

## Burns and Delayed Wound Healing: About Two Cases and Review of the Literature

Z.Badaoui<sup>1</sup>, A.Ouardi, I.Mokfi, F-Z.Fouadi, Y.Ribag<sup>2</sup>, A.Khales, K.Ababou, A.Achbouk, M-K.EL Khatib<sup>2</sup>

<sup>1</sup> Department of Plastic, Reconstructive and Burn Surgery, Mohamed V Military Training Hospital, Rabat, Morocco

<sup>2</sup> Department of Maxillofacial surgery and Stomatology, Mohamed V Military Training Hospital, Rabat, Morocco

**Abstract:** The goal of burn management is to achieve healing as quickly as possible. Several factors are involved in this physiological phenomenon, and a failure of one of them leads to delayed healing with all its hazards. Indeed, the longer the healing process takes, the more pathological it is likely to be, and the more the functional and aesthetic results are likely to be disappointing. Through the study of two observations in patients with delayed healing followed in the department of plastic, reconstructive and burn surgery of the Mohamed V Military Training Hospital and a review of the literature, the authors will briefly and concisely explain the main factors involved and the possible therapeutic measures.

**Keywords:** burn, wound healing, graft

Date of Submission: 08-06-2020

Date of Acceptance: 25-06-2020

### I. Introduction

Wound healing is a complex phenomenon requiring the coordinated involvement of several cell types in an integrated process of detersion, angiogenesis and tissue repair [1], and is the skin's response to any incision, injury or loss of substance. It is carried out by a complex natural repair system in 4 stages: vascular, inflammatory, proliferative, remodelling and cellular apoptosis. This incredible repair system is sometimes unpredictable and random due to individual multifactorial differences.

### II. Observations

#### Case Report 1

The patient was a 21 year old women, student, single, victim of a domestic flame burn due to a butane leak. The patient was not known diabetic, without psychiatric history, she was followed since her childhood for anemia by martial deficiency under medical treatment. On admission, the patient presented severe burns of deep second-degree on the face, and third- degree on the dorsal face of both hands and both feet (Fig.1). The area of skin burned is estimated at 15% of TBS. The clinical examination found a conscious, respiratory and hemodynamically stable patient with a temperature of 37.8°C and SaO<sub>2</sub> in the fingers at 91%. Due to the deep nature of the burns on the dorsal surface of both hands resulting in compartment syndrome, a surgical indication was made and the patient was admitted to the operating room on an emergency basis to perform the discharge incisions after rapid sequence induction and orotracheal intubation. The biologic assessment showed a Hemoglobin of 9.8g/dl, white blood cells of 9500/mm, C- Reactive Protein of 9 mg/l and hypoalbuminemia of 23 g/l. Bacteriological swab samples were taken. An ophthalmological opinion was requested with prescription of ocular topicals and care by daily washing. One week after admission to the intensive care unit, the patient presented with sepsis with bacteriological results in favour of *meti-S staphylococcus aureus* requiring the administration of an appropriate antibiotic therapy. Biologically, the C - reactive protein was 256 mg/L with neutrophil hyperleukocytosis. After treatment of the infection and nutritional preparation of the patient by enteral feeding, a thin skin graft was performed on both hands, two feet and the frontal area of the face (Fig. 2). Postoperatively, hemoglobin was 7.6 g/dl requiring blood transfusion of three red blood cells. The evolution was marked by partial lysis of the graft; daily colistin dressings were made under sedation with staphylococcal antibiotic therapy. On the psychological level, the patient presented anxious manifestations, 1 month after her hospitalization, with insomnia and refusal to eat entering into the post traumatic stress syndrome which motivated a psychiatric opinion with prescription of antidepressants and psychological support. Three months after her hospitalisation, the family decided to discharge the patient against the advice of her doctor. One month after her discharge, the patient presented to the emergency room of the burn unit for substance loss in the graft donor areas, feet and hands, as well as significant undernutrition (Fig.3). The weight was 35 kg, and local

examination found purulent substance loss with a foul-smelling odour in the graft donor areas of the thigh. Biologically, hemoglobin was 8.6 g/l, C - reactive protein was 180 mg/l and albumin was 16 g/l. The patient was admitted to the dressing block under sedation with bacteriological sampling by swab and blood culture. A blood transfusion of two red blood cells was performed with probabilistic antibiotic therapy and enteral and parenteral nutrition. The result of bacteriological sampling and blood culture was in favour of an *Acinetobacter Baumannii* sensitive to Colistin and Amikacin. Psychologically, the patient exhibited anxiety, psychiatric advice was sought, and the family confided episodes of depression with denial of care and nutrition. The evolution was marked, 1 month after her second hospitalization, by a weight gain of 5 kg, normalization of biological markers of infection and sterile bacteriological results, with albuminemia at 34 g/l. Following this evolution, a surgical indication was established to cover the loss of substance on the anterior face of both thighs with a thin skin graft taken from the posterior face of the thighs. The evolution was marked by a lysis of the graft involving half of the operated area, i.e. a body surface area of 10%. An antibiotic therapy against staphylococcal disease was administered, and daily dressings were applied with local colistin. The patient benefited from 10 sessions of hyperbaric oxygen therapy with no notable satisfactory results.

