APPLICATION OF AUTOLOGOUS PLATELET RICH PLASMA (APRP) AS AN ADJUVANT THERAPY IN PLASTIC SURGERY

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Abstract
To study the role of Autologous Platelet Rich Plasma (APRP) as an adjunct therapy for various indications in plastic surgery. This is a retrospective analysis of 31 patients (7 groups) in whom APRP was given as an adjuvant therapy for various indications. In each group, APRP helped as an adjuvant therapy for optimizing the outcome in various cases of plastic surgery. Being a rich source of various growth factors, APRP can act as an adjuvant therapy in optimizing the outcome in various cases of Plastic Surgery.

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INTRODUCTION

Wound healing is an integrated and complex procedure. It consists of a series of overlapping events \(^1\). Various growth factors are needed for the optimum healing and Platelet is one of the important factors responsible for wound healing \(^2\). Role of platelet in wound healing has been proven in several studies. Platelets help in release of several growth factors essential for wound healing. Another action of platelet is release of bioactive proteins responsible for attracting macrophages, mesenchymal stem cells, and osteoblasts. These cells are known to promote removal of necrotic tissue and enhances tissue regeneration and healing \(^3\). Autologous Platelet Rich Plasma (APRP) is also helpful in acceleration of wound healing \(^4\). Platelet-Rich Plasma (PRP) is defined as a portion of the plasma having a higher concentration of platelet. It consists of platelets with clotting and growth factors \(^5\). Platelet derived growth factor (PGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF), epidermal growth factor (EDF) and fibroblast growth factor (FGF) are also present in APRP and in concentration multiple times higher than normal plasma \(^6\). Because of properties of enhancing tissue regeneration and healing, APRP may be used as an adjunct therapy for various cases in plastic surgery. This article highlights the importance of APRP as an adjunct therapy in plastic surgery. Apart from wound healing APRP is also used in various orthopedic conditions \(^7,8,9\).

MATERIALS AND METHODS

This study was conducted in the department of Plastic Surgery, JIPMER, Pondicherry, India. This is a retrospective study done during the period, March 2013 to June 2015. Thirty one cases of plastic surgery were analyzed in whom APRP was used for different indications as an adjuvant therapy. The patients were grouped into seven groups (Table 1) based on various indications of APRP. Patient’s demographic profile was recorded in the study proforma. APRP was prepared using standard and validated technique described by Li, Weiwei et al \(^10,11\). After taking informed consent 4.5 ml of whole blood was taken from peripheral vein with sterile precautions and 0.5 ml of 3.2% Sodium Citrate was added to make it 5 ml (blood: anticoagulant at 9:1). The centrifugation tube was placed in centrifugation apparatus. The solution was centrifuged at 3000 rpm for 10 minutes. Three portions were seen (Figure 1a) after first centrifugation. Upper portion containing plasma and platelets, middle portion
containing White blood cells (WBCs) with some platelets (Buffy coat) and lower portion containing Red blood cells (RBCs). Middle and lower portions are discarded. Upper portion was transferred taken in a new tube for re-centrifugation at 4000 rpm for 10 minutes. Following which two portions were seen. Upper 2/3rd portion containing platelet poor plasma and lower 1/3rd portion containing platelet rich plasma & erythrocyte with platelet Clump (Figure 1 b). Lower 1/3rd portion was used for APRP therapy \[12, 13\].

**Figure 1a.** Centrifuged tube showing three layers after first rotation

**Figure 1 b** After re centrifugation two portions are seen

**RESULTS**

In Group 1 subcutaneous injection of APRP was given around the wound margin circumferentially using 23 G needle and repeated every week, if required (till the complete healing is achieved or wound bed got ready for cover by skin graft or flap).

In Group 2 APRP was sprayed over the recipient raw area before applying the graft, and injected at graft-normal skin junction.

In Group 3 APRP was injected at suture line of flap inset and into the flap.

In Group 4 after the release of contracture APRP was sprayed over the raw area before applying skin graft and injected at junction of graft-normal skin. In case of primary closure APRP was injected at suture line. In cases of Flaps, APRP was injected into the flap and at the site of inset.

In Group 5 After excision of hypertrophic scar, APRP was injected over raw area before applying skin graft and at skin-graft junction.

In Group 6 APRP was used as an adjunct for hair transplantation.

In Group 7 APRP was used as an adjunct to bone healing in Cranioplasty.
Patients with different etiology treated with APRP were analyzed over two year duration in our department. Mean age was 39.3 years, male to female ratio was 3.5 : 1, most common etiology was trauma and most common site was lower limb. All patients were given APRP. Mean duration of APRP therapy 2.5 weeks. Mean Bates Jansen Wound Assessment Score was 45.5 and maximum size of wound was 30 x 20 cm. The most common organism grown in tissue culture was pseudomonas (3 wounds, 9.6%). Methicillin Resistant Staphylococcus Aureus (MRSA) was positive in 2 cases (6.45 %). The most common co-morbidity was anemia, in 18 cases (58.06 %), followed by diabetes mellitus, 3 cases (0.67 %). Osteomyelitis was present in 2 patients (6.45 %). The mean duration of wound bed preparation (WBP) was 2.11 weeks.

