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A comprehensive review on biological and biosynthetic alternatives for management of burns in Veterinary medicine

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Abstract

Burn injuries involving the skin and underlying tissues represent a major cause of morbidity and mortality in animals and humans. Management of burn wounds depends on burn depth, extent, and presence of infection. First and second degree burns with minimal area are commonly treated with topical silver-based agents; however, deep partial-thickness and full-thickness burns require surgical debridement and advanced wound dressings. In recent years, biological and biosynthetic dressings have gained importance due to their ability to promote wound healing, reduce pain, and improve patient outcomes. Biological dressings such as boiled potato peel, banana leaf, honey, and papaya pulp are cost-effective, easily available, and particularly useful in superficial and partial-thickness burn wounds. Banana leaf dressing offers excellent affordability and non-adherent properties, honey provides antimicrobial and chemical debridement effects, while papaya pulp acts as a natural enzymatic debriding agent and enhances granulation tissue formation. Biosynthetic substitutes including Biobrane, Aquacel Ag®, Integra®, and Matriderm® have shown advantages such as faster epithelialization, reduced pain, and shorter hospital stay. However, their application is limited by high cost, availability, and specific indications. Therefore, selection of an appropriate dressing must be individualized based on wound characteristics, infection status, and resource availability. Both biological and biosynthetic dressings play a crucial role in modern burn wound management.

Keywords: Burn injury, biological dressings, Biosynthetic dressings, Banana leaf, Honey, Burn wound management

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Introduction

Burn is an injury of integuments (Skin) & underlying tissues caused by chemical, thermal, electrical, and biological agents. It is a major cause of mortality and morbidity in animals (Hettiaratchy and Dziewulski, 2004; Nandi *et al.,* 2021). First and second degree burn with small area is managed by conventional burn wound using of topical silver-based agents such as silver sulphadiazine and silver nitrate, either alone or in combination with cerium nitrate or mafenide (Slatter, 2003).

The management of deep partial thickness (second degree) and full thickness (third degree) burns involves surgical debridement and advanced wound dressings. In recent years, biological and biosynthetic dressings have gained importance due to their ability to promote wound healing, reduce pain, and improve patient outcomes. Biological dressings like boiled potato peel (Keswani and Patil, 1985; Manjunath *et al.,* 2015), autoclaved banana leaf (Gore and Akolekar, 2003), honey (Subrahmanyam, 2007) and papaya pulp dressings (Jayarajan *et al.,* 2016), have been used with variable success. Additionally, several commercially available biosynthetic skin substitutes such as Biobrane (Greenwood *et al.,* 2010), Aquacel Ag (Lohana and Potokar, 2006), Integra (Alnababtah, 2010) and Matriderm (Shahrokhi *et al.,* 2014), developed from various biomaterials, have been employed in the management of burn wounds in human burn wound management, however, its selection has to be individualized based on wound depth, infection status, and resource availability.

Biological alternatives

Boiled potato peel dressing

It is a readily available dressing which can be stored without difficulty and cost-effective. It is easy to apply and less painful to remove. In superficial partial thickness burns, it seems to prevent burn wound dehydration and permit quicker wound healing with a smoother, less erythematous surface. In deeper burns, the results are not much encouraging. Clinical trials performed in individuals have demonstrated epithelial growth under potato peel dressings in superficial partial thickness dermal burns. In deep partial thickness burns, full thickness burns and in the late granulating burn wound the results are not as favorable (Keswani and Patil, 1985).

Manjunath *et al.* (2015) managed a necrotizing fasciitis wound by surgical treatment with debridement and use of broad-spectrum antibiotics along with a novel adjunctive, 'potato-peel dressing' with promising results. The chronic non-healing wound showed 50% reduction in the wound size by the end of 7 days.

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Figure 1: Necrotizing fasciitis following surgical debridement

Figure 2: Wound dressing with potato peel and sofra-tulle

Figure 3: Post operative reduction in the size of wound

Banana leaf dressing

Banana leaf dressing (BLD) is a suitable and effective dressing for partial thickness burn wounds. The efficacy of banana leaf dressing is comparable to that of boiled potato peel bandage for partial thickness burn wounds. Banana leaf dressing is the cheapest of all available dressings for partial thickness burn wound cover. The preparation is very simple and can be easily learnt and taught. This cheap dressing provides an opportunity to achieve economic independence and supports successful rehabilitation of burn victims. To conclude, BLD is cheap, effective, simple to prepare and easily available, non-toxic, non-antigenic, non-adherent acceptable alternative for management of partial thickness burn wounds.

