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TITLE: XXX

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I. INTRODUCTION: -

In both humans and animals, wound healing is a significant but complex process that is regulated by a number of overlapping but sequential phases, such as the remodeling, proliferation, and hemostasis/inflammation phases. [1] Following a skin injury, the exposed sub-endothelium, collagen, and tissue factor will trigger platelet aggregation, leading to degranulation and the release of growth factors (GFs) and chemotactic factors (chemokines) to form the clot. All of the aforementioned procedures will successfully stop bleeding. [2] As the first cells to reach the site of damage, neutrophils remove bacteria and debris to provide a favorable environment for wound healing. The following describes how macrophages build up, aid in the phagocytosis of bacteria, and cause tissue damage. [3] It usually takes 72 hours to complete the hemostasis and inflammatory phase.

Hemostasis, inflammation, proliferation, and remodeling are the four separates but overlapping stages that make up the wound healing process (Figure 1). The processes of tissue repair involve a wide range of cell types, proteins, hormones, cytokines, enzymes, and others. [4] Hemostasis is activated to produce blood clots and blood vessels constrict to limit blood flow once an injury is produced. Pro-inflammatory cytokines and growth factors are then secreted as part of the normal healing process. [5] These growth factors then cause inflammation, which is aided by neutrophils, lymphocytes, and macrophages that are drawn in by epithelial cells.Growth factors subsequently trigger angiogenesis, where fibroblast and keratinocyte proliferation lead to re-epithelization. Extracellular matrix (ECM) will be deposited as a result of the fibroblasts' subsequent differentiation into myofibroblasts. [6]

A significant portion of the global medical and pharmaceutical wound care industry is made up of wound dressings and devices. Historically, wounds were treated with traditional dressings including cotton wool, gauze, lint, and natural or synthetic bandages, each of which had a different level of absorbency. By permitting wound exudates to evaporate and blocking the entry of dangerous bacteria into the wound, their main purpose was to keep the wound dry. However, it has now been demonstrated that a warm, moist wound environment promotes quicker and more effective wound healing. Many dressings have been introduced during the past 20 years, and new ones are made accessible every year. [7]

WOUND DRESSINGS

Wound dressings have developed over the years from the crude applications of plant herbs, animal fat and honey to tissue engineered scaffolds. Many traditional medicinal plants used in Africa to treat wounds exhibit antibacterial activity.[8] The leaves of Guierasenegalensis used in Senegal and Nigeria for treating wounds and inflammatory swelling, show antibacterial and antiradical effects.[9] Ghanaian researchers have reported that extracts of Commelinadiffusa herb and Spathodeacampanulata bark used traditionally in wound treatment, show antimicrobial and antioxidant activity against Trichophyton species.[10]Nonetheless, most plants would contain germs that, if taken directly or in the form of a crude preparation, could infect. Crude plant extracts also contain other substances that may harm exposed tissue and prevent wounds from healing properly. The understanding of the importance of cleanliness and aseptic technique in both medicine and surgery has led to an improvement in the quality of materials used for wound care.

Numerous wound dressings have been created in an effort to aid in the wound's natural healing process as well as to prevent infection. A

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moist occlusive dressing promotes the rate of re-epithelialization and supports the inflammatory phase by lowering oxygen tension, which activates factors such hypoxia-inducible factor-1 [11]. Furthermore, autolytic debridement is made possible by a small quantity of exudate that is left on the wound, which helps to further encourage effective wound healing. However, when removed, conventional dry gauze wound dressings may worsen this process and result in additional harm. The two main forms of wound dressings that are frequently used are low adherent dressings and semipermeable films, such as Tegaderm, which are intended to prevent liquid and microbiological penetration while permitting air and water vapor to pass through.

