THE EVOLUTION OF BURN TREATMENT: AN ANALYSIS OF SKIN GRAFTS AND THEIR ALTERNATIVES

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ABSTRACT

This article analyzes the evolution of burn treatment, focusing on skin grafts and their therapeutic alternatives. Burns, which can be caused by heat, chemicals, or electricity, cause significant damage to the skin and underlying tissues, often requiring surgical interventions such as skin grafting to promote healing and prevent complications. The research points out that autologous grafts and allografts improve recovery, with emphasis on the use of Nile tilapia skin as a promising alternative in superficial burns. In addition, the study addresses the impact of burns on skin sensitivity and quality of life in patients. The article also explores innovations such as dermal regeneration matrices (DRM) and the use of biological dressings, aiming to reduce costs and improve therapeutic outcomes. The systematic review, based on studies published between 2019 and 2023, provides a comprehensive overview of current clinical practices, identifying factors that influence graft success and potential complications. It is concluded that the treatment of burns must be holistic, integrating clinical and psychological care to ensure an effective and satisfactory recovery.

Keywords: Burns. Skin grafts. Quality of life. Therapeutic innovations.

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INTRODUCTION

Burns are skin injuries resulting from a variety of agents, including heat, chemicals, and electricity, causing damage that can compromise not only the skin but also the underlying tissues. According to the Brazilian Society of Burns, this tissue injury triggers intense suffering, reflected in the pain that persists in all phases of the trauma (Brazilian Society of Burns, 2020). Proper management of burns, especially second- and third-degree burns, often requires surgical interventions, such as skin grafting, which is crucial to promote wound closure and minimize associated complications.

Skin grafts are used to restore skin integrity, prevent infections, and reduce fluid loss. Studies show that the application of grafts, whether autografts or allografts, not only improves healing, but also decreases the length of hospital stay and improves the quality of life of patients (Xavier et al., 2023). The severity of burns, often associated with thermal agents such as direct flame and scalding, contributes to the depth of the lesions, leading to a greater need for grafts. Data indicate that approximately 38.04% of burns in studied populations are classified as major burns, with an average of 13% of body surface affected (Xavier et al., 2023).

Recently, alternatives to conventional grafts have been explored, such as the use of xenografts derived from the skin of Nile tilapia (*Oreochromis niloticus*). Studies have shown that this biomaterial has good adherence to the wound bed and satisfactory results compared to human skin in histological and biomechanical analyses (Miranda & Brandt, 2023). These xenografts offer a promising option for treating superficial burns and may aid in reducing the costs associated with treatment.

In addition, burns can cause significant changes in skin sensitivity, as nerve endings are often damaged. This can lead to an interruption in the sensory pathway, negatively impacting patients' quality of life (Lima et al., 2023). Assessing sensitivity in skin graft areas is therefore critical to understanding the long-term repercussions of injury and treatment.

In view of this scenario, this review article aims to compile and analyze the current literature on the use of skin grafts in burn patients, addressing their failure rates, factors that influence the success of the procedures, and new therapeutic alternatives. It is hoped that this analysis will contribute to a better understanding of the alternatives in skin grafts, based on the principles of the therapy used.

OBJECTIVES

GENERAL OBJECTIVE

To analyze and compare different approaches in the treatment of burns, with emphasis on the use of skin grafts, biological dressings, and dermal regeneration matrices (DRM), in order to identify the factors that influence therapeutic success, such as healing rate, pain control, infections, and graft adhesion.

SPECIFIC OBJECTIVES

2.1. To evaluate the failure rate of skin grafts and the factors that influence their adherence in burn patients, considering aspects such as infections, exudate, and serum albumin levels.

2.2. To analyze the efficacy of the use of dermal regeneration matrices (DRM) in the treatment of major burns in pediatric and adult patients, noting their contribution to future graft integration.

2.3. To compare the use of Nile tilapia skin with Aquacel Ag® hydrofiber with silver dressing in the treatment of 2nd degree burns, focusing on healing time, pain control and the need for dressing replacement.

