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Assessment of Platelet Rich Plasma (PRP) Therapy in Prevention of Chronic Wound Complications

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ABSTRACT

Background: Delayed wound healing is a key factor in the development of chronic wound complications so we can utilize the wound healing promotion properties of platelet rich plasma in decreasing the incidence of these complications.

Aim of the work: To evaluate the effectiveness of platelet rich plasma therapy in prevention of chronic wound complications after surgical debridement of various types of tissue infection.

Patients and Methods: A total number of 50 patients with open wounds resulting after surgical debridement of various types of soft tissue infection were included in this study, two groups with 25 patients for each were divided randomly. Group A patients were treated with platelet rich plasma while group B was the control group treated with ordinary dressing. The two groups were monitored every other day for the first week and then every week until complete wound healing was achieved for pain, wound dimensions over the first three weeks, infection, full recovery time and development of residual complications.

Results: A total number of 50 patients, with a mean age of 22.35 years of them 37 males and 13 females. There was statistically significant difference between the two groups in the mean of pain score with 3.8 for group A and 5 for group B. As regard wound dimensions after three weeks of treatment there was statistically significant difference with a mean of 2.5 cm in the group A and 4 cm in the group B. there was statistically significant difference in wound infection rate and full recovery time with 2% and mean 28 days in group A while 20% and mean 37 days in group B respectively. In group A six cases had 3rd cycle and two cases 4th cycle of treatment while two cases in group B showed failure of full recovery.

Conclusion: PRP therapy seems to be safe and effective in enhancing wound healing and in prevention of chronic wound complications.

Keywords: Chronic wound, Tissue infection, Wound healing, Platelet rich plasma, PRP.

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INTRODUCTION

Wound healing process occurs in the form of overlapped cascade of cellular events that develop after tissue injury. Hemostasis, inflammation, proliferation, and remodeling represent the four stages of healing process, the length of each stage may vary due to different factors, such as infection, ischemia and malnutrition. A chronic wound state can be described when complete healing has not been successfully occurred after six weeks.¹

The initial phase of hemostasis occurs just after tissue injury, where several growth factors are released from the platelets to initiate the healing process. The growth factors are soluble proteins that control cell activities during the wound healing process. After that cell migration and further release of additional factors to remove foreign particles occurs in the inflammatory phase. Then granulation tissue formation and epithelialization take place in the proliferative phase. The final phase is remodeling

and maturation, during which continuous cycle of collagen synthesis and breakdown occur and excessive material is removed.²

The elevated levels of inflammatory cytokines, proteases, impaired fibroblasts and epithelial cells function with reduced levels of growth factors leading to exaggerated inflammatory phase and play a key role in delaying healing process while proliferative phase is trying to occur at the same time. Bacterial contamination also predisposes to chronicity of the wound.³

Chronic wound management plan should include both control of the underlying disease and local wound treatment. The traditional wound care methods do not offer supply of the essential growth factors present in platelets. Blood clots with its platelet content, act as regulators of the inflammation, angiogenesis, cell migration, and proliferation as well as being hemostatic agents. These physiological concepts support the application

of platelet concentrates to promote the wound healing and decrease the incidence of wound complications.⁴

Platelet rich plasma PRP exerts its beneficial effects through degradation of α -granules with subsequent production of different types of growth factors such as platelet derived growth factor (PDGF), transforming growth factor b (TGF-b), insulin-like growth factor (IGF) and vascular endothelial growth factor (VEGF).⁵

The present study was conducted to evaluate the effectiveness of platelet rich plasma therapy in prevention of chronic wound complications after surgical debridement of various types of tissue infection.

A prospective randomized study was carried out in the General surgery department, Al-Hussein hospital, Al-Azhar University; Cairo, Egypt; From April 2018 to December 2019 after obtaining approval from the local ethical committee of the faculty and after fully informed written consent signed by every patient was obtained.