### **Case Report 2**

The patient was a 45-year-old man, a chronic smoker for 15 years, hospitalized in the burn ward of the Mohamed V military training hospital in Rabat, following thermal burns. He was the victim of a thermal burn by flame following a gas leak, resulting in deep second-degree and third-degree burns to the trunk and back as well as the right arm, without any burns to the face or neck. The burned skin surface is estimated at 30% of the total body surface. On admission, the patient was conscious, hemodynamically and respiratorily stable. After conditioning and vascular filling, the patient was admitted to the operating room for silver sulfadiazine dressing under sedation. A laboratory report showed hemoglobin at 14g/dl, C - reactive protein at 23 mg/l and albuminemia at 32g/l. Bacteriological swab samples were taken for staphylococcus aureus. Appropriate antibiotic therapy was administered. 3 weeks after admission, the patient received a thin skin graft in the burnt areas, complicated by bacterial lysis by staphylococcus aureus. We initially readapted the local care but one month later, in the absence of clinical improvement, the patient was hospitalized for not ignoring an unidentified contact factor, a deficiency (prolonged stay in intensive care unit), a pathomimia (post-traumatic stress), a continuation of keratinocyte necrosis or another etiology (bullous disease, déficit immune...). An exhaustive check-up objectified a zinc and vitamin C deficiency, the biopsy was no spécifique and the direct immunofluorescence was negative. Despite optimal local care and correction of the deficiencies, there was no improvement. In light of the favourable use of polyvalent immunoglobulins in Netherton syndrome, we proposed this treatment, but at an immunomodulating dose (2g/kg for 2 days every month). From the first treatment, a clinical bénéfice was observed, in 3 months of treatment the reepidermisation was almost complete. After managing the infection and preparing the patient nutritionally, the patient was admitted for thin skin grafting of the trunk, back and right arm. The evolution was marked by graft lysis involving almost a third of the grafted areas with hyper budding of the substance losses (Figs 4 and 5). The infectious cause was proven to be *Pseudomonas Aeruginosa*. The poorly healed areas evolved under directed healing and the patient left the hospital after 7 months of hospitalization, under monthly monitoring and control.

### **III. Discussion**

Severe burns are very particular traumas because they cause both extensive skin destruction and major metabolic disorders. Paradoxically, it is the same inflammatory reaction that triggers both the healing process and the phenomena of oedema and tissue hypoxia. The healing of burns is therefore rather slow compared to that of other traumatic wounds [1]. The etiologies of delayed healing are numerous. Some local or general factors that can lead to delayed healing are frequently encountered in clinical practice [2]. Polyvalent immunoglobulins have an immunomodulatory effect involving humoral and cellular immunity. Their use in the acute phase of toxic epidermal necrolysis to palliate keratinocyte necrosis is much discussed. The efficiency of polyvalent immunoglobulins in Netherton syndrome suggests an action in the reconstruction of the epidermal barrier by modulation of the production of pro-inflammatory cytokines and a possible anti-infectious action [3]. In our case, the efficiency of polyvalent Ig was surprising, the response was rapid while the patient had a five months delay in healing. Proteases, involved in the degradation of the extracellular matrix, could be responsible for delayed wound healing by degrading matrix proteins, growth factors and their receptors [4]. In both cases of our study, the involvement of pathogens was demonstrated, their presence in a skin wound delays its healing, the mechanisms responsible for this are less so. The studies demonstrated that the pro-inflammatory Th-17 cytokines (IL-22 and IL-17A) in combination with TNF, IL-1 and oncostatin M (OSM) synergistically induce the production of antibacterial peptides and chemokines, promoting proliferation and inhibiting keratinocyte differentiation [5]. Hyperbaric oxygen therapy is a common practice in our department in case of delayed healing, it has been indicated in our two patients (10 sessions). It is a therapeutic method that