The average duration of systemic antibiotic was 10 days to 3 weeks. Mean duration of Negative Pressure Wound Therapy (NPWT) was 2.11 weeks. Average duration of wound healing was 4 weeks. Number of patients managed with APRP alone were 12 (38.70%) (Figure 1a, 1 b).

Number of patients managed with primary suturing along with APRP were 3 (9.67%) (Figure 2a, 2 b).

Figure 1 a Diabetic foot - before APRP

Figure 1 b Wound healed after 3 weeks

Figure 2a Hemi facial avulsion with compromised viability of skin
5 patients (16.12%) patients were managed with APRP assisted skin grafting (Figure 3a, 3b) APRP was injected around the wound circumferentially before applying the skin graft and . 5 patients (16.12%) patients were managed with APRP assisted flaps (Figure 4a, 4b). Three patients (9.67%) of post burn contracture (figure 5a, b) release were managed with APRP before graft/flap. Number of cases of hypertrophic scar in which APRP was used were 2 (6.45%) (Figure 6a, 6b), where scar excision and skin grafting was done and APRP was sprayed over the raw area and graft- skin junction. In one patient (3.22%) APRP was used in hair restoration surgery, where APRP was injected before transplanting the hair (Figure 7a, 7b). In one patient (3.22%) autologous Cranioplasty was done with the help of APRP where APRP was used to mix with the bone dust which was used at bone- bone graft junction as osteogenic agent (Figure 8a, 8b).
Figure 4a Post traumatic raw area
Figure 4b abdomen flap with APRP

Figure 5a Post burn contracture B/L groin
Figure 5b Contracture release with APRP and SSG

Figure 6a Hypertrophic scar over chin and neck
Figure 6b After APRP chin scar contracted

Excision with primary closure done
In all patients wound healed satisfactorily. All grafts were taken fully, all flaps were settled well without necrosis, and no complications were noted in 6 months follow up period (Case summary Table 1).
Table 1. Case Summary

<table>
<thead>
<tr>
<th>S. No</th>
<th>Groups</th>
<th>Indication of APRP</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Group 1: Wound healing</strong></td>
<td>Diabetic foot ulcers</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Post infection raw area</td>
<td>1</td>
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<td></td>
<td></td>
<td>Pressure sore</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>Post Trauma Raw Area</td>
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<tr>
<td></td>
<td></td>
<td>Venous ulcer</td>
<td>1</td>
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<td></td>
<td></td>
<td>Ischemic ulcer</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Donor Site of Split Thickness Skin Graft</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>At the site of primary closure for Hand injuries</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>At the site of primary closure for Facial injuries</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Post burn raw area</td>
<td>4</td>
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<tr>
<td></td>
<td><strong>Group 2: Skin graft surgery</strong></td>
<td>Split Thickness Skin Graft</td>
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<tr>
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<td></td>
<td>Full Thickness skin Graft</td>
<td>1</td>
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<tr>
<td></td>
<td><strong>Group 3: Flap surgery</strong></td>
<td>Local flaps</td>
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<tr>
<th>Group</th>
<th>Procedures</th>
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<tr>
<td>4</td>
<td>Group 4: Contracture surgery</td>
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<tr>
<td>5</td>
<td>Group 5: Hypertrophic scar</td>
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<td>6</td>
<td>Group 6: Hair restoration Surgery</td>
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<td>7</td>
<td>Group 7: Cranioplasty</td>
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**DISCUSSION**

Wound healing is a complex series of overlapping events which includes three phases- Phase of Inflammation, Phase of proliferation, Phase of remodeling \[^{14}\]. Platelets play important role and it is crucial for wound healing especially in initial phases \[^{15}\]. Among other factors platelets is an important factor to mediate wound healing and their deficiency may cause impaired wound healing \[^{16}\]. Optimum wound healing cannot be achieved in absence of growth factors. The concentration of these proteins decreases after 3-5 days \[^{17}\]. Construction of new connective tissue, hemostasis, and revascularization is done by Platelets. Platelet Rich Plasma (PRP) is defined as a portion of the plasma fraction of autologous blood having a platelet concentration. PRP functions as a tissue sealant and drug delivery system, platelet helps in wound repair by releasing locally acting growth factors via \(\alpha\)-granules degranulation. Being an Autologous component PRP is safe as it is free of antigenic components. It is easy to prepare, less time taking and cost effective \[^{14, 15}\]. We prepared APRP in our department for various kinds of wounds reconstructive procedures. Depending on the nature of wound and its response APRP was repeated weekly. We used this modality in almost all kinds of...
wounds and procedures, ranging from chronic wounds to Microvascular flaps and cosmetic surgery. We found this modality as an effective technique for enhancing wound healing and improving outcomes in various fields of surgeries in plastic surgery. Due to small sample size and absence of control group statistical analysis could not be done. A prospective, controlled, large sample size study with statistical analysis is needed for further evaluation.

CONCLUSION

It is helpful in wound healing in variety of cases whether acute or chronic and irrespective of etiology. It is also helpful in burns and cosmetic surgery field. Based on our case series we can conclude that APRP enhances wound healing in all kinds of wounds.

CONFLICTS OF INTEREST - None

REFERENCES