After detailed history and full clinical examination, a total number of 50 patients with open wounds resulting after surgical debridement of various types of soft tissue infection were included in this study. Random classification into two groups with 25 patients in each was done, group A was the treatment group while group B was the control group.

Inclusion criteria: Patients after surgical debridement of the following conditions: Pilonidal (sacrococcygeal) abscess, Gluteal abscess, Breast abscess and significant subcutaneous abscess requiring debridement rather than incision and drainage.

Exclusion criteria: Patients with a contraindication to anesthesia, Patients with hematological disorders, Patients with chronic liver disease, Patients on anticoagulant therapy and patients with specific chronic wounds rather than infection such as venous ulcer and malignant ulcer.

Method:

In the operating theatre, before surgery all patients had received a single dose of 3rd generation cephalosporin and then after ordinary surgical preparation, wide surgical debridement and good hemostasis was achieved followed by normal saline irrigation of the wound area. The wound dimensions were assessed thereafter.

PRP preparation; the patient was first sent to the clinical pathology department two hours before the operation where 30 ml venous blood sample was drawn and divided over three tubes containing acid citrate dextrose as an anticoagulant agent, each tube was centrifuged at 1000 rpm for 3 minutes (soft spin) to separate RBCs at the bottom from plasma at the top. Then the plasma with its platelet content was aspirated and transferred to another three tubes without anticoagulant and each tube was centrifuged

PATIENTS AND METHODS

All patients in this study were managed and followed up at Al-Azhar University Hospitals. A prospective case series study was performed in a period between December 2019 to April 2021. Forty 40 patients (25 males and 15 females) with fracture lateral end clavicle (Neer type II) were divided into two 2 groups; 1st group fixed by Hook Plate (HP) and 2nd group fixed by Tension Band Wire (TBW) with inclusion criteria (recent, extraarticular, unilateral, Neer II with normal function before trauma) while exclusion criteria (open, comminuted and pathological fractures).

All patients were followed up for a minimum period of 11 months and maximum for 16 months with average period of 12 months.

at 4000 rpm for 10 minutes (hard spin) where the lower third of each tube represents the platelet rich plasma PRP (about 5 ml ready for injection) while the upper two thirds is the platelet poor plasma PPP. In order to obtain PRP gel used for dressing the remaining PRP was transferred to another tube containing 0.9% CaCl₂ in a ratio of 4/1 for 20 minutes (**figure 1**).

Group A patients (treatment group); after the mentioned surgical steps PRP was injected at a rate 0.1 cc/cm² about 1 cm from the wound edge and 1 cm apart using an insulin syringe so that the PRP not to be lost inside the wound cavity. Then the prepared gel used to cover the whole wound surface. As the last step, the wound surface was covered by sterile, absorbent, adhesive non allergic dressing.

Group B patients (control group); after the mentioned surgical steps ordinary betadine gauze was used to fill the cavity and then covered by sterile, absorbent, adhesive non allergic dressing.



Fig. 1: PRP and gel preparation steps.

Follow-up:

All patients were received ciprofloxacin 500 mg 1x2x5, metronidazole 500 mg 1x3x5 paracetamol 500 mg 1x3x5. The wound in both groups was inspected for the first time 48 hours after debridement by resident and the dressing was removed then the wound was inspected, further irrigation with normal saline was done and the wound was covered by betadine gauze and sterile, absorbent, adhesive non allergic dressing. The patients in both groups were instructed for home dressing like done by the resident twice daily. The patients in the treatment group were received another cycle of PRP injection and PRP gel dressing after one week then the need for further weekly cycles was judged by the healing process.

The patients in both groups were checked every other day for the first week and then every week until complete wound healing was achieved for the following: Pain using Visual Analogue Scale VAS (from 0-10), Wound dimensions over the first three weeks, Wound infection, Full recovery time and need for further cycles of PRP injection and PRP gel dressing after one week.

RESULTS

I. Personal Data: A total number of 50 patients, their ages ranged between 18 and 43 years with a mean of 22.35 years and there were 37 males and 13 females with no statistically significant difference between the patients in both groups as summarized in (table 1).

