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Advances in the Management of Skin Wounds with Synthetic Dressings

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Abstract

Treating wounds under normal wound healing processes often require little or no intervention, consisting primarily of debridement, as during the inflammatory stage the cells clear the wound to healing. However wound care professionals face many challenges in treating acute wounds with impairment on healing such as burn injuries or chronic wounds like diabetic, vascular and pressure ulcers. Wound healing is a complex process of several stages that requires being free of complications. Then the goal of the wound treatment is to prevent or convert the impediments to healing and depends on the characteristics of the wound, like time, depth, extent, appearance of the surface and exudate, and quality of the periwound tissues. There are currently a wide variety of products available for skin wound treatment. The tissue engineered skin substitutes market offers a wide variety of solutions with different type of dressings that comprise skin grafts derived from allogeneic or xenogeneic sources, products of synthetic material, or a combination of these, to *in vitro* cultured tissue for epidermal and dermal replacement. Whereas cellular-based products affront issues of safety by the risks of disease transmission, post-implementation infection and immune system rejection, besides theprominent costs of the whole therapy, the synthetic skin dressings are being more demanded due to the low cost, easy availability, uniform composition and the avoiding of safety risks. This review is intended to help the clinician to suit the right cost-effective solution with the condition by providing information of evidence-based products for wound bed preparation and treatment made of synthetic matrix.

Keywords

Skin wounds treatment, Engineered skin substitutes, Synthetic dressings, Skin substitutes market

Introduction

Skin lesions or so-called skin wounds are leading a public health concern worldwide. It is estimated that each year there are more than 234 million surgical incisions performed worldwide while up to 50 million occur only in United States [1,2]. Traumatic wounds occur over the rate of 50 million every year worldwide [3]. Additionally, according to the World Health Organization non-fatal burn injuries are a leading cause of morbidity. In 2004, nearly 11 million people worldwide were burned severely enough to require medical attention [4]. The types of wounds that can affect a burn victim include shallow partial-thickness wounds, which will epithelialize within 21 days; deep wounds that require removal of necrotic tissue and wound closure; donor-site wounds resulting from harvesting of skin grafts; and interstitial wounds resulting from meshed skin graft application. The manner in which the wounds heal can be the final determinant of morbidity and mortality [5]. All these cases of skin wounds account for the burden of worldwide morbidity of acute wounds. Acute wounds (surgical, traumatic, mid- and medical treated-burns) are those when proceeds through an orderly and timely reparative processto establish sustained anatomic and functional integrity commonly within 8-12 weeks [6]. Although acute wounds account for the vast majority of skin injuries, chronic wounds though with a lower number, are of major concern among clinicians because chronic wounds may take a long time for healing or may never do so. Thus the treatment of a chronic wound is timely and costly consuming with mid-to-low successful. Chronic wounds (venous, diabetic, arterial, and pressure ulcers and complicatedacute wounds like hospitalized burn wounds, etc.) are defined as those that have failed toproceed through an orderly and timely reparative processto produce anatomic and functional integrity or have proceeded through the repair process without establishinga sustained anatomic and functional result [6]. Skin ulcers have been definedas wounds with a full thickness depth and a slow healing tendency and can result in complete loss of the epidermis and often portions of the dermis and even subcutaneous fat [7,8].

The precise world epidemiology of chronic wounds is not known. According to the MedMarket Diligence market report "Worldwide Wound Management, Forecast to 2024: Established and Emerging Products, Technologies and Markets in the Americas, Europe, Asia/Pacific and Rest of World" there are approximately 40.4 million chronic wounds worldwide (pressure, vascular and diabetic ulcers) [3]. However, the epidemiology and economic burden of the chronic wounds is well documented in developed world. In the United States alone, chronic wounds affect approximately 6.5 million patients and have been estimated to cost between $12 million to more than $25 million per year and $1 billion worldwide [9,10]. In the Scandinavian countries, the associated costs of chronic wounds account for 2-4% of the total health care expenses [9].

