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Autologous Platelet Rich Plasma versus Collagen Dressing in Promoting Healing of Donor Site of Skin Graft

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Abstract

Application of skin graft to cover the raw area is on of the commonest procedure done in plastic surgery. Skin graft can be either split thickness or full thickness, depending amount of dermis harvested. Donor site is always a concern for the patient as well surgeon. Hence it is chosen from hidden areas. Donor site complications are sometimes more cumbersome for the patient. As it is surgically created raw area hence every attempt should be taken to provide good healing without any complications. A successful skin graft surgery not only involves good take of the graft but also well healed donor site. Various techniques have been described for optimizing the donor site healing. Autologous Platelet Rich Plasma (APRP) and collagen dressing are popular methods. But comparative studies are not done to prioritize a single modality. Through this paper we would like to highlight the comparison between APRP and collagen dressing in improving donor site healing.

Keywords: Skin Grafts; APRP; Collagen.

Introduction

A skin graft is a section of epidermis and dermis which has been completely separated from its blood supply in one part of the body, the donor site, before being transplanted to another area of the body, its recipient site. Today, one of the most common procedures done by plastic surgeons is skin grafting. Split thickness skin grafting (STSG) is a frequently used technique mainly for covering soft tissue and skin defects. STSG has wide range of applications which makes it valuable not only to plastic and reconstructive surgeons but also to other surgical specialties. However, a second wound is created in order to gain a skin graft. There has been a multitude of options described for donor site dressing, unfortunately, there is no consensus regarding optimal donor site care or the type of dressing to be used. The technique evolved from use in the back alleys of India and has become one of the most valuable clinical tools in modern surgery [1,2].

Traditionally the STSG donor site areas have been dressed with a low-adherent wound contact paraffin gauze or antibiotic-impregnated tulle and then covered by a secondary dressing made of gauze and absorbent padding. An ideal STSG donor site dressing, in theory, should be easy to apply, promote rapid re-epithelialization, and be pain free, infection free, and relatively inexpensive. Most importantly it must result in good quality healed skin with minimal scarring [3].

The efficacy of collagen is shown by the recent advances in the resurfacing of burn wounds with dermal equivalents and collagen preparations. Compared with the polyurethane dressings, a bovine collagen preparation consisting of type-I collagen has been shown to have improved wound healing. The application of APRP has been documented in many fields.

Studies suggest that the role of platelets in inflammation, postoperative blood loss, infection, osteogenesis, wound, muscle tear and soft tissue healing is due to the abundance of growth factors and cytokines contained in it. In the plastic surgery dept of our institute, both collagen sheet and PRP injections are being used for management of raw areas.

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Methodology

This is a Prospective controlled study conducted in the department of plastic surgery of our institute from November 2012 to December 2014. 56 patients were enrolled in the study and was divided in 2 groups. Informed consent was taken from all the patients. Group 1 is Autologous PRP group and Group 2 is collagen dressing group.

All patients admitted in plastic surgery above 18 years, undergoing Split skin graft for various indications with total graft size at least 30cm^2, for various indications were included. While Patients with Hypo albuminemia, Patients with Hb < 10g/dl, Patients not willing for PRP therapy were excluded.

Two donor sites of Split skin grafts harvested by dermatome adjusted at intermediate thickness each of size at least 15cm^2 in the same patient at the same donor site were assigned randomly, one to the Autologous PRP group and the other to the collagen dressing group. The two areas were separated by a distance of not more than 1 cm.

For preparation of autologous PRP, 10 ml of patients own blood will be withdrawn and an anticoagulant (Sodium citrate) is added. It is transferred to a centrifuge tube and centrifuged in a standard lab centrifuge (REMI) at 3000 rpm for 10 minutes.

The blood will be separated into 3 layers – upper plasma, middle buffy coat and lower RBC. The plasma layer is aspirated and transferred to another centrifuge tube and again centrifuged at 4000 rpm. Now the plasma will be separated into two layers- upper 2/3rd will be platelet poor plasma and the lower 1/3rd will be the platelet rich plasma (Figure 1a,1b).

The platelet rich plasma was aspirtated and injected subcutaneously into the site assigned for PRP, after taking the skin graft [4]. (Figure 2).