2.4. To investigate the incidence of infections and other postoperative complications in patients undergoing grafting procedures and the use of biological dressings.

2.5. To explore the clinical applicability and long-term outcomes of innovative burn treatment techniques, such as the use of biological dressings based on aquatic materials.

2.6. To analyze the contribution of the use of dermal regeneration matrices and biological dressings to the reduction of mortality in patients with extensive burn areas and restriction of skin donor areas.

2.7. Evaluate changes in skin sensitivity, as well as impacts on quality of life, encompassing social stigmas.

METHODOLOGY

This is a Systematic Review that aims to analyze and compare skin graft procedures in patients with second- and third-degree burns, focusing on outcomes related to healing time, complications, and aesthetic results. This review seeks to consolidate recent evidence available in the literature, interpreting the data in a rigorous and systematic way.

The search for studies was carried out in the Virtual Health Library (VHL) database, covering works in Portuguese published between 2019 and 2023. To ensure the relevance

of the results, the descriptors "Burn" AND "Skin Transplantation" AND "Skin" were used, according to the DeCS (Health Sciences Descriptors) controlled vocabulary, applying the Main Subject "Skin Transplantation".

Six studies were found, two of which were discarded because they addressed skin transplantation exclusively in wild animals, so four studies were used in this review, one Case Report, one Clinical Study, one Prospective Cohort Study and one Cross-Sectional Study with convenience sample.

The inclusion criteria were rigorously established to select only original studies involving human patients of any age with second- and third-degree burns undergoing the skin graft procedure.

The data collection process took place in two stages. In the first stage, the titles and abstracts of the articles were screened to exclude those that did not meet the inclusion criteria. In the second stage, the selected articles were read in full, with the aim of extracting detailed information on the main outcomes, such as healing time, associated complications, and aesthetic results observed in the patients.

Data analysis was conducted using a qualitative approach, with the identification of recurring themes and variations in skin grafting techniques, as well as their implications for outcomes, correlating data and common goals discussed in the studies.

This systematic review provides a comprehensive analysis of the efficacy of skin grafting in second- and third-degree burns, highlighting not only objective outcomes but also patient experiences and challenges faced in clinical practice. The systematic approach made it possible to understand the factors that influence the success of the procedure, highlighting the importance of a careful analysis of the available evidence.

DISCUSSION

INTRODUCTION TO THE USE OF GRAFTS IN BURN PATIENTS

The use of skin grafts is a fundamental method in the treatment of burns, especially in third-degree lesions that compromise the entirety of the skin layers. The main function of the graft is to promote the coverage and healing of exposed areas, helping in the recovery and protection of injuries, in addition to preventing complications such as infections and loss of body fluids (MIRANDA; BRANDT, 2019). There are different types of grafts used in clinical practice, including autologous grafts (the patient's own skin), allogeneic grafts (from a donor), and xenografts (from other species). Each type has specific advantages and limitations, according to the patient's condition and the severity of the burn (XAVIER et al., 2023).

Overview of Burns and Morbidity Rates

Burns are one of the main causes of morbidity and mortality in hospital settings, representing a significant demand for medical resources, especially in cases of deep burns that require surgical interventions, such as skin grafts, to facilitate tissue regeneration and minimize complications (GUIMARÃES et al., 2019). Data indicate that patients classified as major burns have prolonged hospitalization rates, with a median of 30.5 days, reflecting the complexity and severity of the treatment (XAVIER et al., 2023).

These patients, due to the extent and depth of the burns, usually require multiple surgical procedures, including an average of 5.5 debridements before grafting, which contributes to increased hospitalization time and the risk of complications (XAVIER et al., 2023). In addition, the socioeconomic impact of these injuries is high, with costs associated with prolonged hospital treatment and patient rehabilitation (MIRANDA; BRANDT, 2019). Studies show that, in situations of severe burns, the length of hospital stay can vary between 24 and 47.5 days, depending on the extent of the injury and the response to treatment, indicating the severity and challenges faced during the management of these cases (XAVIER et al., 2023).

