Topical treatment: which dressing to choose

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Summary

Wounds have existed since the beginning of time. The interest in this subject has been stimulated in the main by conflict and war that have necessitated the development of new ways of managing wounds. In the 1960s the development of new materials that maintained a moist environment in the wound area encouraged a number of commercial companies to produce a wide variety of new materials with physical and chemical properties that might provide a moist environment. However the data to support the use of such materials are limited if one requires evidence that they have produced more rapid healing in chronic wounds kept moist as to those kept dry. Is this due to a problem with the outcome measure rather than a problem with the materials themselves? Rather than seeing this as justification for not using such materials, it should instead lead clinicians to question the validity of endpoint studies in wound healing experiments. There is a lack of evidence regarding the ability of such materials to improve the speed of healing in chronic wounds. Nevertheless considerable clinical experience, obtained from treating many patients, has indicated that not only are such new treatments cost effective, but that they are also proving to be extremely beneficial and acceptable to patients, on account of their ability to reduce pain, odour or leakage from a wound. Copyright © 2000 John Wiley & Sons, Ltd.

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History of wound healing

Wounds have existed since prehistoric times and many famous physicians through the ages have contributed to an understanding of healing. Around 1000 BC Homer provided a detailed description of 147 wounds in the Iliad. Hippocrates in 400 BC wrote 70 essays, many of which describe wounds and how we recognise the value of cleansing and the use of wine and vinegar as topical treatment for wounds. Celsus (20–50 AD) described the cardinal features of inflammation and Galen then dominated medical thinking until the Middle Ages when Paracelsus made the observation that although he dressed the wound God healed it. Subsequently absorbent cotton and gauze materials came into widespread use, and in 1916 Vaseline-coated gauze was first developed. Despite the early development of such materials it is interesting to note how many of these traditional agents are still in use at the end of the 20th century. This is particularly frustrating in view of the huge development in other aspects of medicine including treatment of infection, surgical innovations, and the cure of many other clinical problems.

Moist wound healing

In 1962 [1] Winter published a paper in which he observed 50% faster re-epithelialisation in the partial thickness of acute wounds in pigs. Winter...
recognised that these were only preliminary data but interestingly a huge momentum, initially driven by commercial concerns, led to the development of Winter's concept of moist wound healing. As a result of the preliminary animal data and subsequent commercial support, many clinicians and patients became aware of moist wound healing and clinicians began to use such modern materials to treat patients. At a time of evidence-based medicine and the requirement for significant information before making new treatments available or clinicians changing their practice, it is interesting to speculate if such a development had taken place today would it have been feasible based on such preliminary data.

Subsequent to Winter’s work others [2,3] have demonstrated the benefits of many of these modern materials in animal wounds. However, the dramatic results seen in the animal experiments were not observed in the human situation. Even though one of the first papers with data from human subjects showed the benefit of a more moist environment, the authors, Hinman and Maibach [4], do not know whether their observations were a biological curiosity or of practical importance in human wound healing.

Classification of dressings

The important criteria for optimal wound dressings have been recognised for some years and in 1979 Turner [5] published a series of characteristics which are still in use today:

- Remove excess exudate and toxic components
- Maintain high humidity at the wound/dressing interface
- Allow gaseous exchange
- Provide thermal insulation
- Protect from secondary infection
- Free of particulate or toxic contaminants
- Allow removal without trauma at dressing change.

These criteria, although easily recognised as being important, do not include any mention of the dressings’ beneficial effect on healing. In view of this fact, is there a mismatch of objectives between a clinical desire to develop dressings to heal wounds rapidly and a manufacturer’s desire to provide an optimal environment for healing to occur in an individual patient at its own rate?

