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Review Article

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Innovative Approaches to Severe Burn Care: The Role of Fresh Skin Allografts at Al Mouwasat Hospital

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Abstract

Burn injuries are a significant global health issue, particularly in low- and middle-income countries (LMICs), where they account for a high proportion of morbidity and mortality. This article discusses innovative approaches to severe burn care at Al Mouwasat Hospital, emphasizing the role of fresh skin allografts. With approximately 11 million burn cases annually and over 250,000 deaths, LMICs face unique challenges due to limited healthcare resources and inadequate access to advanced treatments. Effective management of severe burns necessitates early wound coverage to mitigate infection risks and promote healing, particularly for patients with extensive injuries. The use of cadaveric allografts has demonstrated benefits in reducing infection rates and hospital stays; however, their availability is hampered by concerns regarding disease transmission and storage requirements. Establishing skin banks in LMICs could address these challenges by ensuring safe procurement and distribution of skin allografts, ultimately improving patient outcomes. The article highlights the need for comprehensive strategies that encompass legislative frameworks, resource allocation, and donor management to facilitate the development of skin banking systems in resource-constrained settings, while shedding light on innovative approaches for burn management at Al Mouwasat Hospital.

Keywords: Allograft, Free Skin Allograft, Burn Surgery, LMICs, Skin Bank, Burns, Al Mouwasat Hospital, Syria

1. Introduction

Burn injuries represent a critical public health concern worldwide and a leading result of morbidity and mortality [1]. In 2011 a study was conducted, which estimated that approximately 11 million people globally experienced burns, with around 200,000 to 300,000 deaths each year directly linked to burn injuries [2]. According to the World Health Organization (WHO), burns are responsible for the loss of nearly 18 million disability-adjusted life years (DALYs) and over 250,000 deaths per year, more than 90% of which are in low- and middle-income countries (LMICs). The lower the income level of a country, the higher the burn mortality rate [3]. Almost 85% of major burns and 90% of fire-related deaths occur in lower- and middle-income countries (LMICs) which are largely lacking in facilities for skin banking [4]. Women in LMICs have a higher mortality rate in comparison with men, and children <5 years old are at a higher risk [5,6]. Proposed explanations for previously mentioned observation might consist of reduced quality of pre-hospital and hospital care, coupled with restricted access to advanced and expensive treatment [7,8]. Nevertheless, Effective prevention and treatment strategies have contributed to a significant reduction in burn mortality rates in numerous developed countries, due to early procedures being implemented in these countries such as burn wound excision and skin grafting [9,10,11]. Although burn injuries and related moralities predominantly occur in LMICs, prevention programs in these regions are often quite limited [12].

Treatment for severe burns usually requires extended hospitalization, and complex wound and scar treatments, which are challenging to provide in LMICs and resource-constrained healthcare settings, the initial wound coverage of the large surface area burns will require a biological wound cover [13]. It is necessary to replace the skin barrier early in the acute burn phase to reduce heat loss, volume loss, pain, and infection risks, or to provide temporary wound coverage when autografting is not a safe option. One of the primary objectives in burn care is to establish a definitive form of skin coverage that promotes optimal wound healing while minimizing scarring and preserving the quality of life for patients [14]. The application of cadaveric allografts has been shown to significantly reduce infection rates, length of hospital stay, and time to wound healing in patients with total burn surface area (TBSA) injuries exceeding 40%. This is achieved through the implementation of early debridement and temporary coverage [15]. Under the light of many well-resourced contexts, cadaveric skin allografts are mainly used for temporary wound coverage in between debridement and definitive closure [16]. Nonetheless, the accessibility of cadaveric allografts is constrained by concerns regarding disease transmission and the necessity for proper storage [17]. Therefore, the establishment of skin banks is imperative for addressing this pressing challenge in LMICs. Such facilities would facilitate the safe and efficient procurement, storage, and distribution of skin allografts, thereby enhancing the availability of critical resources for burn victims and individuals requiring reconstructive surgery. By mitigating the reliance on cadaveric allografts, skin banks can also reduce the associated risks of disease transmission and immunogenicity, ultimately improving patient outcomes in these regions.

