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Role of hydrogel wound dressings with colloidal silver in management of chronic wounds in young male patients

KEYWORDS

chronic wounds, hydrogel, silver

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ABSTRACT

Introduction: *Chronic wounds due to trauma, peripheral ischaemia and diabetes take long to heal with conventional dressings and are big drain to resources. World over researchers have shown interest in dressings impregnated with silver. The present study was undertaken to assess the efficacy of hydrogel-silver combination wound dressing in decreasing the overall cost.*

Material and methods: *A prospective descriptive study design was used to evaluate our experience. The commonly available hydrogel-silver combination (Hydroheal AM, Dr Reddys' Lab) was used. The wounds were dressed as per protocol. Serial wound swabs for cultures were obtained at each dressing change. The end point of therapy was when wound was free of local infection and healed completely or became fit for split skin graft coverage.*

Results: *A total of 43 patients with 52 chronic wounds were treated during the study period. The median duration of wounds was 9-12 weeks with 26 wounds. The wound size ranged from 8 cm^2 to 200 cm^2, with an average wound size of 48.09 cm^2. The length of hospital stay was much less as 13 (25%) wounds healed on its own and 20 (38.5%) of the wounds were covered with split skin grafts after third dressings. 05 (9.6%) wounds failed to improve or heal and classified as failure to the Hydroheal AM therapy.*

Conclusion: *The colloidal silver was found to be effective in controlling local infection while hydrogel provided moist environment for epithelization. The overall hospital stay of patients decreased due to faster healing or fitness of wounds for split skin graft cover.*

Introduction

"Perhaps the most deceptively simple of all therapeutic procedures is the treatment of cutaneous infection with topical medication. Despite the unique accessibility of the skin to scientific investigation, it has for too long been the playground of crude empiricism"—Professor Sydney Selwyn.[1]

A chronic wound is a wound that does not heal in an orderly set of stages and in a predictable amount of time the way most wounds do; wounds that do not heal within three months are often considered chronic.[2] Chronic wounds seem to be detained in one or more of the phases of wound healing. In acute wounds, there is a precise balance between production and degradation of molecules such as collagen; in chronic wounds this balance is lost and degradation plays too large a role.[3,4] Chronic wounds may never heal or may take years to do so. These wounds cause patients severe emotional and physical stress and create a significant financial burden on patients and the whole healthcare system.[5]

Acute and chronic wounds are at opposite ends of a spectrum of wound healing types that progress toward being healed at different rates.[6] In addition to poor circulation and neuropathy, factors that contribute to chronic wounds include systemic illnesses, age, and repeated trauma. Co-morbid ailments that may contribute to the formation of chronic wounds include vasculitis, immune suppression, pyoderma gangrenosum, and diseases that cause ischaemia. Emotional stress can also negatively affect the healing of a wound, possibly by raising blood pressure and levels of cortisol, which lowers immunity.[7]

Chronic wounds due to trauma, peripheral ischaemia and diabetes take long to heal with conventional dressings and are big drain to resources. World over researchers have shown interest in dressings impregnated with silver. Silver has antiseptic, antimicrobial, anti-inflammatory properties and is a broad spectrum antibiotic. Hydrogel silver combination provides full antimicrobial contact with entire wound bed leading to sustained and effective silver ion release. The present study proposed to evaluate cost effectiveness of hydrogel- silver combination wound dressings in the management of patients with chronic wounds. The commonly available hydrogel-silver combination (Hydroheal AM, Dr Reddys' Lab) was used. The wounds were evaluated on day of reporting for its duration, pus swab cultures, and local treatment being offered. The diabetic control in patients with diabetes was also addressed. The cost effectiveness was measured in terms of cost of dressings, total hospital stay and morbidity/ mortality.

Material and methods

The study was designed as a prospective descriptive analytical study. 43 male patients with 52 ulcer / wounds of more than four weeks duration or showing poor healing in- spite of conventional dressings and other supportive measures were included in study at a tertiary care centre from Jul 2015 to Oct 2016. A total of 52 wounds were included in the study.