Factors Affecting Graft Success

The success of skin grafts depends on a number of factors, both local and systemic. Wound bed preparation is a key aspect, as the presence of infections, exudate, or necrosis can prevent proper adherence of the graft to the recipient bed. Patients who have infections, especially by multidrug-resistant microorganisms, are at higher risk of graft failure (XAVIER et al., 2023). In addition, nutritional factors such as hypoalbuminemia and the presence of exudate play a crucial role in wound healing and graft success (GUIMARÃES et al., 2019).

TYPES OF GRAFTS USED IN BURN PATIENTS

Treatment of severe burns often involves the use of skin grafts, which can be classified into autologous, xenografts, and dermal substitutes. Each of these types has distinct characteristics, with advantages and disadvantages that directly affect the healing process and the recovery of patients.

Autologous Grafts (patient's own skin):

Autologous grafts are considered the gold standard in the treatment of burns, as they use the patient's own skin as grafting material. This approach has significant advantages,

such as a lower probability of rejection and infection, since the tissue is compatible with the patient's body (LIMA et al., 2020). However, in patients with extensive burns, there may be a limitation in the available donor areas, which represents a significant challenge (XAVIER et al., 2023).

In addition, donor areas often behave like new wounds, which can result in intense pain and additional complications during the healing process (GUIMARÃES et al., 2019). This can impact the patient's overall recovery, increasing the length of hospital stay and the need for additional interventions. The study by Lima et al. (2020) highlights the importance of proper wound bed preparation and care of donor areas to optimize autologous graft outcomes and minimize complications.

Xenografts (such as the use of Tilápia skin):

Xenografts, such as tilapia skin, emerge as a promising alternative in the treatment of burns. Miranda and Brandt (2019) emphasize the role of tilapia skin as an effective biological dressing, presenting advantages such as: good adherence to the wound bed and the ability to promote healing. This type of graft has been shown to be advantageous in preventing graft loss, especially when compared to traditional synthetic dressings, such as hydrofiber with silver (Aquacel AG)® (MIRANDA; BRANDT, 2019).

In addition, xenografts offer the advantage of being widely available and less invasive, as they do not require the removal of skin from the patient. This is especially relevant for patients with large burns who do not have adequate donor areas. The use of tilapia skin is supported by studies that demonstrate its effectiveness in reducing pain and the number of dressing changes, contributing to a less traumatic and more efficient treatment (MIRANDA; BRANDT, 2019).

Dermal Substitutes (such as MatriDerm®):

Dermal substitutes, such as MatriDerm®, play an essential role in the treatment of extensive burns, especially in patients who require multiple debridement procedures prior to grafting. Guimarães et al. (2019) discuss the benefits of using dermal matrices, which provide a support structure for tissue regeneration, allowing for faster and more effective healing. These surrogates act as a viable alternative when donor skin areas are limited or compromised.

In addition, the use of dermal substitutes can significantly reduce graft failure, facilitating the integration of subsequent autologous grafts. Studies show that the application of MatriDerm® results in better results in terms of healing and a lower incidence

of complications, such as infections and graft necrosis (GUIMARÃES et al., 2019). This emphasizes the importance of considering dermal substitutes as a key part of the therapeutic arsenal available for the treatment of severe burns.

FACTORS RELATED TO GRAFT SUCCESS AND FAILURE

Clinical Factors

Hypoalbuminemia is one of the most significant clinical factors influencing the success of skin grafts. Studies indicate that patients with altered serum albumin levels have a significantly higher rate of graft failure. Albumin is crucial for the maintenance of oncotic pressure and for the appropriate inflammatory response; thus, its deficiency can compromise healing and increase the risk of complications, including graft failure (XAVIER et al., 2023).

Another relevant factor is the presence of exudate. Patients who have moderate or large amounts of exudate have a high frequency of graft failure. Purulent exudate, in particular, is associated with serious complications, as it indicates a possible infection that prevents adherence and proper integration of the graft to the recipient bed. The literature points out that the reduction of exudate is crucial for the success of the graft, since the presence of this fluid can hinder revascularization and healing (XAVIER et al., 2023).