In addition to being somewhat more long-lasting, hydrocolloids and hydrogels use a hydrophilic substance that absorbs some exudate while maintaining a moist environment. However, because of their impermeable nature, hydrocolloids should not be applied to exudative wounds. In an otherwise dry wound, hydrogels can also be utilized to help encourage moisture. Another choice is alginate dressings, which are non-woven fibers made from seaweed and are typically saved for extremely exudative wounds due to their capacity to absorb a lot of fluid. As a result, dry wounds treated with alginate may have negative effects [12].

Classification of Dressings

The various classifications of dressings have been reviewed recently and are based on their function in the wound (debridement, antibacterial, occlusive, absorbent, adherence), [13], the type of material used to make the dressing (e.g., hydrocolloid, alginate, collagen) [14], and the dressing's physical form (ointment, film, foam, gel) [15]. When choosing a particular dressing, classification criteria might be helpful, but many dressings meet all of the requirements. An occlusive dressing, for instance, could also be a hydrocolloid. The dressings in this evaluation are categorized as either conventional or modern (for wet wound environments). The type of material (hydrocolloid, alginate, hydrogel) used to make the dressing and its physical form (film, foam) are the topics of discussion for modern dressings. [16]

Traditional Wound Healing Agents

These were once frequently utilized, and although though their use has decreased, they can still be somewhat helpful in treating wounds in specific therapeutic contexts. Dry conventional dressings and topical liquid and semi-solid formulations are examples of traditional wound healing agents.

Topical Pharmaceutical Formulations

These formulations, which are widely used, are made as semi-solid (ointments and creams) and liquid (solutions, suspensions, and emulsions) forms. In the early phases of wound healing, solutions like povidone iodine work best to lower the bacterial load and act as debriding and desloughing agents to save healthy tissue from macerating by removing necrotic tissue from the newly opened wound. [17] In order to control or prevent infection, antimicrobial compounds like silver, povidone-iodine, and polyhexamethylenebiguanide are occasionally used to dressings. When cleaning a wound, physiological saline solution is utilized to eliminate dead tissue and wash away any dissolved polymer dressings that may still be present. [18]

Traditional Dressings

Cotton wool, natural or synthetic bandages, and gauzes are examples of traditional dressings; unlike topical pharmaceutical formulations, these dressings are dry and do not create a moist wound environment. They can be used as primary or secondary dressings, or they can be part of a composite of multiple dressings, each of which has a specific function. For instance, Gamgee tissue, which is applied over a primary wound dressing to prevent cellulose fiber contamination, is made up of a tubular cotton gauze wrap encasing a layer of absorbent cotton wool.

Modern Wound Dressings

The conventional wound-healing agents mentioned above have been improved upon by modern dressings. Their primary function is to maintain and produce a moist environment surrounding the area in order to promote wound healing. The materials used to make current dressings, including as hydrocolloids, alginates, and hydrogels, are the primary basis for their classification. These materials typically take the shape of gels, thin films, and foam sheets. [20]

Hydrocolloid Dressings

Among the most commonly used dressings are hydrocolloids. A review of hydrocolloid dressings' functions, characteristics, mode of action, and variety of wounds they can be used on has been conducted. [21] The class of wound care treatments known as "hydrocolloids"

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are made from colloidal (gel-forming agent) ingredients mixed with other materials including adhesives and elastomers. Gelatin, pectin, and carboxymethylcellulose (CMC) are common gel-forming substances. GranuflexTM and AquacelTM (Conva Tec, Hounslow, UK), ComfeelTM (Coloplast, Peterborough, UK), and TegasorbTM (3M Healthcare, Loughborough, UK) are a few examples of hydro colloid dressings.They can be found as sheets, thin films, or composite dressings made with alginates and other materials. Because hydrocolloid dressings stick to both wet and dry surfaces, they are helpful in therapeutic settings. For light to moderately leaking wounds, such as pressure sores, small burns, and traumatic injuries, hydrocolloid dressings are utilized. [22]

