Comparison of an Antimicrobial Adhesive Drape and Povidone-Iodine Preoperative Skin Preparation in Dogs

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The antimicrobial efficacy of an adhesive drape applied after a 1-minute alcohol scrub was compared to a povidone-iodine (PI) skin preparation technique in dogs. Each technique was applied to both sides of 15 adult anesthetized dogs on premeasured, clipped areas of skin. Skin bacteria were quantified before, immediately after, and 1 hour after skin preparation. Predominant skin bacteria were isolated by swabbing the skin. The percentages of bacterial reduction immediately after and 1 hour after skin preparation, percentages of negative culture results, cultures with more than five colony-forming units, and the frequency of skin reactions were calculated and analyzed statistically. Drape adhesion was assessed subjectively. The percentage reduction in skin bacteria was significant for both techniques and comparable to that reported in humans. The adhesive drape was significantly less effective in both the immediate and 1-hour periods. Lift occurred in 66% of drape applications but was not associated with high bacterial counts. Acute contact dermatitis was more frequent after skin preparation with PI. There was no difference between the techniques in recovery of potential skin pathogens. The authors conclude that application of this antimicrobial adhesive drape after a 1-minute alcohol scrub is not as effective in the reduction of skin bacteria in dogs as is PI preparation of the skin.

The goal of preoperative skin preparation is to reduce the number of skin bacteria to a level that minimizes the risk of wound infection. In spite of improvements in skin preparation techniques, the skin is never sterilized, and after 30 to 60 minutes, bacteria from follicles and sebaceous glands migrate to the surface of the skin.

An incise drape is an adhesive film placed on the surgical site and through which the incision is made. Incise drapes have been used for more than 20 years in human surgery to prevent migration of bacteria from adjacent skin into the operative site. The first drapes developed were not universally accepted because not only did they fail to reduce infection rates, some actually resulted in an increase in bacterial growth. Some drapes tended to lift off the edges of incisions, resulting in high wound infection rates caused by skin bacteria migrating into the surgical site. The failure of these drapes was related to drape design and technique of application.

An antimicrobial incise drape has been developed that is efficacious in the reduction of skin bacteria and has improved adhesive properties. Results of several studies in humans have demonstrated the superiority of this drape when it is applied after a short alcohol scrub over a povidone-iodine (PI) skin preparation. However, the antimicrobial efficacy of this drape has not been documented in animals. We cannot extrapolate from the results of human studies because the density of animal hair and the quantity of surface debris may prevent adhesion of the drape to the skin. In addition, the bacterial population of canine skin may not be reduced ef-
fectively by the shorter skin preparation times that were used in these studies.

This study was designed to compare the antimicrobial efficacy of a PI preoperative skin preparation technique with the application of an antimicrobial incise drape after a 1-minute, 70% isopropyl alcohol scrub in dogs.

Materials and Methods

Povidone-iodine and an antimicrobial incise drape developed in 1982 were evaluated on both sides of 15 mixed-breed adult dogs weighing 20 to 35 kg and without gross evidence of skin disease. The exact method of patient preparation has been described.15

After premedication of each dog with acepromazine, anesthesia was induced with a thiobarbiturate and maintained with halothane in oxygen. Hair on the left side of the thorax and abdomen was removed with a no. 40 clipper blade and vacuum. With a felt-tip pen, the clipped area was marked as two 20 × 8 cm rectangular areas; the dogs were then transported to an operating room. Each rectangular area was prepared by either: two 3-minute scrubs with PI surgical scrub,* the removal of the residual iodosphor with 70% isopropyl alcohol-soaked gauze after each scrub, and a final painting with povidone-iodine solution†; or a 1-minute scrub with 70% isopropyl alcohol-soaked gauze and the application of an iodine-impregnated antimicrobial adhesive drape‡ after the alcohol was allowed to air dry.

