CASE REPORT

SPONTANEOUS HEALING AND SCAR CONTROL FOLLOWING ENZYMATIC DEBRIDEMENT OF DEEP SECOND-DEGREE BURNS

CICATRISATION SPONTANÉE ET CONTRÔLE DE L'ÉVOLUTION CICATRICIELLE APRÈS DÉBRIDEMENT ENZYMATIQUE DE BRÛLURES DU SECOND DEGRÉ PROFOND

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SUMMARY. Scarring after a burn injury remains the greatest unmet challenge in the treatment of functional and psychosocial sequelae of burns. The hypertrophic scar represents the most common type of cicatrix after burns, and it has a prevalence of up to 70%. We present a case of upper and lower extremity partial-thickness burns in a female patient treated in two different modalities. Superficial second-degree burns on the upper extremities were treated with conservative dressing with fairly early wound closure but they developed hypertrophic scars. Deeper, lower extremity burns were debrided with a new bromelain-based debriding agent, resulting in scar-free healing. The pathophysiology of hypertrophic scar formation is based on the perturbation of collagen production or degradation or both. The duration and magnitude of the inflammatory phase of wound healing also appears to play a role in hypertrophic scarring. Bromelain has demonstrated an anti-angiogenic effect in various cancer cell lines and it has been shown to regulate a variety of pro-angiogenic growth factors. This case raises the classical question of the relationship between time to healing and formation of hypertrophic scars after burn injury, pointing to other potential factors that may play an important role in burn healing.

Keywords: hypertrophic scar, enzymatic debridement, bromelain, deep second-degree burns, spontaneous healing

RÉSUMÉ. La cicatrization après une brûlure reste le plus grand défi du traitement des séquelles à la fois sur le plan fonctionnel et sur le plan psychologique. La cicatrization hypertrophique représente l'évolution la plus fréquente après brûlure et sa prévalence est supérieure à 70 %. Nous présentons une observation de brûlures du 2e degré au niveau du membre supérieur et du membre inférieur chez une patiente traitée suivant deux modalités différentes. Les brûlures du second degré superficiel du membre supérieur furent traitées par un pansement classique avec une cicatrization précoce, mais suivie de cicatrices hypertrophiques. Les brûlures plus profondes du membre inférieur furent débridées avec le nouvel agent à base de bromelaïne, et permirent une guérison sans cicatrice. La physiopathologie de la cicatrization hypertrophique est basée sur les troubles de production des fibres de collagène, ou de leur dégradation, ou des deux. La durée et l'amplitude de la phase inflammatoire de la cicatrization paraît aussi jouer un rôle dans l'hypertrophie cicatricielle. La bromelaïne a démontré son effet anti-angiogénique dans plusieurs lignées cellulaires cancéreuses ; elle a montré aussi son aptitude à réguler les divers facteurs de croissance pro-angiogéniques. Cette observation soulève la question classique de la relation entre le temps de cicatrization et l'apparition de cicatrices hypertrophiques après brûlure, en soulignant les autres facteurs potentiels jouant un rôle important dans la cicatrization des brûlures.

Mots-clés: cicatrice hypertrophique, débridement enzymatique, bromelaïne, brûlure second degré profond, cicatrization spontanée

Introduction

A major problem in patients surviving thermal injury is cutaneous scarring that significantly affects patient quality of life. The most common type of scar in severely burned patients is the hypertrophic scar, which has a prevalence of up to 70%.

Deep burns that need longer healing time are more prone to hypertrophic scar formation. Thus, burns that are mid and deep dermal are considered to be prone to scarring and have to be operated in order to shorten healing time and reduce scarring. Early surgery that removes the offending eschar prevents eschar-related complications (mainly local and systemic infec-

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tions) and allows early wound closure by autograft. In many cases it entirely prevents the formation of granulation tissue but not scarring that forms at the edges of the grafts, in the meshing incisions and at the donor sites used to harvest the autografts.

We report a case of upper and lower extremity partial-thickness burns in a female patient treated at our burn centre in two different modalities.

Case report

A 25-year-old woman with flame burns on her forearms, hands, knees, legs and feet (29% TBSA) was referred to our Burn Institute 1.5 h after the accident.

On admission burn depth was assessed by senior burn specialists using standard clinical characteristics (colour, capillary refill, skin pliability, sensation, presence of blisters, presence of thrombosed vessels): the upper extremities were assessed as superficial second-degree burns (*Fig. 1*), while the lower extremities were assessed as deep second-degree burns (*Fig. 2*).

