WOUND DRESSINGS WITH NATURAL COMPOUNDS: A REVIEW

Anitha K*, K Krishnakumar, Dineshkumar B*

Dept. of Pharmaceutics, St James College of Pharmaceutical Sciences, Chalakudy, Kerala
St James Hospital Trust Pharmaceutical Research Centre (DSIR Recognized), Chalakudy, Kerala

*Corresponding Author Email: stjamespharmacyproject@gmail.com

Received 16 February 2017; accepted 10 March 2017

Abstract

Wound healing is the body’s natural process of regeneration of dermal and epidermal tissues. Complication in this process may lead to severe damage to the injured part. A wound dressing incorporated with natural compound provides a faster and efficient wound healing. The developments in research and use of natural compounds made a way towards more complex approach to the treatment of wounds. This review gives a general overview regarding the different types of wound dressings and the relevance of natural compounds in the field of wound care management.

INTRODUCTION

A wound can be defined as a break in the continuity of the skin which may arise from an underlying altered physiological state or be primary in origin. Skin is considered as the largest organ in the body; hence damage to it may lead to its abnormal functioning which may lead to unexpected consequence for the individual. It is estimated that 1 - 1.5% of the population is affected by a wound at any point of time [1]. Hence wound healing is a very important process and when healing becomes faster, it improves the quality of life. Healing of the wound is a survival mechanism thereby maintaining normal anatomical structure and function (Fig.1). Many etiological factors like infection at wound site, drug, other disease conditions like diabetes, etc. can adversely affect this process which may lead to impaired wound healing. A well understanding on these factors and their effect on wound healing is vital for developing better options for wound treatment[2, 3].

Fig.1: Schematic representation of 4 different stages of normal wound healing along with the time scale of each phase.
WOUND DRESSINGS
A variety of wound dressings are used in treatment of wounds. Normally, the skin has the power to heal the wound. Hence an ideal wound dressing should have the properties resembling the skin properties. This include:
- Optimum moist environment for wound healing,
- Provide thermal insulation, oxygen transport, fluid drainage and debris removal thus aid in tissue reconstruction,
- Biocompatible and no allergic or immune response reaction,
- Protect the wound from secondary infections,
- Ease of removal without causing trauma [4].

TYPES OF WOUND DRESSINGS
The dressings within each classifications shows similar properties but are not identical. Various types of wound dressing materials are available, i.e., those made of synthetic polymer (such as poly (vinyl alcohol)) or using natural polymer (such as alginate, chitin, chitosan, etc.)[5]. The major categories of the wound dressings include;

1. Traditional dressings- Traditional dressings like gauze, cotton wool, etc. are the most commonly used products in wounds. These dressings do not provide moist environment. The debridement occurs while pulling off the dressing when it get dried and this may damage the tissue. These limitations made gauze a secondary dressings or in combination with other products like hydrocolloid, alginate dressings[6].

2. Modern – These dressings are focused on keeping the wound from dehydration and promote healing. These include;
   a) Semi permeable film: It is made of polyurethane coated with acrylic adhesive. These dressings are thin and transparent which allows wound inspection. Films are permeable to gas but impermeable to liquid and bacteria. They are non-absorbent and hence cannot be used for exudative wound. They can be used as a secondary dressing to primary dressing such as foam. Film dressing may cause trauma on removal[7].
   b) Semi permeable foam: These are highly absorbent and this is controlled by foaming properties like texture, thickness and pore size. Wound exudation and transport of water vapour is facilitated through pores. Foam dressings are not suitable for dry wounds as they depend on exudates for maintaining the moist environment[8].
   c) Hydrogels: Hydrogels is considered as an effective ‘regenerative templates’ for skin regeneration. Hydrogels are macromolecular networks involving cross linked nodes. Due to this unique structure, it shows solid like mechanical (elastic) property which helps it to adapt to the wound site, but also has a diffusive property like that of liquids. Hydrogels can both absorb as well as release water in response to factors like temperature, pH and ionic strength. Hydrogels has the ability to efficiently transport the bioactive molecules to the wound bed. It shows a barrier function as it prevents bacteria from reaching the wound but allows oxygen transport. This is mainly observed in case of tight mesh sized (100 nm in swollen state) hydrogels. Many hydrogels are prepared by physical methods such as repeated freezing and thawing, chemical methods using a covalent cross-linking agent including boric acid, glutaraldehyde, and formaldehyde, or radiation methods using electron beam or γ-irradiation. Polyvinyl alcohol (PVA) hydrogels prepared with a freeze–thawing method is considered as very important due to its non-toxicity and good biocompatibility[9]. These dressings do not stick on to wound and transparent depending on the crosslinking density of the polymer network. The transparency helps in easy monitoring of wound without the removal of dressing[10,11].
   d) Hydrocolloids: It is an occlusive dressing which consists of a matrix made of polymers (like gelatin, pectin, carboxymethylcellulose, etc) with elastomeric and adhesive substances. It absorb exudates, swell and liquefies to form a moist gel promote healing also prevent microbial growth[12]. This creates a warm, moist environment that promotes debridement and healing and can be used in wounds with light to
heavy exudates, sloughing or granulating wounds. This type of dressings are semi-permeable to water and oxygen. However, the application of hydrocolloid dressings in strongly infected wounds may cause hypoxic and excessively moist environment thereby increase the risk of infection at the wound site[13].

e) Alginate: These dressings are used for highly exudative wounds. It is composed of alginic acid from seaweed covered with calcium/sodium salt. These ions interact with serum to form hydrophilic gel when placed in wound. It provide moist wound environment, highly absorptive and can protect from microbial growth. On bleeding wounds, it is said to have haemostatic properties. These dressings cannot be used in dry wound as it does not hydrate the wound. On infected wound, the dressing should be changed daily otherwise it can be placed for 7 days or until it loses its gel viscosity[14].

