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Case Series

Bromelain based enzymatic debridement in burn patients, its outcome, advantages and disadvantages

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ABSTRACT

The aim of this study is to evaluate the outcomes, advantages, and disadvantages of bromelain-based enzymatic debridement in the management of burn wounds. Ours is a study in which we have selected 10 patients with deep dermal and full thickness burns admitted in SMS hospital, Jaipur. These patients underwent bromelain based enzymatic debridement applied as per the manufactures protocol. The patients were then observed for bromelain's efficacy in debridement, wound healing, pain, duration of hospital stay, superadded bacteraemia and cosmetic outcome. Complete removal of burn eschar was observed in 9 out of 10 patients. Bromelain-based enzymatic debridement effectively removed necrotic tissue within a shorter timeframe compared to traditional methods. Patients treated with bromelain-based enzymatic debridement showed significantly faster wound healing, reduced infection rates, and lower pain levels during debridement. Improved cosmetic outcomes, such as reduced scarring and better skin texture, were also observed. Bromelain-based enzymatic debridement offers notable advantages in burn care, including expedited healing and enhanced patient comfort. Despite these benefits, the treatment's higher cost and the risk of allergic reactions are important considerations. The limited availability of bromelain-based products also poses a challenge. These factors suggest that while bromelain is a promising alternative, its use should be carefully evaluated based on individual patient needs and resource availability.

Keywords: Bromelain, Deep burns, Enzymatic debridement, Infection rate, Total burn surface area, Wound healing

INTRODUCTION

Burn injuries are a significant health concern worldwide, often leading to severe complications and requiring effective management strategies to promote healing and minimize morbidity. Debridement, the removal of necrotic tissue, is a critical step in burn wound care in order to prevent secondary infection and late complications such as hypertrophic scar. Traditional methods, such as surgical and mechanical debridement, though effective, can be associated with pain, bleeding and delayed healing. The negative consequences of surgical necrosectomy led to the development of less invasive methods of burns debridement–enzymatic necrolysis. Bromelain is a pineapple plant stem-derived concentrate of proteolytic enzymes (e.g., thiol-endopeptidases, phosphatases, glucosidases, peroxidases, cellulases, glycoproteins, carbohydrates, and other nonprotein components), has become popular for deep partial thickness (DPT) and full thickness (FT) burn debridement.[1-4] The product consists of a powder of enzymes mixed with a hydrating gel. It has anti-inflammatory, anti-oedematous, analgesic, anti-thrombotic and exfoliative properties mediated through the kallikrein-kinin and arachidonic acid pathways, as well as through effects on cell-mediated immunity.[5-7]

Unlike surgical debridement, bromelain is a more selective eschar removal agent resulting in a wound bed with a sufficient quantity of viable dermis to support spontaneous re-epithelialization. Bromelain based debridement is a bedside procedure with no requirement for staff, sophisticated equipment, or expensive resources.

This study aims to explore the outcomes, advantages, and disadvantages of using bromelain-based enzymatic debridement in burn patients. Through a detailed examination of patient cases, this study will assess the efficacy of this treatment modality, its impact on wound healing, patient comfort, and overall clinical outcomes. Additionally, the potential limitations and challenges of bromelain-based debridement will be discussed to provide a comprehensive understanding of its role in modern burn care.

CASE SERIES

A total of 10 patients were included in this study who were admitted in SMS hospital, Jaipur from a period of Januray,2024 to August 2024. Patients diagnosed with acute deep partial to full thickness thermal, electric flash or scald burn injury, of the age greater than 10 years, were included in this study. Exclusion criteria consisted of patients less than 10 years of age, electric contact burn, chemical burn, non-burn wound, immunocompromised patients and patients with known allergies to bromelain. This product can also be applied in children less than 10 years of age, however, further research is still required to prove so.

On admission, patients were examined for total burn surface area and their vitals were noted. Stable patients who fulfilled the inclusion criteria were selected and their wounds were washed and cleaned thoroughly with normal saline after sending pus culture for sensitivity. Bromelain powder (5g) was mixed in a vehicle gel (50g) and applied topically over deep partial to full thickness burn wound and covered with dry dressing material left for 4 hours.

The dressing was then removed and wound examined for debridement. Slough which got separated from the wound due to enzymatic debridement was washed off the bed via normal saline and the wound covered again via saline soaked gauze which was left in place for another 2 hours. Final assessment of the wound was done after this period which was then covered with saline soaked dressing. Patients were dressed daily and culture for sensitivity was sent on third date of admission. Wound was assessed on a daily basis and patients were observed for their vitals and for signs of infection. Patients were followed up for a period of 6 weeks post debridement.

