies and one additional animal served as a reserve conditioned animal. The animals received water and a basalt diet without antibiotics (Purina Control Factor) ad libitum and housed individually in our animal facilities (meeting American Association for Accreditation of Laboratory Animal Care [AAALAC] compliance] with controlled temperature (19^0-21^0C) and light and dark (12h/12h LD).

Burn Wounding and Treatment

The experimental animals were clipped with standard animal clippers. The skin on the back and both sides of the animals were prepared for wounding by washing with a non-antibiotic soap (Neutrogena®). Antiseptics were not used because of their potential influence on the wound healing process.

On the day of burning (Day 0), the pigs were anaesthetized with ketamine (I.M.) and inhalation of a halothane, oxygen and nitrous oxide combination. Four specially designed cylindrical brass rods weighing 358 g each were heated in a boiling water bath to 100 ^{0}C (Figure 1). A rod was removed from the water and wiped dry before it was applied to the skin surface to prevent water droplets from creating a steam burn on the skin. The brass rod was held at a vertical position on the skin, with all pressure supplied by gravity, for six seconds, to make a burn wound 8.5 mm diameter x 0.8 mm deep. Immediately after burning, the roof of the burn blister was removed with a sterile spatula. The burn wounds were made approximately 2 cm from each other.

TEMPERATURE ASSESSMENT

One animal was used for this study. A hypodermic temperature probe which was connected to a thermocouple thermometer (Omega Engineering, Inc.) was placed underneath the skin at a consistent depth (0.3 mm) at a 10^0 angle (Figure 2). The temperature measurements were made at the level of the papillary dermis. A burn was then made directly over the implanted temperature probe. Ten burn wounds on animals were assigned to one of the following treatment groups: 1) air exposed, 2) gauze, or 3) Water-Jel® treated. Water-Jel® was applied at three different time intervals (t=0, 15 and 60 seconds) after burning. The Temperature of the burn wounds were recorded every five seconds post burning.

Results

The mean temperature was calculated for each treatment group and a curve was generated from the data (Figure 3). The normal pig papillary dermis temperature was ~37^0 C. Air exposed burn wounds gradually diminished in temperature over the first two minutes post burning and the leveled off. Immediate treatment with Water-Jel® dressing did not allow the temperature to reach its highest peak. Applying Water-Jel® dressing at t=15 and t=60 sec. caused a reduction in temperature as soon as the dressing was applied. A large reduction in temperature was not seen when gauze was applied to burns. Water-Jel® treatment to burn wound was shown in these preliminary studies to reduce the skin temperature.

BURN PROGRESSION ASSESSMENT

Sixty burn wounds were made as described previously on one animal. Burn wounds were randomly assigned to one of the following treatment groups: 1) air exposed, 2) gauze, 3) Water-Jel® applied 20 minutes after burning, or 5) Water-Jel® applied 45 minutes after burning. Three wounds from each treatment group were biopsied on days 1, 2, 4 and 6 post burning. Biopsies were stained with hematoxylin and eosin. Specimens were examined by a pathologist for progression and extend of injury.

Results

Water-Jel® treated burns, at all application times, did not show histological differences on day 1 and 2 post burning. However, histological sections of burn wounds biopsied on day 4 and treated either 20 or 45 minutes after burning were characterized by a thinner band of coagulative necrosis in the epidermis and dermis when compared to either the air exposed or gauze treated wounds. On day 6 post burning, all treatment groups had a similar zone of leukocytes that were primarily neutrophils between the necrotic tissue and underlying viable tissue. These preliminary results suggest that tissue cooling seen when Water-Jel® was applied may deter amount of eventual dermal necrosis.

EASE OF REMOVING BURNED-ON SYNTHETIC FABRIC

One animal was euthanized and then clipped with standard animal clippers. Two fabrics (100% polyester, 50%/50% polyester/cotton) were cut into 2” x 2” pieces and placed over apportion of the animal’s back. The fabric pieces were pinned down to secure them to the skin surface. The fabric was then ignited and allowed to burn into the skin. Treatments were placed over the burned fabric. Treatments included Water-Jel®, gauze and air exposed. The process was photographed and the ease of removal from the skin was observed.

Results

The burned-on fabrics did not melts onto the skin as anticipated (Figure 4 and 5). Both fabrics pieces ignited and burned, however the charred fabric did not adhere to the skin surface and was readily removed with or without Water-Jel® (Figure 6 and 7). It is possible more heat or pressure is necessary to simulate the effects often seen with burned victims and charred adherent fabrics.

CONCLUSIONS

We have found that Water-Jel® dressing in these preliminary experiments, did reduce the temperature of burned skin at the different time applications. The temperature started to level off after approximately four to five minutes. Observation of histological sections from burn wounds showed differences between treatments only on day 4 post burning.
Further studies of more burns and animals would be necessary to confirm the time intervals between treatments. Additional animals would provide enough data for statistical analysis and may substantiate a relationship between decreasing skin temperature post-burning and burn progression.