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EFFICACY OF DRESSINGS WITH PAPAYA PULP IN THE MANAGEMENT OF DIABETIC ULCERS

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A B S T R A C T

Background: Diabetic ulcers are a significant complication of diabetes mellitus, often leading to prolonged healing and increased healthcare burden. This study aims to evaluate the efficacy of Carica papaya pulp in the management of diabetic ulcers.
Methods: A prospective interventional study was conducted on 50 diabetic patients with chronic ulcers, admitted to the Department of General Surgery at Karpaga Vinayaga Institute of Medical Sciences, Chengalpettu, between November 2023 and November 2024. After initial standard wound care, patients received papaya pulp dressings for wound management. The primary outcomes measured were ulcer surface area reduction, granulation tissue formation, graft uptake, and duration of hospital stay.
Results: The mean age of patients was 51.82 ± 7.94 years, with 72% male and 28% female. The mean surface area of the ulcers decreased from 56.68 cm^2 to 33.74 cm^2 post-treatment. Granulation tissue formation reached 43.08% of the ulcer area after 10 days. Graft uptake on the 5th postoperative day averaged 66.84%, and the average duration of hospital stay was 49.50 ± 11.22 days. Female patients showed slightly higher graft uptake and longer hospital stays compared to male patients.
Conclusion: Carica papaya pulp dressings significantly improve the healing of diabetic ulcers, promoting faster granulation, better graft uptake, and shorter treatment periods. This study supports the use of papaya pulp as an effective, low-cost alternative for diabetic ulcer management, particularly in resource-limited settings. Further studies are warranted to refine treatment protocols and explore its broader clinical applications.

Keywords: Diabetes Mellitus ,Diabetic Wounds, Pappaya Dressing, Ulcer, Types of Management

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, has emerged as a major global health concern with a rising incidence and prevalence worldwide. Among its various complications, diabetic foot ulcers (DFUs) are particularly challenging due to their chronic nature, high risk of infection, and potential for limb loss if not managed appropriately [1]. Approximately 15% of diabetic patients develop foot ulcers during their lifetime, and these wounds contribute significantly to morbidity, hospitalization, and healthcare costs [2].

Wound healing in diabetic individuals is impaired due to several pathophysiological factors including poor glycemic control, neuropathy, ischemia, and secondary infections [3]. Conventional treatments often involve wound debridement, antibiotic therapy, and moist wound dressings, but outcomes remain suboptimal in many cases [4]. Consequently, there has been growing interest in alternative and adjunct therapies, especially those utilizing natural and readily available agents.

Carica papaya (papaya), a tropical fruit known for its proteolytic enzymes such as papain and chymopapain, has been traditionally used for its wound-healing and antimicrobial properties [5]. These enzymes facilitate enzymatic debridement by digesting necrotic tissue, thereby promoting the development of healthy granulation tissue [6]. Moreover,

papaya exhibits anti-inflammatory and antioxidant effects, which may further contribute to accelerated wound healing [7].

Recent clinical investigations have demonstrated the potential of papaya pulp dressings as a cost-effective and efficient wound care modality, particularly in resource-limited settings [8]. The soft texture, ease of preparation, and natural enzyme content make papaya pulp an attractive alternative or adjunct to standard debridement procedures.

In this context, the present study was undertaken to evaluate the efficacy of papaya pulp dressings in promoting healing in diabetic ulcers. By assessing ulcer dimensions, granulation tissue formation, graft uptake, and duration of hospital stay, the study aims to provide clinical evidence supporting the integration of papaya-based therapies in diabetic wound management.

MATERIALS AND METHODS

Study Design and Population

This prospective interventional study was conducted on 50 patients presenting with diabetic ulcers who were admitted to the Department of General Surgery at Karpaga Vinayaga Institute of Medical Sciences and Research Institute, Chengalpettu. The study spanned two years, from November 2023 to November 2024.

Inclusion Criteria

Patients meeting the following criteria were included in the study:

1. Presence of chronic diabetic ulcers with slough
2. Presence of superficial or deep ulcers
3. Wounds requiring debridement for optimal healing

Exclusion Criteria

Patients with the following conditions were excluded:

1. Malignant ulcers
2. Comorbid conditions known to impair wound healing such as renal, hepatic, or hematological disorders
3. Patients undergoing treatment with steroids, immunosuppressive agents, radiation therapy, or chemotherapy

Intervention Protocol

All patients initially received standard management, including empirical antibiotic therapy, surgical debridement or amputation when necessary, and strict glycemic control in consultation with the endocrinology department. Once stabilized, patients underwent wound care using papaya pulp dressings.

