IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 12 Ser. 5 (December. 2024), PP 54-60
www.iosrjournals.org

Use Of Platelet Rich Plasma In Burns Patients At A Tertiary Care Centre, Tamil Nadu.

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Date of Submission: 10-12-2024 Date of Acceptance: 20-12-2024

I. Introduction:

Burns pose a significant risk to human life and can lead to long-term disability. Due to the high rates of mortality and prolonged periods of disability linked to burn injuries, particularly in developing nations, these injuries are considered a critical public health issue. The body's overall immune deficiency, resulting from the impaired function of both the humoral and cellular immune systems, combined with the damage to the skin, which serves as the primary protective barrier makes burn patients more susceptible to hospital-acquired infections, especially with aggressive diagnostic and treatment measures. The etiology of burns is multifactorial including socioeconomic status, race and ethnicity, age, gender, place of residence, intentionality, and other influences. Platelet-rich plasma (PRP) has a platelet concentration that is three to seven times higher than that found in standard blood. PRP contains not only growth factors and various protein molecules but also binding molecules and chemokines, which play crucial roles in processes like cell proliferation, differentiation, and regeneration.

The concentration of growth factors in PRP is directly related to its effectiveness and therapeutic potential. PRP's healing properties are attributed to these biological components. PRP injection post hair transplant surgery, grafted follicular units have shown significant functional improvements. PRP has a wide clinical application, such as skin rejuvenation, chronic wounds, and hair loss. Platelets are essential for the wound healing process. When an injury occurs, they migrate to the affected area and initiate clotting. Platelets contain numerous growth factors and cytokines that aid in the healing process. Platelet-derived growth factors have been shown to effectively treat chronic skin wounds. One of the most critical aspects of treating such wounds is preventing infection at the site. The application of platelet-rich plasma in various medical treatments is attributed to the presence of important growth factors in platelets, which support tissue repair. Beyond just facilitating the healing process, platelets play an active role in it by promoting repair and maintaining haemostasis after tissue damage. We undertook this study to know the impact of human platelet-rich plasma on burn patients admitted to a tertiary care centre in Tamil Nadu, to assess if PRP aids in faster healing of second-degree burns and to assess if PRP improves the wound status of unhealthy post burn raw area.

II. Materials And Methods:

An observational study was conducted during a period of 6 months (from July 2023 to December 2023). During this study period, patients who were admitted with second degree burns covering less than 10% of Total Body Surface Area (TBSA) or with poorly granulated Post Burn Raw Area (PBRA) limited to 5% TBSA and those who have given informed consent were included in this study. Patients who were with first- and third-degree burns, TBSA >10%, and those less than 18 years of age were excluded.

Preparation of PRP:

In our study we use the double centrifuge method as described by Augustus D et al[(12)] for deriving the PRP. 20 ml of whole blood was taken. The volume is divided and added in 2 pre-filled test tubes containing 1.5 ml of Acid Citrate Dextrose. 1st centrifuge of both the test tubes is done at 1800 rpm for 10 minutes. The plasma thus obtained after the 1st centrifuge (Fig. 2), is transferred to a PRP harvest tube (Fig. 3). The 2nd centrifuge is done at 3500 rpm for 15 min. As the platelets are heavier, they settle at the bottom. Thus, the lower 1/3rd of this plasma contains the "Platelet Rich Plasma" (PRP). The above 2/3rd is the Platelet Poor Plasma (PPP). The PRP thus obtained contains 3-5 times concentrated platelets iscolcted in a syringe(Fig. 4). This process was standardized by checking the platelet count in the patient's serum and the PRP obtained.

Fig 1: Centrifuge machine
Fig. 2: After first centrifuge
Fig 3: PRP harvest tube
Fig 4: PRP collected in syringe

