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USE OF HYDROGEL IN THE MANAGEMENT OF ACUTE AND CHRONIC WOUNDS; A PROSPECTIVE STUDY

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ABSTRACT

Wound healing is a physiological phenomenon that involves a complex series of integrated cellular and biochemical responses. Hydrogels are materials that absorb solvents (such as water), undergo rapid swelling without discernible dissolution, and maintain three-dimensional networks capable of reversible deformation. Pharmaceutically acceptable hydrogel polymers of natural, recombinant or synthetic origin, or hybrids thereof, are introduced in a dry, less hydrated, or substantially deswollen state and rehydrate in a physiological environment to undergo a volumetric expansion and to affect sealing, plugging, or augmentation of tissue, defects in tissue, or of organs. Hydrogel dressings are seen as an essential component in many different types of wound care. This is because hydrogel dressing is designed to hold moisture in the surface of the wound, providing the ideal environment for both cleaning the wound, and allowing the body to rid itself of necrotic tissue. The moisture in the wound is also essential in pain management for the patient, and these dressings are very soothing and cooling. Therefore, it is perfect for use in a variety of different applications. With their high moisture content they also help to prevent bacteria and oxygen from reaching the wound, providing a barrier for infections. The most common types of hydrogel dressings are amorphous gels, sheets, filler or fiber types of material and gauze types of dressings. Choosing the right type and shape of hydrogel dressing is important for several reasons, including adequate coverage of the wound area. Typically, wounds treated with the use of hydrogel dressings include diabetic ulcers, pressure sores, surgical wounds, burns and skin tears. They may contain up to ninety five percent water, which is perfect for keeping skin and tissue well hydrated. However, the downside to this high water content is that they cannot absorb liquids from the wound. Typically, hydrogels are not used on wounds that have more than minimal drainage, or they are combined with other types of more absorbent dressings. Hydrogel dressings are non-adhesive to the wound or the tissue, making this a very pain-free type of dressing for the patient. With the variety of options available in hydrogel dressings, small to large wounds can be easily managed by simply selecting the correct dressing option. They are ideal for wounds that are slough-covered, since they don't stick or allow the necrotic tissue to slough off as the healing process occurs. This dressing is also very good for dry and necrotic wounds, since the hydration helps with skin moisture retention and more effective healing.

Keywords: *Wound Healing, Hydrogel Dressings, Topical Formulation*

INTRODUCTION

Despite the progress achieved in the past few decades, wound healing remains a difficult issue to which modern medicine does not always have an efficient response

One option to consider is hydrogel that contains glycerin, allowing it to shape to the surface of the wound and promote healing. These glycerin rich type of hydrogel dressings are also much more fibrous and can be used for deeper wounds and chronic wounds that have created cavities or depressions in the skin.

Hybrid forms of hydrogel dressings are also coming on the market that combine the moisturizing and healing benefits of the hydrogel with the more absorbent properties of a hydrocolloid or calcium alginate dressing. One other benefit of the newer types of hydrogel dressings include having no debris from the dressing left in the wound, eliminating the need for extensive cleaning between dressings. Patients are more comfortable and less stressed, resulting in fewer complaints and problems with wound healing. This would even be helpful on very significant types of chronic ulcers and lesions.

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MATERIALS AND METHODS

This clinical study was conducted as a prospective study in one of the tertiary referral hospitals at coastal Karnataka. The proforma was designed to include relevant demographic information, history of illness and examination findings. a) Inclusion criteria: -Patients with cutaneous ulcer due to traumatic defects, burns, ulcer of venous etiology, decubitus ulcer, diabetic foot. b) Exclusion criteria: -Patients on treatment with immunosuppressors, corticoids, patients with severe peripheral arteriopathy. -Patients suffering from severe malnutrition, malignant cachexia, autoimmune diseases. At the initial examination, patients' age, sex, general health state and comorbidities, age and size of the wounds as well as previous local and systemic treatments were recorded using a standardised questionnaire. Study was accomplished by allocating the patients with chronic wounds in to two groups with 25 patients each: study group (group1) and a control group (group 2). Patients were randomized to two groups by block randomization using a computer program. Allocation was concealed from patients and observers.



Figure 1: The ulcer shows pale granulation tissue with slough



Figure 2: Hydrogel sheet



Figure 3: Hydrogel dressing after opening the cover

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Figure 4: Hydrogel dressing applied over the wound

In group 1 wounds were applied with topical gel containing hydrogel and covered with a sterile dressing bandage. Control (group 2) wounds were dressed with paraffin gauze and covered with standard dry dressings. Dressing change was done daily in both the groups. Treatment efficiency was evaluated with respect to the duration in both the groups. The first evaluation was done on day five. Subsequent evaluations were done at two day intervals until 1 month or complete healing. At the beginning and end of the study, we evaluated the condition of the wound by recording the parameters like proportion of slough, granulation and epithelial tissue. Meanwhile eventual adverse effects were also recorded throughout the follow-up period.

RESULTS AND DISCUSSION

Results

Altogether, 50 patients were included in our study; which included 27 males and 23 females. The gender distributions in the 2 groups were almost similar and there were no statistically significant differences between the study and control groups with respect to gender and age (Table 1). The average age for study group was 62 years and group 2 was 60 years.

Table 1: Age and sex distribution of the study and control group

Study group (Group1)		Study group (Group2)	
Mean Age	62		60
Male: Female	13:12		14:11

Traumatic defects, burns, ulcer of venous etiology are the most frequent pathologies in our study (Table 2).