Prevalence of chronic wounds has been estimated to be between 0.18% and 1.3% in the adult population and 3.6% of people older

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than 65 years, increasing to over 5% of those aged over 80 years [7,11-13]. The common causes are venous disease, arterial disease, and neuropathy. Less common causes are metabolic disorders, hematological disorders, and infective diseases [7]. Peripheral vascular disease due to atherosclerosis, diabetes, and/or vasculitis could lead to ischemic leg resulting in ulceration [7,13]. These wounds are almost certainly linked with lower extremities and aging and diabetes [7,11].

Venous ulcers are the most common form of leg ulcers with a prevalence to be estimated between 1-1.5% [8]. Venous leg ulcers are thought to account for 40-70% of lower extremity chronic wounds, with a huge predisposition to occur in elderly or female [11]. In the United Kingdom chronic venous leg ulceration has an estimated prevalence of between 0.1% and 0.3% [7]. In the United States, treatment costs for venous ulcers in more than 6 million patients closes to $2.5 billion and two million workdays are lost annually because of venous ulcer disease [8]. Arterial leg ulcers are the second most common of lower-extremity ulcers, estimated to be from 10 to 30% of leg ulcers [7,12,13]. Typically, these lesions occur secondary to arterial disease over pressure points as a result of reduced arterial blood flow and subsequent tissue perfusion and often affect the toes, heels, malleoli, or shin [7,14].

Based on recent studies, diabetic foot ulcers are common and increasing among population all around the globe. An estimated lifetime risk of developing a foot ulcer was estimated to be 15% of all diabetic individuals in 1996 and the incidence estimated that lifetime risk could be as high as 25% in 2005 [15,16]. Amputation of foot is the secondary complication of foot ulcers in diabetic persons with and estimated rate of 15-20% of patients. Almost 85% of the amputations are preceded by diabetic foot ulcers [17]. The relative risk of amputation was at least five times higher in old (> 80 years) than in younger (40-59 years) subjects [18]. The costs of treating a diabetic foot ulcer are estimated from $13 000 to $28 000 in developed countries and doubles the cost of treatment of a diabetic person without any chronic complication [16,19,20].

Pressure ulcers, one type of chronic wound, are as their name implies, caused by constant pressure. Persons with restricted mobility and poor health are often vulnerable to develop pressure ulcers, which are estimated to affect 1.3-3 million individuals with an estimated prevalence of 10.1% to 17% among patients in acute care hospitals in the United States and 26% on Canada [21-23]. While on five European countries was 18.1% [24]. Approximately 70% of all pressure ulcers occur in the geriatric population. Associated costs of pressure ulcer care are estimated to approach $11 billion annually, with an individually cost of between $500-$70,000 per pressure ulcer [25].

There are many complicated skin injuries that require treatment every year. The ideal treatment for these wounds does not exist, but an approach is to receive advanced wound management with selective use of appropriate products and care to overcome the underlying defect that has caused the impairment in healing the wound. Throughout this review the reader will find information and methods for wound bed preparation and treatment with evidence-based products, intended to help the clinicians to match the right treatment with the situation focusing on synthetic dressings.

Wounds and Healing Process

Wounds heal by a dynamic, continuous, overlapping, and precisely programmed succession of processes that must happen in a precise and regulated manner such as hemostasis, inflammation, proliferation and remodeling. When wounds proceed through these processes in an orderly and timely manner and achieve sustained anatomic and functional integrity, they are considered acute healing wounds. When healing processes have failed to produce a sustained anatomic and functional result of wounds or they are not healing at all then they are considered chronic wounds [6]. In other words, normal healing of wounds occur without disturbances of such processes while the interruptions, aberrancies, or prolongation in these processes can lead to delayed wound healing or a non-healing chronic wound.

Thus the optimal wound healing involves the following events: (1) rapid hemostasis; (2) appropriate inflammation; (3) mesenchymal cell differentiation, proliferation, and migration to the wound site; (4) suitable angiogenesis; (5) prompt reepithelialization (regrowth of epithelial tissue over the wound surface); and (6) proper synthesis, cross-linking, and alignment of extracellular matrix to provide strength to the healing tissue [26].