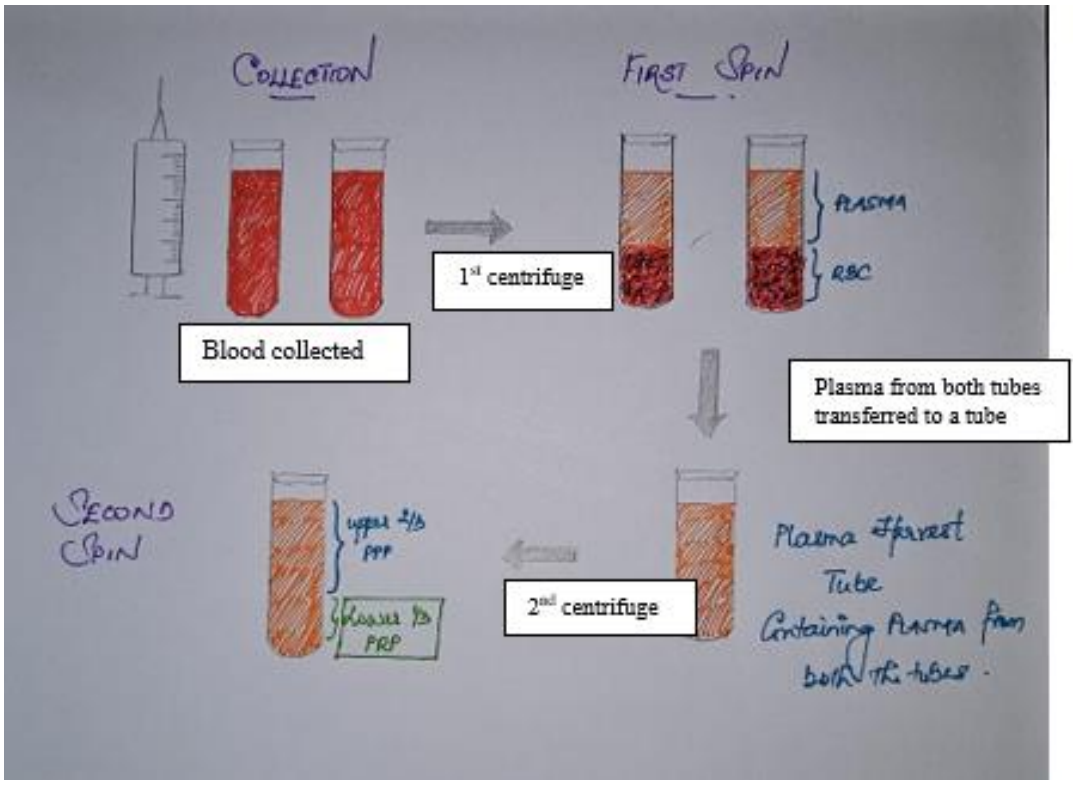

Fig. 5: Schematic representation of PRP preparation

Procedure:

For patients presenting within 72 hours with acute second-degree burns covering less than 10% of their body surface area, the burn area was cleansed with diluted betadine and normal saline under local anaesthesia. Necrotic tissue was removed, and PRP was injected around the wound edges and base of the raw area, approximately 0.5 ml per 1% TBSA. PPP was sprayed over the exposed areas. Dressings with saline or liquid paraffin were applied, and the wound was inspected on the third day. Subsequent dressings were performed every other day using saline or liquid paraffin until complete epithelialization was achieved. For the post burns raw area with unhealthy granulation; PRP injection was given at wound edges and the PPP was sprayed over the raw area. During skin grafting once again PRP was used before the graft was surfaced over the raw area.

The data was analysed using MS Excel and SPSS Version 24 software, employing descriptive statistics (such as percentages, mean, and standard deviation) as well as inferential statistics.

III. Results:

The average age of hospitalized patients was 37.5 years, with persons aged >60 years of 30% (n=9) and 18-60 years were of 70% (n= 21). Females accounted for 67% (n=20) of the patients in the study, while males made up remaining 33% (n=10). In this study platelet value in control was 2.72 lakhs and Platelet value in PRP was 8.1 lakhs. PRP showed effectiveness in 36% of female patients and 21% of male patients, but this difference was not statistically significant. According to the study findings, burns caused by boiling water were the most common, comprising 55% of cases. Regarding burn area, the upper limb was the most frequently affected area, representing 46% of all burns. The study also examined the impact of PRP on type and location of the burn, revealing that flame burns and burns to the lower limbs had the highest response rates to PRP.

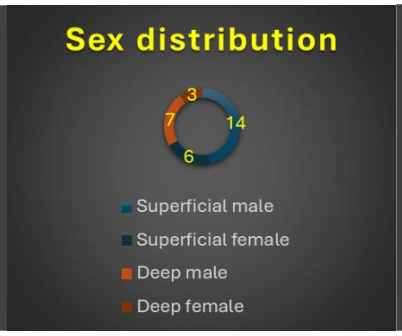

Fig 6: Age wise Distribution
Fig 7: Sex distribution
Fig 8: Time for Epithelisation

Fig 9: Hospital Stay

Clinical Pictures

*PBD- Post Burn Day

Day 0 indicates the day in which PRP was injected


Case 1
PBD-3, Day 0
PBD-3, Day 0
PBD-10, DAY 7
Case 2
PBD-3, Day 0
PBD-9, Day 6
Case 3
PBD-17, Day 0
PBD-22, Day 5
PBD-27, Day 10
PBD-32, Day 15
Case 4
PBD-12, DAY-0
PBD-17, DAY-5
PBD-24, DAY-12


Case 5
PBD 13
PBD- 21 Day- 0
PBD- 26 Day- 5
PBD-31
PBD- 41
Case 6
PBD-16, DAY-0
PBD-16, DAY-0
PBD-23, DAY- 7
PBD-23, DAY- 7

The addition of PRP to standard treatment significantly reduced the average time required for epithelialization in burn areas compared to conventional method. The average platelet count among patients was 188.5, lower than the typical range observed in healthy individuals, likely due to stress from the burns. On average, patients were hospitalized for 10.5 days. PRP treatment consistently accelerated epithelial tissue formation in the burn area compared to routine care alone. When PRP was added to routine treatment, the average time required to form epithelialized tissue in the affected areas was 6.6 days, compared to 9.25 days with routine treatment alone. This represents a 29% reduction in epithelialization time, a difference that was statistically significant ($p = 0.000$). Furthermore, no significant relationships were found between the effectiveness of PRP and variables such as age, sex, height, weight, burn percentage, burn mechanism, burn site, platelet count, or white blood cell count, as all p-values for these factors were greater than 0.05.

