Enzymatic Debridement: A failed promise, or hope for the future?

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Wound Debridement

Wounds can be characterized by the presence of devitalized, necrotic tissue that stalls wound healing in the inflammatory phase primarily through increased inflammatory mediators and bacterial colonisation leading to impaired formation of granulation tissue (2)(8)(4). Removal of this nonviable or contaminated tissue through debridement has been documented since the late 1800s as an essential step in healing (4)(8)(16). Since the earliest descriptions of healing (16)(16), it has been recognized that military wounds, techniques have expanded significantly. Currently available methods of debridement include: surgical, bio-surgical, autolytic, mechanical, chemical and enzymatic (16)(16). A particular method may be selected based on evaluation and considers the factors of cost: ease of infection, clinician experience, tissue type & patient preferences (16)(16).

Enzymatic debridement

Enzymatic debridement is the application of exogenous enzymes to the wound bed in order to degrade necrotic tissue while maintaining the normal function of healthy tissue (6)(6). The literature reveals claims that enzymatic debridement acts as itself to a clinically effective, safe and inexpensive method of debridement (7)(8). It is stated to be an excellent choice of debridement in patients with infected or contaminated wounds requiring the removal of yellow slough or black eschar, as well as in patients who have opted for surgical debridement excluded due to anticoagulant therapy (8)(8). However, a 2010 Cochrane review on wound debridement revealed that enzymatic debridement is relatively slow and requires more frequent dressing changes (2). The review also communicated that there is minimal hard evidence (level A studies) for the use and efficacy of different enzymatic debriding agents (2). This is customary for most forms of debridement, where practice is based on tradition and anecdote as opposed to evidence based wound care (6).

Current products for enzymatic debridment

From the literature, there appears to be significant promise in the realm of enzymatic wound debridement, however clarity and rigor is lacking. There is a need for rigorous clinical trials comparing the three main potential enzymes in enzymatic wound debridement: bromelain-derived products, collagenase-based products and cyanate proteases derived from Carica Papaya such as papain. There is also a need for comparisons between these products and current standards of care (surgical and non-surgical). This poster illustrates fundamental information on each of these three enzymatic debriding agents.

BROMELAIN

- Bromelain is a natural complex of proteolytic enzymes which are extracted from the stem and trunk of pineapple (Ananas comosus) and its leaves.
- These enzymes have been demonstrated in vitro and in vivo to have anti-inflammatory, anti-fibrotic, anti-thrombotic and antimicrobial effects.
- It is used in the treatment of inflammatory and fibrotic conditions such as osteoarthritis and diabetic ulcers, as well as tailoring for malignancy (12).
- More recently, it is being studied for its potential use in the treatment of chronic venous disease.
- With regards to treatment, it is a well researched form that is considered safe and effective for use.
- It is noted that bromelain is a potent anticoagulant which means that it has the potential to increase bleeding.
- Bromelain is a natural, non-toxic and non-toxic way to enhance wound healing.
- It has been shown to promote tissue repair, reduce inflammation, and increase blood flow to the wound site.
- Bromelain is clinically effective and safe for use in a variety of wound conditions.

COLLAGENASE

- Collagenase (Spectra, PharmaFlow) is a natural enzyme derived from bacteriophage that degrades collagen tissue.
- The enzyme is derived from the bacillus subtilis strain and is used to remove nonviable tissue.
- It is a fibrinolytic agent that breaks down fibrin, which is the main component of the extracellular matrix.
- Collagenase is effective in removing nonviable tissue, especially in cases of deep wounds or where the tissue is more fibrotic.
- Collagenase is not absorbed into the bloodstream and is therefore considered safe for use.

PAPAIN

- Papain is a proteolytic enzyme isolated from the latex of Carica papaya. It is a potent collagenase that degrades collagen tissue.
- Papain is known for its high specificity for collagen, making it a popular choice for debridement.
- Papain is also used in various medical applications including in the treatment of chronic wounds.
- However, papain has some limitations, such as the risk of allergic reactions and the need for careful application.

Molecular activity and Tissue selectivity

- There are limited studies in the molecular activity and tissue selectivity of collagenase, papain and bromelain, however the studies that have been conducted show promising results.
- The molecular activity of each enzyme is specific to the type of tissue it degrades, allowing for selective removal of nonviable tissue.
- Tissue selectivity is critical in ensuring that only nonviable tissue is removed, allowing for healthy tissue to remain intact.

Clinical efficacy

- There is some limited evidence reporting the benefits of debridement as a debriding agent.
- However, the evidence from a study in 2013 indicates that patients treated with bromelain experienced significant faster debridement rates than those treated with other agents or no surgery alone. Average time to debridement was 1.7 days for bromelain versus 9.4 days for control.
- The study also found that bromelain was more effective in non-viable tissue in patients with diabetes.
- Some studies have noted that collagenase may be more effective in wounds with less tissue damage.
- However, there are challenges in the clinical efficacy of debridement agents due to the variability of wound characteristics and patient factors.

Conclusion

There is a great potential for the use enzymatic debridement on acute/chronic wounds, including burns. However, the current use of these products appears to reflect a failed promise. This may be a result of a number of restricting factors, most prominent being a lack of strong evidence on the clinical efficacy of each product and comparisons between products. The costs of debridement agents can vary significantly between products, including application and incorporation into wound preparation options for wound specialists. Further, staff need to be competent in applying the product correctly. Specific to each product, there are various precautions that have limited their use in most countries. However, the example papain is known to cause pain to the patient due to its tissue non-selectivity. It also poses a risk of hypersensitivity reactions in a small number of recipients.

What the future holds for enzymatic debridement is uncertain. However, if the current products were to be refined and their clinical properties and standards of use are developed, then there is considerable prospect for their inclusion into best practice wound management in Australia and abroad.

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References