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Case Report

Short-term storage of surplus split-thickness skin grafts in platelet-poor plasma: Clinical utility of a by-product

Sriram V S[1], Ravi Kumar Chittoria[1]*, Amrutha JS[1]

[1]Dept. of Plastic Surgery, JIPMER, Pondicherry India.

Abstract

Temporary storage of split-thickness skin grafts (STSGs) is often required in staged reconstructive procedures or when harvested grafts exceed immediate coverage needs. Conventional storage media, like normal saline, lack nutritional support for cellular viability. Platelet-poor plasma (PPP), an autologous derivative of whole blood and a byproduct of platelet-rich Plasma preparation, retains plasma proteins and nutrients, making it a potential alternative for short-term graft preservation. We present the case of a 12-year-old boy who sustained high-voltage electrical burns involving both feet and the forehead, for which he underwent serial tangential excision and skin grafting. The surplus skin graft was treated after wrapping the surplus grafts in sterile gauze stored at 4°C for 3 days. The graft retained normal appearance and texture and was reapplied to a residual raw area after 3 days. This case highlights the feasibility of using PPP as a temporary storage medium for surplus skin grafts. The autologous nature of PPP and its biochemical composition make it a safe, effective, and low-cost alternative to traditional storage solutions. Further controlled studies are needed to establish standardised protocols and assess long-term outcomes.

Keywords: Platelet-Poor Plasma (PPP), Skin Graft Preservation, Split-Thickness Skin Graft (STSG), Autologous Plasma, Temporary Graft Storage

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1. Introduction

Split-thickness skin grafting is a cornerstone of reconstructive surgery for large wounds. In cases requiring serial surgeries and staged reconstruction, surplus harvested grafts may require temporary storage. Standard practice involves saline and refrigerated conditions, which are conventionally used but provide limited metabolic support. Ideal solutions or media used for graft storage should maintain cell viability during storage. Various media have been explored for skin graft storage, such as Dulbecco's Modified Eagle's Medium (DMEM), Roswell Park Memorial Institute (RPMI) medium, University of Wisconsin solution (UW solution), amniotic fluid and Platelet-rich Plasma.

Platelet-poor plasma (PPP), derived autologously from centrifuged whole blood, is rich in plasma proteins and nutrients but lacks concentrated platelets and leukocytes.

It can act as a source of nutrients necessary for cell survival and stimulate cell production using growth factors released from activated platelets. There is limited information available on its use as a graft storage medium. This report presents a successful case of using PPP to store surplus grafts for 3 days before reapplication.

2. Materials and Methods

This study was conducted in the Department of Plastic Surgery of a Tertiary Care Centre after getting the Departmental Ethical Committee approval. Informed consent was obtained from the patient's legal guardian. The patient was a 12-year-old male child who had sustained high-voltage electrical burns of mixed second-degree to his face, neck, and both lower limbs involving 15% total body surface area. Following initial resuscitation and supportive management, he underwent early tangential excision of the burn eschar under general anaesthesia, and the resultant raw area was covered with split skin graft. The grafted areas were managed according to standard protocol. Graft site examination on the 5th post-operative day revealed partial graft loss requiring regrafting. Subsequent skin graft harvesting was done from the left thigh and used to cover the residual raw area. The

*Corresponding author: Ravi Kumar Chittoria
Email: drchittoria@yahoo.com

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surplus skin graft fragment of approximately 3 x 2 cm that was available after covering the raw area was stored in PPP.

To prepare the PPP, 10 mL of the patient's venous blood was drawn, mixed with 3.2% trisodium citrate (9:1 ratio), and centrifuged at 3000 rpm (400 x g) for 10 minutes. This resulted in the formation of three layers: the top layer of plasma, the bottom layer of red blood cells, and an intermediate zone known as the buffy coat. Using an 18G needle and syringe, the top layer was aspirated off and centrifuged for a second time at 4000 rpm (800 x g) for 10 mins. This separated the plasma into the upper 2/3rd of PPP and the lower 1/3rd of PRP. The layers were collected separately using an 18-G needle. The PRP was administered at the skin graft sites as a regenerative therapy to promote graft take. The PPP left behind was utilised for graft storage.

The Swiss roll technique of graft storage was employed. The leftover skin graft was laid out epithelial side down onto a dry collagen sheet, and PPP was sprayed over the dermal side (**Figure 1**). The graft was then folded on itself to prevent drying out (**Figure 2**). It was rolled up in a Swiss roll style, wrapped in saline gauze, placed in a sterile sample container, labelled, and transferred immediately to a refrigerator at 4°C for storage (**Figure 3**).

3. Results

The stored graft was retrieved after 3 days and examined. There were no evident signs of infection or discolouration, and hence the graft was used to successfully cover a raw area in the patient's foot secondary to partial graft loss (**Figure 4**). The skin graft patch had satisfactory take on subsequent follow-up, and the raw area was epithelialised.

