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Use of Autologous Fibrin and Scar Evolution of a Facial Burn Infected with Staphylococcal Impetigo in an Older Adult

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Abstract

Burns by direct fire, in most cases, are caused by occupational or domestic accidents. These cause significant skin lesions that require rapid and effective treatment, to avoid complications and sequelae typical of a burn, regardless of the depth and extent, as occurs with associated infections, which represent a real challenge for the Plastic Surgeon.

We present a clinical case with the intention of showing the usefulness of autologous fibrin in mesh or "membrane", applied topically in the repair and scar modulation of a second-degree facial burn complicated by Staphylococcal Impetigo in an older adult. There were no additional complications, managing to control the infection. Recovery in the short, medium and long term was optimal. In this way, it was possible to efficiently avoid the physical and emotional sequelae caused by these injuries.

The objective was to stimulate the repair of the affected epithelial tissue and observe the scar modulation response up to 8 months after the episode.

"Managing a facial burn is a significant challenge for the plastic surgeon".

Keywords: Fibrin Tissue Adhesive, burns, Staphylococcal Skin Infections

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Introduction

Burns represents one of the most frequent, serious and disabling injuries that a person can suffer. Generated by a physical or chemical agent, these generate from partial damage to the destruction of the skin, from which the severity of the injury derives [1]. The characteristics of a burn wound facilitate bacterial colonization, making its prevention and control very difficult [2]. Depending on the extension and depth, the risks of sepsis and mortality increase [3]. These injuries significantly affect healing, hinder rehabilitation, and increase the sequelae [4].

Faced with this, health professionals who treat burns usually have different approaches or protocols when determining the treatment and indicating the respective care, unlike what happens with respect to the assessment and diagnosis of burn emergency [5].

Discrepancies generally occur in topical treatment or special care when immediate and appropriate management action is required for these lesions. In cases of deep II° burns like this, it is usual to indicate dermabrasion and coverage with biological or synthetic dressings until the compromised area is repaired [1]. This may be the key to avoiding or reducing immediate complications, the physical and emotional scarring consequences that cause this type of injury in the most vulnerable populations.

Burn wounds have characteristics conducive to triggering infectious processes that are difficult to prevent and control [6], with *Staphylococcus aureus* being the Gram-positive opportunistic microorganism most isolated in burns [4,7,8].

The burn patient's management, treatment, and rehabilitation are known, but little literature talks about using blood products for these purposes. The interaction through Epidermal Growth Factor (EGF), Transforming Factor Beta (TGF-β1) and Vascular Stromal Growth Factor (VEGF), contained in this blood derivative, could act to stimulate its self-renewal, proliferation and continuity in its functions [8].

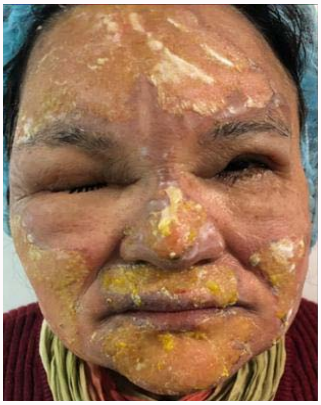

Figure 1: Patient 48 hours after the event with topical treatment. Note significant facial edema and affected areas.

The aim of presenting this isolated infectious clinical case is to observe the benefits that we can obtain by using autologous fibrin in mesh as coverage and biological repair modulator [9] in a second-degree facial burn complicated with Impetigo due to *Staphylococcus aureus* in an elderly adult.

Case Presentation

A 63-year-old female patient, from Lima, Peru, was treated for presenting a II-degree facial burn due to a work accident due to deflagration through the ignition of Benzene. According to what was recovered in the initial interview, after the event occurred (two days ago), he went to a National Burn Reference Hospital in Peru, where they recommended covering the affected area with partial skin autograft as soon as possible to avoid serious complications and sequelae. Because of the patient's refusal to receive skin grafts and after verifying the absence of warning signs of respiratory complications due to the cause of the burn, silver sulfadiazine was applied, and voluntary withdrawal and instructions for home care were given.

Come to our service - two days after the incident occurred - as indicated - to request a revaluation of the injury.