This study's results were mainly divided into two outcomes namely primary and secondary. Primary outcomes pertained to wound healing, infection rates, pain levels (measured by a visual analogue scale), scar formation and hospital stay. Secondary outcomes included Patient satisfaction and occurrence of adverse effects (e.g., allergic reactions). Out of 30 patients screened, 10 people met the inclusion criteria. The patient demographics have been summarized in Table 1. Maximum number of patients were found to be of the age group 46-55 years whose average total burn surface area was 30 %. Deep partial thickness burn wound epithelized within 3 weeks of bromelain-based debridement in 9 out of 10 patients. One out of 10 patients wound did not epithelize and a larger area of wound cover was required. The remaining deep full thickness burn wound developed into raw areas and then was covered with autologous split thickness skin grafting within 15 days of debridement.

Pus culture for sensitivity of all patients was sent on third and fifth day of bromelain debridement and recorded. Gram positive and negative pathogens were present in the culture and it was found that the culture profile of these patients was similar to those of patients who were not treated with bromelain. Sharaf et al, showed that the microbial profile of 40 burn patients treated with bromelain was similar to what is widely reported in cases treated without enzymatic debridement in all stages of wound healing.[8] Pain experienced by the patients was analysed with the help of visual analogue scale and it was found that most of the patients experienced moderate amount of pain on day 3 of bromelain application which then reduced on day 6.

Table 1: Demographics.

Age (in years)	Male	Female	TBSA (%)
15-25	1	0	35
26-35	1	1	25
36-45	2	0	40
46-55	3	1	30
56-65	1	0	50

Table 2: Severity of burn wound.

Age (in years)	TBSA (%)	Deep partial thickness (%)	Full thickness (%)
15-25	35	20	15
26-35	25	20	5
36-45	40	25	15
46-55	30	10	20
56-65	50	20	35

Table 3: Pain scale.

Visual analogue scale	Number of patients	
	Day 3	**Day 6**
0-2 (mild)	3	7
3-5 (moderate)	5	3
6-8 (severe)	2	0
9-10 (very severe)	0	0

Table 4: Scar formation.

Vancouver scar scale	Number of patients	
	Day 21	Day 42
0-3	0	1
4-6	3	6
7-9	6	2
10-13	1	1

7 out of 10 patients with 25-35% of total burn surface area were discharged within 7-10 days of admission. 3 out of 10 patients with greater than 40% total burn surface area were admitted for more than 10 days and were discharged only after covering their deep full thickness wound with split thickness skin grafting. Scar formation was assessed on day 21st and day 42nd of burn via Vancouver scar scale. Figures 1-3 describes the cases before and after bromelain-based debridement. Figures 1a, 2a and 3a represent wounds on the day of burn and 1b, 2b and 3b represent post bromelain application day 3 wound.

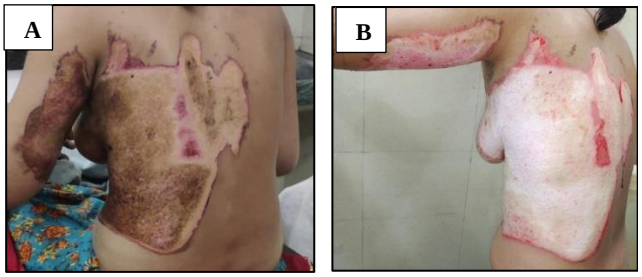

Figure 1 (A & B): Pre and post enzymatic debridement.

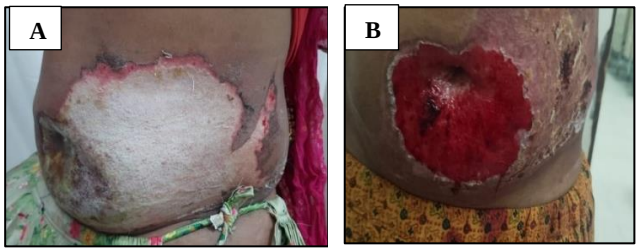

Figure 2 (A & B): Pre and post enzymatic debridement.

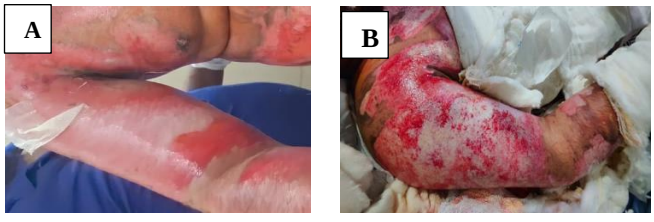

Figure 3 (A & B): Pre and post enzymatic debridement.

DISCUSSION

This study demonstrates that bromelain-based enzymatic debridement offers several advantages in the management of burn wounds, particularly in terms of healing time, infection rates, pain levels and cosmetic outcomes. These findings provide valuable insights into the potential of bromelain as an effective alternative to traditional debridement methods in burn care.