Gore and Akolekar (2003) compared banana leaf dressing (BLD) and boiled potato peel bandage (BPPB) in patients with burn size less than 50% total body surface area (TBSA) and concluded that although efficacy of BLD and BPPB was parallel in all respects, BLD was 11 times cheaper than BPPB. Banana plants are easily grown, available throughout the year and the leaves of banana offer coverage of larger wound surface area. Additionally, the surface of leaves is non-adherent, waxy and cool.

Honey Dressings

Honey has been popular for its medicinal properties for years now. Ayurveda – The Indian medicine system describes honey as “The nectar of life” and suggested its use in the treatment of ailments like diarrhoea, ulcers, etc. Honey is a nutritious food, recommended to be taken early in the morning along with lemon juice and hot water. It was used for embalming the dead in Egypt and also as a component of beauty creams.

Honey has not only been used as an adjuvant for accelerating wound healing in burns, ulcers and infected wounds but also been used for storing skin grafts. In 1933, Honey was described as the best natural dressing after its use in burns. Honey caused relief of pain with its soothing action hence was used to treat scalds (Subrahmanyam, 2007).

Experimental studies conducted in animal models demonstrated faster healing and reduced inflammation in infection-free superficial burns than controls and also in full-thickness

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wounds and wounds experimentally infected with Staphylococcus aureus. There have been case reports describing burn wounds not responding to conventional treatment but healed when honey dressings were used.

In 1996, Subrahmanyam compared the honey dressings and boiled potato peel dressings (BPPD) for treatment of burns in human patients divided in two groups of 50 patients each. Based on the healing effects of both he concluded that honey performs chemical debridement, prevents bacterial colonization on wounds and caused healing of wounds within 15 days. On the other hand, Boiled potato peel dressing, did not provide any antibacterial effect leading to which persistent infection was noted and only 50% wounds treated showed healing within 15 days period, however, it was observed that BPPD provided depigmentation which was not significantly evident in case of honey.

Papaya pulp wound dressings

The concept of using papaya as a debriding agent came from its use in Ayurvedic practice by local Ayurvedic physicians after use of papaya latex as a debriding agent. Bhavaprakasham Nighantu, an Ayurvedic classic written in the sixteenth century by Bhava Mishra, describes the characteristics and the use of various plants and minerals in medicine. Wound cleansing effect of papaya was mentioned in book. Carica papaya, with a long history of being a very effective medicinal plant, is considered to have significant wound healing properties. It consists of proteolytic enzymes, papain, and chymopapain in various levels in the fruit, latex, leaves, stems, and roots. Its proteolytic action is marked in any pH solutions while having a digestive power at a wide range of temperatures and pH (Jayarajan *et al.,* 2016).

Papain from Carica papaya has been used since ancient times in Ayurvedic medicine in India. The activity of papain is higher in extracts from the younger fruit than the older fruit. Vitamin C in papaya converts proline to hydroxyproline, which is an indicator of collagen content of granulation tissues. While, the latex from papaya has been used to treat bronchitis, urinary tract infections, skin conditions, parasitic manifestations etc., antioxidant property of papain prevents the risk of oxidative damage to tissues.

Figure 4 : Boiled potato peel

Figure 5 : Banana peel

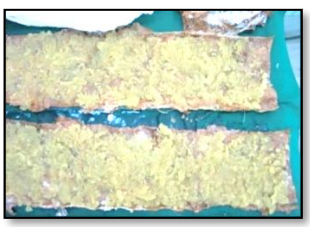

Figure 6 : Papaya pulp

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Biosynthetic alternatives

Biobrane

Biobrane is a temporary biosynthetic skin dressing used on superficial and partial-thickness wounds and donor/sites. It is composed of a silicone membrane bonded to a nylon mesh to which peptides from a porcine dermal collagen source have been bonded to the nylon membrane to form a flexible and conformable composite dressing (Greenwood *et al.,* 2009). Advantages of biobrane include:

- ✓ Decreases length of patient stay
- ✓ Increased speed of healing
- ✓ Decreased Pain
- ✓ Increase rate of Epithelialization
- ✓ Increased Mobility

Disadvantages of biobrane include:

- ✓ It does not adhere to the wound bed if the wound is not meticulously debrided which often requires anaesthesia
- ✓ The bandage may fall off if there is post operative infection.
- ✓ It is expensive.

Type	Size	Cost (~)
Biobrane	10 x 15 in	£110.00
	15 x 20 in	£224.00

Aquacel Ag®

Aquacel Ag® is a silver-impregnated hydrofibre that releases silver within the dressing for up to two weeks. It has been reported to be a beneficial dressing for the management of partial-thickness burns. It promotes an appropriate environment for re-epithelialization of the burn wound. Overall analgesic requirements were reduced with subsequent dressing changes. It was easy to apply and non-adherent but, overall, Aquacel Ag® appeared to be a safe, effective, and comfortable dressing.

