



Comparing the Effects of Topical Hyaluronic Acid and Betadine on Wound Healing Using the Bates-Jensen Wound Assessment Tool

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(Received: 05 October 2023)

Revised: 12 November

Accepted: 07 December)

KEYWORDS

Topical hyaluronic acid, betadine, assessment tool

Abstract: Ulcers on extremities represent a prevalent surgical issue encountered in outpatient healthcare settings throughout India, affecting individuals from all societal backgrounds and geographic regions. These ulcers can lead to considerable health complications, occasionally necessitating major amputations and even resulting in fatalities. Consequently, numerous recent studies have been undertaken to explore innovative approaches to manage extremity ulcers locally. Some of these methods, such as Vacuum Assisted Closure, leverage wound healing principles and have exhibited promising success rates. However, one drawback of many of these approaches is their higher associated costs, rendering them inaccessible to the average person who urgently requires effective local ulcer management. Hence, a prospective, interventional study was conducted at KIMS, Karad hospital, aiming to assess the role of topical hyaluronic acid in wound healing. This research aimed to provide a more cost-effective option for individuals seeking comprehensive ulcer treatment.

I. INTRODUCTION

Wound healing is a intricate biological process focused on restoring both the structural and functional integrity of damaged tissue. This intricate process enlists various types of cells, including neutrophils, macrophages, mast cells, lymphocytes, and fibroblasts. They collaborate with a range of signaling molecules such as cytokines, growth factors, and metalloproteinases. Together, they work harmoniously to accomplish critical stages including hemostasis (bleeding control), inflammation, proliferation (cell growth), neoangiogenesis (formation of new blood vessels), and ultimately, tissue remodeling marked by the production and deposition of collagen. Hyaluronic acid is a naturally derived proteoglycan, synthesized from N-acetylglucosamine and glucuronic acid. This substance serves as a prominent constituent of the extracellular matrix within the human body. Its involvement in wound healing is pivotal, contributing through various pathways, such as angiogenesis (new blood vessel formation), activation of keratinocytes (skin cells), the expression of pro-inflammatory cytokines (molecules involved in inflammation regulation), and the attraction of white blood cells (leukocyte chemotaxis) to the wound site. High

molecular weight Hyaluronic acid exhibits anti-angiogenic properties, inhibiting the formation of new blood vessels. Conversely, low molecular weight Hyaluronic acid promotes inflammation and angiogenesis, supporting the development of new blood vessels. Hyaluronic acid has demonstrated its effectiveness in reducing edema (swelling) and facilitating corneal wound healing, showcasing its beneficial impacts on these aspects of the healing process. Therefore, given the widespread occurrence of extremity ulcers in India and the substantial contribution of hyaluronic acid to the wound healing process, this study was conducted to investigate the effectiveness of topical hyaluronic acid in wound healing when compared to conventional betadine dressings. Furthermore, the study aimed to explore the possibility of using hyaluronic acid as a supplementary treatment alongside betadine for wound management.

II. MATERIAL AND METHODS

The main aim of this study is to assess the effectiveness of topical Hyaluronic Acid in promoting wound healing in comparison to Betadine, using the Bates Jensen Wound Assessment Tool as a measurement instrument. An additional goal of this study is to



calculate the percentage reduction in the wound surface area after the application of topical hyaluronic acid in comparison to Betadine dressing. Inclusion Criteria: (a) Ulcers located on the lower limb with a size greater than 1x1 cm. (b) Chronic ulcers that have not shown signs of healing. (c) Ulcers occurring in individuals with comorbid conditions such as Type II Diabetes Mellitus. (d) Ulcers in individuals with impaired vascularity, such as those with Peripheral Vascular Disease. Exclusion Criteria: (a) Ulcers with a size less than 1x1 cm. (b) Ulcers located on the upper limb. (c) Ulcers accompanied by underlying bone osteomyelitis. A total of 100 patients were included in this study and assigned randomly to either the test or control group, resulting in two groups, each comprising 50 subjects. In the test group, patients received topical hyaluronic acid as part of their wound dressings, while in the control group, patients were treated with traditional Povidone-Iodine dressings. All participants in both groups also received appropriate parenteral antibiotics as part of their treatment regimen. In both groups, subjects underwent daily wound dressings conducted with strict aseptic precautions. Specifically, in the test group, subjects received hyaluronic acid dressings daily for a duration of 7 days. At the conclusion of the 7-day period, subjects in both groups were assessed for the following parameters:

- 1) Percentage reduction in the surface area of the ulcer.
 - 2) Presence or absence of granulation tissue, slough, and discharge.
 - 3) Wound assessment based on the Bates Jensen Wound Assessment tool, comprising 13 parameters:
 - a. Size
 - b. Depth
 - c. Edge
 - d. Undermining
 - e. Necrotic Tissue Type
 - f. Necrotic Tissue amount
 - g. Exudate type
 - h. Exudate amount
 - i. Skin color surrounding the wound
 - j. Peripheral tissue edema
 - k. Peripheral tissue induration
 - l. Granulation Tissue
 - m. Epithelialization
 - n. Location and Shape
- The collected data was organized into tables and subjected to analysis using various statistical tests, including the chi-square test, Mann-Whitney test, and independent t-test. These statistical methods were employed to evaluate and compare the outcomes between the test and control groups.

III. RESULTS

- 1) The average age in years among the control group was

58.27 years, while in the case group, it was 57.31 years.

