Late and Most Severe Complications of Burn Injury: Marjolin Ulcer

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ABSTRACT

OBJECTIVES: **The goal of our study was to analyze and present the demographic characteristics, surgical interventions, results, and complications of patients diagnosed with squamous cell carcinoma that developed on the base of burn scars in our clinic. Through this research, we aimed to enhance the understanding and to improve therapeutic strategies for the management of Marjolin ulcer.**

MATERIALS AND METHODS: **We conducted a comprehensive review of patients who underwent surgery for squamous cell carcinoma from May 2013 to May 2023. We specifically identified those with squamous cell carcinoma originating from burn ulcers. For these patients, we systematically collected data, which encompassed demographic details, photographic evidence, details of surgical interventions, lymph node outcomes (if dissection occurred), and any recurrences or complications observed during the postoperative follow-up.**

RESULTS: **Of the 741 patients diagnosed with squamous cell carcinoma, 11 had a burn-related Marjolin ulcer. The average age was 53 years, with an average time from burn to squamous cell carcinoma diagnosis of 12.2 years. Six patients had excisions with lymph node dissections. In 6 patients, the excision material was removed with a clean margin, whereas 3 had margins with pseudo-epithelial hyperplasia and dysplastic epithelium. Local recurrence developed in 2 patients during postoperative follow-up. Average follow-up period was 4.8 years.**

CONCLUSIONS: **Marjolin ulcers derived from burn scars present substantial clinical challenges. A thorough surgical and clinical approach, coupled with careful follow-up, is essential for optimal management. In contrast to the prevailing literature that suggests a poor prognosis for squamous cell carcinoma from burn scars, our findings showed no distant metastasis. For a more comprehensive understanding and improved patient care, multicenter studies are recommended, and there is a pressing need to enhance patient education about protective measures and the importance of regular follow-up.**

KEY WORDS: ***Burn, Skin ulcer, Squamous cell carcinoma, Treatment***

INTRODUCTION

Marjolin ulcer, first described by Jean Nicholas Marjolin in 1828, is a distinctive and significant clinical entity associated with scar tissues. Marjolin ulcer is not limited to scar tissues, but it can also originate from chronic osteomyelitis and even from fistula openings.[1]

This ulcerative condition possesses a profound clinical relevance, particularly when pathologists have identified its surface to bear invasive squamous cell carcinoma (SCC) or precursors leading to this invasive pathology.[2] The transformative potential of this ulcer, transitioning from benign scar tissue to a malignant lesion, underscores its importance in clinical and pathological landscapes.

In the context of burn injuries, especially severe ones where the dermis layer has experienced profound damage, the healing process can be unpredictable. Scar tissues resulting from such injuries often present as depigmented regions devoid of melanin.[3] These scars are characterized by a weakly adherent epithelium due to the underlying dense bindings, rendering them particularly vulnerable to external stressors such as ultraviolet radiation and repetitive trauma.[4] Consequently, these scars are labeled as "unstable scar tissues," emphasizing their propensity to undergo pathological changes.[5]

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ACKNOWLEDGEMENTS: The authors have not received any funding or grants in support of the presented research or for the preparation of this work and have no declarations of potential conflicts of interest.

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Burn Care and Prevention 2023/2: 51-55

Even with careful grafting techniques, extensive burn wounds can still present challenges. Secondary healing areas might emerge, potentially transforming into an unstable depigmented scar regions.[6] Unstable scars, one of the sequelae of burns, should be closely monitored clinically, and, if any ulceration develops on the scar tissue, the patient should be advised to obtain immediate medical consultation.[7]

In this study, we aimed to present and discuss the demographic characteristics of patients diagnosed with SCC that developed on the base of burn scars in our clinic, the surgical interventions applied, their results, and complications. Through this, we hope to offer valuable insight that could guide future therapeutic strategies and enhance patient care outcomes.

MATERIALS AND METHODS

This study followed the principles of the Declaration of Helsinki. Ethical approval for this study was obtained from the local clinical research ethics committee. Written informed consent, including with regard to publication of data and images, was obtained from all patients included in the study.

