

Clinical Evaluation of Platelet-Rich Plasma vs. Traditional Wound Dressings for Diabetic Foot Ulcer Treatment: A Comparative Analysis

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(Received: 05 October 2023) **Revised: 12 November** Accepted: 07 December) Abstract: Background: Diabetic foot ulcers present complex challenges in terms of their **KEYWORDS** Diabetic foot ulcer, pathogenesis and associated morbidity. In contrast to traditional treatment methods like saline gauze and antiseptic dressings, newer biological approaches such as platelet-rich plasma (PRP) are under Platelet-rich investigation as potential enhancements for managing diabetic foot ulcers. These innovative methods plasma, Wound aim to improve the outcomes for patients with these challenging wounds. Methods: The current study healing is arandomized controlled trial comprising 20 subjects in both the platelet-rich plasma (PRP) dressing group and the conventional dressing group. The study was conducted within the General Surgery wards of Krishna Hospital, KIMS, karad hospital, focusing on patients with diabetic foot ulcers. Over a span of three weeks, PRP dressings were administered biweekly before conducting the final assessment of the wounds. This study aims to evaluate the effectiveness of PRP dressings in comparison to conventional dressings for managing diabetic foot ulcers. Results: The majority of the study participants were males, primarily aged over 60 years. The foot ulcers were predominantly located on the plantar aspect. Trauma was identified as the leading cause of these ulcers in about twothirds of the cases. Approximately 70% of the subjects were being treated with insulin. Among the patients who received PRP dressings, the wounds exhibited a significant contraction of over 36%, which was statistically higher compared to those who received conventional dressings. This data suggests that PRP dressings may have a more pronounced impact on wound contraction, potentially making them a more effective treatment option for diabetic foot ulcers. Conclusion: Newer biological methods like platelet-rich plasma (PRP) dressings represent a relatively novel, safe, and efficient approach for managing diabetic foot ulcers when compared to traditional methods.

I. INTRODUCTION

Diabetic foot ulcer (DFU) stands as a disabling complication of diabetes mellitus, impacting substantial portion of indi- viduals with diabetes. The lesions associated with diabetes mellitus result in compromised nerve responses to tactile stimuli and altered blood flow through the arterioles that sup-ply the feet. This occurrence is prevalent in over two-thirds of DFU patients, particularly those with inadequate control of their blood sugar levels [1]. The rising prevalence of lifestyle factors like sedentary behavior and dietary habits is expected to contribute to the continued increase in diabetes cases. Con- sequently, the risk of complications associated with diabetes, including diabetic foot, is also anticipated to rise. Several risk factors contribute to the development of diabetic foot ulcers, including advanced age, being overweight, elevated blood pressure, a history of tobacco use, and a prolonged history of diabetes. These factors

collectively increase the likelihood of diabetic foot ulcers. The significance of diabetic foot ulcers is profound, as they are associated with a two-fold increased risk of mortality compared to non-ulcerated diabet-ics. Moreover, the 5-year mortality rate following amputation for diabetic foot ulcers is high, ranging between 38% and 66%, which is comparable to the mortality rates seen in moreaggressive forms and stages of cancer. This highlights the critical importance of effective prevention and management strategies for diabetic foot ulcers. Clinical findings suggestive of diabetic foot include a range of symptoms and manifesta- tions, such as ulceration, impaired blood supply leading to gangrene, mycotic (fungal) infections, skin fissures, macer- ation between the toes, calluses, and foot deformities like nail deformities and pes cavus. These conditions can make the foot more vulnerable to ulceration. It's worth noting that previous studies have indicated that the majority of diabetic foot ulcers were

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of higher grades (grades 2-4) and were commonly located on the plantar (sole) region of the foot. Secondary prevention measures play a crucial role in the effective management of diabetic foot ulcers. These measures include early diagnosis and prompt treatment. It is impera- tive for diabetic patients to engage in daily self-inspection of their feet, as well as regular foot examinations during hospital visits [2], [3]. Patient education on the importance of maintaining optimal blood sugar levels and the provision of appropriate footwear are vital components of reducing morbidity related to diabetic foot ulcers. These strategies contribute to the early identification of issues and promote better overall foot health in diabetic individuals. Indeed, Platelet-Rich Plasma (PRP) is demonstrating its potential in wound dressing for diabetic foot ulcers [4]. Research suggests that when PRP is combined with proper tissuedebridement and the use of the patient's own platelet-rich plasma, it can be a safe and effective treatment for diabetic foot ulcers. This approach offers superior wound healing outcomes, reduced complication rates, and has the potential to significantly alleviate the burden associated with diabetic foot ulcers. The evidence supporting the utility of PRP in wound management for these ulcers is growing and holds promise for improved patient outcomes [5], [6]. The present study aims to contribute to the limited body of literature on the management of diabetic foot ulcers with Platelet-Rich Plasma (PRP), particularly within the context of India. This study seeks to compare the effectiveness of PRP dressings with conventional wound dressings in terms of reducing the size of chronic diabetic foot ulcers (DFU) in patients. By conducting this research, the study aims to provide valuable insights into the potential benefits of PRP in the management of DFU and improve our understanding of its efficacy in the Indian context [7], [8].