- 2) Among the control group, 75.8% of the subjects were males, whereas in the case group, 86.9% were males.

- 3) The mode of onset was spontaneous in 88.9% of the control group and in 82.2% of the case group.

In this study, the associated comorbidities among the participants were examined. It was found that a significant portion of patients in both the control and test groups had hypertension, with 31.1% of patients in the control group and 40.0% in the test group reporting this condition. Ischemic Heart Disease was also noted, with 17.8% of the control group and 6.7% of the test group having this comorbidity. Chronic cigarette consumption was prevalent among the participants, with 62.2% of the control group and 53.3% of the test group reporting a history of chronic cigarette use. Anemia, defined as having a Hemoglobin level less than 10.0 g/dL, was observed in both groups, but it was more common in the control group, affecting 51.1% of patients, compared to 24% in the test group. Interestingly, peripheral neuropathy was found in only one patient in the control group and none in the test group. These findings shed light on the prevalence of associated comorbidities among the study participants and their potential impact on wound healing outcomes. The rate of granulation tissue formation was notably faster in the case group. At the end of Day 7, 97.8% of the cases exhibited granulation tissue, whereas only 69% of the control group had granulation tissue. The percentage reduction in the surface area of the ulcer between Day 1 and Day 14 was significantly higher among the cases, with a reduction of 17.12%, in contrast to the control group which experienced a reduction of 5.82%. These findings suggest that the application of topical hyaluronic acid had a more favorable impact on wound healing compared to the conventional treatment with Betadine dressings.

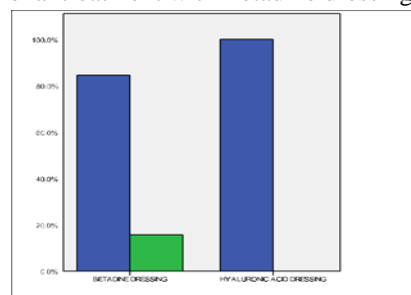


FIGURE 1: Graph showing amputations done amongst cases and controls

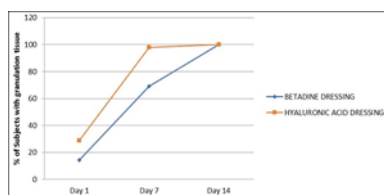


FIGURE 2: Graph showing rate of granulation tissue formation amongst the two groups

IV. DISCUSSION

The occurrence and frequency of extremity ulcers in India are widespread, leading to substantial health challenges and potential loss of life. While India, primarily due to sepsis that arises as a consequence of infected extremity ulcers. This underscores the critical need for effective and timely interventions to manage and prevent these ulcers and their associated complications. This study aimed to investigate the potential of topical hyaluronic acid in promoting wound healing. The research spanned a duration of 18 months and included a total of 100 participants. These subjects were randomly divided into two equal groups: cases and controls. In the case group, wound management involved the application of hyaluronic acid alongside conventional betadine dressings. On the other hand, the control group received treatment solely through betadine dressings. This study design allowed for a comparative analysis of the effectiveness of hyaluronic acid as an adjunct to standard wound care practices. The study employed the Bates Jensen Wound Assessment tool, which comprises 13 parameters to evaluate wound healing progress. A lower score on this tool indicates a faster rate of wound healing. Among the cases group, there was a notable reduction in the score between Day 0 and Day 14, with a decrease of 19.55. In contrast, the control group experienced a reduction in score during the same period, but it was less significant at 9.98. The p-value of <0.0001 suggests a statistically significant difference, signifying a notably faster rate of wound healing in the cases group. The study also considered the surface area of the wounds, calculating the percentage reduction between Day 0 and Day 14. The results indicated a substantially higher percentage reduction in surface area among the cases (17.22%) compared to the controls (5.82%), with a p-value of <0.0001 . This outcome underscores a significantly faster rate of wound healing in the cases group.

advancements in higher-generation antibiotics and improved wound debridement techniques have contributed to a reduction in mortality rates, extremity ulcers, especially those linked to or resulting from Type II Diabetes Mellitus and Peripheral Arterial Occlusive Disease, continue to pose a significant health burden. These ulcers can result in severe health complications unless they are promptly and appropriately treated. In the present landscape, a significant number of limb amputations are being performed, both within our hospital and in other medical facilities across

Furthermore, the rate of granulation tissue formation was found to be markedly faster among the cases group when compared to the controls, further reinforcing the favorable impact of hyaluronic acid in wound healing as observed in the study.

V. CONCLUSION

In summary, the treatment of extremity ulcers necessitates a comprehensive approach that includes aggressive local management alongside systemic antibiotics and supportive interventions to facilitate wound healing. This study has provided compelling evidence that the application of topical hyaluronic acid yields several favorable outcomes. These include higher rates of granulation tissue formation, a more rapid wound healing process (as assessed using the Bates Jensen Wound Assessment Tool), a reduced incidence of major amputations, and a swifter reduction in the surface area of wounds. Based on these findings, it can be reasonably concluded that topical hyaluronic acid has the potential to serve as a valuable adjunct to traditional betadine in local wound management. This highlights the importance of considering hyaluronic acid as part of the therapeutic strategy for extremity ulcers, aiming to improve patient outcomes and reduce the need for major amputations.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or nonprofit sectors.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.



AUTHORS' CONTRIBUTIONS

All authors equally contributed to preparing this article.

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