The skin antiseptics were applied with sterile 4 × 4 cm gauze sponges by the same person, who wore sterile surgical gloves that were changed between the application of each technique. The locations of the rectangular skin preparation areas were varied on each side of each dog to eliminate local differences in skin bacteria and hair coat.

The clipped areas of the thorax and abdomen were draped with sterile cloth towels and a paper drape. The dogs remained in the operating room until all cultures were obtained. The skin antiseptics were applied with sterile 4 × 4 cm gauze sponges by the same person. The swabs were plated on 5% sheep blood agar and incubated in the same manner. Identification of Bacillus sp., Corynebacterium sp., and Streptococcus sp. was done to the genus level only.

Potential skin pathogens such as Staphylococcus sp., Pseudomonas sp., and enteric organisms were identified to the species level with commercial identification kits.7

The percentage of bacterial reduction for the immediate (% BRI) and hour-1 periods (% BRH) were calculated as follows:

% Immediate Bacterial Reduction (%BRI) = \( \frac{\text{No. of CFU Prescrub} - \text{No. of CFU Postscrub}}{\text{No. of CFU Prescrub}} \times 100 \)

% Hour 1 Bacterial Reduction (%BHR) = \( \frac{\text{No. of CFU Prescrub} - \text{No. of CFU Hour 1}}{\text{No. of CFU Prescrub}} \times 100 \)

The percentages of cultures with no growth, cultures with more than five CFU, and frequency of skin reactions after 1 hour were calculated. Skin reactions were characterized by erythema, edema, papules, wheals, and "weeping" of serum from the skin.

Analysis of variance was used to determine the significance of %BRI and %BRH (p < .05). The chi-square test was used to determine the significance of negative culture results, cultures with more than five CFU, and the frequency of skin reactions (p < .05). The specific skin flora were identified at each sampling period and compared subjectively.

Results

There was a significant reduction in skin bacteria with both techniques in the immediate and hour-1 cultures.
460 SKIN PREPARATION TECHNIQUES

PI DRAPE

TECHNIQUE

Immediate (% BRI)    One Hour (% BRH)

* 70% Isopropyl Alcohol Only

** Significance \( p < .05 \)

Fig. 1. Mean percentages of bacterial reduction immediately after (% BRI) and 1 hour after (% BRH) preoperative skin preparation with povidone-iodine (PI) and an antimicrobial adhesive drape in dogs (\( n = 30 \)).

comparable to that reported in human studies (\( p < .001 \)) (Fig. 1). \(^1,2,14\)

Although there was no statistical difference between the techniques in immediate percentage bacterial reduction, the PI technique resulted in significantly fewer cultures with no growth immediately after skin preparation than did the drape technique (Fig. 2). There were significantly more cultures with high counts (>5 CFU) immediately after and 1 hour after application of the drape (Fig. 3). It should be noted that five CFU was an arbitrary number chosen to represent cultures with high colony counts.

There was a significant difference in the frequency of skin reactions 1 hour after skin preparation (Fig. 4). Acute contact dermatitis occurred in nearly 50% of areas prepared with PI, whereas none of the areas prepared with the drape developed such skin reactions.

Adhesion of the drape was evaluated subjectively. Severe lift occurred after 20 of 30 applications (66%). There was no correlation between bacterial contamination and lift of the drape.

The microorganisms most commonly isolated immediately after and 1 hour after skin preparation were *Staphylococcus intermedius*, a potential pathogen (12 of 15 dogs cultured), and *Bacillus* sp., a normal resident or transient skin inhabitant (7 of 15 dogs cultured). There appeared to be no selectivity of organisms after either preparation technique.