Studied variable	Treatment group	Control group
Age	21.70 ± 2.50	23.81 ± 3.21
Male/Female ratio	18/7	19/6

Table 1: Age and sex distribution

II. The underlying etiology of tissue infection: The direct pathological cause of tissue infection was found to be pilonidal (sacrococcygeal) abscess in 11 (22%) cases, gluteal abscess in 13 (26%) cases, breast abscess in 9 (18%) cases, and large subcutaneous abscess in 17 (34%) cases as summarized in (table 2).

Etiology	Treatment group	Control group
Pilonidal abscess	7 (28%)	4 (16%)
Gluteal abscess	8 (32%)	5 (20%)
Breast abscess	3 (12%)	6 (24%)
Subcutaneous abscess	7 (28%)	10 (40%)

Table 2: Etiology of tissue infection distribution

III. Post-operative follow up criteria: post-operative pain was assessed by VAS after teaching the patient about how to use the chart over the first 10 days and there was statistically significant difference in the mean of pain score for the treatment group 3.8 while in the control group was 5 as summarized in (figure 2). The wound dimensions just after debridement and before the beginning of treatment showed that there was no statistically significant difference in both groups with mean of 7.5 cm in treatment group and 7 cm in the control group. The wound dimensions after the first three weeks of the beginning of treatment showed that there was statistically significant difference between both groups with a mean of 2.5 cm in the treatment group and 4 cm in the control group as summarized in (table 3) & (figure 3).

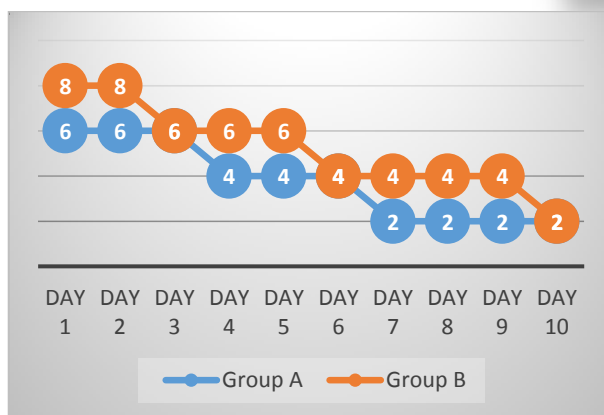


Fig. 2: VAS over the first 10 days

Wound dimensions	Treatment group	Control group
Before beginning of treatment	Min. – Max.	Min. – Max.
	5.5 – 16 cm	5 – 14.5 cm
After the first three weeks	Mean	Mean
	7.5 cm	7 cm
After the first three weeks	Min. – Max.	Min. – Max.
	1.5 – 5 cm	3.5 – 7 cm
After the first three weeks	Mean	Mean
	2.5 cm	4 cm

Table 3: Wound dimensions before and after two weeks of treatment distribution in both groups

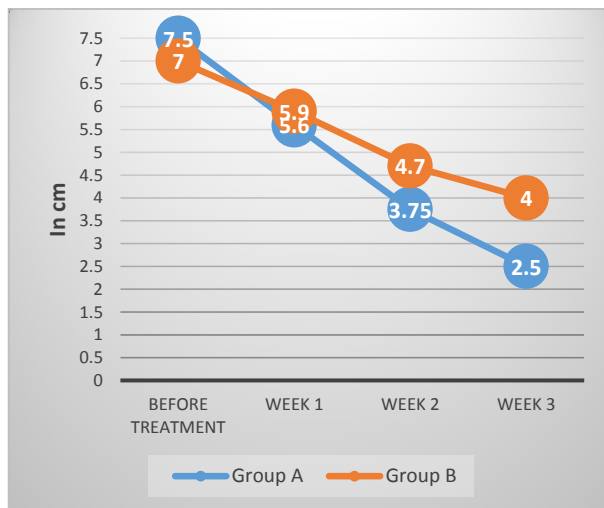


Fig. 3: Wound dimensions mean distribution over the first three weeks

Wound infection has diagnosed in 2 (8 %) cases in the group A and 5 (20 %) cases in group B. There were six cases in the treatment group who achieved less than 50% reduction in wound size at the end of second week and further cycle of PRP injection and PRP gel dressing were done at the end of second week, of whom two cases were failed to achieve 75% reduction in wound size at the end of third week in the treatment group and further cycle of PRP

injection and PRP gel dressing were done at the end of third week.

