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Comparison between negative pressure wound therapy and platelet-rich plasma therapy in management of diabetic foot

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ABSTRACT

Background: Foot infections and ulceration are the most frequent reason for hospitalization in patients with diabetes mellitus (DM), accounting for up to 25% of all patients with DM admission. In the new advanced therapies for treating diabetic foot ulcers (DFUs), platelet-rich plasma (PRP) and negative pressure wound therapy (NPWT) have shown promising results. **Aims and Objectives:** The objectives of the study are as follows: To study the role of NPWT and PRP in management diabetic foot wounds and to compare granulation tissue formation, total duration of wound healing, and hospital stay between two therapies in diabetic foot wounds. **Materials and Methods:** This study was conducted with 100 patients of diabetic foot wounds meeting the inclusion criteria with pre-structured proforma and written informed consent for the therapies. After surgical debridement of the wound, the enrolled patients were randomized into two groups to receive either PRP therapy (Group A) (n = 50) or NPWT (Group B) (n = 50). **Results:** PRP and NPWT both were effective in healing process of diabetic foot patients. The mean value of Group A in granulation tissue score were 2.10 ± 0.73 and 1.90 ± 0.60 in Group B showed no significant difference. The duration of hospital stay was lower in Group A as compared to Group B that is 19.04 ± 4.85 days in Group A and 35.86 ± 7.35 days in Group B. The total duration of wound healing in Group A was longer that is 7.22 ± 3.34 weeks in Group A and Group B was 4.0 ± 2.27 weeks. **Conclusion:** PRP (Group A) and NPWT (Group B) are novel tools in management of DFUs. PRP is more simple, more safe, less costly, less equipment requirement, less complication, shorter time for the method, less painful, less hospital stay, and autologous nature in the preparation and had proved the superiority over NPWT.

Key words: Diabetic foot wounds; Platelet-rich plasma therapy; Negative pressure wound therapy

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INTRODUCTION

Hazards of diabetes mellitus (DM) usually presents as complications; diabetic foot ulcers (DFUs) are considered one of the most common and devastating chronic complications which affect the quality of life in such patients.[1] Foot infections and ulceration are the most frequent reason for hospitalization in patients with DM, accounting for up to 25% of all patients with DM admission. About 88% of all leg amputations were related to DFUs becoming the most common cause of lower extremity amputation.[2] The new advanced therapies for treating DFUs, platelet-rich plasma (PRP), and negative pressure wound therapy (NPWT) have shown promising results.

Autologous PRP is a platelet suspension in which plasma derived from whole blood is being used in clinical practice

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for the treatment of DFUs.[3] A variety of growth factors from PRP used for enhancing wound healing.[2] It reflects on decrease in cytokine release, increase in capillary growth, and has some antimicrobial effects against some organisms.[4]

NPWT has shown to be efficacious in wound healing and increased rates of granulation tissue formation.[5] It stimulates the healing process through changing in perfusion leading to local increase of angiogenesis related growth factors in the wound and delivers nutrients, decrease in bacterial load and thus enhancing wound healing.[3]

Many studies have done previously in separate way to show the outcomes on DFUs, the novelty of this study is to compare the efficacy of each therapy in DFUs.

Aims and objectives

The objective of the study are as follows: To study the role of NPWT and PRP in management diabetic foot wounds. To compare granulation tissue formation, total duration of wound healing and hospital stay between two therapies in diabetic foot patients.

MATERIALS AND METHODS

The study was carried out with patients attending general surgery outpatient department (OPD), plastic surgery OPD, emergency department, transferred from other department in Sanjay Gandhi Memorial Hospital associated with Shyam Shah Medical College, Rewa (M.P) during the period of September 1st, 2022–December 31st, 2023 (15 months) after approval from ethical committee (IEC NO. 20763).

Inclusion criteria

All patients with informed consent and with DM irrespective of age and sex with lesions of foot like cellulites, blister, abscess, and DFUs classified under Meggitt Wagner classification as Grade I and II.

Exclusion criteria

Patient presenting with: coagulopathy, peripheral vascular disease, underlying osteomyelitis, ulcer with malignancy/neoplasm, diabetic foot with Charcot's joint, and DFUs classified under Meggitt Wagner classification as Grade III, IV, and V.

A total of 100 DFU patients who met the inclusion criteria were enrolled for the study. A structured pre-prepared case proforma was used to enter the patient details.

Initial treatment with surgical debridement of the wound was done. These wounds were defined fit to include in the study when the DFUs was deemed "clean" by the treating surgeon and the wound culture shown no growth or skin flora.