3. Tissue engineered substitute: A tissue therapy for cutaneous wound, made of type 1 bovine collagen and cultured allogeneic cells(keratinocytes and fibroblasts) isolated from human neonatal foreskin[15]. Tissue engineering involves mimicking the composition and structure of the original tissue. The essential components in tissue engineering are (stem) cells, matrix or scaffold, a bioreactor and cytokines. The tissue engineered wound healing products are of two types; Acellular (consist of matrix without cells) and Cellular(cells are embedded on matrix)[16].

4. Bioactive dressing: These dressings provide optimal microenvironment for wound and also deliver bioactive materials thereby faster healing of the wound is achieved.[17] These dressings are biocompatible and biodegradable and are derived from natural tissues or synthetic sources like collagen, hyluronic acid, chitosan, alginate and elastin [18, 19]. These are used alone or in combination with biological compounds likeanti-inflammatory, anti-microbial, anti-septics, growth factors, supplements, etc. to facilitate tissue regeneration and reduced scar formation[20].

5. Composite dressing: Also called combination wound dressing. This can be used as primary or secondary dressing and can be used for minimum to heavy exudate wounds. Most of them are made up of 3 layers.

- Inner contact layer- non adherent, protect the wound from trauma that may occur during removal of dressing.
- Middle layer- It provide moist environment by absorbing the exudates and prevents the wound from maceration. Hydrogel, semi-permeable foam, hydrocolloid or alginate constitute the middle layer.
- Outer layer- It is made of semi-permeable film and hence act as a bacterial barrier.Composite dressings are available as pre-packaged forms[21].

6. Medicated: Medicated dressings are incorporated with drugs which has a major role in faster wound healing. Most commonly used compounds include antimicrobials, growth factors and enzymes[22].

**NATURAL COMPOUNDS IN DRESSINGS**

The invention of phytochemicals and naturally derived substances has improved the wound healing in the field of wound care management. Natural products are given more importance because of the progression of resistance in many infectious organims due to overuse of conventional medicines such as antimicrobials, antibiotics[23]. Various natural compounds are used for the formulation of dressing materials. One such natural product is honey. In a review of honey conducted to investigate its potential in wound and burn treatment, it was found that honey dressing provided a moist environment at the site due to its osmotic effect leading to formation of a dilute honey layer over the wound surface. Honey provide nutrition to the damaged tissues. High osmolarity of honey prevented tissue maceration and bacterial growth by its anti-bacterial activity[24]. Another compound is the curcumin, a naturally occurring phytochemical polyphenol from rhizomes of turmeric(Curcuma longa). It was formulated as a polymeric bandage along with oleic acid(skin penetration enhancer)and evaluated its activity ina rat model. The oleic acid provided a sustained release of drug from matrix to the site and also increased vascular endothelial growth factor-alpha which inturn enhance neovascularisation and increased production of interleukin-1 beta. These factors aid in phagocytosis of infected tissue. The curcumin in the dressing reduced the gene expression of antioxidant enzymes thereby curcumintraps the reactive oxygen species. It showed a better wound healing due to anti-oxidant,anti-inflammatory and anti-infective activity of curcuminand sustained availability of curcumin metabolites at the wound site[25]. A flavanol glycoside, rutin, is said to have multiple pharmacological activities. One of it include wound healing activity. The Study suggested that rutin dressing increased fibroblast proliferation and collagen production leading to the production of extracellular matrix(ECM) . The bioactive injectable hydrogel dressing of rutin in conjugation with chitosan has shown an improved healing of dermal wound[26]. Polyphenolic compounds are widely used as a therapeutic agent in various inflammatory diseases.Ferulic acid, a polyphenolic acid, was formulated as thermosensitive chitosan based hydrogel for corneal wound.Polyphenolic compounds enhanced the mRNA level of tissue inhibitors of metalloproteinases(TIMP) which reduces the degradation of collagen and proteoglycan by matrix metalloproteinases(MMPs) A reduction in inflammation level and apoptosis was also observed due to its anti-oxidant activity[27].A study was conducted showing the wound healing activity of quercetin incorporated collagen matrices in rats. An improvement in wound healing was observed due to increased activity of catalase which was stimulated by conversion of superoxide radical to hydrogen peroxide. It revealed an effective scavenging of free radicals by quercetin incorporated matrix when compared with the normal collagen matrix[28]. Polyherbal formulations can be formulated as wound dressing, a research work based on the use of triphala incorporated collagen sponge was conducted for determining its efficacy in wound healing. Triphala is a compound formulation consisting of Terminaliachebula, Phyllanthusemblica, and Terminaliabierrlica. There observed a reduction in matrix metalloproteinases(MMP) which reduced the inflammatory
cells. The result suggested that the formulation was very suitable for reducing the risk of infection and also improved wound healing. Recent studies based on the incorporation of natural compounds in normal wound dressings have shown an improvement in the healing of wounds. Better and well-controlled studies are essential for identifying more natural bioactive compounds for wound care.[29]

CONCLUSION
A wide range of wound dressings are commercially available today. Even though these dressings are available, management of wound is a common problem in the wound care. Currently, the demand of natural compounds in skin wound care is increasing due to their therapeutic activities and reduced side effects. The fusion of natural origin compounds to normal wound dressings offer new perspectives in wound care.

REFERENCES
26. Tran NQ, Joung YK, Lih E, Park KD. In situ forming


Source of support: Nil; Conflict of interest: None declared