The presence of bleeding at the graft site is also a critical factor that can lead to the failure of the procedure. When bleeding occurs, hematomas may form, which prevents efficient graft revascularization and, consequently, its adhesion to the wound bed. The analysis shows that the presence of bleeding increases the probability of graft failure by five times, underscoring the importance of proper site management during the procedure (XAVIER et al., 2023).

Aspects of Infection:

Aspects related to infection are critical in the analysis of the factors that impact the success of skin grafts. Infection with multidrug-resistant microorganisms, such as *Klebsiella pneumoniae* and *Acinetobacter*, was significantly associated with graft failure. Data show that patients whose tissue fragment cultures were positive for these pathogens had an elevated risk of graft failure, with an increased chance of up to 2.89 times compared to patients without documented infection (XAVIER et al., 2023).

In particular, colonization by *Klebsiella Pneumoniae Carbapenemase* (KPC) and *Acinetobacter* resulted in a 100% failure rate in the cases analyzed, indicating the severity of infection in these contexts (XAVIER et al., 2023). In addition, the presence of infection

not only compromises graft adhesion but also significantly prolongs the length of hospital stay and increases the need for additional interventions, such as new debridements (LIMA et al., 2020).

TECHNICAL ASPECTS OF SURGICAL PROCEDURES

Number of Debridements:

The number of debridements performed before skin grafting is a technical factor that directly impacts the success of the procedure. Patients who underwent five or more debridements had a success rate of 73.91%, compared to patients who had fewer debridements, whose success rate was only 41.18%. This highlights the relevance of a properly prepared wound bed for graft integration (XAVIER et al., 2023).

This finding reinforces the need for a meticulous approach during the wound bed preparation phase. The data show that when debridement is performed effectively and in sufficient numbers, healing is accelerated, with a median healing time of 21 days, compared to 30.5 days in patients who received fewer interventions. In addition, the rate of complications, such as infections and graft failures, was reduced from 58.82% to 26.09%, highlighting the importance of proper wound preparation (XAVIER et al., 2023).

Graft Type and Removal Site:

The type of graft used and the site of removal are fundamental technical aspects that directly influence the success of grafting. The predominant use of partial grafts, especially in the lower limbs, has been shown to be more effective, with a success rate of 82%, as observed in patients with extensive burns (XAVIER et al., 2023). These grafts are preferred because they are less invasive and provide better adaptation to the wound bed, especially in well-vascularized areas, such as the lower limbs and trunk (LIMA et al., 2020).

On the other hand, total grafts have a higher risk of failure, with a failure rate of up to 58% in places with compromised vascularization, such as joint regions and areas with bone exposure (LIMA et al., 2020). The main cause of this difference in success is the greater thickness of the total graft, which requires a more robust blood supply to ensure its survival. When the recipient bed is unable to provide the necessary vascularization, graft integration is impaired, resulting in a significant increase in complications and the need for surgical reinterventions (XAVIER et al., 2023).

These data suggest that the choice of graft type should be based not only on the extent and depth of the burn, but also on careful evaluation of the recipient site. Partial grafts offer a safer option in well-vascularized areas, while total grafts require greater care

in site selection, due to the increased risk of failure and the need for new procedures for correction.

NUTRITIONAL IMPACT ON GRAFT SUCCESS

Several studies point out that adequate nutritional status plays a crucial role in the success of skin grafting. Patients with major burns, who face a marked hypermetabolic response, have their caloric and protein needs increased, making nutritional support essential to optimize healing. Hypoalbuminemia, common in malnutrition, is associated with a higher rate of graft failure. Early enteral nutrition is often preferred due to its benefits, such as reducing infections and complications, while parenteral nutrition is an alternative in cases where enteral nutrition is not feasible, although it should be carefully monitored due to potential complications. Both nutritional approaches, when applied properly, favor healing and improve clinical outcomes, reducing the risk of failure and length of hospital stay (XAVIER et al., 2023).

