

The role of alginate dressings in wound healing

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ARTICLE POINTS

1 Alginate dressings are composed of the calcium and sodium salts of alginic acid, a natural component of brown seaweed.

2 They are highly absorbent and therefore suitable for moderate to highly exuding wounds.

3 They have useful haemostatic properties.

4 Their gelling action creates a warm moist environment that is ideal for wound healing.

5 Appropriate use of dressings can only be achieved through a thorough understanding of the wound healing process and how dressings can enhance that process.

KEY WORDS

- Alginates
- Wound healing
- Gel formation
- Dressing selection

Introduction

Wound healing is complex: the natural progression is a single continuous process with no clear divisions between the various stages of healing (Payne, 1994). It is a cellular and biochemical process, involving essentially an inflammatory reaction that leads to successful healing. It is not dressings themselves that heal wounds, but the careful selection of appropriate dressings that provide the optimal wound-healing environment for the individual wound (Eich and Stadler, 1999). This article reviews the role of alginates in promoting optimal wound healing.

Alginate dressings have been available since 1984 (Smith, 1992) although the benefits of seaweed have been known for centuries, when it was known as the 'Mariner's cure' (Jones, 1999).

Alginate dressings are produced from alginic acid, which occurs naturally in brown seaweed found on the west coast of Ireland, and in the Outer Hebrides, Europe and the USA. Alginic acid is a polymer of mannuronic and guluronic acid molecules, and alginate dressings vary in their proportions of these molecules, depending mainly on the origin and species of seaweed and which part of the plant is used in the manufacture.

The dressings are composed of calcium and sodium alginate fibres, which have been entangled to form a strong cohesive product (Thomas, 2000). This produces a highly absorbent, non-adherent dressing that transmits oxygen and moisture vapour (Choucair and Phillips, 1998). In the presence of exudate, the fibres form a hydrophilic gel (Thomas, 2000).

During manufacture, a solution of sodium alginate is extruded under pressure through a fine orifice into a bath containing calcium ions. This results in ion exchange, leading to the formation of insoluble calcium alginate fibres (Thomas, 2000). When the dressing is applied to a wound, significant proportions of the calcium ions are replaced by sodium ions from the

wound, and the fibres swell to form a gel-like mass that fills the wound (Thomas, 2000).

Although it is recognised that there are differences between brands of alginates, it is generally assumed that these are of little relevance to the dressing's performance clinically or at cellular level (Thomas, 2000).

By controlling the manufacture of the alginate dressing it is possible to replace some of the calcium within the alginate with sodium, to accelerate the gelling process. These dressings are known as calcium-sodium alginates (Qin and Gilding, 1996).

Role of calcium alginate and zinc in haemostasis

Alginate dressings have a high calcium content. When in contact with wound exudates containing sodium ions, ion exchange occurs and the insoluble calcium alginate is partially converted to soluble sodium alginate. This can be useful in the treatment of wounds that bleed easily, as the calcium ions released into the wound assist in the clotting cascade (Jarvis et al, 1987; Collins et al, 2002), promoting haemostasis (Morgan, 1997; Sirimanna, 1989).

Segal et al (1998) showed that the extent of coagulation activation varied with the proportions of mannuronic and guluronic residues in the dressing, and that alginates containing zinc ions had the greatest potentiating effect on prothrombotic coagulation and platelet activation.

Table 1. Status of alginates as an ideal dressing

Properties of an ideal wound dressing	Status of alginates
Keeps wound moist	Yes
Keeps wound warm	Yes
Non-adherent	Yes
Occlusive	No
Absorbent	Yes
Impermeable to bacteria	No, but has the potential to absorb and remove bacteria
Free of contaminants	Yes
Non-toxic	Yes

Source: Hampton and Collins (2003)

Physiological effect on wound healing

Dressings themselves do not heal wounds, although an appropriate dressing can provide the optimal environment for wound healing (Table 1).

Sayag et al (1996) compared an alginate dressing with dextranomer paste in a randomised controlled trial of 92 patients with full-thickness pressure ulcers. They found a minimum 40% reduction in wound size in the alginate group within four weeks, whereas the dextranomer group took eight weeks to achieve similar reductions in size. Sayag et al concluded that: 'The striking healing efficacy of an alginate dressing suggests it possesses pharmacological properties which require further investigation'.

Blair et al (1988) found that the alginate dressing Kaltostat was significantly better at arresting haemorrhage than the control dressings (collagen, oxidised cellulose, or gauze).

Schmidt (1986) suggested that calcium alginate might activate or stimulate the wound-healing process as it appeared to promote the growth of mouse fibroblasts. These findings were confirmed by Doyle et al (1996), who suggested that calcium alginate had an effect on cell proliferation and migration that was believed to have been mediated by the release of calcium ions into the wound bed.

Bacterial binding and alginates

Although Lawrence (1994) was probably the first to recognise the importance of 'containing' bacteria in dressings, he was very

closely followed by Dehaut and Mainguault (1994), who recognised the ability of the alginate dressing Algosteril to bind and retain bacteria within it. When the dressing is removed, the bacteria are also removed and disposed of. Optimal wound care to prevent progression from colonisation to infection remains the foundation of good clinical practice (Wysocki, 2002).

