A PROSPECTIVE TRIAL COMPARING BIOBRANE®, DUODERM® AND XEROFORM FOR SKIN GRAFT DONOR SITES


Many new dressings have been introduced for use on split-thickness skin graft donor sites in an effort to reduce pain at the donor site and decrease healing time, while maintaining a low infection rate and cost. To assess these factors in two such dressings, Biobrane® (temporary wound dressing) (Winthrop) and Duoderm® (hydrocolloid dressing) (Convatec), we compared them with a conventional fine mesh gauze dressing, xeroform, in a prospective, randomized study of 30 donor sites in the same number of patients. Wounds were considered healed when they were 100 per cent re-epithelialized and required no further dressings. Patient self-assessment of pain was quantified on a scale of zero to ten, with ten being the most severe pain. Donor sites dressed with xeroform had a healing time of 10.5 days, which was significantly better (p<0.05) than Duoderm (15.3 days) or Biobrane (19.0 days), although the protocol for Duoderm use (wound visualization at seven day intervals) extended the apparent healing times in this group. Duoderm was the most comfortable dressing (0.53 grade) when compared with Biobrane (1.44) and xeroform (2.41, p<0.05). No infections occurred in donor sites dressed with xeroform, but two developed in patients using Biobrane. One patient with a Duoderm dressing had a donor site infection during a drug-related neutropenic reaction. Xeroform was the least expensive dressing to use ($1.16 per patient), followed by Duoderm ($54.88 per patient) and Biobrane ($102.57 per patient). The results of our study confirm the usefulness of xeroform as a donor site dressing as it promotes relatively rapid healing, is easy to use and is inexpensive. We found Duoderm to be ideal for smaller donor sites when pain could be significantly reduced with minimal increase in cost. Biobrane is too costly and the infection rate too high for it to be used routinely as a skin graft donor site dressing.

SPLIT-THICKNESS SKIN GRAFTING is a frequently used reconstructive technique. While many of the principles of graft site care have been well established, there is currently no consensus on the optimal donor site dressing. Ideally, such a material would be easy to use, promote rapid re-epithelialization, be pain-free and relatively inexpensive. Classically, surgeons have used fine mesh gauze impregnated with various compounds (for example, bismuth—xeroform, scarlet red). While these dressings are easily managed, patients often complain of significant discomfort—usually greater in the donor area than in the graft site.

Biobrane® (temporary wound dressing) (Winthrop Pharmaceuticals) is a biocomposite of ultrathin semipermeable silicone membrane bonded to a flexible knitted nylon fabric. The two layers are covalently bonded to porcine collagen peptides, which increase wound adherence. The flexibility and stretch of Biobrane enable its application to many different donor site areas; its high water vapor permeability minimizes fluid collections, and the ability to see through it permits ongoing evaluation of the wound. A limited number of studies comparing Biobrane with more
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TABLE I.—AGE AND INDICATIONS

<table>
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<th>Indication</th>
<th>Biobrane</th>
<th>Duoderm</th>
<th>Xerofonn</th>
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<tr>
<td>No.</td>
<td>Per cent</td>
<td>No.</td>
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<tr>
<td>Stasis ulcer</td>
<td>2 29</td>
<td>4 40</td>
<td>3 25</td>
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<tr>
<td>Trauma</td>
<td>1 14</td>
<td>1 10</td>
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<tr>
<td>Diabetic ulcer</td>
<td>1 14</td>
<td>1 10</td>
<td>2 15</td>
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<tr>
<td>Chronic wound/fecision</td>
<td>2 29</td>
<td>3 30</td>
<td>5 39</td>
</tr>
<tr>
<td>Minor burns</td>
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<tr>
<td>Total</td>
<td>7 10</td>
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The mean age for the patients with Biobrane was 51.0 years; for Duoderm, 51.4 years, and for xeroform, 50.8 years.

Duoderm® (hydrocolloid dressing) (Convatec), an oxygen-impermeable, hydrocolloid dressing, is being used extensively for treatment of dermal ulcers, burns and minor abrasions, and as a dressing for skin graft donor sites. It is composed of an outer layer of polyurethane foam that is impermeable to oxygen and water and an inner layer of hydrocolloid polymer complex that is occlusive and hydrophilic. Its oxygen impermeability has been shown to promote the rate of epithelialization and collagen synthesis and to decrease the pH of wound exudate, thus potentially reducing bacterial counts (3, 4). Because the dressing does not adhere to open wounds, it neither damages newly formed epithelium nor causes irritation or pain during dressing changes. The results of studies comparing Duoderm with conventional fine mesh gauze have confirmed its potential clinical usefulness for skin graft donor sites with certain reservations (5–7).

We undertook a prospective randomized study to compare Biobrane, Duoderm and xeroform (a fine mesh gauze impregnated with 3 per cent bismuth tribromophenate), as split-thickness skin graft donor site dressings. We were interested in further investigating how these newer dressings compared with xeroform in regard to rate of wound re-epithelialization, pain to the patient, incidence of infection and cost.