The patient arrives in apparently good general condition and by herself. The preferential physical examination revealed an extensive II-degree lesion (partial thickness) that occupies 80% of the face, with a yellowish-white coverage associated with significant facial edema (Figure 1). Airway compromise is not expressed verbally or evident on physical examination. The patient was diagnosed according to the American Burn Association as; "major burn or great burn, by the criteria of the second and third degree, burns that involve eyes, ears, face, hands, feet, main joints, perineum and genitals" [10].

Nothing relevant is reported in the clinical history and laboratory tests are within normal parameters. Surgical cleaning and outpatient treatment are carried out with indications for daily follow-up.

Eight days after the surgical cleaning, and until then, with favorable evolution, the patient traveled outside of Lima. On day 10, he contacted us by telephone, stating that small yellowish lesions appeared on his chin (Figure 2A). Topical treatment and oral antibiotic therapy (Clindamycin) are indicated under suspicion of contamination, which has so far not been determined.

It records her evolution the next day – day 11 - for which she was given an appointment by emergency (Figure 2B). When she arrived at the consultation – day 13 -, the lesions looked like confluent intense yellow plaques with a very bad smell and presented slight facial edema (Figure 2C).

Upon arrival 13 days later and due to the appearance of the lesions, the diagnosis of Impetigo was suspected. A smear was taken from the yellowish plaque and the bloody bed for direct examination and sample culture respectively. There were no signs of general malaise or increased body temperature. Next, exhaustive cleaning of the affected area with povidone-iodine foam solution and subsequent washing with plenty of 0.9% NaCl is carried out in the operating room.

With the intention of covering the affected area with fibrin membrane, 20 cc of peripheral venous blood is extracted and immediately conditioned in tubes with 3.2% Sodium Citrate, for subsequent centrifugation and preparation of fibrin mesh or membrane, all under system closed.

This scaffold, membrane, or mesh block is obtained once the blood has been centrifuged, and from this, the entire yellow series (serum and platelet-rich plasma) is extracted by adding 10% calcium

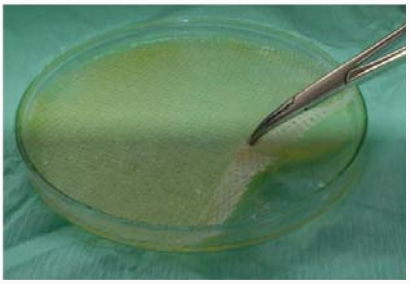

Figure 3: Mesh, membrane, fibrin scaffold, and block, supported by sterile gauze with Vaseline.

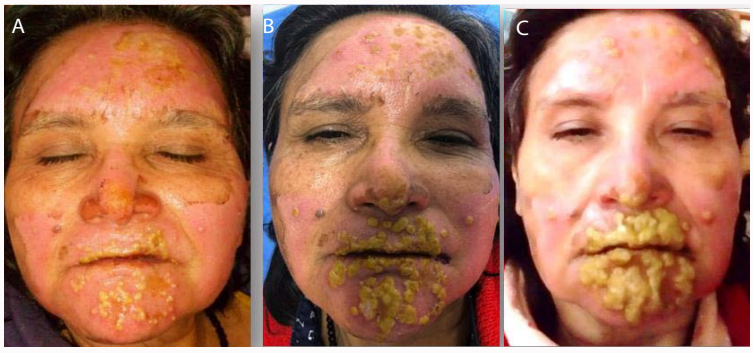

Figure 2: Infectious evolution in 3 days of Impetigo after facial burn.

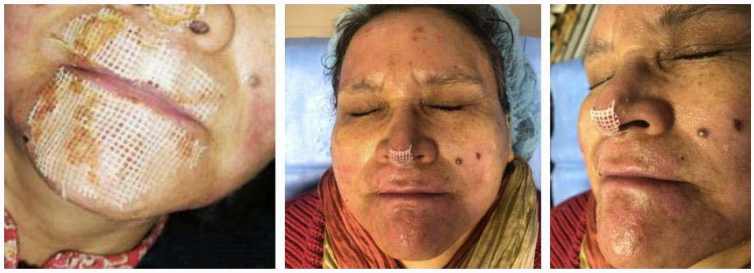

Figure 4: On the third day of control, the mesh is removed, and topical treatment with platelet-rich plasma with antibiotic coverage is recommended.