After satisfying the above criteria, the enrolled patients are then randomized into two groups, Group (A) including 50 diabetic wounds received PRP (Figures 5 and 6) and Group (B) including 50 diabetic wounds received NPWT (Figures 1 and 2). The size of wound was recorded before treatment and every week till complete healing. The time needed for satisfactory wound healing was calculated by the number of days from the start of the study till the wound was fit for grafting.

RESULTS

1. Hospital stays: The maximum number of cases in Group A were having hospital stay duration of 15–28 days with the mean±SD of 19.04±4.85 days and in Group B were equal to or more than 29 days (80% of cases) with the mean±SD of 35.86±7.35 days (Table 1)
2. Granulation tissue score: The mean value granulation tissue score in Group A was 2.10±0.73 (Figures 7 and 8) and the mean value of granulation tissue score in Group B was 1.90±0.60 (Figure 3). There was no significant difference between the two studied groups (Table 2)
3. The total duration of wound healing: Was ranged from 2 weeks to 12 weeks with a mean value in Group A with was 7.22±3.34 weeks and in Group B was 4.0±2.27 weeks (Figure 4). No change in wound even after more than 12 weeks were in total 18% of cases (P=0.0352) (Table 3).

Table 1: Distribution of cases as per hospital stay

Hospital stay	Group A (n=50)		Group B (n=50)	
	No	%	No	%
≤14 days	07	14	-	-
15–28 days	40	80	10	20
>29 days	03	6	40	80
Total	50	100	50	100
Mean±SD	19.04±4.85		35.86±7.35	
	P=0.0403 Significant			

Table 2: Distribution of cases as per intervention done according to granulation tissue score

Granulation tissue score	Group A (n=50)		Group B (n=50)	
	No	%	No	%
1	11	22	12	24
2	23	46	31	62
3	16	32	07	14
Total	50	100	50	100

DISCUSSION

In the present study, the hospital stay, in Group A, were mean±SD of 19.04±4.85 days and in Group B were mean±SD 35.86±7.35 days. The mean value of total duration of wound healing in Group A was 7.22±3.34 weeks and Group B was 4.0±2.27weeks (P= 0.0352). No change in wound even after >12 weeks were in total 18% of cases. This showed that the hospital stays in comparison of both therapies Group A patients had less hospital stay than that of Group B patients but Group A had longer total duration of wound healing as compared to Group B. The mean value of Granulation Tissue Score in Group A was 2.10±0.73 and in Group B was 1.90±0.60. We found that there is improvement in the granulation tissue score in both therapies which is consistent with other studies.

Table 3: Distribution of cases as per intervention done according to total duration of wound healing

Total duration of wound healing	Group A (n=50)		Group B (n=50)	
	No	%	No	%
2–5 weeks	03	6	23	46
6–9 weeks	24	48	16	32
>9 weeks	16	32	-	-
Stationary	07	14	11	22
Total	50	100	50	100

Figure 1: Negative pressure wound therapy suction machine

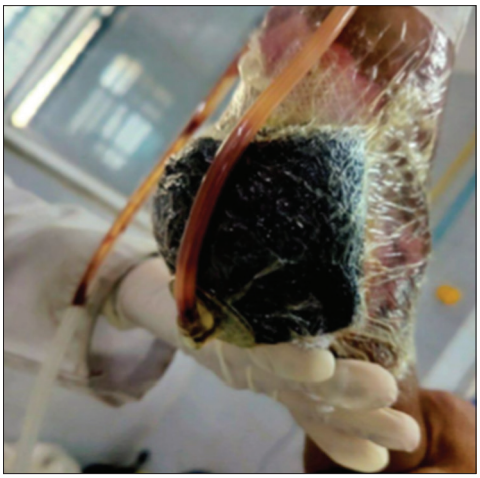

Figure 2: Negative pressure wound therapy air tight dressing

A meta-analysis was conducted by Chen et al.,[6] in which 18 RCTs involving 1294 patients with chronic wounds were included, showed that the combined effect of PRP and

Figure 3: (a) Before negative pressure wound therapy, (b) 1 week after negative pressure wound therapy

Figure 4: (a) Before negative pressure wound therapy, (b) 1 week after negative pressure wound therapy, (c) 4 weeks after NPWT.