Informed consent was obtained from each patient. A detailed clinical history was recorded. The demographic and epidemiologic data were recorded for each patient. The patients were off all parenteral or oral antibiotics at the initiation of therapy with hydrogel-silver combination (Hydroheal AM, Dr Reddys' Lab). The Hydroheal AM consists of hydrogel component of Propylene glycerol IP 4.96 % w/w and Carbomer IP 0.76% w/w, with colloidal silver in a concentration of 32 ppm. This clear antimicrobial wound gel containing colloidal silver provides full antimicrobial contact with entire wound bed leading to sustained and effective silver ion release for 3+ days. The Gel dressing remains clear while in use and there is no discoloration or staining of tissue. It has ideal viscosity –very easy to apply & remove .The patients who developed features of systemic infection and required antibiotics were included is study as failed treatment of Hydroheal AM therapy.

The wounds were cleaned with normal saline after taking the swabs for culture and then covered with ½ inch thick coat of Hydroheal AM for shallow wounds or Hydroheal AM was completely filled in for deeper wounds. They were further covered with wet gauge as secondary cover and dressed. The dressings were left in situ for three days or changed earlier if soakage was high. On day four dressings were removed, the Hydroheal AM with absorbed exudates were removed using saline irrigation to reach the wound floor. Repeat wound swabs for cultures were obtained and the wounds were re-dressed in similar fashion as on day 1. Next dressing changes were done after three days successively, till the wounds healed or were fit for split skin graft (SSG) or flap cover.

The wounds were serially photographed on each dressing change to see the changes in the wound. The end point of therapy was when wound was free from local infection and healed completely or wound became fit for split skin graft coverage.

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Results

This was a prospective descriptive analytical study carried out in a tertiary care hospital of North India .The incidence of chronic wounds/ problematic wounds not responding to conventional dressings as reflected in the study includes both work related accidents, mostly burns, and domestic accidents. A total of 43 patients with 52 such wounds were treated during the study period of Jul 2015 to Oct 2016.

The study included only male patients as that was one of the defining criteria of the study. The female patients and children, even though treated with Hydroheal AM were not included in the study. The age range varied from 19 years to 56 years, with an average age of 32.27 yrs.

The commonest co-morbidity in this study was diabetes mellitus which was present in 10 patients (23.3%).This was followed by chronic venous insufficiency in 3 patients (6.9%), peripheral arterial disease in 2 (4.7%) and paraplegia in 1 patient (2.3%). There was no co-morbidity in rest of the 27 (62.8%).

The commonest cause of the wounds in this study were burns (flame, electrical and contact) which was responsible for 21 wounds (40.4%).This was followed by trauma in 10 wounds (19.2%), infective origin in 7 (13.5%), mine blast in 4 (7.7%), arterial insufficiency in 2 (3.8%), venous insufficiency in 2 (3.8%) and gunshot in 1 (2.3%). There was no definitive cause of the wounds could be identified in 5 wounds and were classified under idiopathic causes (9.6%).

The duration of wounds ranged from 04 weeks to 36 weeks, with an average of 12.56 weeks. The median duration was 9-12 weeks with 26 wounds. The location of wounds involved lower limbs in 43 (82.7%), upper limbs in 7 (13.5%) and 1 wound each (1.9% each) on sacrum and forehead. The wound size ranged from 8 cm^2 to 200 cm^2, with an average wound size of 48.09 cm^2.

The day 1 culture isolated Staph aureus in 12 wounds (23.1%), E. coli in 12 (23.1%), Pseudomonas aeuroginosa in 12 (23.1%), Acenobacter in 5 (9.6%), Klebsiella pneumonia in 1(1.9%), MRSA in 1(1.9%) and no growth in rest of 9 wounds (17.3%). The day 4 culture had a no growth in 35 wounds (67.3%), Staph aureus in 1(1.9%), E.coli in 4 (7.7%), Pseudomonas aeuroginosa in 4(7.7%), Acenobacter in 6 (11.5%), Klebsiella pneumonia in 1(1.9%) and one wound healed. At the end of third dressing change i.e., on day 8, one wound has a growth of Psedomonas aeuroginosa, 8 wounds (15.4%) have healed and remaining 43(82.7%) has no growth.