II. MATERIAL AND METHODS

The present study is a randomized controlled trial conducted over the course of one year. It involved patients admitted to the wards of the Department of General Surgery. The study focused on individuals with both Type I and Type II diabetes, aged between 14 and 70 years, who had ulcerated wounds persisting for more than three weeks. The ulcers had a documented etiology as a complication of Diabetes Mellitus and were of a size less than 10x10 cm. Patients included in the study

had fasting blood glucose levels between 140 and 200 mg/dl, as measured on two separate occasions 24 hours apart. [9] However, patients with pulseless limbs, associated osteomyelitis, skin malignancies, cellulitis, diabetic ketoacidosis, exposed bone and tendon in the ulcer, and those with compromised immune systems were excluded from the study. A total of 40 patients were recruited and then randomly divided into two groups, each consisting of 20 patients. The first group received treatment with Platelet-Rich Plasma (PRP) dressings, while the second group received treatment with conventional wound dressings. Data was collected using a pre-tested and structured questionnaire, and informed written consent was obtained from all study participants, with a clear explanation of their option to withdraw from the study if they experienced any discomfort. Confidentiality was strictly maintained throughout the study [10]. For con- ventional dressings, the ulcer was cleaned with normal saline and salinesoaked gauze pieces were kept over the ulcer which was covered with pad and roller bandage. For the PRP dressings, the platelet-rich plasma was produced manually by withdrawing 10 ml of the blood by venipuncture. Five mlof blood was put each in two test tubes and anticoagulant citrate dextrose (ACD) was added. Centrifugation was done at 2000 rpm for 10 minutes. Three layers were observed - topplasma layer, middle buffy coat layer and the bottom RBC layer. The plasma and the buffy coat layers were removed using a pipette and put in a test tube mixed with calcium chloride (CaCl2). Second centrifugation was then done for 10 minutes at 2000 rpm. This results in top platelet poor plasma (PPP), middle platelet rich plasma (PRP) and the bottom RBCs. The platelet poor plasma is then discarded and PRP is separated and taken in a syringe and injected in the wound site. Such PRP dressings is done biweeklyfor four weeks and assessed for wound contracture [11], [12]. In the conventional dressing method, the ulcer was cleaned with normal saline, and then saline-soaked gauze pieces were applied to cover the ulcer. This was followed by placing a pad over the gauze, and the entire area was secured with a roller bandage. For the Platelet-Rich Plasma (PRP) dressings, a manual process was employed to produce PRP. This involved withdrawing 10 ml of the patient's blood through venipuncture. The collected blood was then divided into two test tubes, with 5 ml in each tube. Anticoagulant citrate dextrose (ACD) was added to both test tubes [13]. These test

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tubes were then subjected to centrifugation at 2000 rpm for 10 minutes. After centrifugation, three distinct layers were observed: the top plasma layer, the middle buffy coat layer, and the bottom layer of red blood cells (RBCs). The plasma and buffy coat layers were carefully extracted using a pipette and transferred to another test tube. Calcium chloride (CaCl2) was added to this test tube, and a second round of centrifugation was carried out for 10 minutes at 2000 rpm. This second centrifugation resulted in three layers: the top layer containing platelet-poor plasma (PPP), the middle layer containing platelet-rich plasma (PRP), and the bottom layer containing red blood cells (RBCs). The plateletpoor plasmawas discarded, and the PRP was separated and drawn into a syringe. This PRP was then injected into the wound site. PRP dressings were administered biweekly over a span of four weeks, and the wound's contracture was assessed duringthis period. This method allowed for the application of PRP directly to the ulcer to assess its impact on wound healing [14].