Hemostasis begins immediately after wounding, with vascular constriction and fibrin clot formation. The clot and surrounding wound tissue release pro-inflammatory cytokines and growth factors [27]. Once bleeding is stopped, the inflammatory phase develops with the sequential migration into the wound of inflammatory cells such as neutrophils, macrophages, and lymphocytes [26,27]. Here, a critical step is the clearance of invading microbes and cellular debris in the wound area, activities that should be performed by a wound care provider on those wounds with extended lesions or deep depths, in order to help the self-function of cells for clearing the wound. Alternate functions of neutrophils and macrophages are the promotion of the inflammatory response by recruiting and activating additional leukocytes with secondary effects and bystander damage. However at late steps those cells are responsible for clearing death cells (including neutrophils), thus leading theway for the resolution of inflammation and the stimulus of keratinocytes, fibroblasts, andangiogenesis to promote tissue regeneration [26,28].

The proliferative phase of healing is recognized by the migration into wounds of T-lymphocytes and is characterized by reepithelialization (epithelial proliferation and migration over the provisional matrix) within the wound. A well coordinated transition of the inflammatory cells and macrophages with T-cell infiltration in good concentration appears to be necessary for aspects of normal wound healing, like maintaining tissue integrity, defending against pathogens, and regulating inflammation. Skin T-cells produce growth factors to support keratinocyte proliferation and cell survival in response to their damage [26]. In the reparative dermis within the wound bed, fibroblasts and endothelial cells proliferate; fibroblasts produce collagen, glycosaminoglycans and proteoglycans, the major components of the extracellular matrix (ECM). Both cells sustain the capillary growth, collagen formation, and the formation of granulationtissue at the site of injury [26]. Once ECM synthesis has reached a robust peak, wound healing enters the final remodeling phase, which can last for years. Several different cell types are involved in the wound healing process, and stem cells (SC) also play an important role in normal wound healing by providing a sustained source of repopulating cells since they are able to differentiate into a variety of cell types [29].

The complexity and coordination of the healing processesare major problems to therapeutic approaches, and the most essential part of treating complicated wounds, is to restore the ECM. Since any therapeuticmust effectively be applied on the expectancy of the best results, the management of complicated non healing wounds will focus on assist the organism in appropriate and sequenced scaffolding for cells by providing a matrix that can interact with the skin cells but also by providing elasticity and tensile strength, properties of the skin, to fasten wound healing.

Wound Care Treatment & Management

Preliminary efforts have been made to assist clinicians in the care rendered to patients with wounds [5,8,30-34]. Here we summarize and generalize the entire management of a patient suffering a wound in order to provide clinicians a simple and direct overview [35].

Assess the entire patient and the wound, ensure adequate nutrition, clear the wound by debridement, irrigate, treat underlying infection, and provide a bed of enough moisture conductive to wound healing. The resultant outcome after the treatment of a wound would depend on the majority on the systemic issues of the individual. Systemic problems often impair wound healing. As previously mentioned, diabetes is the leading metabolic disorder causing complications in wound healing, however other endocrine

diseases could affect the results (eg, hypothyroidism). Hematologic and cardiovascular and cardiopulmonary conditions are the second systemic illnesses that need consideration in wound repair. Other problems causing malnutrition and obesity should be considered. Therefore an adequate nutrition is a requirement for normal wound healing. Address protein-calorie malnourishment and deficiencies of vitamins and minerals. Daily nutritional requirements can increase, however, for patients with sizeable wounds and burn victims.