In the collagen group, Collagen sheet (bovine collagen, type 1 and type3 collagen) dressing available in the department were used.

Both sites are dressed with paraffin gauze and saline dressings. Clinical parameter (total healing time and epithelialization) were recorded at 7, 14, 21 and 28 days. Raw area was calculated by planimetry software (Image J) on 7, 14, 21 and 28 days [5].

Percentage of healing = (Initial raw area – total epithelialised area)/ Initial raw area x 100

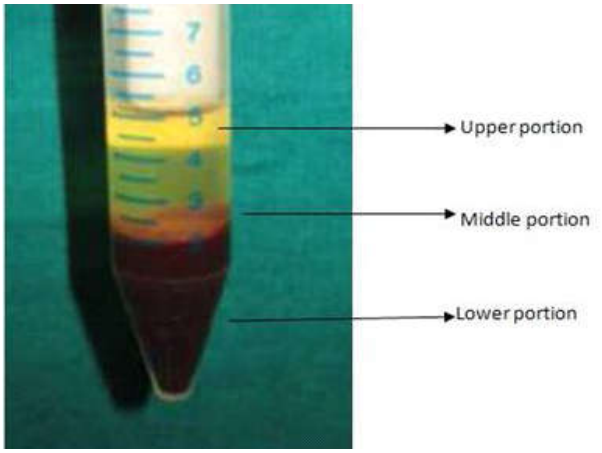

Fig. 1a: Centrifuged tube showing three layers after first rotation

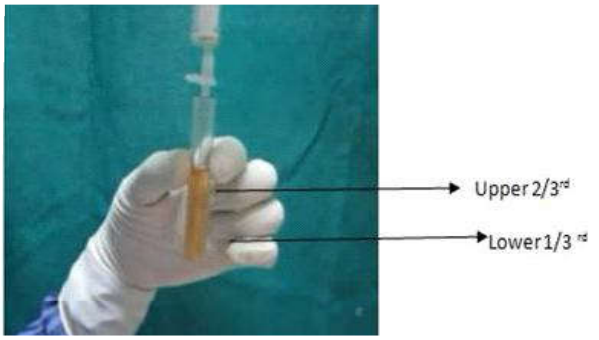

Fig. 1b: After re centrifugation two portions are seen

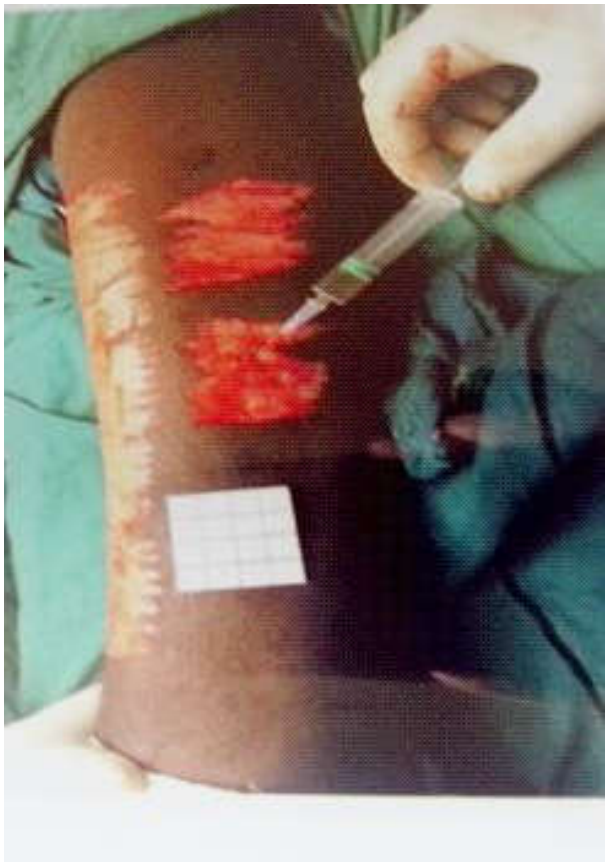

Fig. 2: APRP being injected in graft donor site

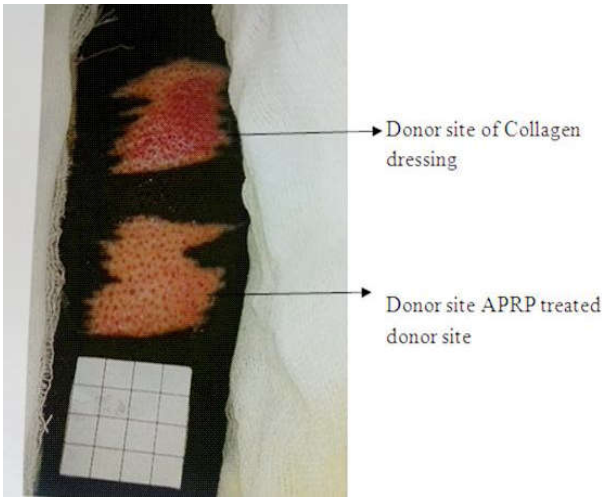

Fig. 3: APRP treated donor site shows better healing

Result

The comparison of area of epithelialization between the groups at baseline was carried out by using Independent student's t-test/ Mann Whitney U test. The change in area of epithelialization over time within each group was carried out by using one way repeated measures of ANOVA. The comparison of changes of epithelialization area over time between the groups was carried out by using two way repeated measures of ANOVA. The average change in epithelialization area as an impact of treatment between the groups was compared by using independent student's t-test or Mann Whitney U test, whichever is appropriate.

Statistical Significance was set at p <0.05

Mean age of study participants was 34.98 years. 46.40% patients were male while 53.60% were females. A significant deference between APRP and Collagen dressing group was noticed on day 7 (p value= < 0.05). There was no significant deference noticed on 14^{th}, 21^{st} and 28^{th} day. One way repeated measure of Anova for APRP showed Mauchly's W = 0.013, Chi Square= 230.45, df = 9 and p value 0.00. Values revealed that findings reject the null hypothesis. One way repeated measure of Anova for collagen showed Mauchly's W = 0.003, Chi Square= 317.68, df = 9 and p value 0.00. Values revealed that findings reject the null hypothesis. Two way repeated measure Anova between APRP and collagen group showed that there was a significant deference between APRP group and collagen dressing group (mean square= 55.509. F value= 5.434, p value= 0.022).

Discussion