We reviewed patients at our clinic who underwent surgery with a diagnosis of SCC between May 2013 and May 2023. Patients were searched in the hospital information management system. We searched medical histories of patients diagnosed with SCC; patients with SCC that developed on the basis of burn ulcers were identified. Data on these patients, including their demographic characteristics, photographs, the surgical interventions performed, the lymph node results if a dissection was done, and the recurrences and complications during their follow-up, were systematically investigated and determined.

RESULTS

Over a span of 10 years, of the 741 patients diagnosed with SCC in our clinic, 11 were identified to have a burn-related Marjolin ulcer. Among these patients, 9 underwent treatment at our facility. The average age of the patients was 53 years, and the average time from the formation of the burn to the diagnosis of SCC was 12.2 years. Four of the lesions were in the lower extremity, 2 in the upper extremity, 1 on the scalp, and 2 on the torso. Six patients underwent excision along with selective lymph node dissection. In 6 patients, the excision material was removed with a clean margin, whereas in 3 patients, the margins were continuous with pseudo-epithelial hyperplasia and dysplastic epithelium. Among the dissection materials, only 1 had macrometastasis. The defects formed after excision were repaired with split-thickness skin grafts in 5 patients. Above-knee amputation was applied to 1 patient. Two defects were repaired with local flaps, and 1 patient had repair with a free flap. Local recurrence developed in 2 patients during postoperative follow-ups. The average follow-up period was 4.8 years (Table 1).

Patient 6

Patient 6, a 32-year-old fisherman, sustained severe flame burns covering 40% of his body at the age of 14 years. The burns spanned across his chest, both upper extremities, and legs. He presented to our clinic with a notable exophytic ulcer on his arm measuring 12 cm × 10 cm (Figure 1). Clinical examination was suboptimal because of burn scars present in the left axillary and cubital regions.

To accurately diagnose and manage the lesions, the patient received a 4-quadrant biopsy, which further confirmed the moderately differentiated SCC. The lesion was excised with a 2-cm margin. For subsequent reconstruction, the primary goal was not only to ensure adequate tissue coverage but also to preserve the smooth gliding of the tendons. A fasciocutaneous flap was contemplated. However, because of scars present at the potential donor site, the use of an anterolateral thigh flap was deliberately avoided. Because of the potential for the defect to enlarge, given the characteristics of scar tissue, the patient received a combined parascapular and scapular flap. The radial artery served as

TABLE 1. Demography, Localization, and Surgical Intervention

Patient No.	Age, y/Sex	Burn to Diagnosis Period	Localization	Surgical Intervention
1	64/female	11 y	Lower extremity	Amputation
2	59/female	9 y	Abdomen	Local flap
3	53/male	12 y	Scalp	Local flap
4	49/male	9 y	Upper extremity	Split-thickness skin graft
5	62/female	13 y	Anterior chest	Split-thickness skin graft
6	32/male	18 y	Upper extremity	Free flap
7	46/female	13 y	Lower extremity	Split-thickness skin graft
8	58/male	10 y	Lower extremity	Split-thickness skin graft
9	54/male	9 y	Lower extremity	Split-thickness skin graft

the recipient artery, and an anastomosis with the circumflex scapular artery was performed. After the surgery, the donor site showed wound dehiscence, but no lymphedema and no lymph node metastasis were observed. No recurrence was reported during a follow-up duration of 6 years.

Of note, several alternative reconstruction methods were diligently evaluated. The groin flap remained a consistent consideration. However, given its potential future utility for addressing scars on the sternum, use of this flap was judiciously reserved for potential future procedures. The patient's surgical journey also entailed a reverse abdominoplasty. This highlights the intricate and comprehensive surgical approach necessary during the treatment of complex cases of Marjolin ulcers. The case of patient 6 underscores the importance of a forward-thinking surgical approach, emphasizing both immediate surgical needs and potential future challenges.