Alginate Dressings

The calcium and sodium salts of alginic acid, a polysaccharide made up of mannuronic and glucoronic acid units, are used to make alginate dressings. Alginate dressings come in two forms: flexible fibers, which are recommended for filling cavity wounds, and freeze-dried porous sheets, or foams. The main reason alginates are used as dressings is because of their high absorbency, which allows them to gel when they come into touch with wound exudates. Strong hydrophilic gel formation, which restricts wound secretions and reduces bacterial contamination, is the mechanism underlying the high absorption [23].while hydrated, alginates high in mannuronate, such SorbsanTM (Maersk, Suffolk, UK), create soft, flexible gels; while absorbing wound exudate, alginates high in guluronic acid, like KaltostatTM (Conva Tec), form stiffer gels. Some, like SorbsanTM and TegagenTM (3M Healthcare), contain calcium alginate fiber. ComfeelPlusTM is a dressing that combines hydrocolloid and alginate. When applied to wounds, the ions found in the alginate fiber combine with those found in blood and exudate to create a gel-like protective layer. This keeps the lesion at the ideal temperature for healing and moisture content. [24]

Alginate dressings work well for wounds that exude moderate to heavy fluid. When trapped in a wound, alginate dressings in the form of fibers are easily biodegradable and can be removed with saltwater treatment. [25] Because granulation tissue is not destroyed by subsequent removal, changing a dressing is almost painless. Alginate sutures are utilized in surgical wound closures because of their ease of biodegradation. Significant variations in properties including fluid retention, adhesion, and dressing residues were found in a study comparing many types of alginate dressings. [26] Alginate dressings cannot be applied to dry wounds or wounds with hard necrotic tissue because they need moisture to work properly. This is because their main drawback is that it may cause the wound to get dehydrated, which would delay healing.

Hydrogel Dressings

Made from synthetic polymers like polyvinyl pyrrolidine and poly (methacrylates), hydrogels are insoluble, swellable hydrophilic materials. Certain dressings, such PurilonTM (Coloplast) and Nu-gelTM (Johnson & Johnson, Ascot, UK), are hydrogel/alginate blends. Hydrogels can be used as an elastic, solid sheet or film or as an amorphous gel. The polymeric components are crosslinked to physically trap water in order to prepare the sheets. When the sheets come into contact with suppurating wounds, they have the ability to absorb and hold large amounts of water**.**Lay Flurrie has analyzed the characteristics of hydrogels by looking into the findings of studies on their effectiveness and talking about the kinds of wounds that can be treated with hydrogel. Hydrogel dressings typically need to be changed often and require a secondary covering, like gauze, when applied to the wound as a gel. [27]Hydrogel dressings are used for light to moderately oozing wounds because they contain large volumes of water (70–90%), which prevents them from absorbing much exudate. Fluid buildup can cause bacterial growth and skin maceration, which gives infected wounds an unpleasant odor. Furthermore, hydrogels are difficult to work with because to their poor mechanical strength, which has been shown to have an impact on patient compliance. [28]

Semi-Permeable Adhesive Film Dressings

The long-standing benefits of these dressings on the healing of moist wounds were initially Film dressings were initially occlusive since they were composed of nylon derivatives held in an adhesive polyethylene frame. However, the initial film dressings made of nylon had a limited capacity to absorb enough wound exudates, which led to the buildup of extra exudates underneath the dressing. This makes them unsuitable as wound dressings since it causes skin abrasion ness, bacterial development, and infection risk. As a result, they need to be changed frequently and the wound needs to be irrigated with saline. In addition to being challenging to apply, the original nylon dressings have a tendency to wrinkle when taken out of their packets. [29]