Discussion

The incise drape used in this study is superior to previous drapes in water vapor transmission, pliability, and conformability. \(^2\) It is coated with an adhesive that slowly releases an iodophor to reduce the number of skin bacteria by constant antiseptic contact. Because a skin antiseptic is incorporated into the adhesive, the drape might be used without skin preparation or with only a short scrub, thereby decreasing the time needed for anesthesia. Besides reducing the risks of anesthesia, this would improve operating room efficiency and lower costs. Unfortunately, when it is used without any skin preparation, the drape has been shown to be less effective than preparation with PI. The inferior performance of the drape was attributed to an inadequate concentration of iodine on the skin to produce a bactericidal effect. \(^1,6,17\)

However, studies in humans have shown that the antimicrobial efficacy of drape application after a short alcohol scrub is equal or superior to the PI preparation technique. \(^2,14\)

Therefore, the manufacturer recommends application of the drape after either conventional skin preparation or a 1-minute alcohol scrub.

In this study, the drape applied after a 1-minute alcohol scrub was not as effective as PI preparation in the immediate reduction of skin bacteria of dogs. The difference between these results and those in humans could be attributed to the short scrub duration, which might be inadequate to remove surface debris in dogs, thereby preventing access of the alcohol to hidden skin bacteria. It is
It is difficult to determine why drape adhesion was so poor in this study. It might have been that the duration of the alcohol scrub or the concentration or type of alcohol used did not effectively defat canine skin. Ninety percent isopropyl alcohol has been shown to be more effective than 50% or 70% isopropyl alcohol in defatting human skin. The ability of differing concentrations of ethyl or isopropyl alcohol to defat canine skin has not been compared. In retrospect, it appeared that the most important factor in determining drape adhesion was hair density under the drape. On densely haired skin, air was trapped beneath the hair stubble left by clipping, preventing direct contact of the adhesive with the skin. Shaving the hair might have resulted in better adhesion of the drape.

The lack of apparent correlation between lift and bacterial contamination might be explained by the short evaluation time, which did not allow for significant multiplication of skin bacteria. However, it is more likely that the alcohol was so ineffective in the initial reduction of skin bacteria that the effect of the lift was negligible in comparison.

As was found in humans, no skin reactions were observed after application of the iodine-impregnated drape. However, nearly 50% of areas prepared with PI developed acute contact dermatitis. Skin reactions or irritations are commonly observed in dogs after preparation with PI, and they predispose human skin to wound infections. After reviewing the literature, we conclude that the significance of acute contact dermatitis is underestimated.

There was no difference between PI and the drape in the types of microorganisms cultured in a study of hu-

Important to remember that we tested only dogs with healthy skin. One would expect the difference in efficacy between the techniques to be even greater in dogs with skin disease because of higher bacterial populations and more surface debris.

In this study, the drape was also less effective than PI after 1 hour. The difference between these results and those in humans may again reflect failure of the alcohol scrub to reduce the number of skin bacteria initially. In addition, it seems that the concentration of iodine available on the skin was inadequate to produce a bactericidal effect after 1 hour.

Significant lift of other adhesive drapes applied to human skin has been reported to vary from 24% to 44% and has been associated with a six-fold increase in wound infection rates. In the same report, only 5% to 10% of the drapes evaluated in this study suffered lift, depending on the preparation of the skin. Lift was not “severe” in any of 104 patients, and it was not associated with an increased incidence of wound infections. The definition of “severe lift” was not given. In the current study, there was significant lift (air bubbles visible under the drape) in 66% (20/30) of the applications. A higher frequency of lift would be expected in clinical cases with prolonged surgical times and retraction of tissues, both of which have been shown to increase lift in humans.
mans. The most commonly isolated organism from humans was *Staphylococcus epidermidis*; whereas we isolated *S. intermedius* and *Bacillus* sp. most often. The drape did not appear to favor specific organisms in our study.

In conclusion, because of its inferior antimicrobial efficacy immediately after and 1 hour after application, this antimicrobial adhesive drape applied after a 1-minute alcohol scrub is not superior to preparation with PI for routine use in dogs. For procedures in which surgery time is prolonged or wound infection would be devastating, this drape should not be used in dogs after a 1-minute alcohol scrub.

References