Managing bio-burden and devitalised tissue: an early intervention using Woundaid®

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Abstract

Complex wound management provides many challenges to the clinician, all of which are determined by the presentation of the wound and the aims for healing. How we, as clinicians, approach this may be determined by our individual wound assessment, best practice and also our own clinical experience.

Wound bed preparation maximises the optimal wound healing environment; necrotic tissue is related to bacterial load and can have an adverse effect on wound healing. Necrotic tissue can be managed by debridement in the majority of wounds. However, this should only be considered following full assessment of the ability of the wound to heal and the patient's pre-existing comorbidities[1].

Autolytic debridement uses moisture-retentive dressings to facilitate the breakdown of necrotic tissue. Today there is a diverse range of wound care products designed to promote moist wound healing. Choice of dressing may be determined by availability, ease of use or cost-effectiveness. But how often is a product chosen for its anti-inflammatory activity or antimicrobial action when debridement is the initial goal?

This article reports the management of three case studies taking this early approach using a relatively new product called Woundaid®. The outcomes of this "first line" method of wound debridement and the positive outcome in wound healing can be seen. This is the first publication relating to this therapy according to current literature.

Introduction

Wound debridement removes necrotic tissue and bacteria that can impede the wound healing process. Effective management of devitalised, necrotic tissue can minimise complications associated with wound healing and facilitate a positive outcome for the patient[1]. Debridement can be achieved using different methods: surgical or sharp wound debridement, enzymatic, mechanical, autolytic or biosurgical[2]. The choice of debridement is determined by a comprehensive assessment of the person, their wound and the most suitable method[3].

The principles of acute wound management have been derived from the understanding of the wound healing process. Timely debridement and application of appropriate dressings are used to accelerate healing which in a healthy individual occurs in around 21 days without further clinical intervention[1]. Failure to progress through the healing process sees changes within the cellular environment and a disruption to a usually orderly process, subsequently leaving the clinician the challenges of managing a chronic wound.

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Chronic wound management is far more costly than simply the challenge to the clinician. Whilst the fiscal costs of ongoing care are relevant to the health service, we cannot forget the impact of a chronic wound on an individual's quality of life[4]. Quality of life can be significantly reduced with a non-healing wound[5]. There may be social isolation due to high levels of exudate and odour, ongoing pain associated with a wound and reduced functional capacity, whether this is decreased function in daily activities or loss of working time due to wound management practice.

Therefore, the ideal would be to prevent wounds reaching the stage of chronicity, to maximise healing outcomes by facilitating progression through the healing spectrum. When addressing the concept of wound bed preparation[1] should we consider the early use of an antimicrobial, anti-inflammatory product that will minimise the bacterial load, facilitate debridement and subsequently reduce the likelihood of an elongated inflammatory phase of healing leading to wound chronicity?

Today we are faced with a plethora of "moist wound healing products". Choice may be determined by availability, ease of use or cost-effectiveness. But how often is a product chosen for its anti-inflammatory activity or antimicrobial action when debridement is the initial goal? More often than not antimicrobials, antiseptics and anti-inflammatory products are seen as a measure against bacterial contamination in a chronic wound to overcome bio-burden and stimulate the normal healing process[6]. Indeed the decision to utilise these products is often several weeks post-injury, when a wound has become a chronic one.

Woundaid® is an emerging advanced wound care product in the Australian market with unique properties that can facilitate wound healing. It is a hydrogel containing 4% tea-tree oil, emulsifier and surfactants (Rye Pharmaceuticals).

Melaleuca (tea-tree) oil is a popular (natural) therapy[7] and has well-documented broad-spectrum, antibacterial, antifungal and antiviral properties[8]. However, its use in wound management products is still limited both in Australia and internationally.

Studies investigating the antimicrobial action of tea-tree oil have found that the mechanisms of antibacterial activity depend upon the pathogen involved and include "a loss of intracellular material, inability to maintain homeostasis, and inhibition of respiration". Much of the data relates to *in vitro* studies looking at the efficacy of tea-tree oil in killing methicillin-resistant *Staphylococcus aureus* (MRSA)[8]. Furthermore, investigation into the effects of tea-tree oil and biofilm formation[9] suggests that low concentrations of tea-tree oil can inhibit the growth of microorganisms which suggests justification of the use of tea-tree oil products for wound management.