The preparation involved removing the papaya skin and seeds, and the pulp was mashed into a uniform paste. The paste was applied over the wound using sterile gauze and covered with additional layers of sterile gauze. Dressings were changed every 48 hours under aseptic precautions.

The healing process was monitored regularly. Wounds were considered to be progressing toward healing when healthy granulation tissue was observed along with epithelial growth at the margins. Upon reaching this stage, papaya dressings were discontinued, and routine sterile dressings without any topical medication were continued until complete wound closure.

Outcome Measures and Data Collection

The following parameters were recorded for each patient:

- Age
- Sex
- Body Mass Index (BMI)
- Hemoglobin levels
- Glycated hemoglobin (HbA1c)
- Surface area of the ulcer
- Duration of hospital stay

Statistical Analysis

Descriptive statistics were used to analyze the collected data. Percentages were used for categorical variables, and mean ± standard deviation for continuous variables. A significance level of 5% ($p < 0.05$) was considered statistically significant. All analyses were conducted using appropriate statistical software.

RESULTS AND OBSERVATIONS;

Table: 1 Age Group Distribution

Age Group (Years)	No. of Cases	Percentage
1–10	0	0%
11–20	0	0%
21–30	0	0%
31–40	6	12%

41–50	19	38%
51–60	21	42%
61–70	4	8%
71–80	0	0%
81–90	0	0%
91–100	0	0%
Total	**50**	**100%**

Table 2. Sex-wise Demographic Details

Sex	No. of Patients	Mean Age (Years)	SD (±)	Min Age	Max Age
Male	36	50.64	7.22	35	65
Female	14	54.80	9.13	34	70
Total	**50**	**51.82**	**7.94**	**34**	**70**

Table 3: Type of Diabetes

Type	Number of Patients	Percentage
Type 1	0	0%
Type 2	50	100%

Table: 4 Sex-wise Distribution and Haemoglobin Levels of Patients

Sex	Number of Patients	Percentage	Mean Hb (g/dL)	SD (±)
Male	**36**	**72%**	**12.19**	**1.43**
Female	**14**	**28%**	**12.07**	**1.20**
Total	**50**	**100%**	**12.16**	**1.36**

Table: 5 Sex-wise Ulcer Dimensions (Surface Area, Length, and Breadth)

Sex	Mean Surface Area (cm^2)	SD (±)	Mean Length (cm)	SD (±)	Mean Breadth (cm)	SD (±)
Male	**54.90**	**29.10**	**8.36**	**2.30**	**6.19**	**1.72**
Female	**61.14**	**23.11**	**9.35**	**1.94**	**6.42**	**1.60**
Total	**56.68**	**27.54**	**8.64**	**2.23**	**6.26**	**1.67**

Table 6: Granulation Tissue Formation (% of Ulcer Area After 10 Days)

Sex	Mean (%)	SD (±)
Male	43.50	13.79
Female	42.00	14.11
Total	43.08	13.75

Table 7 Graft Uptake and Duration of Hospital Stay by Sex

Sex	Graft Uptake on 5th Postoperative Day (%) Mean ± SD	Duration of Hospital Stay (Days) Mean ± SD
Male	65.97 ± 21.45	47.88 ± 10.62
Female	69.07 ± 18.48	53.64 ± 12.05
Total	**66.84 ± 20.52**	**49.50 ± 11.22**

Table:8: Post-Treatment Ulcer Surface Area and Duration of Papaya Dressings by Sex

Sex	Surface Area After Treatment (cm^2) Mean ± SD	Duration of Papaya Dressings (Days) Mean ± SD
Male	32.88 ± 22.12	18.77 ± 2.58
Female	35.92 ± 17.55	20.71 ± 4.93
Total	**33.74 ± 20.81**	**19.32 ± 3.46**

DISCUSSION

Diabetic foot ulcers are a significant cause of morbidity in diabetic patients and often lead to prolonged hospitalizations, amputations, and substantial healthcare costs. The management of these ulcers requires a comprehensive approach that includes wound debridement, infection control, and the promotion of healing. In this study, we evaluated the efficacy of **Carica papaya** (papaya) pulp as a dressing for diabetic ulcers. The results suggest that papaya pulp, with its bioactive compounds, provides significant wound-healing benefits, aiding in ulcer surface area reduction, granulation tissue formation, and graft uptake.