Since the description by Winter of the benefits of moist wound healing, a wide variety of new materials have been developed and can be broadly classified as shown below:

- Films
- Foams
- Hydrogels
- Hydrocolloids
- Alginites
- Medicated dressings

Film dressings

The first type of moist wound healing dressings developed were the semi-permeable films. Whilst a number of variants are available commercially (e.g. Opsite, Tegaderm), they vary mainly in their ability to transmit moisture vapour from the wound to the external surface of the dressing. These materials are presented as thin sheets of clear material bound, on the wound-contact surface, with an adhesive. Work in the 1980s demonstrated the benefits of such materials in the healing of skin graft donor sites [6] and superficial burns [7]. However, evidence of beneficial effects on healing of chronic wounds is not evident. The most common use of such materials in chronic wounds appears to be in the treatment of superficial pressure ulcers. Their use in diabetic foot wounds is limited, based on current literature. The major benefits of such materials are that they do form a bacterial barrier, they are durable and often do not require changing more than every 4–5 days, and they are relatively cheap. The disadvantages of using such materials are that they are only really of value on flat surfaces or in treating superficial wounds. They can be difficult to release from their backing materials and, in addition, some patients develop skin stripping or sensitisation to the adhesive in the dressing when used over a period of time.

Foams

There are a wide variety of foam-based materials currently available (e.g. Lyofoam, Allevyn) with a wide range of absorbencies. More recently foam-based technologies have used an adhesive layer to the dressing (e.g. Tielle) to hold the material in place over a wound. In addition, foams may provide thermal insulation to a wound and they are easily cut and shaped to fit awkward areas [8,9]. It should be recognised that the variability of absorbency of different foams means that a simple substitution of the material may not result in the same benefit to the patient. Although many foams are available in sheets, in recent years the development of foam to fill cavity wounds has occurred (e.g. CaviCare, Allevyn cavity wound dressing). As with films, there is limited published data to identify exactly how best to use such materials in diabetic foot ulceration. The potential benefit to patients with such wounds could be conveyed by the padding and absorbency provided by such materials over an ulcerated area. However, the beneficial effect of padding needs to be reconciled with the requirement of a dressing to fit in a shoe for the patient who remains ambulant.

Hydrogels

Hydrogels are a mixture of polymers with water making up to 90% of the weight of the dressing [10]. The
particular benefit of hydrogels appears to be as a selective, non-surgical means by which wounds can be debrided with a dressing-facilitating autolysis [11]. The formulation of different hydrogels results in a varying ability to donate water and absorb fluid from the wound [12]. Hydrogels exist both as sheet forms (e.g. Vigilon) and in amorphous forms (e.g. Intrasite, Sterigel). The clinical experience of many individuals has suggested that such materials are useful in clearing slough from wounds [13]. This effect is difficult to quantify and may not necessarily lead to more rapid healing of a wound. It therefore again calls into question the enthusiasm of many to suggest that ‘days to healing’ is the only outcome measure useful in the evaluation of wound dressings.

**Hydrocolloids**

These materials are very popular and have some potential benefits in the treatment of diabetic foot ulcers (e.g. Granuflex, Comfeel) [14]. Indeed, one study found them to be the second most popular dressing used for the treatment of diabetic foot ulcers [14]. Despite this enthusiasm there has in recent years been considerable debate as to their potential for increasing the rate of infection in patients with diabetic foot ulcers, in view of their occlusive and opaque nature which prevents daily observation of the wound [15]. Some researchers working in this field however have good experiences of using these materials and have not observed an increase in the rate of wound infection [16]. It has been suggested subsequently that these materials, although having the potential for use in the treatment of diabetic foot ulcers, require regular monitoring of the patient by the clinician to prevent difficulties arising. This is particularly so in preventing maceration of the surrounding skin and the development of infection that may be unrecognised if a dressing is not changed or the wound monitored on a daily basis. The potential practical benefits of using such materials are as follows: they can be used relatively easily within a shoe, the adhesive surface prevents slippage, they do not require daily dressing changes, and they have significant potential for being a cost-effective therapy [17].

**Alginates**

A wide diversity of these materials are available with differing properties depending on the proportion of calcium and sodium alginate present in the material (e.g. Sorbsan, Kaltostat). They are useful as absorbents of exudate, can be used as a packing material, and some products have haemostatic properties [18]. In common with hydrocolloids, concern has been voiced over the risk of infection when using alginates; work by Pecoraro and colleagues in North America has however shown this not to be the case [19]. Following contact with wound exudate these materials biodegrade and therefore do not cause trauma to the wound bed at dressing change. Although some work has shown incorporation of alginate fibres into the granulation tissue in the early stages of healing, there did not appear to be any adverse effect on healing [20]. Particular concern in diabetic foot wounds has been expressed over the potential for these materials to dry out and form a plug within the wound bed. This can be prevented by the use of copious amounts of saline to remove all remaining traces of dressing material.