The components of tea-tree oil exhibit antifungal and anti-inflammatory properties. Whilst initial evidence relating to these properties was anecdotal, more recently there is research (*in vitro* and *in vivo*) demonstrating that the component terpinen-4-ol of tea-tree oil can kill and inhibit yeast[8], in addition to suppressing the prolonged inflammatory response seen in chronic wounds[10]. As a native plant to Australia, tea-tree oil has long been used by our Indigenous population for medicinal purposes[11] and if you look at the shelves of the local pharmacy today it is also utilised as a treatment for acne or head lice or for fungal skin infections.

The following three case studies review the wound management of inpatients at a large inner-city teaching hospital, and shows the outcomes of their wound healing with the early application of Woundaid®.

Case study 1

Doug is an 81-year-old gentleman who lives independently at home. He was admitted after a fall. He did not sustain any bony injuries but had multiple pressure ulcers from lying on the floor for a prolonged period of time (approximately three days). He has a history of multiple myeloma and cardiac arrhythmia. His current medications are Thalidomide for myeloma. Documentation in Doug's admission notes state he has significant peripheral neuropathy and proprioceptive loss in his lower limbs.

On admission to the emergency department he had raised troponin levels and this was indicative that there may have been a cardiac precipitant to his fall. He was catheterised and given a loading dose of intravenous antibiotics and then commenced on oral tablets. All pressure ulcers were assessed and staged according to the Australian Wound Management[12] Clinical Practice Guidelines (consistent with the National Pressure Ulcer Advisory Panel; NPUAP). Initial wound assessment showed:

Right cheek – Stage IV pressure ulcer, black necrotic tissue size 1 cm x 0.5 cm, nil erythema or signs of infection.

Chest – Necrotic ulcer 1.5 cm x 2 cm, dry eschar, with a graze extending approximately 5 cm long, superficial, appeared clean, nil exudate.

Pressure ulcers to right and left knees – Both ulcers classified as Stage IV pressure ulcers. Black necrotic tissue, nil exudate, erythema to surrounding skin, painful to touch.

Both feet – Numerous areas marked from pressure to toes. Each of the pressure ulcers on Doug's toes were unbroken, with persistent redness and classified as Stage I. His left heel was classified as a Stage I pressure ulcer. Both feet had strong, palpable pedal pulses and his skin was uncompromised. Both lower legs had areas of marked erythema and a few superficial skin tears. His wounds were painful to touch but not on resting.

Wound management goals

Reduce bioburden, maintain moisture balance, remove devitalised tissue and prevention of further pressure injury.

Wound management plan on admission to ward

Right cheek – Woundaid® was applied with film dressing and this was redressed second daily.

Chest – Woundaid® with film was applied to the ulcer; hydrocolloid was applied to the graze and left intact for five days then redressed.

Right and left knees – Woundaid® adaptic and gauze with tubular retention dressing was applied. The dressing was reapplied second daily.

Skin tears – Mepilex border was applied and left intact for seven days.

Left heel – Foam dressing was applied for protection and an alternating mattress on his bed. His toes were left exposed and observed for any deterioration. He was placed on a pressure-relieving mattress according to his risk assessment status.

His wounds were photographed (Figure 1) one week post-admission and these were put in to the progress notes. This management plan continued for the next 12 days. He made good progress and his recovery was uneventful. Doug was then transferred to the inpatient rehabilitation unit.

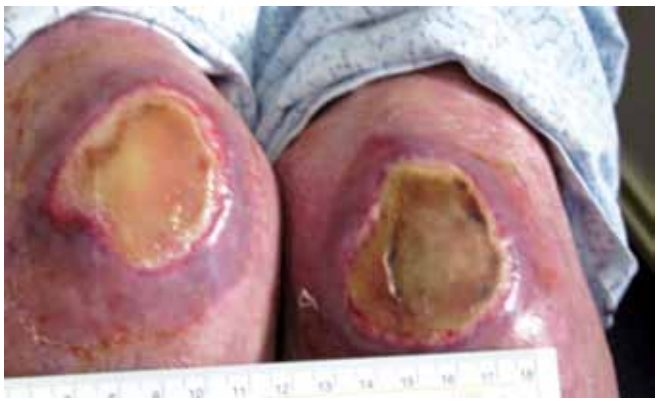

Figure 1. Knee wounds one week post-admission.