The length of hospital stay was significantly much less as 09 (17.3%) wounds healed by the time they were due for third dressing and 04 wounds (7.7%) healed by the time they were due for fourth dressing. 06 (11.5%) of the wounds were covered with split skin grafts after two dressings, 20 (38.5%) of the wounds were covered with split skin grafts after third dressings, 05 (9.6%) wounds were covered after fourth dressing and 01(1.9%) wound after six dressings. 02(3.8%) wounds were covered with flap. 05(9.6%) wounds failed to improve or heal and classified as failure to the Hydroheal AM therapy.

The decreased hospital stay and number of dressing changes cut the cost to patient by almost 50%.

Discussion

Chronic wounds may affect only the epidermis and dermis, or they may affect tissues all the way to the fascia .8 They may be formed originally by the same things that cause acute ones, such as surgery or accidental trauma, or they may form as the result of systemic infection, vascular, immune, or nerve insufficiency, or co-morbidities such as neoplasias or metabolic disorders .[8] The reason a wound becomes chronic is that the body's ability to deal with the damage is overwhelmed by factors such as repeated trauma, continued pressure, ischemia, or illness .[6,8]

Though much progress has been accomplished in the study of chronic wounds lately, advances in the study of their healing have lagged behind expectations. This is partly because animal studies are difficult because animals do not get chronic wounds, since they usually have loose skin that quickly contracts, and they normally do not get old enough or have contributing diseases such as neuropathy or chronic debilitating illnesses .[7] Nonetheless, current researchers now understand some of the major factors that lead to chronic wounds, among which are ischemia, reperfusion injury, and bacterial colonization .[7]

The treatment of the different chronic wound types varies slightly, appropriate treatment seeks to address the problems at the root of chronic wounds, including ischemia, bacterial load, and imbalance of proteases .[7] Various methods exist to ameliorate these problems, including antibiotic and antibacterial use, debridement, irrigation, vacuum-assisted closure, warming, oxygenation, moist wound healing, removing mechanical stress, and adding cells or other materials to secrete or enhance levels of healing factors .[9]

Silver has been used as an antimicrobial since the 1800s. Silver has antiseptic, antimicrobial, anti-inflammatory properties and is a broad spectrum antibiotic. But since the discovery of systemic antibiotics in the early 20th century, the use of silver has declined. In the last two decades interest in silver for wound treatment resurged. The recent increase in the incidence of infections due to bacterial resistance to antibiotics has been recognized as an alarming problem, especially in the hospital environment with probability of cross-infection. The potency of silver as an antimicrobial was found to be related to the amount and rate of free silver released onto the wound bed. Silver is biologically active when it is in soluble form ie, as Ag+ or Ag0 clusters. Ag+ is the ionic form present in silver nitrate, silversulfadiazine, or other ionic silver compounds. Ag0 is the uncharged form of metallic silver present in nanocrystalline silver. Free silver cations have a potent antimicrobial effect which destroys microorganisms immediately by blocking the cellular respiration and disrupting the function of bacterial cell membranes. This occurs when silver cations bind to tissue proteins, causing structural changes in the bacterial cell membranes which in turn cause cell death. Silver cations also bind and denature the bacterial DNA and RNA, thus inhibiting cell replication. Controlling micro-organisms within a wound environment promotes wound healing.