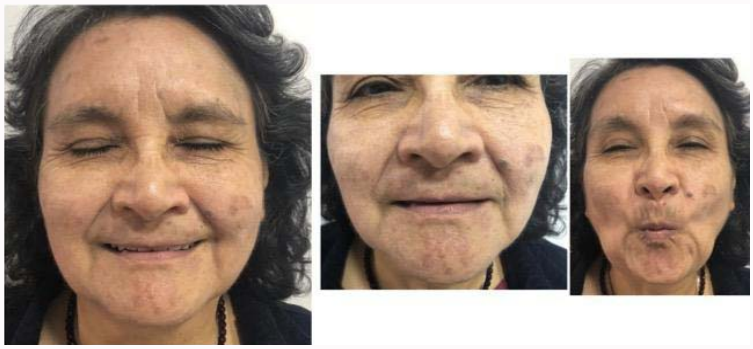

Figure 5: Scar evolution of areas affected by *Staphylococcus* after one month. Slight sequelae evident from hyperpigmentation can be observed.

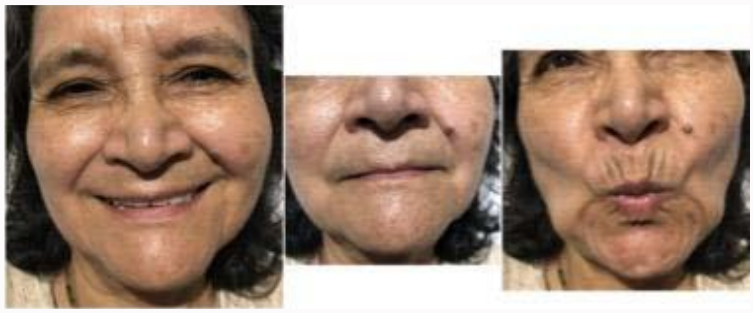

Figure 6: Scar evolution of areas affected by *Staphylococcus* after four months. Improvement in the coloration of affected areas.

gluconate, and placing the solution in a Petri dish or tubes without preservative for approximately 15 min. The intention is to activate coagulation and form a gel. This gel contains Epidermal Growth Factor (EGF), Transforming Factor Beta (TGF-β1), Vascular Endothelial Growth Factor (VEGF), etc. All of this is inserted in this architectural scaffolding in a solid block (mesh or membrane) manufactured with fibrin using a protocol described by Hernandez et al. [9] (Figure 3).

Three days after the procedure for cleaning infectious lesions and placing mesh (Figure 4A), exudate can be seen during its control. The meshes were removed and topical autologous serum (spray) was prescribed, which was done with his own blood. After 8 days (Figure 4B, 4C) you can see the obvious changes in the skin and the modulation of healing. In Figures 5, 6 and 7, the evolution at one month, 4 and 8 months is recorded.

Figure 7: Scar evolution of areas affected by *Staphylococcus* at 8 months. Without obvious epithelial sequelae and full functionality of the perioral and nasal area.

Discussion

Impetigo is a most common bacterial infection in children [11]. In our case, our patient was 63 years old. Approximately 70% of cases of impetigo are classified as non-bullous, and 30% of cases represent bullous impetigo [12]. Bullous impetigo is caused exclusively by *Staphylococcus aureus*; in the case presented the pathological culture analysis confirmed a single bacterial agent of *Staphylococcus aureus*.

The pathogenesis of bullous impetigo occurs due to the cleavage of desmoglein-1 mediated by exotoxins, which produce intraepidermal peeling; this is due to the local release of toxins from the bacteria [13].

This is characterized by small vesicles that progress to form flaccid blisters [14]. The progression of the lesion begins with small vesicles, which become superficial flaccid blisters with clear or yellow liquid content [15]. In our patient the lesions were located on the face, the progression of the lesions began with small yellowish lesions on her chin, then progressed to intense yellow plaques, adding a bad odor and slight facial edema.