Nutritional Status

The nutritional status of the patient is a critical determinant in the success of skin grafts. The diagnosis of malnutrition has been identified as a relevant factor in graft failure, especially in patients with major burns who face a marked hypermetabolic response (XAVIER et al., 2023). This condition leads to an increase in caloric and protein needs, making adequate nutritional support essential to optimize healing.

Studies have shown that hypoalbuminemia, often associated with malnutrition, is correlated with an increase in complication rates and graft failure. Therefore, ensuring a stable and adequate nutritional status can significantly improve the outcomes of surgical procedures and reduce the risk of complications (XAVIER et al., 2023). Thus, assessment of nutritional status should be a priority in the management of burn patients, with nutritional interventions implemented quickly to minimize the negative impact of malnutrition on recovery.

Enteral and Parenteral Nutrition

Enteral and parenteral nutrition is a vital approach to meeting the nutritional needs of burn patients, especially during the initial phase of treatment. The review of studies points out that early nutrition, through enteral interventions, can lead to significant benefits, such as the reduction of infections and graft failures (XAVIER et al., 2023). Enteral nutrition is

preferred whenever possible, as it provides a number of advantages, including maintaining bowel function and modulating the inflammatory response.

In addition, parenteral nutrition may be necessary in cases where enteral nutrition is not feasible. However, its use should be carefully monitored, as it can be associated with complications, such as infections and electrolyte imbalances. The combination of both approaches, when applied early and appropriately, is crucial to promote effective recovery and minimize the risk of graft failure in patients with major burns (XAVIER et al., 2023). This nutritional strategy not only supports wound healing but also contributes to the patient's overall recovery by reducing length of stay and improving clinical outcomes.

POST-GRAFTING OUTCOMES AND QUALITY OF LIFE

The outcomes of skin grafting procedures go beyond simple healing, extending to functional and psychological repercussions that affect patients' lives. Lima et al. (2020) highlight that graft failure, particularly in the upper limbs, is directly associated with poorer functional and sensory recovery, affecting patients' ability to perform daily activities and compromising their independence. In addition, Guimarães et al. (2019) emphasize the importance of considering the psychological complications resulting from grafting failure, which can impact body image and self-esteem, especially when there are visible scars and physical limitations.

The psychological impact discussed by Lima et al. (2020) will also be addressed, who emphasize the relationship between physical complications and the development of conditions such as depression and anxiety, which can lead to social isolation and decreased life satisfaction, highlighting the need for a multidisciplinary approach, as suggested by Miranda and Brandt (2019), that includes psychological support and rehabilitation therapies.

Functional Impact

Graft failure, especially in the upper limbs, is associated with impaired functional and sensory recovery, as highlighted by Lima et al. (2020). Loss of motor function and decreased sensation in the affected areas significantly compromise patients' ability to perform daily tasks such as dressing, eating, and manipulating objects. These physical limitations negatively impact patients' independence, resulting in restrictions on professional life and daily activities. It is also emphasized that patients who face these difficulties report a reduction in self-esteem and in their social interactions, demonstrating the need for

effective clinical management of grafts to minimize complications and promote better functional recovery.

Psychological Complications

In addition to the functional consequences, skin graft failure is strongly associated with psychological complications. Patients who are unsuccessful in grafting may face significant challenges regarding body image and self-perception, especially when they have to deal with visible scars and physical limitations, as described by Lima et al. (2020). These psychological aspects can contribute to the development of disorders such as depression and anxiety, affecting the general well-being of patients and impairing their ability to reintegrate socially and professionally. Negative perception of one's physical condition often results in social isolation and reduced life satisfaction.

According to Guimarães et al. (2019) and Lima et al. (2020), these psychological impacts are described qualitatively as significant, but were not quantitatively measured in the studies reviewed. Although they recognize the importance of these effects, the authors did not apply standardized instruments, such as depression or anxiety scales, to assess the degree of psychological distress of patients. Thus, the relationship between graft failure and psychological problems is discussed based on clinical observations and patient reports, without specific quantitative data that can measure the prevalence of these disorders.