Table 2: Clinical type of ulcer included in our study

Cause proportion		No of subjects	
Group 1		Group 2	
Venous leg ulcer	5		5
Decubitus ulcer	6		6
Diabetic ulcer	5		5
Burn	4		4
traumatic wound	3		3
Others	2		2

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The majority of the patients had chronic wounds, which were six months old on an average. The general health was assessed as very good in 20 patients and age-appropriate in 20 patients. 10 patients had a reduced physical state due to comorbidities.

Table 3: Wound condition at the end of study Wound Features

	Group 1 (Wound area in %)
Epithelialization	25%
Granulation tissue	90%
Slough	10%

At the end of 1 month of treatment, slough fell from 60 to 10% in group1. At the same time, the area covered with granulation and epithelial tissue markedly increased drastically in group 1 compared to group 2. The wound size (length x width) fell significantly i.e. from 4.5x3 cm to 3 x 2.5 cm in group 1. Four wounds were completely re-epithelialised at the end of the study. The number of patients reporting wound pain decreased markedly in the course of the five dressing changes compared to control group. A significant acceleration of epithelialization across the wound surface was noted following daily hydrogel treatments. Apart from mild discomfort and itching around the wound site in 2 cases, no other significant adverse effects were recorded in study group. Mean & SD were calculated for age and extent of decrease in wound size for 2 groups separately. "Statistical analysis was performed using the SPSS computer package version 20.0. The mean $\pm$ SD was used for quantitative variables. Independent samples t-test was applied, to assess the differences in means of quantitative variables between patients and controls. P-value and Confidence intervals were calculated. P<0.05 was considered as statistically significant.



Figure 5: The ulcer with granulation tissue after hydrogel dressing

Discussion

When the skin is injured, the body initiates a cascade of processes that eventually lead to a re-epithelialisation of the wound area. As a fundamental response to tissue injury, wound healing is a normal complex process including four general phases of hemostasis, inflammation, cell proliferation, extracellular matrix production, and remodeling, which usually in each phase occurs consequently in a regulated manner. If the precisely coordinated interplay of inflammatory cytokines, mitogenic growth factors, extracellular components and enzymes such as proteases is disturbed, stagnation of the repair process can occur, resulting in a chronic wound. Chronic wounds are of various origins and have different aetiologies. Vascular causes such as venous insufficiency, arterial occlusive disease, diabetic angiopathy and neuropathy are the most common systemic disorders. At the local level, infections, and the presence

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of a foreign body in the wound can delay wound healing. In addition, prevailing systemic diseases include malnutrition, malignant cachexia can also hamper wound healing. Taking a systematic and disease-specific diagnosis of these local and systemic factors is a prerequisite for successful wound treatment. Because of the complex pathophysiology of a chronic wound, therapy should not be directed only toward isolated local factors. Parameters like size and location of the wound, the degree of exudation, presence of slough, necrosis, and possible signs of infection as well as the healing phase of a wound at any given time of the wound state influence the choice of the appropriate wound dressing.

This comparative study showed that the hydrogel dressing promotes production of granulation tissue and epithelialisation.

Several authors have reported that the colloidal silver enhances wound healing rate, compared to other conventional or topical applications in a variety of clinical conditions, namely, acute and chronic wounds, infected surgical wounds, and pressure ulcers.

Various authors reported mild or no pain during dressing change with Amorphous hydrogel wound dressing with colloidal silver dressing as compared to other treatments.

Topical antimicrobial dressings, including those that contain silver, are used to prevent or manage infection in a wide range of wounds. Although silver dressings have been used extensively, a recent study and two Cochrane reviews have concluded that there is insufficient evidence to show that silver dressings improve healing rates.

There is growing concern amongst clinicians that arbitrary withdrawal of silver dressings could lead to increased morbidity and prolonged treatment time relating to uncontrolled wound bioburden.

In the context of increasing resistance to antibiotics and the dramatic fall in the number of antibiotics in development, restriction of other potentially useful antimicrobial treatments such as silver dressings is particularly unfortunate. Topical antiseptics, such as silver, differ from antibiotics: they have multiple sites of antimicrobial action on target cells and therefore a low risk of bacterial resistance.

Silver is found in dressings in a number of forms:

- elemental silver – eg silver metal, nanocrystalline silver*
- an inorganic compound – eg silver oxide, silver phosphate, silver chloride, silver sulfate, silver-calcium-sodium phosphate, silver zirconium compound, SSD
- an organic complex – eg silver-zinc allantoinate, silver alginate, silver carboxymethylcellulose.

Silver ions are highly reactive and affect multiple sites within bacterial cells, ultimately causing bacterial cell death. They bind to bacterial cell membranes, causing disruption of the bacterial cell wall and cell leakage. Silver ions transported into the cell disrupt cell function by binding to proteins and interfering with energy production, enzyme function and cell replication. Silver ions are active against a broad range of bacteria, fungi and viruses, including many antibiotic-resistant bacteria, such as meticillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococci* (VRE).

Conclusion

Amorphous hydrogel wound dressing with colloidal silver is more effective as compared to povidine iodine dressing in achieving complete healing, reducing wound surface area and pain, and increasing comfort in subjects with chronic wounds. Hydrogel dressings are non-adhesive to the wound or the tissue, making this a very pain-free type of dressing for the patient.

With the variety of options available in hydrogel dressings, small to large wounds can be easily managed by simply selecting the correct dressing option. They are ideal for wounds that are slough-covered, since they don't stick or allow the necrotic tissue to slough off as the healing process occurs. This dressing is also very good for dry and necrotic wounds, since the hydration helps with skin moisture retention and more effective healing

The hydrogel dressings promote the wound healing process, reduce wound pain and thus improve the patient's quality of life.

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Research Article

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