Figure 5: Platelet rich plasma preparation

Figure 6: Platelet rich plasma application

Figure 7: (a) Before platelet rich plasma application, (b) 4 weeks after platelet rich plasma application (wound is ready for grafting)

NPWT therapy improving the clinical efficacy of chronic wounds. In the study by El Nagar et al.,[2] reported the hospital stay with a mean 4.88±1.73 week in PRP group and 2.0–10.0 weeks with a mean 4.38±2.56 week in NPWT group (P=0.312). In the study Seidel et al.,[7] reported that the

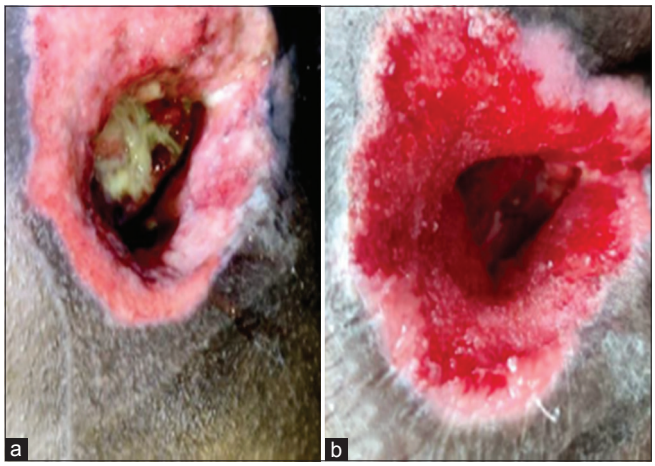

Figure 8: (a) Before platelet rich plasma application, (b) 3 weeks after platelet rich plasma application

treatment duration was 16 days shorter with NPWT (mean [SD] 82.8 [31.6]; U test, P=0.001) and 14.9 days shorter outpatient treatment. In the study, Wang et al.,[8] in 31 DFUs patients, the healing time of ulcers in the combination group (NPWT with PRP) healed much faster (93.8% healing rate) than ulcers in the control group (NPWT with standard dressing) (53.3% healing rate) (P<0.0001). Overall, this study indicated that, compared to NPWT paired with standard dressing, NPWT combined with PRP therapy could accelerate ulcer healing and reduce DFU mortality. In the study done by Liu et al.,[9] the efficacy of PRP therapy on pressure injuries after 21 days of treatment was seen. The study compared levels of vascular endothelial growth factor (VEGF), stromal cell-derived factor 1-alpha (SDF-1α), and chemokine receptor 4 (CXCR4) in control group and PRP group showed that the levels of VEGF, SDF-1α, and CXCR4 were higher in study group. This shows the evidence of PRP therapy in formation of granulation tissue (P<0.05). In the study Cao et al.,[10] a phenomenon named "hyperglycaemic memory" had major impact on recurrence of diabetic ulcers was reported. In this phenomenon, platelet count was upregulated showed in Tokarz-Deptula et al.,[11] NPWT combined with PRP therapy, which might improve blood parameter normalization and lower the recurrence rate of diabetic foot lowering "hyperglycemic memory" phenomenon.

Other study He et al.,[12] showed the role of allogenic PRP on DFUs and evidence of its derived growth factors such as transforming growth factor, platelet-derived growth factor, insulin-like growth factor, fibroblast growth factor and VEGF, which play an important role in tissue repair and regeneration Liao et al.,[13] and decrease in hospital stay. In the study Gao et al.,[14] 13 eligible trial comparison was done of which 2 were randomized controlled trials and 11 cohort study. They found that NPWT in surgical site infection patients significantly increased wound healing

rate and accelerated wound healing time. In the study, Borys et al.,[15] clinical trials in DFU patients demonstrated that NPWT is superior to standard therapy in terms of efficacious outcomes, including wound healing and the rate of amputation. According to international guidelines, NPWT is a crucial adjuvant therapy for DFU, and its use is anticipated to rise.

Numerous studies have already demonstrated the effectiveness of PRP therapy and NPWT therapy in role of wound healing. This study is different from previous trials in the type of comparison. Previous studies were conducted either on each type of application separately or efficacy of combined application (NPWT combined with PRP) on different types of wounds, but comparison between these two therapies was unexplored. This comparison between NPWT and PRP therapy is done in our present study.

Limitations of the study

1. Small sample size
2. Lack of standardized PRP preparation methods.

CONCLUSION

The application of Group A and group B in patients with DFUs is significantly effective. Both therapies promote diabetic foot wound healing, shorten diabetic foot wound healing time and increase healing rates, and has substantial practical value in clinical practice. The hospital stay was significantly less in Group A as compared to Group B patients. As the PRP (group A) is more simple, more safe, less costly, less equipment requirement, less complication, shorter time for the method, less painful, less hospital stay, and autologous nature in the preparation had proved the superiority over NPWT (Group B).

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Authors' Contributions:
EJ- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article; **SS-** Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **RG-** Design of study, statistical analysis and interpretation; review manuscript; **AP-** Literature survey and preparation of figures; **NS-** Coordination and manuscript revision; **SSY**- Coordination and manuscript editing and revision.

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