Following transfer to rehabilitation, Doug was seen by the wound CNC. At this stage, Doug's ulcer on his cheek had debrided well. It was clean, granulating and a hydrocolloid was applied to promote epithelialisation. The ulcer on his chest and graze had healed and was left exposed. Similarly the skin tears to his lower legs had also healed. The pressure areas on his toes had improved significantly and were left exposed. The left heel ulcer had deteriorated since admission and was now a Stage III ulcer. His knees remained sloughy with the eschar having been rehydrated using the Woundaid®.

Three weeks post-admission it was decided to apply maggot debridement therapy to both Doug's knee ulcers to facilitate wound debridement (Figure 2). Up until this point in time the necrotic tissue had been too dry for maggot application. Following discussion with the medical team and Doug, it was decided that this was a preferred choice to surgical debridement in view of his age and the risks associated with an anaesthetic.

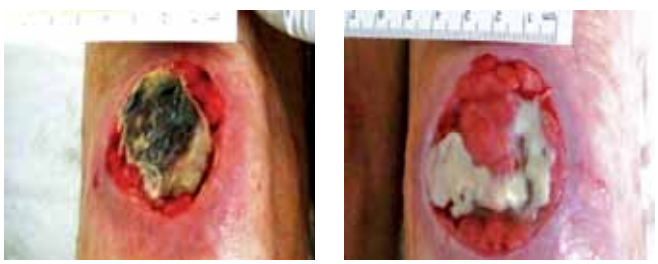

Figure 2. Knee wounds pre-maggot debridement therapy.

The maggots were left in situ for three days with an excellent result (Figure 3). On removal there was evidence of hypergranulation to the left knee, which was managed by applying local pressure using a polyurethane foam and fixation tape. This subsequently resolved within three days and Woundaid® was reapplied.

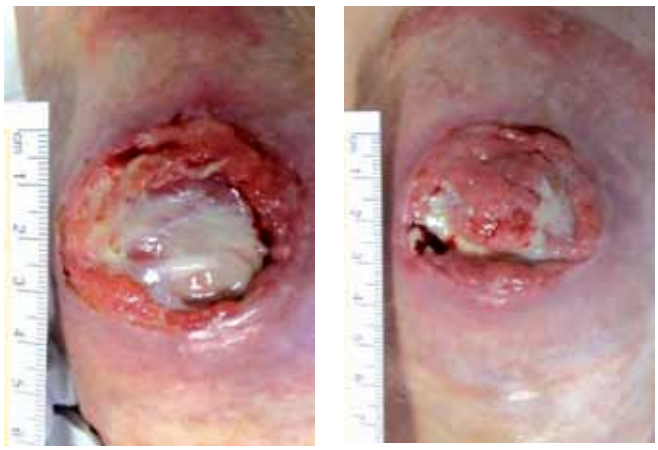

Figure 3. Post-maggot debridement therapy (three days later).

On admission, Doug was seen by the dietician and commenced on Arginaid with a thickening agent due to swallowing difficulties for nutritional support, which continued for the time he was in hospital.

Several weeks post-admission Doug's wounds continued to heal (Figure 4) and he was discharged home with community nursing support. Since discharge, all wounds continued to heal and Doug remains at home with support from the community nursing team for wound care only.

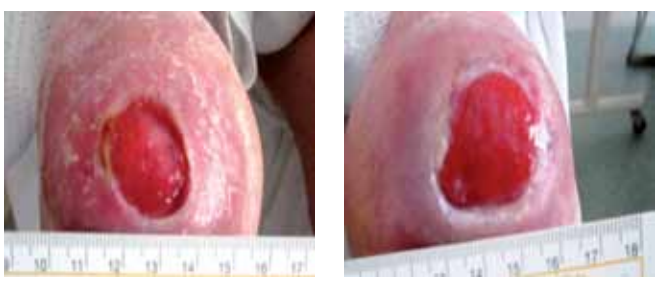

Figure 4. Knee wounds on discharge.