Aquacel Ag® can be used on most parts of the body. Since, the dressing normally adheres to the burn wound for up to two weeks or until re-epithelialization commences, it requires fewer dressing changes. The dressing reduced overall pain and subsequent analgesic requirements during dressing changes. The dressing was flexible, easy to apply and comfortable but like Biobrane, non-adherence was one of the problems encountered. Based on cost comparison, Aquacel Ag® was considered a more cost-effective dressing (Lohana and Potokar, 2006). It retained adequate antimicrobial properties and provided an ideal

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environment for the management of superficial and mid-dermal partial-thickness paediatric burns.

Type	Size	Cost (~)
Aquacel Ag®	10 x 10 cm	£4.00
	15 x 15 cm	£7.60
	20 x 30 cm	£18.60

Integra®

The innermost layer of skin, i.e., the subcutaneous tissue, which is made up of fat, connective tissues, and larger blood vessels, is the layer on which Integra is placed. Integra skin graft matrix is designed to help rebuild Dermis. Like the skin, the Integra skin graft matrix is also made up of several layers. The main layer of Integra functions as a scaffold, which when placed on an appropriate wound, blood vessels and other cells start to migrate into the matrix and start to build a new layer of dermis inside the matrix. Over a period of 4 weeks, the collagen making up the matrix is replaced by the collagen made by body and at the same time, new blood vessels grow into the matrix to supply blood to the growing dermis (Alnababtah, 2010).

Once the dermis contained in the Integra matrix has all the blood supply it needs, it can be covered with a split-thickness skin graft. However, until then, the new dermis needs an alternative source of protection. This takes the form of the second layer of Integra—a silicone sheet. This sheet protects the wound and the growing skin. It reduces the risk of infection and keeps everything moist and safe.

Risks and contraindications:

- ✓ Integra should be avoided in people sensitive to bovine collagen or chondritin.
- ✓ It is not recommended for use in 3rd degree burns
- ✓ It should be avoided on irradiated wounds as it does not uptake well, but it can be used before the irradiation therapy is given as it can survive the treatment.
- ✓ Hematoma or seroma formation is the most common complication noted which needs to be addressed
- ✓ Infection is a potential risk, and this can lead to uptake not happening. If the matrix adherence is inadequate, the dressing may need to be removed and replaced.
- ✓ In cases where the silicone sheet starts to separate early, it may require the skin graft to be performed sooner but only if the new dermis has a good blood supply.

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Type	Size	Cost (~)
Integra	5 x 5 cm	₹26,400

Matriderm®

Matriderm® is a multiporous membrane of bovine origin, composed of collagen (types I, III and V) and a hydrolysate of elastin alpha, treated with gamma rays. It functions to enhance skin elasticity and improve scar quality in wounds, especially in the case of burns. The bilayer form of the former one contains chondroitin-6-sulfate, which has antigenic properties, in contrast to elastin. That is the reason, it requires up to 3 weeks to become fully vascularized, in contrast to other artificial biological material, which can have a split-skin graft applied in a one-step procedure. It is useful mainly in the paediatric population to enhance scar quality. However, there is lack of clinical data on the development of wound contracture (Shahrokhi *et al.,* 2014).

Type	Size	Cost (~)
Matriderm	37 x 52 x 2 mm	₹20,790

Figure 6 : Biobrane

Figure 7 : Aquacel Ag

Figure 8 : Integra

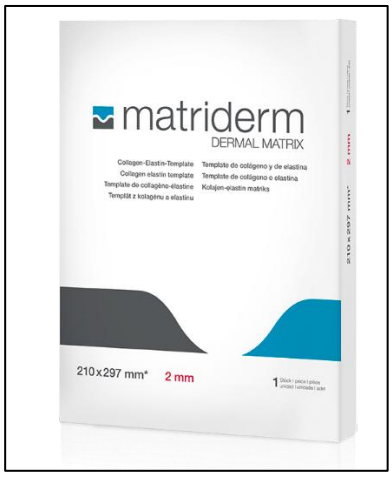

Figure 9 : Matriderm

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Conclusions

Biological and biosynthetic dressings play an important role in burn and wound management in veterinary as well as human medicine. Biological alternatives such as boiled potato peel, banana leaf, honey, and papaya pulp are inexpensive, easily available, and particularly useful in superficial and partial-thickness burn wounds. Among these, banana leaf dressing is a highly cost-effective option, while honey provides additional antimicrobial and debriding benefits. Papaya pulp serves as a natural enzymatic debriding agent whilst enhancing granulation. Biosynthetic alternatives like Biobrane, Aquacel Ag, Integra, and Matriderm provide better epithelialization, faster healing and reduced pain but are limited by expensive nature and specific indications. Selection has to be individualized based on wound depth, infection status, and resource availability.

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