Wound pain during removal of dressings

Choosing the most appropriate dressing is important in optimising healing and minimising pain (Bettinger et al, 1996). Lalau et al (2002) compared alginates with paraffin gauze dressings in the treatment of diabetic foot ulcers and found that pain on dressing removal was lower in the alginate group ($p=0.047$) and that fewer dressing changes were required ($p=0.07$). The authors concluded that the alginate was more appropriate for topical treatment of diabetic foot lesions.

Lalau et al (2002) confirmed the findings of Bettinger et al (1996). Heenan (1998) found that alginates were easy to remove and caused less pain, and he described the removal of alginate dressings as virtually painless, particularly when they were well soaked with sodium chloride solution (Vanstraelen, 1992).

Although alginate dressings generally become moistened within the wound, they should not be used in very dry wounds because a burning sensation may be experienced as fluid is 'drawn' from the wound bed as a result of the hydrophilic effect. If a wound is dry as a result of arterial insufficiency, alginates could potentially draw fluid from an area that has very little fluid within the tissues, causing damage. At the same time, there is a potential for dried-out alginate to increase pressure on the wound bed and this can lead to compromised healing in the diabetic foot.

The author witnessed this situation when a consultant ordered an alginate dressing to be placed on a slow-healing arterial leg ulcer. The wound was granulating but dry. Forty-eight hours after application the dressing was removed, revealing a necrotic and dry eschar. The wound never returned to its original healing state. The patient

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- 1 Alginates are not appropriate for dry wounds.
- 2 If used in sinus wounds, care should be taken to change the dressing regularly to ensure that it does not dry out and to allow the sinus to drain.
- 3 They are easily removed from the wound by irrigation with saline.
- 4 Alginates remain an important component of wound care with several useful applications (e.g. as a haemostat).

eventually underwent amputation, with its associated pain and discomfort, as well as the pain of making a life adjustment.

It is important to note that it is not the dressing that created this situation, but the inappropriate choice by a practitioner with a limited knowledge of wound healing. It is possible that this patient would have had an amputation in spite of the wound condition, but it serves to remind us that dry dressings are not appropriate for dry wounds, and that education is important if dressings are to be used appropriately.

Action of alginate dressings

Studies suggest that residues of alginate fibres remain in the wound for some time after the dressing has been removed (Schmidt and Turner, 1986). A foreign body reaction to alginate fibres was reported seven months after the product was used (Odell et al, 1994). However, the reaction took place in a dental wound, and Berry et al (1996) found that the fibres from alginate dressings used in cavity wounds disappear as the wound matures.

Morgan (1997) describes alginates as:

- interactive, i.e. they produce an environment above the wound, which allows optimal healing
- bioactive, i.e. they intervene in the healing process by promoting optimal conditions for wound healing.

It is of extreme importance that the wound should never be 'plugged' with a dressing, as this can lead to entrapment of the wound as the fluid collects below the dressing.

Presentation

Many companies produce alginate dressings. Examples of some of the alginate dressings currently available are shown in *Table 2*.

Sinus wounds

Alginate dressings are used in sinus wounds, where they are very effective in absorbing fluid and helping to reduce the collection of pus in the 'bulb' at the base of the sinus as cleansing and drainage are important in diabetic foot lesions. Nevertheless, care should always be taken when 'plugging' any sinus with a dressing, as the dressing may dry out. This could have an adverse effect, blocking the exit of fluid

and thereby increasing the collection of pus in the sinus base, which could potentially increase the size of the sinus. This is particularly relevant in the diabetic foot, which often has tracking wounds and which alginates may not be appropriate for.

If alginates are used in sinus wounds, care should be taken to change the dressing regularly to ensure that it does not dry out and to allow the sinus to drain. Care should also be taken to ensure that residual fibres do not remain within the sinus track (or any wound bed).

Ease of removal

Alginates are easily removed from the wound with saline, regardless of the type of alginate used. Alginates that are rich in mannuronic acid (e.g. Sorbsan) form a soft and flexible gel that is dissolved with saline and easily washed out of the wound. Alginates that are rich in guluronic acid (e.g. Kaltostat), however, tend to form a firmer gel (Morgan, 1997), which is removed from the wound intact and should be soaked well with saline before removal.

Conclusion

It is essential to ensure appropriate use of dressings, and this can only be achieved through a thorough understanding of the wound healing process and how dressings can enhance that process.

Although wound dressings are constantly progressing to new levels, alginates remain an important component of wound care with several useful applications (e.g. as a haemostat), which will guarantee their place in the dressings cupboard for many years to come. ■

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Table 2. Examples of alginate dressings

Alginate ribbon (several types)
Algisite
Algisite M
Algosteril
Curasorb
Kaltostat
Melgisorb
SeaSorb
Sorbalgon
Sorbsan
Tegagen

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