The program in Singapore identified several key barriers to its establishment and maintenance, including legislation and guidelines, availability of specific resources, donor selection, skin retrieval, and processing, as well as distribution and documentation [18]. Nevertheless, a systematic compilation of lessons learned from diverse global contexts, particularly in low-resource settings, has yet to be published [19]. Even with the astonishing outcomes from burn centers that have used cadaveric allograft due to their access to skin banks access, cadaveric allograft remains a limited resource in LMICs. A review by Gupta et al, that included 458 hospitals in 14 LMICs/MICs are capable of performing initial burn management and resuscitation but are inadequate in further burn management such as skin grafting [20]. Another observational study had similar claims, the review included 32 LMICs and their capacity of health facilities for acute burn management and deficiencies in further burn management. The study included 1337 health facilities only 379 could do skin grafts, and approximately half of them had access to blood banks at all times. These results mean almost only 18% of healthcare facilities have the potential for early deep burns coverage [21]. The number of facilities in LMICs that have skin banks or utilize skin allografts is alarmingly low [22]. Skin allografts , cadaveric and living donor allografts have proven that they can provide biological wound cover with significant clinical benefits [23]. Skin allografts are clinically used to include coverage of extensive full-thickness wounds, meshed skin autografts, and healing of partial-thickness wounds [24]. Recovering and processing also maintaining the storage, and distribution of allografts for transplantation requires establishing skin banks and skin banking systems [25]. As previously mentioned, skin banks are mostly unavailable in LMICs despite the urgent need for them, patients in need of allografts will have to either travel to higher-income countries or eventually suffer the consequences that could lead to their death [26].

Glycerolized skin banking is a viable and doable option to sustain skin banking for LMICs [27]. Glycerolized skin banking should be used in LMICs as part of their protocol for burn patients especially major burns. This will massively improve the mortality rates from major burns in the LMICs [28].

This paper aims to shed light on the implementation of Fresh Human Skin Allograft for severe burns in Al Mouwasat hospital.

2. Methods

2.1 Source of Allograft

Skin allografts are harvested from live donors, from body contour surgeries such as abdominoplasty, brachioplasty, and breast reduction surgeries, who have signed an informed consent in which they agree to donate their removed skin after the surgical operation.

2.2 Selection of Donors

Potential donors for skin allografts undergo many preparation procedures starting with a general check up, both past medical history and past surgical history will be taken and well documented. Screening for transmissible diseases, including human immunodeficiency virus types 1 and 2 (anti-HIV-1 and anti-HIV-2), hepatitis B surface antigen, hepatitis C virus (anti-HCV), syphilis, human T-lymphotropic virus I and II, and cytomegalovirus (CMV). Also, they undergo a malignancy screening, especially for skin. Which are disease states that are contraindications to the skin donation [29]. Potential donors are excluded if they have extensive dermatitis, acute burn injuries, coetaneous malignancies, poor skin quality, or skin infections [30].

2.3 Harvest of Skin Allograft

Human skin allografts are obtained as full-thickness skin grafts using a scalpel blade, particularly when the source of the allografts is from body contour surgeries.

2.4 Allograft Skin Processing

The obtained allograft undergoes dermolipectomy. This technique involves excising the excess fat and skin to create a thinner graft, to improve the integration and healing when applied to a recipient site [31].