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Foam Dressings

Porous polyurethane foam or polyurethane foam sheet, occasionally with adhesive borders, make up these dressings. Certain foam dressings, like TielleTM, contain an occlusive polymeric backing layer to stop excessive fluid loss and bacterial contamination, as well as extra wound contact layers to prevent adhesion when the wound is dry. [30] Foam dressings are easy to wear, offer thermal insulation, and keep the area surrounding the wound moist. [31] They are quite absorbent, and the texture, thickness, and pore size of the foam all affect how absorbent they are. A high moisture vapour transmission rate (MVTR) is another benefit of the open pore structure.Because of the dressings' porous construction, they can be used on partial or full-thickness wounds with little to moderate drainage or on wounds that exude a lot of fluid. [32]
Since foam dressings have been shown to effectively treat overgranulation, they are also recommended for granulating wounds. [33] Because of their high absorbency and moisture vapor permeability, they are utilized as primary wound dressings for insulation and absorption, and typically no secondary dressing is needed. Since foam dressings, in contrast to polymer films, rely on exudates to create the ideal wound healing environment, they are not appropriate for dry epithelializing wounds or dry scars. [34]

Biological Dressings

These dressings, commonly known as "bioactive dressings," are composed of biomaterials that actively contribute to the healing process of wounds. Tissue-engineered materials made from synthetic or natural tissues are also considered bioactive wound healing dressings. [35] Collagen, hyaluronic acid, chitosan, alginates, and elastin are among the polymers that are typically combined in these technologies. The benefits of biomaterials include their ability to constitute a portion of the natural tissue matrix, their biodegradability, and the fact that certain of them actively contribute to the production of new tissue and normal wound healing. From a toxicological and biocompatibility perspective, these qualities make them desirable options. For distribution to the wound site, they might occasionally be combined with active substances like growth hormones and antibiotics. [36]

One of the main structural proteins of any organ, collagen is a naturally occurring component of connective tissue. Its physical, chemical, biological, immunological, and structural characteristics have all been extensively covered in the literature. From the induction of clotting to the creation and appearance of the final scar, collagen is known to be essential to the natural wound healing process. 60 When endothelial cells come into contact with injured tissue, it speeds up their migration and promotes the production of fibroblasts. [37]

A glycol aminoglycan that makes up the extracellular matrix, hyaluronic acid has special biological and physicochemical properties that include lubricating joints and reducing inflammation. It is not immunogenic and is inherently biocompatible and biodegradable. [38] Additionally, films of hydrogel crosslinked hyaluronic acid have been created for use as polymeric drug delivery biomaterials. There have been studies and reports on the use of hyaluronic acid-modified liposomes as bioadhesive carriers to transfer growth factors to wound sites. [39] According to a recent open-ended study, hyaluronic acid-based dressings are useful for treating acute wounds, especially when it comes to safety and effectiveness. [40] However, no standard wound dressing was chosen for comparison in this study, and the dressing was applied to various types of wounds. The utilization of chitosan in wound healing has been examined, and it is known to speed up granulation during the proliferative stage of wound healing. According to reports, bioactive dressings are preferable to both conventional and synthetic dressings, such as hydrogel dressings and gauze, respectively. [41]

II. CONCLUSION

Topical medications, conventional wound dressings, hydrocolloids, alginates, hydrogels, polyurethane film, foam, and new biomaterials like collagen, chitosan, and hyaluronic acid that are applied directly or as tissue-engineered matrices for skin replacement have all been covered in this review. There has also been discussion of polymeric dressings intended to administer therapeutic chemicals directly to the surface of wounds. Alginates, chitosan, pectin, and hyaluronic acid are examples of natural polymers; collagen sponges and other hydrogel materials; tissue-engineered goods; and artificial skin grafts.There are still a number of issues that must be taken into account while creating innovative medication delivery formulations for wound healing. For instance, significant differences in the rate at which wound exudate is produced point to the challenge of developing a single, perfect dressing that can be

used on all kinds of wounds. Composite dressings that combine the many features of existing methods seem ideal. In order to guarantee efficient, thorough wound healing and quicker healing times for chronic wounds, this will help target the various facets of the intricate wound healing process.(and other wounds that are hard to cure). It is envisaged that this review article will offer a key to the knowledge of the numerous undiscovered polymeric dressings with idealized qualities needed for the efficient and long-lasting delivery of therapeutic medicines to chronic wounds.

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