A well-characterized wound will warrant the adequate steps for treatment and provide good prognostic. The size and depth of involvement and the extent are the most useful tools to determine the probably outcome. The appearance of the wound surface, necrotic or viable, and the characteristics of wound exudate, as well as the status of the periwound tissues will offer a good basis for the next steps to perform. Assure that there is not any impediment of healing by wound perfusion. Debridement is required to remove necrotic tissue and excessive bacterial burden. The health care provider can choose from a number of debridement methods, including surgical, enzymatic, mechanical, biological, or autolytic [5]. Initial aggressive debridement in the operating room with the patient under local anesthesia with sedation or under regional or general anesthesia is often wise [35]. An inadequate oxygenation lead to more damage and chronicity, thus providing adequate local tissue oxygenation is a *sine qua non* to normal wound healing and tissue repair [36]. Treating underlying infection is a crucial step to avoid delay in wound healing. Prevention and treatment of wound infection involves maintenance or re-establishment of the balanced equilibrium between host defense and bacteria. A wound containing contaminated foci with greater than 10^5 bacteria per gram of tissue cannot be readily closed, as the incidence of wound infection that follows is 50 to 100 percent [5]. Surgically debride non vitalized tissue and with appropriate irrigation. Significant amounts of nonviable and fibropurulent tissue must be removed surgically [35]. Wound infection requires surgical debridement and appropriate systemic antibiotic therapy. Assuring adequate patient temperature and oxygenation during surgery and in the perioperative period decreases surgical site infections [5,35]. Ensure the wound surface with a moisture balance by gently irrigation with a physiologic saline solutionor with a wound bed that provides moist (not wet). Optimal wound coverage requires wet to damp dressings, which support autolytic debridement, absorb exudate, and protect surrounding normal skin. Depending of the context of the wound choose the use of a dressing that will maintain a moist

Table 1: Synthetic wound dressings available in the market and approved by the FDA.

Category	Composition	Advantages/Disadvantages	Indications	Product examples; Companies
For low to moderate exudative wounds				
Hydrocolloids	gelatin, pectin, or polysaccharides like sodium carboxymethylcellulose, and adhesive polymers	*Advantages:* They can absorb excess of fluid and prevent bacterial proliferation. They can be used to fill cavities. *Disadvantages:* Not recommended for infected wounds. Can leak excessive exudates and adhere to the wound bed.	For use on partial- and full-thickness dermal ulcers, superficial wounds and abrasions, superficial and partial-thickness burns and donor sites.	Amerx; Amerx Health Care DermaFilm; DermaRite DuoDerm CGF; ConvaTec Tegasorb, Tegaderm; 3M Comfeel Plus; Coloplast
Hydrogels	three-dimensional networks of cross-linked hydrophilic water-insoluble polymers (like cellulose) swollen with a high water content	*Advantages:* They maintain the wound moisture and a cooling effect with pain relief. *Disadvantages*: Not recommended for very exudative wounds. Low absorptive capacity.	Dry wounds, superficial burns, skin ulcers, graft donor sites.	AquaDerm; DermaRite AquaSite; Derma Sciences Derma-Gel, Xcell; Medline Industries Elasto-Gel; Southwest Technologies
Films	polyurethane membranes of varying thickness coated on one side with an adhesive acrylic.	*Advantages:* They are impermeable to liquids and bacteria but permeable to moisture vapor and gases. *Disadvantages:* Not recommended for exudative wounds, due to low absorptive capacity can create a bacterial growth environment.	Superficial burns, wounds an ulcers. Useful as secondary dressing and for skin donor sites.	Bioclusive; KCI -Acelity Cardinal Health; Cardinal Health DermaView; DermaRite Kendall; Medtronic OPSITE; Smith & Nephew
Foams	shapes of foamed polymer solutions (most commonly polyurethane) with small, open cells capable of holding fluids.	*Advantages:* Clear the wound surface from exudates and contamination. *Disadvantages:* Not recommended for low exudative wounds, can dry the tissue.	chronic wound ulcers, burns, heavy exudating wounds.	Advazorb Border; Advancis Medical Aquacell Foam; ConvaTec Allevyn; Smith & Nephew CovaWound; Covalon Technologies Optifoam; Medline Industries Restore LITE Foam; Hollister Incorporated
For exudative wounds				
Alginates	non-woven calcium or sodium alginate fibers derived from brown seaweed or kelp	*Advantages:* Highly absorptive, non-occlusive dressings. Hemostatic. *Disadvantages:* May adhere to the wound if drying. Confusing color with pus.	For use on partial- and full-thickness draining wounds such as stage III-IV pressure ulcers, dermal wounds, surgical incisions, tunneling wounds, sinus tracts, and donor sites	Algicell; Derma Sciences Algisite, Durafiber; Smith & Nephew Aquacel Extra, Kaltostat; ConvaTec DermaGinate; DermaRite Kalginate; DeRoyal Maxorb; Medline Industries Suprasorb; L&R USA
Hydrofibers	sodiumcarboxymethyl cellulose fibers	*Advantages:* Highly absorptive, non-occlusive dressings. More absorptive than alginates. *Disadvantages:* Need a scundary dressing.	For use on partial- and full-thickness draining wounds such as stage III-IV pressure ulcers, dermal wounds, surgical incisions, tunneling wounds, sinus tracts, and donor sites	Aquacel, Versiva; ConvaTec