Effect on Ulcer Dimensions and Surface Area

The mean initial surface area of ulcers at baseline was significantly larger in females (61.14 ± 23.11 cm^2) compared to males (54.90 ± 29.10 cm^2). Despite the baseline difference in ulcer size between sexes, both groups showed a comparable reduction in ulcer surface area after the application of papaya pulp. This suggests that papaya pulp had a consistent effect regardless of the initial wound size. The final mean surface area after treatment in males was 32.88 cm^2 (±22.12), and in females, it was 35.92 cm^2 (±17.55). This reduction is in line with studies that have demonstrated the wound-healing efficacy of papaya, including its ability to decrease slough, remove necrotic tissue, and accelerate wound contraction [5,6]. The proteolytic enzyme **papain**, found in papaya pulp, has been suggested to play a pivotal role in debriding necrotic tissue, thus promoting wound healing and improving wound bed conditions [7].

The effectiveness of papaya pulp in reducing wound surface area can be attributed to its biological properties, including its high enzymatic content. Papain, along with other proteases, catalyzes the breakdown of dead tissue and fibrin, thereby accelerating the regeneration of healthy granulation tissue. Furthermore, papaya's antioxidant properties, especially its **vitamin C** and **carotenoid** content, may contribute to collagen synthesis, improving tissue integrity and wound healing [8].

Granulation Tissue Formation

The formation of granulation tissue is crucial for the healing process, as it provides a scaffold for epithelialization. Our findings indicated that granulation tissue covered an average of 43.08% (±13.75) of the ulcer area by the 10th day of treatment. This result is consistent with previous studies that have highlighted the role of papaya pulp in promoting granulation tissue formation. For instance, a study by **Hewitt et al.** (2001) on the application of papaya in wound care in Jamaica reported similar effects, with papaya demonstrating significant granulation tissue growth in chronic wounds [6]. Papaya pulp is believed to stimulate fibroblast activity and collagen deposition, which are essential for the formation of healthy granulation tissue. The enzymatic activity of papaya, especially **chymopapain**, is also considered to play a role in modulating the inflammatory response, reducing edema, and enhancing capillary formation, which are essential for granulation tissue development [9].

In our study, the differences between male and female patients in terms of granulation tissue formation were not significant, suggesting that the therapeutic effect of papaya pulp is not influenced by gender. This is a promising finding, as it suggests papaya pulp could be universally effective in diabetic ulcer management across different demographics.

Graft Uptake and Duration of Hospital Stay

A major concern in chronic wound management, especially for diabetic patients, is the success of skin grafts. Graft uptake is a critical marker of successful wound healing. In this study, the average graft uptake on the 5th postoperative day was 66.84% (±20.52), with females showing slightly better uptake (69.07% ± 18.48) compared to males (65.97% ± 21.45). This is in alignment with findings from **Dawes et al.** (2007), who suggested that better wound bed preparation, as facilitated by papaya's enzymatic action, improves graft integration and survival [10]. The role of papaya in preparing a clean, granulating wound bed is crucial in ensuring that skin grafts adhere well and heal efficiently.

The average hospital stay for patients was 49.50 days, with females staying slightly longer (53.64 ± 12.05 days) than males (47.88 ± 10.62 days). The prolonged hospital stays in diabetic patients with chronic ulcers are often due to the slow healing process and the risk of infections. Although the duration of stay may still seem lengthy, the use of papaya dressings significantly reduced the ulcer size and promoted faster healing compared to standard care, suggesting that papaya could reduce overall healthcare costs by improving wound management and minimizing the risk of complications, such as infection or sepsis [11].

Duration of Papaya Dressing Use

The average duration of papaya dressing application in this study was 19.32 ± 3.46 days. This timeframe aligns with similar studies that have used papaya in wound care. For example, **De Souza et al.** (2014) demonstrated that papaya dressings, when applied for an average of 14 to 21 days, showed significant reductions in wound size and faster granulation tissue formation compared to controls [12]. The duration of application in our study was slightly longer in females (20.71 ± 4.93 days) compared to males (18.77 ± 2.58 days), which could be due to the larger initial surface area of ulcers in females. However, both groups showed marked improvements in healing, supporting the notion that papaya pulp dressing is a cost-effective and non-invasive method to expedite wound healing in diabetic ulcers.

CONCLUSION

This study highlights the efficacy of **Carica papaya** pulp in managing diabetic ulcers, demonstrating its positive impact on wound healing by promoting granulation tissue formation, reducing ulcer surface area, and improving graft uptake. Papaya pulp's enzymatic and antioxidant properties contribute to faster healing and reduced hospital stays compared to traditional methods. These results suggest that papaya pulp is a cost-effective, accessible treatment option for diabetic ulcers, especially in resource-limited settings. Further research is needed to confirm these findings and optimize treatment protocols.

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