Figure 1: PPP being applied on the graft

Figure 2: Graft folded on itself to avoid drying out and wrapped in collagen sheet and sterile gauze

Figure 3: Graft rolled in Swiss roll style and transferred to sterile container for storage

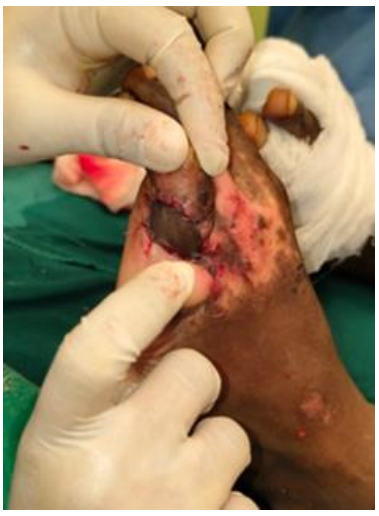

Figure 4: Stored graft used to cover raw area over foot

4. Discussion

Preserving skin grafts for delayed application is a well-established practice in plastic surgery and burn management. Graft viability after storage is usually determined in clinical practice by its colour, texture, hardening, and other morphological changes. Various methods of graft storage have been explored in scientific literature, with the techniques differing regarding the media used, storage parameters, and the process of graft packaging for storage. A 2013 online survey in Europe reported that the most common medium used for storage was saline, and the preferred storage method was in a refrigerator at 4–6 °C in a moist gauze. The mean storage duration was 7 days.[1]

Available methods of storing skin grafts include refrigeration, freeze drying, and cryopreservation with glycerine or dimethylsulfoxide.[2] The optimum temperature for refrigeration is also not standardised, but 4 °C is the most commonly used, allowing the use of domestic refrigerators, which are widely available in hospital settings.

Sterne et al described that grafts could be refrigerated either rolled up in moist gauze (Swiss Roll technique) or stored flat with the graft covered with a filter paper moistened with saline.[3] This was based on the assumption that laying the graft flat would maximise the area available for metabolic diffusion from the storage media.[4] The study also compared the storage of meshed and unmeshed grafts. The study's findings suggested that rolled specimens showed less shrinkage and clefting than flat stored grafts, probably owing to reduced desiccation. Storage after meshing also inflicted additional trauma to the tissue and resulted in more pronounced histological changes and subsequent shrinkage. They recommended that stored graft viability could be improved if stored as a rolled, unmeshed tissue at a constant temperature of 4 °C.

In a study comparing various chemical media for skin graft storage, Basaran et al reported that Roswell Park Memorial Institute-1640 solution (RPMI) was superior to University of Wisconsin solution, Histidine-tryptophan-ketoglutarate solution, and saline in maintaining graft viability. [5] When meshed grafts stored in saline, Hartmann's solution, and Dulbecco's Modified Eagle Medium (DMEM) were compared, it was reported that Hartmann's and saline failed to maintain keratinocyte growth potency at 7 days. All media studied were prone to microbial contamination as well.[6,7]

The superiority of RPMI was attributed to its high amino acid content. Amniotic fluid, a rich source of peptides, nutrients and electrolytes, has also been evaluated as an alternative preservation medium. On histological assessment, grafts stored in RPMI did not differ significantly from those stored in amniotic fluid.[8] However, sterile amniotic fluid is not readily available and is associated with ethical concerns, limiting its use in clinical practice.

PRP as a storage medium for skin grafts was reported in a few studies. Odlozilova et al compared graft preservation in PRP with conventional saline and Custodiol crystalloid, a solution commonly used in hypothermic organ preservation for transplantation. Based on histological evaluation of stored grafts, they concluded that Custodiol was the optimum preservation fluid and could not find any significant difference between the saline and PRP groups. They also reported that grafts should not be used beyond 15 days of storage.[9]

A similar study by Keskin et al also compared PRP with saline solution for graft storage.

They looked at histological parameters such as dermo-epidermal junction integrity, collagen organisation, cellular apoptosis, and fibroblast counts. They reported that grafts preserved in PRP were histologically superior to those stored in saline. This beneficial effect of PRP was noticed up to 8 days. They hypothesised that the beneficial effects of PRP were due to the nutrient support provided by plasma and the presence of growth factors.[10] Cetin et al also reported their findings of storage of skin grafts in plasma and saline, and showed that mean viable keratinocyte counts at 30 days by the Tryptan blue method were higher in the plasma stored grafts.[11]

A few studies have compared the biochemical compositions of platelet-rich and poor plasma. In a proteomic analysis of autologous blood products, low leucocyte PRP and PPP were found to share around 50% of proteins involved in regulatory and inflammatory pathways.[12] Although lesser than PRP, PPP also contains several growth factors secreted by prematurely activated platelets, plasmatic growth factors, and the various nutrients in plasma.[13] Hence, we hypothesised that PPP may be an ideal medium to support skin graft storage similar to PRP.

For the preparation of platelet-rich plasma and platelet-poor plasma, we followed the protocol described by Franco et al, who were able to achieve mean platelet concentrations of 6.03×10^8 platelets/ml in the PRP preparation with each 40ml of venous blood yielding 12ml of PPP and 6ml of PRP.[14] We did not immerse the graft in PPP; instead, we used PPP as a spray over the graft to prevent graft destruction by maceration.[15]

5. Conclusion

Platelet-poor plasma is a promising, safe, and effective autologous medium for temporarily storing split-thickness skin grafts. This approach provides a pragmatic and resource-efficient use of platelet-poor plasma, a byproduct of platelet-rich plasma preparation that is often discarded, thereby adding value to an otherwise underutilised component of autologous blood products. Further studies are warranted to validate its use in broader clinical settings and compare it against conventional storage media.

6. Source of Funding

None.

7. Conflicts of Interest

None.

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