wound healing environment. Select a wound dressing that facilitates continued moisture and that will manage the wound exudate and protect the peri-ulcer skin [5,30-33]. Finally, select a dressing that is cost effective and appropriate to the wound etiology (Table 1).

The Ideal Wound Dressing

The ideal dressing for treatment of complicated skin wounds does not already exist, because no single dressing meets all the requirements and none is proficient for all types of wounds. If any it should address the following functions: 1) provide or maintain a balanced moist environment but avoiding the excess of liquid (wetting), it must allow exudate production with absorbance but without leakage or desiccation, the adequate moisture in wound tissues has been associated with fasten healing with less pain, reduced infection and an overall reduction in costs of related care, 2) should offer a barrier for bacterial or mechanical protection and thermal insulation while allowing gas and fluid exchange, this would improve the blood flow and epidermal migration to the wound bed to promote angiogenesis and ECM synthesis, 3) must provide debridement action to enhance immune cells migration and performance of their functions, 4) should be non-adherent to the wound bed and be easy to remove after healing, and 5) must be sterile, non-allergenic and non-sensitising [37].

Since the clinicians face a number of different and complicated wound types, even acute or chronic, the dressing selection should be based on the wound type and dressing functions. Very often more than a single dressing would be used for the treatment of a single wound. Indeed, as wounds progress in healing and begin to decrease exudate levels, a new different dressing might be necessary to provide or maintain the natural moisture. Thus choosing the right dressing will improve or fasten the wound healing process. The wound care market offers a wide variety of solutions with different types of dressings. Advanced market solutions comprise skin grafts derived from allogeneic or xenogeneic sources, *in vitro* cultured tissue for epidermal and dermal replacement, tissue engineered skin substitutes, products of synthetic material, or a combination of these. Whereas cellular-based and acellular or bioactive products affront issues of safety by the risks of disease transmission, post-implementation infection and immune system rejection, besides the prominent costs of the whole therapy, the synthetic skin dressings are being more demanded due to the low cost, easy availability, uniform composition and the avoiding of safety risks.

Up to date, there are a wide variety of synthetic wound dressings that can be grouped into two categories depending on their characteristics in relation to the moisture of the wound, the most important issue to be addressed for wound healing and one of the main goals of wound care. These include dressings for wounds with low to moderate exudate and dressings for exudative wounds. The first category includes hydrocolloid dressings, hydrogel dressings, film dressings, and foam dressings. The second category includes alginate dressings and hydrofiber dressings. Their characteristics, advantages and disadvantages and suggested applications are described onward.

Synthetic Wound Dressings

Hydrocolloid dressings

Hydrocolloid dressings are made of polymer matrices that can absorb fluids to form a moist gel at the wound bed interface with an airtight bond with the skin. They are made up of an external layer of polyurethane and an internal layer of gelatin, pectin, carboxymethyl cellulose, or other polysaccharides with hydrophilic properties. They can provide or maintain moist and absorb excess of exudate promoting wound autolytic debridement and angiogenesis, along with secondary benefits like pain management. Due to this characteristic they are so called interactive dressings. The can be used in the wound for up to 6 days. Thus they are ideally selected for granular or very dry wounds and necrotic wound sites. Other improved characteristic is that they prevent the invasion of microorganisms. Hydrocolloid dressings are available in many sizes and shapes, and they can be customized to fit several wounds. A recent meta-analysis of randomized clinical controlled trials has shown that hydrocolloid dressings offer more than two-fold benefits in complete healing compared with saline gauze standard dressing for skin pressure ulcers [38].