Patient 1

Patient 1, 64-year-old female patient, had sustained flame burns that covered 25% of her body. The burns resulted in scars on both of her lower extremities. The lesion exhibited a fixed, nonmobile property (Figure 2). Magnetic resonance imaging revealed bone destruction in the anterior cortex of the tibia, accompanied by increased infiltration within the bone marrow. The patient had biopsies of areas on both lower extremities. A histopathological examination of the right extremity confirmed a diagnosis of SCC. Given the extent of the defect, which reached the bone in a circular pattern, an above-knee amputation was deemed necessary. To further evaluate the possible metastatic spread of the SCC, an inguinal dissection was conducted concurrently with the amputation procedure. The dissected lymph nodes tested negative, indicating no evident spread of the carcinoma.

DISCUSSION

The pathophysiology of Marjolin ulcer has been discussed for over 100 years. Various etiological factors are responsible for malignant transformation. It is crucial to acknowledge that the pathogenesis of Marjolin ulcer is likely multifactorial, weaving together elements of chronic irritation[8] and local toxins,[9] which foster neoplastic changes and allow a sanctuary for proliferation, particularly in settings where immune mechanisms are altered or compromised.[10] When a chronic refractory wound or unstable scar, characterized by atrophic scarring, depigmentation zones, or hyperkeratotic zones, is apparent, 4-quadrant biopsies should be

FIGURE 1. Patient 6

A, preoperative photograph of the lesion. **B**, reconstruction with scapular and parascapular fasciocutaneous flap.

FIGURE 2. Patient 1

A, preoperative photograph of the lesion. **B**, inguinal dissection. **C**, split thickness graft.

conducted. Multiple 4-quadrant biopsies remain the gold standard for diagnosis of Marjolin ulcer; these biopsies should be performed for all suspicious lesions, with review by an expert histopathologist.[11]

Despite a 4-quadrant biopsy, the histopathological findings, such as with pseudo-epithelial hyperplasia, chronic irritation, and hyperkeratosis, might not confirm SCC. However, when the physical appearance of the lesion suggests atrophy and scarring, which are indicative of malignancy, especially in the absence of specific staining patterns, a clinical judgment call may necessitate moving forward with treatment of the lesion as SCC. It is imperative to always suspect SCC in the context of atrophic scars, regardless of biopsy outcomes. In chronic burn wounds, pseudoepitheliomatous hyperplasia can be challenging to differentiate from SCC. Given its potential as a transitional state toward malignancy, such findings should be approached and treated with the same caution as malignancies.[12]

Imaging and physical examination in regions such as the axilla and inguinal areas, particularly when treating scars resulting from burns, cannot be overstated.[13] The underlying scarring can impede both ultrasonographic imaging and thorough physical examination, necessitating a reliance on clinical suspicion and adjunct imaging modalities.[14]

It is crucial to formulate a careful reconstruction plan and always have alternative plans in place, acknowledging that the journey with these patients might necessitate additional interventions in the future due to the persistent nature of the condition. Expecting the defect to enlarge because of the inherent nature of scar tissue, the surgeon's foresight in planning and flexibility can significantly improve patient outcomes in managing such challenging cases.

Reconstruction of alopecic areas on the scalp is often done using an expander.[15] The bases of these alopecic areas should be meticulously examined for Marjolin ulcer. The fundamental rationale behind tissue expansion is to increase the turnover of epidermal cells by physically exerting pressure on the skin, thereby inducing them to undergo mitosis.[16] When lesions on the scalp need to be addressed, the decision to use an expander should be made with caution; consequently, treatment of SCC located near the expander could be in complete contradiction to oncological principles.

In contrast to literature findings that SCC, especially those originating from burn scars, inherently progress toward a poor prognosis, our series interestingly did not show patients with distant metastasis.[17-19] Furthermore, the recurrences that we encountered were predominantly superficial, enabling us to manage them effectively with appropriate excisions.

A limitation of our study is the small sample size. Multicenter studies are needed for better evaluation of our results. A crucial aspect of treatment is patient education. Patients should learn to avoid ultraviolet exposure and perform necessary moisturizing procedures to protect scar tissue from the irritation caused by the sensation of itching. They must also be aware of the risks they carry, and follow-up appointments should be scheduled.

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