IV. Discussion:

Various treatment methods are available today for managing acute and chronic wounds, with a focus on reducing the time patients spend in hospital burn units. This is essential due to the challenges of effective treatment, potential complications, and the high costs associated with burn care. Recent advancements in treatment approaches have brought both benefits and drawbacks. A-D ointment is commonly used in hospitals for daily wound cleansing, dressing, and monitoring healing and epithelialization. Although antibiotics were widely utilized in burn care for years, their use has declined in some hospitals due to concerns over inefficacy and the development of resistance, as noted by several credible sources. PRP therapy, being autologous, is cost-effective to prepare and has shown no reported acute side effects, making it a safe option for burn patients. This study examines the impact of platelet-rich plasma on hospitalized burn patients. Our study demonstrated that using PRP alongside routine treatment significantly reduced the average duration of epithelialization compared to routine treatment alone. This finding aligns with a review by Huang et al., which reported that topical PRP treatment on burn wounds improved healing rates compared to sulfadiazine silver and normal saline. PRP has also been shown to accelerate healing time, reduce pain, and minimize scar hyperplasia, consistent with our results.

Platelets are central in mediating the therapeutic effects of platelet rich plasma due to the release of growth factors from their alpha granules. During the initial stage the activated platelets form fibrin matrix. This matrix later serves as a tissue scaffold which releases growth factors and cytokines that stimulate cell recruitment and maturation. Growth factors which are released from the platelets are platelet derived growth factor (PDGF), vascular endothelial growth factor (VEGF), basic fibroblast growth factor (bFGF), transforming growth factor β (TGFβ), epidermal growth factor (EGF) and insulin like growth factor (IGF-1). The functions of the growth factors are described in table 1.

Function

Growth factors	Function
PDGF	Stimulates cell proliferation, chemotaxis and differentiation Stimulates angiogenesis
TGF-ß	Stimulates production of collagen type I and type III Stimulates angiogenesis and re-epithelialization Stimulates synthesis of protease inhibitors to inhibit collagen breakdown
VEGF	Stimulates angiogenesis by regulating endothelial cell proliferation and migration
EGF	Influences cell proliferation and cytoprotection Accelerates re-epithelialization Increases tensile strength in wounds Facilitates organisation of granulation tissue
bFGF	Stimulates angiogenesis Promotes stem cell differentiation and cell proliferation Promotes collagen production and tissue repair
IGF-1	Regulates cell proliferation and differentiation Influences matrix secretion from osteoblasts and production of proteoglycan, collagen and other non collagenous proteins

Table 1: Function of the growth factors released by platelets. Ref 13-16

Similarly, studies by Knighton et al. and Ganio et al. reported enhanced epithelialization in chronic lower limb wounds with PRP. Kazakos also found PRP gel effective in managing acute wounds, including friction burns. In a study involving five pigs, Henderson demonstrated that autologous platelet gel (PRP concentrate) influenced wound healing by triggering a robust inflammatory response.

Kao et al. (2021) concluded that PRP was superior to conventional dressings and placebo for burn wound treatment. These findings suggest that PRP can be a valuable treatment option for burn patients in clinical practice. Mahdavi and Falahi (16) highlighted that PRP stimulation of the skin promotes cell proliferation and accelerates exfoliation, helping to prevent scars and excess tissue formation. This makes PRP an effective approach for achieving satisfactory burn wound healing. The method is considered safe, with minimal side effects, and delivers

quick results. However, it is crucial to monitor the patient's condition closely, with doctors overseeing the treatment to ensure effective wound control and healing.

The average hospital stay for patients was 10.5 days, as discharge typically occurs only after all wounds are healed and epithelialized tissue has formed in the affected areas. The findings from the two studies were not directly compared.

Limitations:

Our study focused only on patients with second-degree burns, as PRP is likely to have a reduced effect on third- and fourth degree burns due to the more extensive tissue destruction in these cases.

V. Conclusion:

Treating burns patients with PRP yielded positive outcomes, suggesting that PRP could potentially become a routine practice in burn care if its use is expanded. Its application may shorten hospital stays and lower the costs borne by patients, ultimately reducing the overall expenses for the healthcare system. However, further research is necessary to explore the use of platelet-rich plasma in burn wound treatment especially in larger burn areas and to assess its long-term clinical outcomes. For these the allogenic PRP with the help of blood banks could be path breaking and needs to be assertained in depth.

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