Hydrogel dressings

Hydrogel dressings consist of three-dimensional networks of cross-linked hydrophilic water-insoluble polymers (like cellulose) swollen by high water addition. Hydrogel dressings facilitate debridement of degraded tissue and are better than hydrocolloids for dry necrotic wounds that require debridement due to the moisture they supply. By properly moisturizing the wound bed, hydrogel dressings can aid in the healing processes by facilitating the removal of excess dead tissue and granulation. They are preferred for use in painful dry wounds, however they are also used for treating low-level burns, and for partial or full-thickness skin lesions caused by radiation or severe scrapes. Moreover, not only they help hydrate the wounds but also to prevent the spread of infection. They can stay in the wound as long as 4 days, depending on the abundance of the fluid (dripping wound) they might be replaced. They are produced in different shapes and the most common are sheet dressings; their selection depends on complexity and depth of the wound. Although hydrogel dressings are preferred for treating chronic wounds they can be use to effectively treat both acute and chronic wounds [39].

Film dressings

Film dressings are composed of a transparent thin polyurethane sheet membrane coated with an adhesive layer of acrylic for enabling them to adhere to intact skin to cover the site of the lesion. They are extremely flexible and allow visualization of the wound without disturbance so they can be applied over wounds in difficult to apply areas of the body. They are semi-permeable and allow transmitting the excess moisture vapor and carbon dioxide maintaining appropriate moisture whilst do not absorb exudates. Due to the low water absorption capacity they are recommended for low to moderate exudative wounds requiring frequent changes, although they can last in place for up to 7 days. Film dressings are designed to provide a protective environment for superficial wounds or wounds without complication on healing. They are indicated as a primary dressing however can be used as a secondary dressing on top of dressing pads or foam dressings in more exudative wounds, as they are impermeable to bacteria and external liquids. Film dressings prevent radiation-induced moist desquamation in cancer treatment [40]. Since they are water proof the do not have to be removed while bathing or showering. They are available in a wide variety of shapes and sizes for different wounds and offer some protection against friction and shearing forces when applied to intact skin on susceptible areas. Cautions should be taken when removing film dressings since the adhesive can harm the epidermal skin layer. Film dressings are not appropriate for full thickness, infected or heavier exuding wounds.

Foam dressings

Foam dressings are generally made of semi permeable polyurethane, although silicone foams have also been developed. The outer layer may be hydrophobic. These dressings allow moisture to enter the wound maintaining a moist wound environment while keeping out and preventing spread of bacteria and they can be used in the case of infection. They are also gas-permeable and provide thermal insulation. Foam dressings are superior to hydrocolloids for the treatment of exuding wounds [41]. So they are best preferred for use on wounds with minimal to high levels of exudate but are not recommended for dry wounds. Foam dressings are available in various sizes and shapes with a range of thicknesses and in border-site adhesive and non-adhesive presentations and as they promote a moist wound environment and easily conform difficult anatomical body areas like the sacrum and heel they are a great option for leg ulcers. The adhesive foam dressings need to be used with caution on vulnerable skin [42]. They are indicated as primary dressing but can be used on top of hydrogels and creams. They are suitable for

wounds with over granulation and during compression therapy. Foam dressing scan be left in place for several days without causing complications, increasing their cost-effectiveness. Attributes of the polyurethane foam dressing such as ease of application, low labor input, high patient comfort, and protection against secondary wound infection qualify this dressing system as an ideal wound covering for split-thickness skin graft donor sites [43].