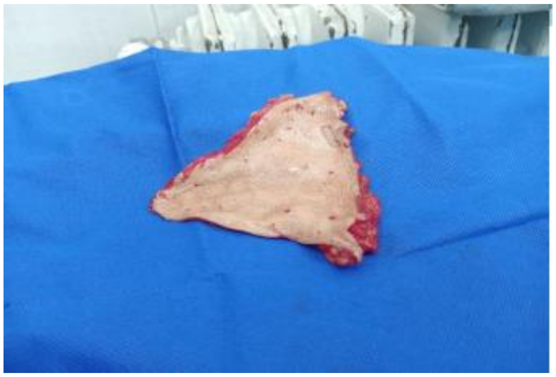

Figure 1

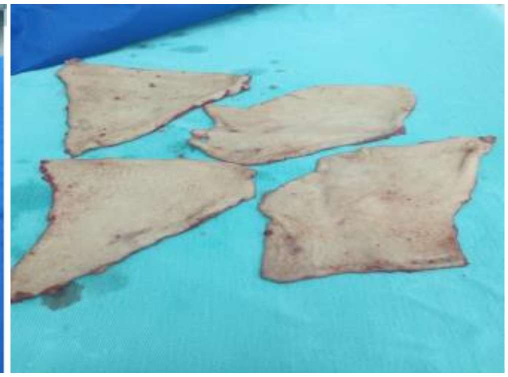

Figure 2

Subsequently, the allograft undergoes a thorough washing procedure using 0.5 liters of saline serum and utilizing an antibiotic solution comprising Ceftriaxone, Gentamicin, and Fluconazole. This washing process is conducted over 30 minutes, with the solution being refreshed every 10 minutes. This protocol is repeated three times in total to ensure optimal antimicrobial efficacy and to minimize the risk of infection prior to graft application.

Figure 3

Subsequently, the skin allograft is meticulously dried using sterilized gauze and positioned on sterilized hock towels. Multiple swabs are then obtained from the desiccated skin allograft for bacterial culturing and subsequent analyses to ensure the viability of the graft. Following this, the allograft is folded so that both undersurfaces of the skin are in contact.

Finally, the specimen is sealed within two sterile pouches and appropriately labeled with a numerical identifier, the donor's name, the date of procurement, and the type of procedure performed. It is then stored in a freezing unit maintained at -30°C. The allograft remains viable for up to 14 days post-harvesting, provided it is stored under optimal conditions.

Figure 4

2.5 Allograft Skin Preparation and Re-Applying

The process starts with thawing the allograft, which is warming up the frozen allograft to a temperature that is suitable for transplantation. Thawing by definition is the process of transitioning a substance from a frozen state to a liquid state, which is crucial for the viability of tissue grafts. Proper thawing minimizes cellular damage and preserves the integrity of the tissue [32]. Thawing skin allografts at 37°C is commonly recommended because this temperature closely mimics body temperature, facilitating cellular metabolism and reducing thermal shock [33]. Studies show that thawing at physiological temperatures (around 37°C) helps maintain cell viability and function better than at higher or lower temperatures [34]. Proper thawing techniques are critical in clinical settings to ensure that allografts can integrate successfully into the recipient's tissue without complications [35]. The Allograft undergoes the same previously mentioned bacterial analysis check. After that process, The Allograft undergoes an essential Fenestration process, Fenestration refers to creating small openings in skin allografts to promote drainage and reduce fluid accumulation beneath the graft. This technique can improve allograft take by allowing exudate to escape and facilitating adherence to the underlying tissue [36]. Studies have shown that fenestrated skin grafts can lead to improved outcomes in terms of graft survival and integration when compared to non-fenestrated grafts [37]. Also, this design facilitates the infiltration of cells and nutrients from the host tissue into the graft, which is crucial for successful healing [38].

The Alexander surgical technique for the treatment of severe burns is used after applying the graft which is a method that teaches individuals how to improve their posture and movement, which can be beneficial for physical rehabilitation [39]. While this Technique is not directly related to surgical procedures like skin allografting, its principles can be applied in rehabilitation settings post-surgery, helping patients regain mobility and improve body mechanics [40].