Case study 2

Alice is an 86-year-old lady admitted for removal of an infected dynamic hip screw and insertion of right hip arthroplasty. Her past medical history includes ischaemic heart disease, atrial fibrillation (rate controlled), hypertension, anterior myocardial infarction, fractured right neck of femur

in 2010 with insertion of a dynamic hip screw. Following her admission with a fractured neck of femur, Alice was discharged home, independently mobilising. Two months following discharge she began to experience an increased pain in her right hip. Further investigation revealed a peri-prosthetic fracture.

On admission, Alice had an ulcer of unknown aetiology on her right lower leg. The infected metalwork was removed under anaesthetic and copious amounts of pus removed around the plate. The area was debrided and she was commenced on intravenous antibiotics for six weeks and complete bed rest. Her operation notes state that the source of infection was likely from the ulcer on her right lower leg.

Swabs taken during surgery (from her hip) showed no bacterial growth, whilst there was *Staphylococcus aureus* and *Pseudomonas aeruginosa* found in the lower leg ulcer with the report stating probable colonisation and sensitivity to Flucloxacillin.

Initial wound assessment showed:

Lower leg ulcer – Size 5 cm x 4 cm, superficial. Sloughy tissue, moderate levels of serous exudate. Peri-skin dry and intact. Oedema to the lower leg and foot. Not painful. Aetiology unknown but it has been there for approximately eight weeks. Very weak pedal pulse.

Wound management goals

Reduce bioburden, maintain moisture balance and remove devitalised tissue.

Initial management

Iodosorb paste was applied to the ulcer and this continued daily for five days. During Alice's first week of admission she was commenced initially on intravenous Vancomycin, which was stopped following the wound swab results (after three days) and Flucloxacillin (intravenous) commenced with oral Rifampicin. She was also seen by the dietician and commenced on nutritional supplements. At this point in time she remained on complete bed rest.

Following the initial application of Iodosorb there was a decrease in sloughy tissue, increase in granulation tissue and a marked decrease in exudate levels and erythema surrounding Alice's ulcer. However, as the ulcer dried out there were increased pain levels, not only during dressing changes but periodically at other times. Her analgesic regime was modified with good effect.

The decision was made to change to Woundaid® to rehydrate the wound and facilitate further granulation and continue management of bioburden (Figure 5). This was redressed second daily.

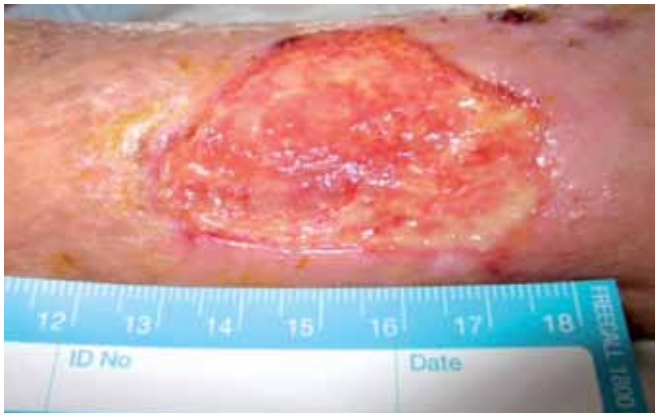

Figure 5. Leg ulcer pre Woundaid® application.

Following orthopaedic review, Alice began to mobilise non-weight bearing and was then able to shower her wound. The wound management plan continued for the following three weeks and pre-discharge she was reassessed and the primary dressing changed to a silicone-based adhesive dressing. On discharge there was a marked decrease in ulcer size and this has since healed (Figure 6).

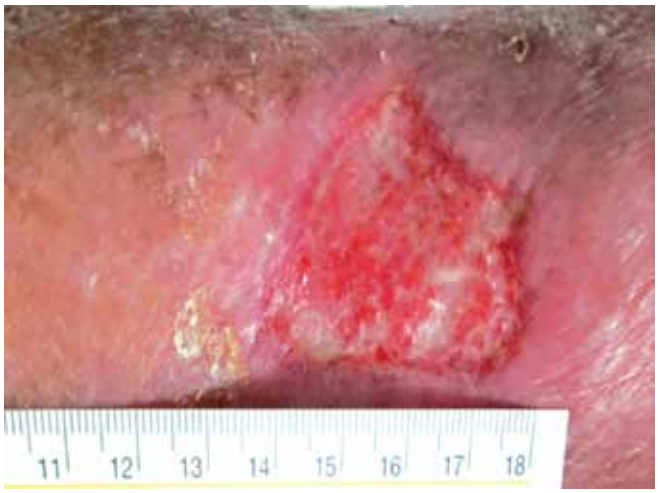

Figure 6. Leg ulcer following three weeks treatment with Woundaid®.