Miranda and Brandt (2019) reinforce the need for a multidisciplinary approach to deal with these complications, recommending psychological support and rehabilitation therapies as essential components of treatment. This integrated approach is seen as key to helping patients accept their new physical conditions and improve their quality of life after the procedure. The inclusion of psychological interventions in the management of burn patients can minimize the adverse impacts of graft failure, promoting a more comprehensive recovery and greater satisfaction with life.

FINAL PERSPECTIVES

Treatment of burns with skin grafts requires a careful approach, including pre-grafting protocols that assess factors such as infection and nutritional status, in order to improve graft integration and reduce complications. In addition, innovations such as negative pressure therapy and advanced biomaterials have shown promising results, optimizing healing and patient recovery, especially in cases with limited donor areas. The combination of these strategies can significantly improve treatment outcomes.

Importance of Pre-Grafting Protocol:

Implementing pre-grafting protocols is critical to increasing the success rate of skin grafts in burn patients. It is suggested that these protocols carefully evaluate risk factors such as infection, nutritional status, and the presence of exudate before grafting (XAVIER et al., 2023). Identifying and mitigating these factors can significantly improve wound bed conditions, increasing the chances of graft integration and minimizing postoperative complications.

Studies indicate that proper assessment of patient conditions, including monitoring of nutritional status and the presence of infections, can lead to timely interventions that optimize treatment outcomes. In addition, the adoption of standardized protocols could promote a more systematic approach to burn management, favoring the health team in decision-making and the implementation of more effective treatment strategies (LIMA et al., 2020).

Innovations in Treatment

The discussion about innovations in the treatment of burns is essential for the evolution of care in the area. The use of emerging therapies, such as negative pressure therapy and new biomaterials, has shown promising results in optimizing burn treatment and improving graft adhesion (GUIMARÃES et al., 2019; XAVIER et al., 2023). Negative pressure therapy, for example, not only promotes healing but also improves graft perfusion, contributing to faster and more effective recovery.

In addition, the development and use of advanced biomaterials, which can offer structural and functional support to grafts, is an area of growing interest in regenerative medicine. These materials have the potential to reduce the failure rate of grafts and improve healing, providing a viable alternative in situations where donor areas are limited (GUIMARÃES et al., 2019). The integration of these new technologies with established clinical practices can result in more effective treatment and better outcomes for burn patients, reinforcing the importance of staying up-to-date on innovations in the field.

FINAL CONSIDERATIONS

The literature review on skin grafts in burn patients highlights the complexity of the challenges faced in this field, with an emphasis on failure rates and associated risk factors, as noted by Xavier et al. and Lima et al. Identifying variables such as burn severity, patient age, and postoperative care is crucial to understanding the underlying causes of complications. In addition, the analysis of sensitivity in grafted areas and its impact on

patients' quality of life emphasizes the need for a holistic approach in treatment, considering not only skin healing but also the emotional and functional well-being of individuals.

In addition to the clinical aspects, it is imperative to consider the biopsychosocial dimension of the patient. Physical pain, aesthetic scarring, and sensitivity in the grafted areas have a profound impact on quality of life, affecting emotional well-being and social reintegration. Thus, psychological support and rehabilitation must be integrated into treatment, ensuring that patients' emotional and social needs are met. This holistic approach can reduce the stigma and anxiety associated with the appearance and functionality of the affected areas.

Research on innovations, such as the use of dermal regeneration matrices and xenografts, also shows promise, suggesting new possibilities to improve clinical outcomes and reduce failure rates. Thus, the effective management of burns must involve a multidisciplinary team, focused on personalized strategies that integrate clinical and psychological aspects, in addition to the use of advanced technologies.

In conclusion, the continuity of research and the improvement of clinical practices are essential to optimize the results in the treatment of burns. Collaboration between healthcare providers and the development of evidence-based protocols are key to providing a more complete and satisfactory recovery for affected patients.

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