MATERIALS AND METHODS

Patients undergoing split-thickness skin grafting at the Roosevelt Division of the St. Luke's/Roosevelt Hospital Center were entered into the study beginning July 1988. Just prior to skin grafting, an envelope containing one of the three dressing assignments was opened. Skin grafting was done using a Brown-type dermatome set at 0.015 to 0.018 inches and epinephrine soaked gauze was placed over the donor site for hemostasis.

Biobrane was applied firmly with maximal stretch and held in place with staples to avoid wrinkles. Rolled gauze bandages then elastic bandage were applied and then removed 24 hours postoperatively. Small collections of blood under the Biobrane were aspirated; however, large clots required changing of the Biobrane. The dressing was removed when re-epithelialization had occurred, allowing separation of the dressing from new epithelium.

The Duoderm dressings were applied to donor sites with a 1/4 inch overlap over normal skin; finger contact with the adhesive surface was minimized. The dressing was applied in a rolling motion and smoothed firmly into place. The edges were secured with 1 inch hypoallergenic tape, and an elastic bandage was applied and removed after 24 hours. Duoderm dressings were examined on a daily basis and changed only if leaking of exudate was noted. Nonleaking dressings were left in place for seven days and then removed. When re-epithelialization had occurred, no new dressing was re-applied.

Xeroform was applied over donor sites and covered with a rolled gauze bandage that was removed after 24 hours. Heat lamp treatments were then applied four times per day for an additional 72 hours to aid in drying of the gauze. The xeroform dressing was removed when complete re-epithelialization had occurred, allowing separation of the dressing from the new epithelium.

All patients received perioperative intravenous antibiotics, and antibiotics were given orally until the donor site healed. Patients were assessed on a daily basis and questioned regarding pain at the donor site, graded on a scale from zero (no pain) to ten (maximal pain). Wounds were inspected for evidence of infection; when infection occurred, the dressing was removed and the wound cultured. Infections were then treated with normal saline solution soaked gauze dressings. Xeroform and Biobrane dressings were also inspected for exudate (serous, bloody, purulent, none, moderate, large) and adherence (none, fair, good). The date of healing was recorded at the time...
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no further dressings were needed, when 100 per cent re-epithelialization had occurred. For each patient, the number of dressings used and cost per dressing were also recorded and costs for each type of donor site dressing were calculated. The average healing time and pain scores were analyzed using the Wilcoxon signed-rank test.

RESULTS

Thirty patients who underwent skin grafting were considered during the study period. Seven patients were randomized to have Biobrane used as the donor site dressing, ten to Duoderm and 13 to xeroform. An analysis of age and indications for skin grafting, as given in Table I, revealed the three groups of patients to be similar.

Mean healing time differed considerably between the three groups, as can be seen in Figure 1. Patients whose donor sites were dressed with xeroform healed the fastest—an average of 10.46 days. This is significantly different from those dressed with Biobrane—19 days (p=0.023)—or Duoderm—15.3 days (p=0.002).

Infection rates among the dressing groups varied as well. Xeroform dressings were associated with no infections. Biobrane dressings had a 29 per cent infection incidence in our study (two patients). One patient had a skin graft for venous stasis disease (cultures grew Enterobacter species), the other for a traumatic wound (cultures grew Staphylococcus species). One patient with a Duoderm dressing had an infection at the donor site. This patient was a diabetic who had a severe neutropenic reaction (a leukocyte count of 1,400) after administration of an oral hypoglycemic agent (Micronase® [brand of glyburide] [Upjohn]). This patient had an infection develop at the donor site (cultures grew Staphylococcus species) which responded quickly to normal saline solution dressing changes, and the leukocyte count returned to normal soon after Micronase was discontinued.

Assessment of pain in the three groups revealed Duoderm to be the most comfortable dressing, as illustrated in Figure 2. The average pain of all patients with Duoderm dressings was 0.53 on a scale of zero to ten. Dressings of Biobrane were slightly more painful with an average of 1.44 and patients with xeroform donor site dressings experienced the most pain—the average being 2.41 on the same scale, a significant difference when compared with Duoderm (p=0.01).

To compare the cost of using each of the three study dressings, the price for a standard unit was obtained. During the time of the study, St. Luke’s/Roosevelt Hospital Center paid $78.90 for a 10×15 inch sheet of Biobrane, $11.20 for an 8×8 inch sheet of Duoderm and $0.98 for a 5×9 inch sheet of xeroform. The average number of these standard units, the cost per square inch of dressing and the average cost of each dressing per patient are given in Table II. Clearly, xeroform is the least expensive of the three dressings and Biobrane the most expensive. The cost of treating infection is not reflected in these figures, but given the rates of infection noted would only make these differences greater.