Case study 3

William is a 60-year-old gentleman admitted for evacuation of rectus sheath haematoma secondary to over-coagulation of warfarin. His past medical history includes pulmonary hypertension, ischaemic heart disease, atrial fibrillation, diabetes mellitus (Type II), hypertension and peripheral vascular disease, for which he underwent a left bypass graft.

William underwent surgery for evacuation of a rectus sheath haematoma and removal of a vas catheter. His admission was complicated due to ongoing anaemia. He developed a respiratory tract infection (and was admitted to the intensive care unit), sepsis and several surgeries for further removal of necrotic tissue and wound closure. On admission to hospital

he was MRSA-negative but did receive several courses of antibiotics due to his infections.

Wound history

William's initial surgical wound was left open.

Day 3 – Return to surgery for debridement and primary closure following removal of necrotic rectus muscle and fatty tissue.

Day 12 – Further debridement of the anterior aspect of the abdominal wound. Consultation with the plastic surgeons and negative therapy commenced to the abdominal wound.

Day 25 – Debridement and split skin graft to abdominal wound. Donor site left thigh, postoperative negative therapy applied to graft site.

Following this, William made a slow recovery and his skin graft had approximately an 80% take; his donor site healed without complications. However, central to the graft there was a persistent area of sloughy tissue and the vascular team requested a consultation from the wound CNC 11 days post-graft.

Initial wound assessment

Skin graft to abdominal wound, shallow cavity with skin graft (Figure 7). Non-healing sloughy area in the middle of the graft running from anterior to posterior aspect, probing showed depth at posterior wound 0.3 mm. Small area of hypergranulation on graft. Minimal exudate. Nil odour to wound. Peri-skin dry but intact. Nil pain associated with the wound.

Wound management goals

Reduce bioburden, maintain moisture balance, remove devitalised tissue and protect initial graft to prevent breakdown.

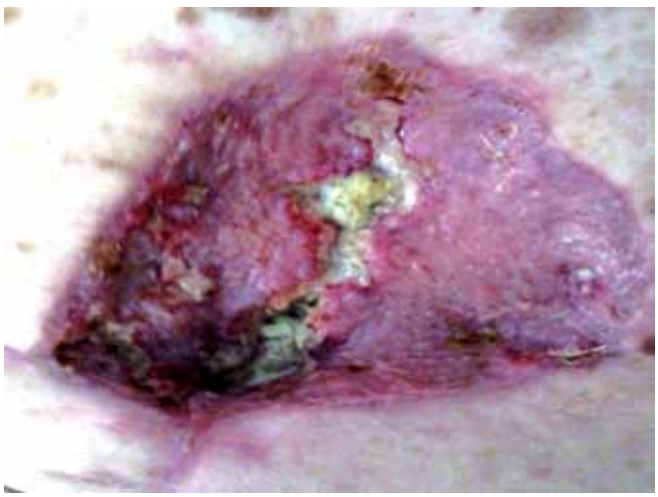

Figure 7. Abdominal skin graft pre Woundaid® application.

On admission to rehabilitation, William was seen by the dietician and commenced on nutritional supplements to facilitate wound healing and supplement his dietary intake. Since admission to hospital he had lost approximately 10 kilos.

Woundaid® was applied to the wound with gauze to fill the cavity and a pad for protection as a secondary dressing. William showered the wound second daily and Woundaid® continued whilst as an inpatient.

William was discharged six weeks following admission (including two weeks in the rehabilitation unit) and was independent with self-care. His wound had made good progress (Figure 8) and wound management was handed over to the community nursing service. Unfortunately, William developed a haematoma on the lower part of his abdominal wound which was a new setback and was readmitted to hospital three weeks later. On readmission the initial skin graft had completely healed with the sole use of Woundaid®.