2.6 After Application

The initial phase lasts typically around 2 to 3 weeks after allograft application. During this time, the allograft undergoes a process known as revascularization, where blood vessels from the host tissue begin to invade the allograft, establishing a connection that is vital for nutrient supply and waste removal [41]. The acute phase of recovery usually refers to the first few weeks post-surgery when the focus is on managing pain and preventing complications. After this phase, patients may transition into a rehabilitation phase where they can begin to engage in more active recovery strategies such as The Alexander surgical technique [42]. In the end, the Viability of grafts is essential for successful integration and healing. A viable graft will have an adequate blood supply and cellular activity, which can be assessed through imaging or histological studies post-surgery. Ensuring that the graft remains viable is critical to achieving the desired outcomes [43].

Figure 5

Figure 6

3. Results

A total of 37 allografts were procured between March 23, 2023, and July 30, 2024. These allografts were sourced from 37 distinct body contouring surgical procedures. Specifically, 27 of the 37 allografts (72.9%) were derived from abdominoplasty, 8 (21.6%) from breast reduction procedures, and 2 (5.4%) from brachioplasty. Of the total allografts, 25 (67.5%) were discarded after 14 days post-harvesting due to non-utilization, while 9 (24.3%) were completely utilized and 3 (8.1%) were partially utilized.

4. Discussion

The burn units in Syria, particularly in Damascus, face significant challenges. In 2022, a dataset was collected from the burn unit at Al Mouwasat Hospital, detailing monthly admissions and mortality rates.

	Admissions	mortality	%
Jan	27	2	7.5%
Feb	30	5	16.6%
Mar	35	8	22%
Apr	38	4	21%
May	32	4	12.5%
Jun	29	3	10%
Jul	25	2	8%
Aug	26	3	11.5%
Sep	28	3	11%
Oct	31	5	16%
Nov	33	5	15%
	334	48	14.5%

Table 1

The accompanying table provides insights into the delays encountered before patient admission to the burn unit at Al Mouwasat Hospital.

	Under 4 hours	Between 4-8 hours	After 8 hors
	Early	Late	Late
Jan	7	12	8
Feb	6	9	15
Mar	11	13	11
Apr	12	14	12
May	7	17	8
Jun	5	14	10
Jul	3	14	8
Aug	7	13	6
Sep	4	13	11
Oct	0	21	10
Nov	6	15	12
	68	155	111

Table 2

These delays are correlated with elevated mortality rates and suboptimal outcomes, even when appropriate management is administered. This issue is critical, as it severely restricts the quality of care that can be delivered. Given that Syria is classified as a low- and middle-income country (LMIC), this challenge is one among many that healthcare providers confront on a daily basis.

Several factors hinder the procurement of skin allografts in LMICs. These obstacles include legislative restrictions on skin organ transplantation, cultural or religious objections to the harvesting of allografts, economic considerations, and logistical or institutional limitations. In many cases, the absence of legislation governing organ transplantation increases the risk of potential abuse or litigation concerning skin organ donation and harvesting practices.

Another significant challenge in the field of skin transplantation is the establishment of skin banking systems and the maintenance of readily available allografts. As previously noted, harvested allograft skin has a viability of only 14 days when stored in freezing units, and the availability of human skin allografts is limited, relying primarily on surgically excised excess skin.

These multifaceted issues contribute to substantial inefficiencies within burn units throughout Syria.

5. Conclusion

Glycerolized skin banking represents a viable strategy for sustaining skin banking initiatives in LMICs , particularly given the constraints posed by limited financial resources and underdeveloped infrastructure. This approach necessitates the integration of comprehensive medical education focused on skin donation and skin banking among healthcare providers, thereby enhancing the utilization of skin allografts and facilitating skin transplantation procedures.

Furthermore, fostering public awareness regarding the significance of skin and organ donation is imperative to mitigate prevailing religious and cultural reservations. Such educational initiatives are likely to give more favorable attitudes towards skin donation, ultimately promoting greater acceptance within communities. However, the establishment of cadaveric skin allograft banking remains would not be obtainable without appropriate legal frameworks to support such practices.

Consequently, glycerolized skin banking emerges as the most pragmatic and sustainable solution to address the pressing challenges faced in this domain.

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Conflicts of Interest

There are no conflicts of interest.

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