Silver in solution exists in three oxidation states: Ag+, Ag++ and Ag+++. Each of these is capable of forming inorganic and organic compounds and complexes, although the Ag++ and Ag+++ forms are unstable or insoluble in water .[10] Ionic silver is active against a wide range of pathogenic organisms but not all forms of silver exhibit antimicrobial activity. In a laboratory-based study, van Hasselt et al examined the antimicrobial properties of three types of colloidal silvers against a range of test organisms, showing a complete lack of activity and concluding that 'claims of its potency are misleading and that there is no place for it as an antiseptic'.[11]

When the silver content and antimicrobial properties of 10 silver-containing dressings were compared in a laboratory study, highly significant differences were demonstrated in the activity of the products concerned.[12] Although there was a clear relationship between the silver content and antimicrobial activity of the products examined, the researchers conclude that there are other factors that influence a dressing's ability to kill micro-organisms. These include the distribution of the silver within the dressing (whether it is present as a surface coating or dispersed through the structure), its chemical and physical form (whether it is present in the metallic, bound or ionic state) and the dressing's affinity to moisture, which is a prerequisite for the release of active agents in an aqueous environment. Products that have their silver content concentrated on the surface of the dressing, instead of being bound up within their structure, performed well in these tests, as did dressings that had silver present in the ionic form.[12]

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Although some bacteria can develop resistance to silver, this is not regarded as a serious problem as available evidence suggests that most preparations capable of delivering sustained silver-ion release are effective against MRSA and VRE, and as yet no resistant strains have been encountered clinically .[13, 14] It follows, therefore, that any silver-containing dressing that shows acceptable levels of activity against a range of non-resistant bacterial species should show comparable activity against antibiotic-resistant strains of the same organism.

In our study the Hydroheal AM therapy found to be more cost effective as change of dressings were lesser as compared to daily dressing change required in conventional (wet to dry or wet to wet dressings) .[15] All wounds were cultured to see the efficacy of silver in controlling local infection. The culture reports became negative in all but one wound by tenth day. Patients were off all parenteral/oral antibiotics at the start of therapy. The colloidal silver was thus found to be effective in controlling local infection. The epithelization was much faster with the therapy as conventional daily dressings expose wounds to mechanical and chemical manipulation and leads to damage to granulation tissue. Moreover, lesser number of dressing change results in lesser pain killer requirement for the patients. The overall hospital stay of patients decreased due to faster healing or fitness of wounds for split skin graft cover. The hydrogel-silver dressings were most effective in healing second degree superficial burns and decreased the requirement of pain-killers during dressing changes and otherwise. In conclusion this study has tried to achieve the objective to improve and hasten the healing of problem wounds using hydrogel-silver leading to decrease hospital stay and thus reducing overall cost of treatment.

Conflicts of interest

Author has none to declare.

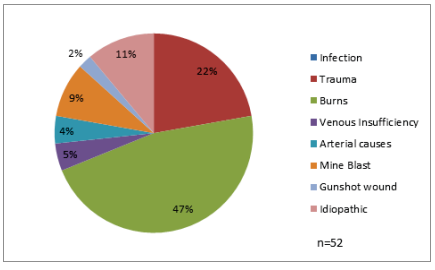

Figure 1

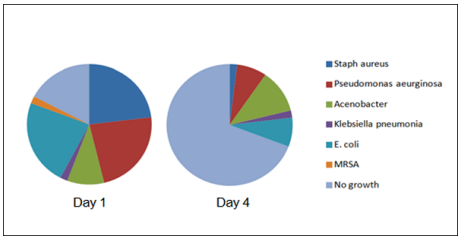

Figure 2

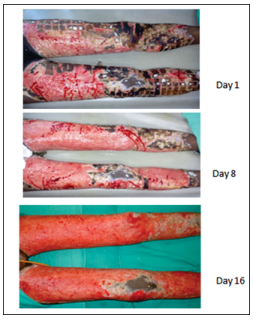

Figure 3

Legend to figures

Figure 1. Aetiology of the wounds

Figure 2. Comparision of culture growth on Day 1 and Day 4 of the therapy

Figure 3. Six weeks old mixed burns wound on Day 1(at first dressing), Day 8 (after two dressings) and Day 16 (after four dressings)

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