The character of the skin varies greatly inter and intra individually, and within each person it varies with age, sun exposure, and area of the body. Approximately 95% of the skin is dermis and only 5% is epidermis [6].

An autograft is a graft taken from one part of an individual's body that is transferred to a different part of the body of that same individual. A split-thickness skin graft (STSG) contains is a graft which contains epidermis and a variable amount of dermis. Depending upon the thickness of the dermis harvested, the skin graft can be either a thin, intermediate or thick skin graft. The wound healing process immediately begins following a tissue injury, consists of 4 phases Haemostatic phase (clot formation), The inflammatory phase, The proliferative phase and Tissue remodeling phase. Although these 4 phases appear independent from one another, they overlap significantly during the healing process.

Various growth factors derive from platelets are required for healing. Growth factors are contained in the alpha granules of platelets as well as other cells such as macrophages and endothelium. Specific platelet-isolated growth factors include platelet-derived growth factor (PDGF), transforming growth factors-beta (TGF-beta), vascular endothelial growth factor (VEGF), and epithelial growth factor (EGF).

Platelet derived growth factors initiate connective tissue healing, increases mitogenesis of fibroblasts, stimulates angiogenesis in the wound bed, initiates bone generation and repair, and activates macrophages. Then necessary nutrients and oxygen for optimal healing is brought by the newly created blood vessels and blood flow. Transforming growth factors beta promotes cell mitosis and differentiation for connective tissue and bone.

TGF beta also acts on stem cells, osteoblasts precursors, and fibroblasts. Vascular endothelial growth factors stimulate angiogenesis and related vascular permeability enhancing activities specific for endothelial cells. VEGF is chemo attractive for osteoblasts. Epithelial growth factors induce (EGF) epithelial development and promotes angiogenesis. In the third phase which is the remodeling phase, collagen is continually produced and broken down. Inflammatory cells regress and the maturation of the scar may take 2 years. Several growth factors regulate the remodeling process. Restoration of the wound site to a mature scar depends on the perfect balance of collagen degradation and synthesis [7,8].