DISCUSSION

Current dressings for split-thickness skin graft donor sites can be categorized into the following

![Fig. 1. Healing times for Biobrane® (temporary wound dressing), Duoderm® (hydrocolloid dressing) and xeroform.](image)

![Fig. 2. Pain index for Biobrane® (temporary wound dressing), Duoderm® (hydrocolloid dressing) and xeroform. Average pain from harvesting until re-epithelialization recorded on a scale of zero (no pain) to ten (maximal pain).](image)
four groups: open, semi-open, occlusive and semi-occlusive.

Open technique. The open technique of leaving the wound uncovered is the least expensive of any dressing, but is quite painful and is associated with prolonged healing times (8, 9).

Semi-open technique. Prior studies of fine mesh gauzes impregnated with various substances have described their ease of use and low cost, especially for large donor sites (8, 10). These dressings are semi-open: there is egress of fluid and bacteria through the fine mesh; as the dressing dries, fibrin from the wound bed causes temporary bonding of the dressing to the wound (2). We found xeroform, a popular fine mesh gauze, to be inexpensive, easy to use and associated with a low infection rate. Our results also confirm that re-epithelialization of donor sites covered with xeroform occurs in about ten days. However, xeroform was more painful as a dressing than Biobrane or Duoderm (p<0.05). We noted that patients seemed to complain most when the rolled gauze bandage was removed on the first postoperative day. Coagulum caused the xeroform to stick to the gauze and removal was quite painful. Since the conclusion of our study, we have begun using Telfa (a nonadherent gauze pad) (The Kendall Co.) between the xeroform and the gauze bandage on those larger donor sites where xeroform is used.

Biobrane is a collagen-synthetic composite membrane that contains pores and so in clinical use is similar to a semi-open fine mesh gauze—both require adherence of the dressing to permit healing beneath it. The mechanism of attachment, however, is quite dissimilar in that the collagen peptide content of Biobrane enables actual incorporation into the wound, allowing the dressing and tissue to move together (1). It is, therefore, not surprising that the results of our study, as well as those of two others (1, 2), found Biobrane to be more comfortable than fine mesh gauze as a donor site dressing.

Donor site infections occurred in two of seven patients with Biobrane dressings in our study. Others have noted a high rate of infection in Biobrane covered donor sites as well. A 57 per cent rate of infection has been associated with Biobrane dressings when it was compared with a fine mesh gauze (scarlet red) (1). In a recent study (11) in which donor site infections in patients having small burn skin grafts was reviewed, six of 30 patients with Biobrane had donor site infections.

Occlusive technique. The early occlusive dressings consisted of a fine mesh gauze covered with an impermeable dressing; these were abandoned in favor of fine mesh gauze alone because of the potential for bacterial proliferation and difficulty in application to many areas, especially those other than extremities (12). The use of Duoderm as a new type of occlusive dressing for skin graft donor sites was predicated on the biologic factors of moist environments and their ability to permit rapid infection-free re-epithelialization (5). Duoderm was the least painful of the three dressings we studied. Others (13) found Duoderm to be more comfortable than Omiderm® (polyurethane film) (OmiKron Scientific), which is transparent, hydrophilic and highly permeable to water. Another group (14) found that there was less pain associated with Duoderm (maximum pain 2.1 on a scale similar to ours), than with saline solution soaked gauze (maximum pain 6.5). While other investigators (5) also found Duoderm to be preferred by patients over fine mesh gauze, they noted that it caused pain during change of the dressing 76 per cent of the time, a finding not confirmed by us.

Although we have noted an average healing time of 15 days in those patients with Duoderm dressings in our study, this is probably artificially high, as these dressings were left on for seven days (when no leakage occurred). In some of these instances, it is possible that re-epithelialization occurred prior to the seventh day but was undetected beneath the opaque dressing. Other studies found re-epithelialization under Duoderm to occur after six to eight days (5-7, 13, 14).

Semi-occlusive technique. The group of clear films often referred to as SAM dressings (synthetic adhesive moisture-vapor-permeable) was introduced for use on skin graft donor sites because these dressings (for example, Op-Site® [Smith-Nephew] and Tegaderm™ [3M]) can prevent conditions suitable for anaerobic bacterial growth. They are also bacteria and liquid impermeable and so are considered semi-occlusive (3). While the results of numerous studies have shown these dressings to promote more rapid and less painful healing, they tend to be labor-intensive, especially in large donor sites, because of the potential for large fluid collections. This problem often requires placement of a drain beneath the dressing at the time of initial application or, alternatively, frequent aspiration or changing of the dressing (15-17).
SUMMARY

Based on the results of our prospective study of split-thickness skin graft donor sites in 30 patients, we conclude that Biobrane, although less painful than a standard fine mesh gauze dressing, is expensive and is associated with an unacceptably high infection rate. Duoderm is most useful on smaller donor sites when minimal leakage keeps costs and dressing care manageable but allows for a significant improvement in patient comfort with no increase in the incidence of infection. For larger donor sites, a fine mesh gauze is still the preferred dressing because of its ease of use, low cost, consistent rate of healing and low infection rate.

REFERENCES