has proven its effectiveness in the management of wounds with difficult healing due to ischemic or infectious field. The beneficial effect of hyperbaric oxygen therapy in the management of delayed wound healing has a satisfactory pathophysiological explanation. This means of treatment must be integrated into medical protocols combining other means such as antibiotic therapy, and physical measures such as dressings. Wound infection is the most common cause of delayed healing [6]. Bacterial infection extends the inflammatory phase and interferes with epithelialization, wound contraction and collagen deposition. Bacterial endotoxins stimulate phagocytosis and the release of collagenase, which degrades collagen and promotes the destruction of surrounding normal tissue. Mechanical and antibiotic treatment is necessary to decrease the number of bacteria and reduce inflammation [7]. In burned patients, hypercaloric and hyperprotidic enteral nutrition is essential to cope with the hypercatabolism observed in these patients and to obtain faster healing under good conditions [8]. Nutritional support promotes healing and reduces complications, particularly infectious ones [9]. In clinical practice, smoking has often been blamed for delayed wound healing, but this effect has been poorly documented, both clinically and in terms of the intrinsic mechanisms of skin healing. [10]. The "burn" event is not the only traumatic factor. The pain, especially intense and long-lasting, is a factor of disorganization of the psyche, as well as the sudden loss of autonomy, the separation from the usual family and social environment. For the most serious burn victims, the length of hospitalization, physical treatment procedures and repeated surgical interventions are traumatic in themselves [11]. Several studies have shown that stress can delay healing in acute wound models in animals and humans. This delayed healing may be due to decreased expression of pro-inflammatory cytokines and certain growth factors during wound healing in the stressed animal and increased susceptibility to infection [12]. Plastic surgeons are increasingly called upon to manage patients with deep and extensive skin lesions with comorbidities that make the healing process more complex. In the case of extensive lesions, as in the case of burns; in order to achieve skin coverage, dermo-epidermal autograft remains the mode of reference to ensure the replacement of burned skin areas after their excisions or detorsions. Unfortunately, healthy areas for graft harvesting are often missing [13]. This is why, faced with these needs, research has turned to the development of skin substitutes. The various techniques that can be used - xenografts, allografts, cell cultures, etc. - are temporary or permanent, epidermal, dermal, biological, synthetic or biosynthetic.

#### IV. Conclusion

Wound healing is a complex phenomenon requiring the coordinated involvement of several cell types in an integrated process of detorsion, angiogenesis and tissue repair. Delayed wound healing can be a real headache for surgeons and their patients. Faced with these cases of scarring impasses, the use of surgical coverage alternatives becomes a priority.

#### References

- [1]. Echinard C, Latarjet J. Évolution de la lésion et cicatrisation. In: Echinard C, Latarjet J, editors. Les brûlures. Paris: Masson; 1993. p. 73-84.
- [2]. Le Pillouer-Prost A., Coulomb B. Physiologie de la cicatrisation cutanée. EMC (Elsevier Masson SAS, Paris), Cosmétologie et Dermatologie esthétique, 50-040-A-10, 2009.
- [3]. L. Dequidt1, \*, A.-S. Darrigade1, T. Camus2, A. Taieb1, B. Milpiedt. Intérêt des immunoglobulines polyvalentes dans un retard de cicatrisation au cours d'un syndrome de Lyell. Annales de dermatologie et de vénérologie, 2017. page 51
- [4]. P. Senet Service de gérontologie V, hôpital Charles-Foix. Physiopathologie des retards de cicatrisation: quelles implications pratiques? 2008. P :20-21
- [5]. Parisa, S. Charreaub, J.F. Jegoua, E. Guignouarda, M. Garniera, C. Burucooa, L. Favot-Laforgea, V. Huguiera, F.X. Bernardab, B. Ryffelc, F. Morela, J.C. Lecrona,\* Rôle majeur des cytokines Th17 dans le retard de cicatrisation des plaies infectées. Annales de dermatologie et de vénérologie 2013. Page 634
- [6]. Amici JM, Rogues AM, Lasheras A, Gachie JP, Guillot P, Beylot C et al. Aprospective study of incidence of complications associated with dermatological surgery. Br J Dermatol. 2005;153(5):967-71.
- [7]. Howell-Jones RS, Wilson MJ, Hill KE, Howard AJ, Price PE, Thomas DW. A review of the microbiology, antibiotic usage and resistance in chronic skin wounds. J Antimicrob Chemother 2005;55:143-9.
- [8]. Deitch EA. Nutritional support of the burn patient. Crit Care Clin 1995; 11:735-50.
- [9]. M.M. Berger, Y.A. Que. Traitement nutritionnel du grand brûlé. EMC, Réanimation - Vol. 18 - N° 8 - p. 694-701, 2009.
- [10]. Towler J. Cigarette smoking and its effects on wound healing. JWound Care 2000;9:100-4.
- [11]. Blettery, M. Combris. Prise en charge des troubles psychologiques et psychiatriques. Les brûlures. Paris : Masson ; 2010. p.183-192.
- [12]. Sheridan JF, Padgett DA, Avitsur R, Marucha PT. Experimental models of stress and wound healing. World J Surg 2004;28:327-30.
- [13]. Dantzer E. Indications des substituts cutanés et des allogreffes. EMC - Techniques chirurgicales – Chirurgie plastique, reconstructrice et esthétique 2014;9(4):1-14 [Article 45-158].

**Figures**



**Fig 1:** third-degree burns on both hands (H+4)



**Fig 2:** thin skin graft



**Fig 3:** loss of substance in both thighs (graft donor areas), both feet and hands



**Fig 4:** hyperblooming substance loss in the graft areas (two months after hospitalization)



**Fig.5:** aspect of the scars on the back after the 2nd graft (six months after hospitalization)

Z.Badaoui, et. al. “ Burns and Delayed Wound Healing: About Two Cases and Review of the Literature.” *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(6), 2020, pp. 45-49.