Stages of Donor Site Wound Healing

The healing of donor site wounds can be divided into two phases, wet and dry phases. The wet phase is when copious amounts of exudate is produced. An absorbent dressing such as a foam, alginate or hydrofibre dressing can be used to absorb the excess exudate. The dry phase is when the exudate levels fall dramatically and the wound bed becomes dry. It can be treated with a simple non-adherent silicone dressing, which can remain undisturbed without adhering to the wound bed for several days or until the wound has healed. It is in the patient's best interests that one dressing is applied and remains in situ until healing is achieved.

Donor Site Dressing

The ideal dressing should be simple to apply, cost effective , should allow the patient to move or walk around without disturbing the healing procedure, should allow the donor site to heal without bleeding, infection and pain, should be available sterile and ready for use.

Open method is where no dressing is applied, It tends to be painful and is associated with prolonged healing time. It is definitely one of the cheapest of possible dressings, provided the prolonged healing time does not result in extended hospitalization.

However, most authors, prefer to protect the donor site wound from trauma and infection by covering it with a low-adherent, Vaseline-impregnated fine mesh gauze. Medicated layers such as Jelonet and Sofra Tulle are often used as well. Early occlusive dressings consisted of fine mesh gauze covered by an impermeable membrane. These were quickly abandoned because of potential bacterial proliferation and because they were difficult to apply to areas other than the extremities. Semi-occlusive dressings comprise the group of clear films often referred to as "SAM" (synthetic adhesive moisture-vapor-permeable) dressings. They are impermeable to bacteria and liquids. However, as with Duoderm, fluids tend to collect beneath these dressings, requiring frequent drainage or replacement.

Biological dressings include the re-application of excess autogenous skin graft is another method to cover the donor site. Collagen dressings used are composed of type 1 and type 3 bovine collagen which is similar to human collagen and thus prevents rejection. It is commercially available in a sterile pack and is thus easy to use. Collagen dressing have been showed to improve time to re epitheliazation significantly compared to standard paraffin gauze dressings. The pain of dressing change and patient comfort has also been shown to be less with collagen dressing. The collagen provides scaffolding for epithelial regrowth and prevents exudation from the raw area [9,10,11].

More recent evidence in the literature suggests that good hydration is the single most important external factor responsible for optimal wound healing [12,13,14].

By definition, PRP must contain a higher concentration of platelets than baseline, however just an increase in platelets is a very gross description of PRP and does not accurately describe the variability among different types of PRP. There are several parameters that need to be taken into account when considering PRP, including: platelet concentration above baseline, whether or not the PRP has been anti coagulated and whether it requires exogenous activation. Graziani et al suggested that the optimal concentration of PRP was 2.5 times the baseline and above this there may be an inhibitory effect [15].

Platelets contain an abundance of growth factors and cytokines that can affect inflammation, postoperative blood loss, infection, osteogenesis, wound, muscle tear and soft tissue healing. It contains vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF2), transforming growth factor (TFG)-alpha 1 and TGF alpha 2, epidermal growth factor (EGF), and Platelet derived growth factor (PDGF- AA, PDGF- BB and PDGF AB), endostatin, calcium, serotonin, histamine and proteolytic enzymes.

PRP has a pH of 6.5 to 6.7 compared with a mature blood clot of 7.0 to 7.2. It has been that PRP inhibits bacterial growth. The effects of PRP injection at a molecular level has been studied [16,17].

PRP has been used for various clinical applications, Like Oral and Maxillofacial Surgery,

Neurosurgery as a biologic sealant in to create a watertight dural closure. Facial Plastic and Reconstructive Surgery to Decrease in postoperative swelling, hematoma formation, seroma formation, and healing time. Orthopedics for more rapid epithelialization, more dense and mature bone with better organized trabeculae, and greater bone regeneration.

Conclusion

The use of subcutaneous injection of Platelet rich plasma is associated with a faster healing of the

skin graft donor site as compared to collagen dressing.

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