Impetigo can be primary or secondary, in the first case it occurs due to a direct bacterial invasion of normal skin, and in the second case, it occurs due to an infection of the previous wound site or an area of compromised skin [14] as is the case of our patient, who previously presented an extensive II-degree lesion (partial thickness) occupying 80% of the face with a significant burn or large burn diagnosis. Infection in lesions of great extent and depth increases the risks of sepsis and mortality [14]. The infection also delays healing, physical therapy and rehabilitation of patients, increasing the sequela [15].

Treatment of bullous impetigo is based on the severity of the disease. Depending on whether *S. aureus* is methicillin-sensitive or *S. aureus* is methicillin-resistant, the first-line treatment is usually topical mupirocin. Other topical options include retapamulin or ozenoxacin. One study demonstrated that 3 to 4 days of ozenoxacin resulted in 75% pathogen clearance, *vs.* retapamulin, which demonstrated 60% pathogen clearance over the same time period; but these cases were small injuries and were not secondary to another injury such as a burn [16]. Systemic antibiotics can be started if the disease is extensive (more than five lesions), resistant to topical treatment, or has associated complications, such as cellulitis or burns. In the case of methicillin-sensitive *S. aureus*, cephalexin or dicloxacillin is considered the first-line treatment; Second-line treatments for extensive disease include oral erythromycin or clarithromycin. For extensive impetigo due to methicillin-resistant *S. aureus* or contamination secondary to an injury such as a burn, first-line treatments include doxycycline or clindamycin. Trimethoprim-sulfamethoxazole [14]. In our patient, topical treatment was indicated and antibiotic treatment with oral Clindamycin was started due to suspicion of contamination.

According to the World Health Organization [17], burns cause approximately 180,000 deaths annually and have long been a global public health problem. In developed countries, death rates from burns have been decreasing. Still, in the case of developing countries, such as Peru, there is a higher prevalence of deaths from burns, indicating a high impact of socioeconomic level on health [18]. Integrated care plans for burn patients are usually expensive. In the United States, it is estimated that the annual economic burden of burns is more than $7.9 billion [19,20]. Therefore, caring for burn patients is relatively expensive; It becomes relevant to shorten the healing time. However, no existing dressing material can control bacterial colonization and at the same time help accelerate wound healing [21]. Since 1970, Platelet-Rich Plasma (PRP) has been studied for its properties, such as the high concentration of autologous Growth Factors (GFs) and secretory proteins, which can accelerate the healing process at the cellular level [22]. Furthermore, its potential to inhibit bacterial growth [23].

PRP is autologous plasma with a higher concentration of platelets than normal plasma [23,24]. Taking a combination of Growth Factors (GF) [22]. When the lesion is exposed to PRP, platelet degranulation begins within 10 min; within the first hour, GF secretion occurs and continues to be released throughout the period of platelet viability [25]. RPR contains GFs that are transforming Growth Factor β (TGF-β), platelet-derived growth factor, Insulin-like Growth Factor (IGF)-I and II, fibroblast growth factor, epidermal growth factor and vascular endothelial growth factor, endothelial cell growth factor. These GFs play an essential role in all stages of healing [26]. In a systematic review with meta-analysis of clinical trials that evaluated the effectiveness of RPR in the healing of burn wounds [27]. Burn patients treated with RPR exhibited faster epithelialization and wound closure rate at weeks 2 and 3 post-injury. Furthermore, no increase in the infection rate was observed, concluding that the application of RPR in burned and infected patients can accelerate wound closure compared to conventional dressings [27].

In conclusion, this case highlights the importance of considering the use of autologous fibrin block PRP as a possible treatment in burned and infected patients due to its properties that help accelerate wound closure and non-proliferation of infections. Despite its low prevalence, bullous impetigo due to *Staphylococcus aureus*, secondary to a facial burn, significantly impacts the patient's quality and economic life, and requires treatment options that accelerate the healing process, as in the case of RPR. Nevertheless, future studies should provide more information on the efficacy of RPR in burn patients infected with *Staphylococcus aureus*.

Finally, could the use of autologous fibrin prevent bacterial over colonization in burns, stimulate healing in such a way that the new skin is very similar or equal to the real human skin? Will the physiology of the skin be maintained under normal conditions? These are some of the questions we can ask ourselves to continue working on these blood derivatives in the repair of skin lesions.

Ethical Aspects

The patient authorized in writing by informed consent the publication and scientific dissemination of the case showing her face.

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