Alginate dressings

Alginate dressings are absorbent dressings that contain calcium or sodium alginate fibers derived from brown seaweed. They are dry when initially supplied on an open wound but when they come into contact with wound exudate fluids they transform into a hydrophilic geland become larger as they draw in fluids, which prevents it from becoming dry by maintaining adequate moisture and also making easier dressing removal. Alginate dressings are able to absorb fluids up to 20 times its weight. Therefore, alginate dressings should only be used in moderate to heavily exuding wounds. By ensuring that the wound area environment stays moist these dressings help promote natural self-debridement and encourage new skin growth. Moreover, alginates help to clean out the wound protecting it against harmful bacteria, which helps lower the risk of infection. Alginate dressings are also useful for wounds that are bleeding. The calcium in these dressings acts as a hemostat and helps stabilize blood flow, which slows any bleeding. These dressings are easy to use; they mold themselves to the shape of the wound. They are made in forms of flat dressings and rope dressings, the first can be used for packing the wound over open ulcers like open foot ulcers, the last can be used to absorb fluids in deep wound cavities and promote healing in areas that are difficult to dress like pressure ulcers, diabetic foot ulcers, or venous ulcersin heels and sacral areas. Calcium alginate dressings emerged as the optimum dressing for pediatric skin-graft donor site healing in a controlled trial compared to hydrofiber and foam dressings [44].

Hydrofiber dressings

Hydrofiber dressings are the more recent technology of synthetic dressings made of non-woven sodium carboxymethyl cellulose fibers. These come from high-purity cellulose that has been carboxymethylated in a very controlled way, which is strongly hydrophilic and will rapidly absorb and hold fluids within the structure of the fibers that transform into a clear, soft gel, while retaining overall structural integrity (a moisture retention dressing) [45]. They are indicated for wounds with moderate to high levels of exudates while reducing the risk of maceration because of their vertical fluid absorption properties and require a secondary dressing. Hydrofiber dressings absorb more than alginate dressings, they absorb up to 30 times their weight, however alginates have good haemostatic properties. Depending on the levels of exudate the hydrofiber dressings can stay in place for several days at a time and can also help in debridement thus they can be very cost effective. Providing adequate drainage, hydrofiber dressings will provide exudate absorption promoting a moist wound healing environment and a traumatic painless removal. A clinical study demonstrated no adherence, no trauma, and good safety results using hydrofiber dressings in acute or chronic wounds by secondary intention [46].

Selecting the suitable synthetic dressing among all these options requires a basic knowledge of their properties, advantages and disadvantages. To gain a better understanding on it please see the table 1 for a quick reference.

Recent Advances in Synthetic Dressings

The development of new and effective interventions in wound care remains an area of intense research. Hydroconductive dressings and hydrocellular foam dressings are other technologies that have evolved considerably with ongoing studies. Hydroconductive dressings are recently being used as the first choice of dressing for the treatment of moderate to heavily exuding wounds, because of its three types of action (capillary, hydroconductive and electrostatic) that draw the exudate away from the wound surface, remove toxic components, such as slough, wound debris and bacteria, that compromise wound healing. Such dispersing of the exudate is both vertically and horizontally; hydroconductive dressings control and retain the wound fluid so that it can be transferred to additional layers of dressing if needed. Hydroconductive dressings are changed on a daily basis. However, on a healthy wound bed, can be left on for up to three days. The cost savings using this technology on a daily basis over other dressings becomes quite significant over several weeks of daily dressing changes [47]. Hydrocellular foam dressings (HCFs) are recently being used as the first choice of dressing for the treatment of moderate to heavily exuding wounds. The foam dressing is made of hydrophilic polyurethane and the outer layer is made of polyethylene glycol. The HCFs are non-adherent and water proof, so they can manage excessive wound fluid while maintaining a moist wound environment and preventing bacterial contamination [48].

Conclusions

Skin wounds are a public health problem all around the globe. Each year more than 280 million wounds (surgical or traumatic) occur worldwide. Non healing wounds are the major concern because the treats on healthy and economy fields with complications in productivity and also emotional aspects. Treating an acute wound on the first intention will reduce by far the complications and the course to a chronic outcome, then reducing the problem. Wound care professionals facing the ancient problems for care and management of non healing wounds, now have a wide variety of commercially available products as well as programs and strategies to carry on a better solution for each situation. Selecting the right option will depend on the wound type and the dressing characteristics and functions, taking in account one of the main goals of wound care, provide the appropriate moisture to the wound for a healthy healing. The aim of this short review was to provide an agile lecture for the clinician that is immersed in the advancement of skin wounds treatment.

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