Antibiotics were started and continued according to wound flora monitoring.

The upper extremity burns were cleaned and covered with Ag Hydrofiber dressing, and reepithelialization took place within the twentieth day.

We deemed the deep partial thickness burns on the lower extremities to need debridement. Written informed consent was obtained and then the lower extremity burns were treated with a new bromelain-based enzymatic topical debriding agent. Our past experience with this enzymatic agent proved that it could effectively debride deep burns in a single 4-hour application, under adequate analgesia.

In this patient, enzymatic debridement was successful, leaving an eschar-free deep dermal bed (*Fig. 3*). The lower extremities were then treated with Vaseline gauze and various topical preparations with the dressing changed every two days. Autografting was not needed and spontaneous healing took place within the twenty-eighth day.

No local or systemic infection or other adverse event was found during the patient's stay in the hospital. The patient was discharged one month after admission with continuous physiotherapy and wearing pressure garments.

The Patient and Observer Scar Assessment Scale (POSAS) was used to evaluate the scars and their development on hospital discharge and after 30, 60, 120 and 180 days at the outpatient clinic.

At discharge, the upper extremity score was 84 (35 observer score, 49 patient score) and the lower extremity score was 87 (38 observer score, 49 patient score).

At 180-day follow up, the upper extremity score was 85 (35 observer score, 50 patient score) (*Fig. 4*) and the lower extremity score was 59 (30 observer score, 29 patient score) (*Fig. 5*).

Discussion

Hypertrophic scar (HTS) following thermal injury is a dermal fibroproliferative disorder that leads to physical and psychological morbidity.¹

Hypertrophic scars are characterized by decreased collagenase activity and collagen breakdown with increased collagen synthesis and increased presence of fibrocytes, myofibroblasts and plated-derived growth factor expression.²

Fig. 1 - Flame burn on right upper extremity assessed as superficial second-degree burn.

Fig. 2 - Flame burn on left lower extremity assessed as deep second-degree burn.

Fig. 3 - Left lower extremity burn after a single 4-hour application of a new bromelain-based enzymatic topical debriding agent.

Fig. 4 - Right upper extremity at 180 days follow-up.

Fig. 6 - Right upper extremity with late HTS formation at 60 days follow-up.

Fig. 5 - Lower extremities at 180 days follow-up.

Fig. 7 - Left upper extremity with late HTS formation at 60 days follow-up.

The normal mechanism of scar formation typically involves a reduction in myofibroblasts and wound contracture, low TGF- β expression, increased collagenase activity, increased production of elastin and replacement of type III collagen with type I collagen.³

The pathophysiology of hypertrophic scar formation is

based on the perturbation of collagen production or degradation or both. This dysregulation results in the over-production of type III collagen while type I collagen is reduced.⁴ The duration and magnitude of the inflammatory phase of wound healing also appears to play a role in hypertrophic scarring.

The presence of dermis, even the deep one with epithelial reserve of skin adnexae, may be the difference between healing by epithelialization over dermis or inflammation and granulation tissue resulting in HTS.

Bromelain has demonstrated an anti-angiogenic effect in

various cancer cell lines.^{5,6} Bromelain has been shown to regulate a variety of pro-angiogenic growth factors, enzymes and transcription factors including bFGF, VEGF, angiopoietin-1 and 2, COX-2, MMP-9, AP-1 and NF- κ B.^{7,8}

In our case we treated two kinds of burn: superficial dermal and deep dermal. The conservative treatment of the superficial dermal burns ended in fairly early wound closure but it followed an inflammatory process that led to the sloughing of the thin eschar followed by epithelialization. The inflammatory process was sufficient to cause late HTS formation (*Figs. 6 and 7*). The deeper, lower extremity burns were debrided and the deep dermis had the opportunity to epithelialize without an inflammatory process, ending in scar-free healing. It is possible

that the anti-inflammatory properties of the Bromelain-based debriding agent also contributed to these results.

Conclusions

This case raises the classical question of the absolute or relative importance of earlier than 21-day wound healing, pointing to other factors that may play an important role in burn healing. Our results regarding the anti-inflammatory properties of Bromelain are in line with other previous publications, but more data from different sources and a basic study on Bromelain inflammation modulation potential are needed.

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