Complete healing was achieved in all cases of the treatment group in a duration range 19-39 days with a mean duration of 28 days, while in the control group was achieved only in 23 cases with a duration range 23-47 days with a mean duration of 37 days, while two cases in the control group was developed chronic wound state after period of three months follow up were found primarily in sacrococcygeal abscess cases and chronic pilonidal sinus was developed and further surgical debridement strategies were needed as summarized in (table 4).

Studied variable	Treatment group	Control group
Wound infection	2 (8 %)	5 (20 %)
Full recovery time (days)	19-39 Mean 28	23-47 Mean 37
Need for further treatment strategy	6 for 3 rd cycle 2 for 4 th cycle	2 for treatment of pilonidal sinus

Table 4: Follow up variable distribution in both groups

DISCUSSION

During the physiological process of wound healing, platelets are immediately activated at the site of injury releasing various growth factors, fibrinogen and cytokines essential for the process of wound healing, and according to this, platelet rich plasma is considered an excellent source of these growth factors, and consequently has angiogenic, mitogenic, and chemotactic properties, so it represents promising adjunctive treatment for reluctant wounds.⁶

PRP therapeutic application started in 1980 in the field of regenerative medicine, and shortly after that, it was progressively used in maxillofacial and oral medicine. At present there are many different techniques for preparation and many different fields of therapeutic uses either intralesional or topical or both applications.⁷

The wound should be adequately debrided and cleaned prior to PRP application. The choice of further secondary dressing depends on the amount of wound discharge. The most appropriate frequency of PRP application have not been established, however, it is normally used on a weekly basis.⁸

This study was conducted to evaluate the beneficial promoting effect of PRP application on wound healing and its role in preventing development of chronic complications.

In this study, there was statistically significant difference between both groups in pain score with mean of 3.8 in group 1 and 5 in group 2. In consistent with Suthar M. et al. who revealed that PRP

application in treatment of chronic wound has pain reducing effect.⁹

In this study, there was statistically significant difference between both groups as regard wound healing rate as measured by changes in wound dimensions over the first three weeks of follow up period with a mean of 2.5 cm in group 1 and 4 cm in group 2 and also in full recovery time where in the treatment group it was ranged between 19-39 days with a mean duration of 28 days, while in the control group was achieved only in 23 cases with a duration range 23-47 days with a mean duration of 37 days. There were two cases in group 2 failed to achieve full recovery and developed chronic wound state even after a period extending to three months, it worthy noted that these two cases were primarily after debridement of sacrococcygeal abscess and chronic pilonidal disease was diagnosed in both cases. After analysis of literature, this was consistent with Babaei V. et al¹⁰ and Cieslik-B. et al¹¹ who confirmed the accelerating effect of PRP on wound healing and in achieving full recovery over a short period.

In this study, there was statistically significant difference between both groups as regard wound infection rate as it was diagnosed in 2 (8%) cases in the group 1 and 5 (20%) cases in the other group. This was consistent with Zhang J. et al¹², Andia I. et al¹³, and Anitua E. et al¹⁴ all had clarified the antibacterial effect of PRP and hence decreased incidence of wound infection by therapeutic application of PRP.

The limitation of this study was that still more investigations are required to demonstrate the prophylactic effect of PRP therapy after surgical debridement of sacrococcygeal abscess specifically and prevention of development of chronic pilonidal disease in these cases.

CONCLUSION

PRP therapy seems to be safe and effective in enhancing wound healing after surgical debridement of various types of tissue infection and in prevention of chronic wound complications.

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