**Medicated dressings**

In recent years there has been considerable heated debate over the use of antiseptics in wounds. This has led to a reluctance to use such agents on patients with chronic wounds. The evidence to support this statement is, however, based on cell culture and animal model studies which have suggested that such agents are toxic not only to bacteria but also to living tissue [21,22]. Contrary to this view there are a number of physicians who are confident to use topical antiseptics in many patients, but once again there is no evidence in a human chronic wound model that the use of such agents may have consistent beneficial effects on the healing of such wounds. This again illustrates the problem of relying on ‘days to healing’ as an outcome measure to demonstrate efficacy of topical antimicrobial agents and, indeed, the efficacy of such agents may best be measured by modification of bacterial flora within the wound [23].

**Selection of wound dressings**

It can be seen from the previous comments that the range of dressing materials available to treat wounds is extremely diverse. It is also important to recognise that a number of factors may influence the ultimate choice of a dressing for a particular patient. A wound healing matrix has been developed [24] which has formed the basis of a medical student text on wound healing. In this matrix, six factors are felt to be important in choosing the best dressing for a wound:

- Tissue involved
- State of healing
- Aetiology of wound
- Condition of wound
- Environment and carer
- Healthcare system.

The treatment of a particular patient with a wound will vary dramatically depending on the tissue involved. It should be recognised that treatment of a superficial skin wound will require totally different dressings than will a wound which is much more extensive and which may involve both skin and bone. Similarly, a wound that is actively granulating may be better treated with quite a different dressing material to that used to treat a wound at the epithelialising phase of healing. A summary of
suggested dressings types and their useful functions in the treatment of diabetic foot ulcers is illustrated in Table 1.

The identification of neuropathic, neuroischaemic and ischaemic disease as a cause of diabetic foot ulcers will obviously result in the requirement for different local wound treatments. A deep sinus may require a different dressing to a wound that is producing copious amounts of exudate. Provision of care to patients in a hospital setting will obviously differ from that provided to patients in a community setting. Finally, it should be recognised that the different healthcare systems operating in different countries will also have a significant impact on the ultimate choice of dressing for an individual patient.

The future of wound dressings

As has already been mentioned, focusing entirely on data that demonstrate an improvement in ‘days to healing’ following the use of moist wound healing products may be one of the root causes that prevents the appropriate use of modern materials to treat a wide variety of wound types including diabetic foot ulcers. Whilst it should be recognised that studies should be performed that demonstrate the efficacy of an intervention, efficacy of wound dressings could be demonstrated in a number of ways; reduction of leakage, alleviation of pain, and prevention of odour may be equally important to the patient with a chronic wound.

In addition to such measures of efficacy, studies to measure the efficiency of new dressings should be undertaken to ensure that days to discharge from hospital, number of community nurse visits, and the potential for patient-manageable dressing regimens may all be equally important ways in which one could demonstrate the benefits of modern wound healing materials. Finally, at a time of economic constraint in most healthcare systems around the world, studies of cost effectiveness should be performed to demonstrate that many of these moist wound healing materials may well be very cost-effective options for treating patients with diabetic foot ulcers, and a combination of measures of efficacy, efficiency and cost effectiveness should provide a comprehensive package of information to ensure clinicians make an appropriate choice of wound dressings in the management of patients with diabetic foot ulcers.

Table 1. Dressing types and their useful functions in the treatment of diabetic foot ulcers

<table>
<thead>
<tr>
<th>Dressing type</th>
<th>Dressing function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Films</td>
<td>Superficial wounds, use as protection</td>
</tr>
<tr>
<td>Foams</td>
<td>Protection, padding, absorbency</td>
</tr>
<tr>
<td>Hydrogels</td>
<td>Debriding, rehydrating</td>
</tr>
<tr>
<td>Hydrocolloids</td>
<td>Debriding, protection</td>
</tr>
<tr>
<td>Alginates</td>
<td>Absorbency, potential for some to act as haemostatic agents</td>
</tr>
<tr>
<td>Medicated dressings</td>
<td>Potential for use in locally infected wound or in combination with systemic antimicrobial agents</td>
</tr>
</tbody>
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References