One of the most significant outcomes observed in this study was the reduction in healing time for patients treated with bromelain-based debridement. The enzymatic action of bromelain effectively breaks down necrotic tissue, facilitating a quicker transition to the proliferative phase of wound healing. This accelerated healing process can lead to a reduction in hospital stay duration and a decrease in overall healthcare costs.[1] As seen in Table 2, the deep partial thickness wound epithelized within 3 weeks of bromelain debridement in 9 out of 10 patients.

The remaining 1 patient developed deep full thickness burn wound which formed raw areas and had to be covered. The faster healing observed in this study aligns with previous research that suggests enzymatic debridement can enhance wound closure rates by maintaining a moist wound environment conducive to tissue regeneration.[9-11] This benefit is particularly important in burn patients, where prolonged wound exposure increases the risk of infection and other complications.

The study also found that infection rates were significantly lower in the group treated with bromelain compared to those who underwent traditional debridement methods. The rapid removal of necrotic tissue, which can serve as a breeding ground for bacteria, likely contributes to this reduction in infection risk. Pus for culture and sensitivity profile showed that patients who underwent conservative management without bromelain debridement was same as that of those who received bromelain debridement.

Additionally, bromelain's anti-inflammatory properties may help reduce local inflammation and swelling, creating a less favorable environment for bacterial growth. This outcome is crucial in burn care, where infections can lead to severe complications, including sepsis, prolonged hospital stays and increased mortality. By lowering infection rates, bromelain-based debridement not only improves patient outcomes but also reduces the need for antibiotics, which can help mitigate the risk of antibiotic resistance.

Another notable advantage of bromelain-based debridement highlighted by this study is the reduced pain experienced by patients during the debridement process. Traditional debridement methods, such as mechanical or surgical debridement, can be quite painful and often

require anesthesia or significant analgesia. In contrast, enzymatic debridement with bromelain is less invasive and typically less painful, making it a more tolerable option for patients. Pain experienced by patients reduced on day 6 as compared to day 3. Only 2 patients experienced severe pain on day 3 who were diagnosed with greater than 40% total burn surface area. The reduction in hospital stay is a significant outcome of using bromelain-based enzymatic debridement for burn patients. Several factors contribute to this outcome, primarily the accelerated wound healing process and reduced complication rates associated with enzymatic debridement. Patients with total burn surface area of greater than 40% had to be admitted for more than 10 days as the area of wound was bigger and the percentage of deep full thickness burn was also more.[10]

Cosmetic outcomes are a significant concern for burn patients, as scarring can have profound physical and psychological effects. In this study, we found that 6 out of 10 patients had a VSS score of 7-9 on day 21 and 6 patients had 4-6 score on day 42. Only 1 out of 10 patients who had total burn surface area of 50% had 10-13 score on VSS. The study found that patients treated with bromelain had better cosmetic outcomes, with less hypertrophic scarring and improved scar texture and colour. The gentle debridement process of bromelain preserves healthy tissue while selectively removing necrotic material, potentially leading to more favourable healing conditions and less scar tissue formation. This is particularly advantageous for patients with burns in highly visible or functional areas, where minimizing scarring is crucial for both aesthetic and functional recovery. After having discussed all the advantages of bromelain based enzymatic debridement, there are a few disadvantages which need attention. These include the risk of allergic reactions, higher costs, limited availability and accessibility, variable efficacy, the need for strict wound management protocols, potential tissue maceration and lack of long-term data. For patients with known allergies to pineapple or other plant-based enzymes, bromelain is contraindicated, limiting its use in certain populations. The need for specialized training to apply bromelain-based debridement correctly may limit its use in settings without adequately trained healthcare professionals.

Due to its enzymatic action, bromelain can occasionally lead to maceration of surrounding healthy tissue if not applied correctly or if excessive moisture is retained in the wound area. Careful application and frequent wound assessments are necessary to prevent these complications, which may not be feasible in all healthcare settings, particularly those with limited staff or resources. Clinicians should weigh these disadvantages against the benefits when deciding whether to use bromelain-based debridement for their patients, considering individual patient needs, healthcare setting capabilities, and available resources.

CONCLUSION

Bromelain-based enzymatic debridement represents a promising advancement in the management of burn wounds, offering several notable advantages over traditional debridement methods. The findings of this study highlight that bromelain is effective in accelerating wound healing, reducing infection rates, minimizing pain, and improving cosmetic outcomes. These benefits are particularly valuable in burn care, where prompt and efficient wound management is crucial to preventing complications and enhancing patient recovery.

The use of bromelain-based enzymatic debridement should be carefully considered based on individual patient needs, available resources, and the healthcare setting. While it offers a less invasive and potentially more comfortable alternative to mechanical and surgical debridement, it is essential to balance these benefits with the associated disadvantages such as allergic reactions, higher costs, limited availability and accessibility, variable efficacy, the need for strict wound management protocols and potential tissue maceration.

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