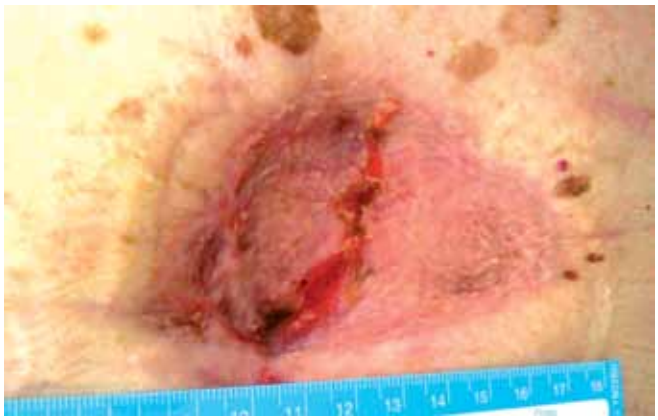

Figure 8. Abdominal skin graft on discharge (two weeks post Woundaid® application).

Discussion and implications for practice

These case studies demonstrate the positive outcomes for wound healing with the application of an antimicrobial, anti-inflammatory product. Woundaid® had the advantage of maintaining a moist wound environment and did not cause any maceration to the peri-skin.

The combination of a hydrogel with tea-tree oil allows antimicrobial activity whilst facilitating debridement of necrotic tissue. As previously stated, tea-tree oil demonstrates broad spectrum antimicrobial activity against a variety of organisms which may be present in a wound. At the same time the presence of tea-tree oil could prevent the prolonged inflammatory state[13].

With the combination of antimicrobial, anti-inflammatory properties, the decision to apply Woundaid® to these wounds at an early stage was to facilitate debridement of necrotic

tissue, inhibit chronic inflammation and subsequently improve wound healing outcomes.

Ease of application to wounds using Woundaid® was seen for both cavities and superficial areas. It is conformable to cavities and was easily applied in combination with a gauze or non-adherent dressing. The advantage of application with a gauze dressing was identified as a low-cost alternative.

From a wound management perspective, the ease of use was further supported by the performance of the product in terms of moisture management. There was no maceration seen to the peri-skin in any of the case studies shown. In fact unlike other hydrogels there was more of a tendency for the Woundaid® to dry out if left in situ for too long. In view of this observation, the Woundaid® was reviewed every two days to ensure a moist environment was maintained to maximise wound healing.

The 4% concentration of tea-tree oil in Woundaid® produced a notable but not overpowering odour that was well received by both patients and staff alike and was useful in managing malodour in these wounds.

Woundaid® is a registered pharmaceutical and whilst sensitivity has been associated with tea-tree oil use this is related to undiluted tea-tree oil causing skin irritation[9]. Prior to the application of Woundaid®, patients were asked whether they had previously experienced any sensitivity or reaction to tea-tree oil.

Summary

With such positive outcomes and achieving wound healing in all of the case studies included in this article and other wounds within the hospital, Woundaid® is now a first choice of hydrogel for wounds requiring debridement, irrespective of length of time following injury.

Woundaid® costs significantly far less than traditional hydrogels (in NSW) with the added advantage of an antimicrobial and anti-inflammatory effect. The ability of its simplicity for application and decreased dressing frequency and application time further supports the potential cost saving using the product. The financial cost of managing chronic wounds has been well documented. Cost may be associated with dressing materials, nursing time, frequency of changes and cost of the care setting[14].

The positive outcomes seen using Woundaid®, with a decrease in debridement time, decrease in healing time and potentially a decrease in length of stay for the patient, further support this choice as a first-line wound management product.

Early intervention to manage bio-burden is achievable with the application of a suitable product. In an era when we are seeing the increasing resistance to antibiotics and the concerns regarding the ongoing use of silver as an antimicrobial wound dressing, perhaps we should revisit the 'natural' approach to wound management and take a leaf out of our forefathers' book!

Declaration

Dressing products used in the identified case studies were supplied through the usual channels for the facility via stores. No products were supplied free of charge or as part of a company trial.

Acknowledgements

Thank you to all the patients used in the case study for giving consent to photograph their wounds and allowing me to share their history and experiences with a wider audience.

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