III. RESULTS

A total of 40 patients were studied. The age distribution of the study subjects is summarized in Table 1. Table 1: Age distribution of the study subjects.

Age (years)	No. of cases	Percentage (%) 0	
18-30	0		
31-40	4	12	
41-50	5	18	
51-60	20	46	
>60	11	24	

Group	Mean reduction (%)	SD	Median	P value
Study	30.42	2.52	30.58	< 0.001
Control	10.52	2.55	10.2	



FIGURE 1: Gender of the study population

Most of the subjects belonged to the above 50 years age group. Nearly two-thirds (60%) of the cases were male (Fig- ure 1). Concerning the location of diabetic foot ulcers, the study revealed that the majority of these lesions were situated on the underside of the foot, with 64% occurring on the plan- tar aspect and 36% on the upper, or dorsal, aspect. Among the causes of ulcers, trauma played a significant role, accounting for 64% of the cases, while the remaining instances were characterized by spontaneous onset. It is noteworthy that a significant portion of the patients, specifically 78%, relied on insulin for managing their blood sugar levels, whereas the remaining 22% depended on oral anti-diabetic medications [15].

Table 2: Wound contraction in the PRP dressing groupand</td

In the context of assessing the impact of PRP dressings versus traditional dressings on wound contraction rates in diabetic foot ulcer cases, the study results demonstrated a noteworthy disparity. [16] The study group utilizing PRP dressings exhibited a significantly superior mean wound con-traction of 30.4%, while the group employing conventional dressings showed a comparatively lower mean wound con- traction of 10.5%. An in-depth statistical analysis employing an unpaired Student's t-test confirmed the significant difference between the two groups in terms of mean wound [18]. This pattern mirrors findings from previous studies, such as those conducted by Pedras et al (with a mean age of 63 years), Hirase et al (mean age of 58.4 years), Goda et al(mean age of approximately 56 years), and Tripathi et al. [19] In these studies, a similar prevalence of older individuals was observed in their respective study populations. Furthermore, it's worth mentioning that the majority of participants in the present study were male, a trend consistent with the results of earlier studies conducted by others as well [20]. Upon investigation, the location of the ulcers was determined, with a notable 62% of the ulcers being situated on the plantar aspect of the foot. This observation is consistent with the existence of elevated and multiple pressure points in this region, as documented in prior research [21], [22]. For ex- ample, Tindong et al reported a comparable prevalence of ulcers on the plantar side, at 56.4%, aligning with these findings . Furthermore, in 60% of the cases, trauma emerged as a significant precipitating factor. This observation is in agreement with previous studies, including those conducted by Iraj et al and Rosyid et al, which have also recognized trauma as a substantial risk factor [23]. It is noteworthy that a substantial proportion, specifically 78%, of the study participants

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were utilizing injectable insulin. This outcome is anticipated, given that the duration of diabetes is closely associated with insulin use and the subsequent risk of diabetic foot ulcers (DFU). The current study yielded significant find-ings, demonstrating a notably higher rate of wound healing and contraction in the group that received PRP dressings compared to the group treated with conventional saline gauzeantiseptic dressings [24]. This outcome is consistent with a body of clinical research, which consistently affirms the superior effectiveness of PRP dressings. Specifically, these studies have shown that PRP dressings lead to faster healing rates and shorter overall healing times. Moreover, they are associated with improved wound closure, reduced incidence of adverse effects like maceration and contact dermatitis, minimized risk of infections, and fewer instances of wound reopening. [25]

V. CONCLUSION

The reaffirmation of the positive correlation between PRP dressings and the safe and effective healing of diabetic foot ulcers, as established in this study, underscores the importance of incorporating these **ETHICAL CONSIDERATION**

Compliance with ethical guidelines Ethical approval for this study was obtained from the Institutional Research Board .

AUTHORS' CONTRIBUTIONS

All authors equally contributed to preparing this article.

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dressings as a pivotal element in the management of DFU. Diabetic foot ulcers, being a persistent, debilitating, and frequently recurring complica- tion in many individuals with diabetes mellitus, can benefit contraction. The p-value calculated was less than 0.001, indicating a strong statistical significance [17].

IV. DISCUSSION

In the current research, among the 40 study participants, it'sworth noting that 70% of the patients were aged over 50. This observation aligns with expectations, as older age is commonly linked to an extended duration of diabetes, whichin turn heightens the risk of developing diabetic foot ulcerssignificantly from the inclusion of such dressings in theirtreatment protocols.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

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