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CASE REPORT

Hand

Delayed Abdominal Flap for Upper Extremity Soft Tissue Coverage

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Summary: Unlike other body parts, the upper extremity has critical structures close to the skin, making soft tissue injuries more complex. These injuries can result from various causes, including trauma and necrotizing soft tissue infections, necessitating reconstruction. Historically, pedicled flaps from the groin and abdomen were commonly used for upper extremity reconstruction, but they had limitations, such as the need for flap division and debulking, patient discomfort, and stiffness. Free flap reconstruction has become the preferred method, but it still faces challenges like patient and facility issues, the absence of recipient vessels after injury, and multi-surface wounds. This case report describes a 67-year-old patient with a severe necrotizing soft tissue infection in the right upper extremity. After multiple debridement procedures, the patient underwent hand amputation and soft tissue coverage using an abdominal wall-based flap. The objectives of achieving stable soft tissue coverage while preserving maximal length of the upper extremity were successfully achieved, and the patient expressed satisfaction with the outcomes. Inadequate management of upper extremity wounds can lead to amputation and psychological distress. The reconstructive ladder is used to approach upper extremity soft tissue defects, with free tissue transfer being the standard for larger defects. However, abdominal flaps still have indications when free tissue transfer is not feasible or contraindicated. It is imperative that plastic surgeons have these techniques in their armamentarium to provide a service to the ever more complex patient with an upper extremity wound. *(Plast Reconstr Surg Glob Open 2024; 12:e5766; doi: 10.1097/GOX.0000000000005766; Published online 19 April 2024.)*

Unlike in many parts of the body, critical structures of the upper extremity lie just beneath the skin.[1] Consequently, soft tissue injuries of the upper extremity pose a more difficult reconstructive problem for the surgeon than similar injuries elsewhere.[1,2]

Necrotizing soft tissue infections are rapidly spreading infections that are associated with high mortality.[3] It necessitates aggressive debridement, often leaving exposed structures such as the bone, tendon, and neurovascular bundles requiring soft tissue coverage.[3]

In the 1970s, pedicled flaps from the groin and abdomen were the workhorses in upper extremity reconstruction.[4] These flaps have several disadvantages, including the need for flap division, patient discomfort, increased hospital stays, and inability to mobilize the hand, resulting in stiffness of the digits. For these reasons, free flap reconstruction has become the method of choice in coverage of complex upper extremity defects.[4] However, barriers to microsurgery persist, including patient and facility issues, vessel availability, and multi-surface wounds requiring coverage.[5]

Although many reconstructive options exist, abdominal flaps are still relevant and can serve as a lifeboat in the surgeon's armamentarium.[5]

CASE REPORT

The discussed patient is a 67-year-old who presented with a necrotizing soft tissue infection in the right upper extremity after the placement of an intravenous line. Upon presentation, the patient was in severe septic shock and required intubation, resuscitation, initiation

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Fig. 1. Initial evaluation exhibiting complete loss of skin, subcutaneous tissue, and fascia from the axilla to the metacarpophalangeal joints, with the hand deemed nonviable. The patient underwent hand amputation at the level of the wrist and debridement of the remaining upper extremity.

of broad-spectrum antibiotics, and high-dose vasopressor support. Multiple rounds of debridement were performed by the general surgery service.

Upon evaluation by the plastic surgery team, the patient exhibited complete loss of skin, subcutaneous tissue, and fascia from the axilla to the metacarpophalangeal joints, with the hand deemed nonviable (Fig. 1). Consequently, the patient underwent hand amputation at the wrist and further debridement of the remaining upper extremity, which showed healthy, viable tissue.

As further debridement was unnecessary, the focus shifted to achieving stable soft tissue coverage. Although dermal substitutes and skin grafting were considered, concerns arose regarding malnutrition and fluid/electrolyte imbalances due to the substantial amount of skin graft required. Therefore, the decision was made to use a random pattern abdominal wall-based flap by burying the arm, providing the patient with the best cosmetic and functional outcome.

A posterior axillary incision was made, extending vertically from the axillary wound to the costal margin, then continued down to the external oblique fascia level. A tunneled flap toward the umbilicus was elevated and joined to an abdominal incision, creating a pocket. The arm was placed in this pocket, and a wound vacuum-assisted

Fig. 2. Execution of an abdominal wall-based flap by burying the arm.

Fig. 3. Elevation of the superior portion of the flap and wrapping around the extremity. A wound vacuum-assisted closure was placed on the abdominal wall donor site.

closure (VAC) device was applied (Fig. 2). Over 2 weeks, the wound VAC was changed thrice weekly to monitor healing and prevent infection.

On postoperative day 14, flap formation commenced. A template from the contralateral forearm guided flap sizing on the abdominal wall. The superior and anterior incisions of the planned flap were made, with dissection being carried down to the level of the fascia. No additional dissection was performed to promote vascularization of the flap via a delay phenomenon. The wound VAC was replaced, and changes continued bedside.

Nine days later, the superior flap portion was elevated along the abdominal wall fascia, wrapping the extremity's superior part. A wound VAC was placed on the abdominal wall donor site (Fig. 3).

One week thereafter, the inferior flap portion was transected and elevated along the fascia, providing circumferential coverage (Fig. 4). The medial and posterior upper arm

Fig. 4. Transection of the inferior portion of the flap resulting in freeing the flap and the patient's arm from the abdominal wall. A wound vacuum-assisted closure was applied to the abdominal wall flap donor site.

areas lacking tissue were covered with a split-thickness skin graft. Nonviable tissue in the abdominal wall flap donor site was debrided, and a wound VAC applied, serving as a bolster for the skin graft. Four days later, a split-thickness skin graft was performed on the abdominal wall donor site wound.

The 2-month, multi-step process from initial debridement to final closure concluded successfully, leading to the patient's discharge to an acute inpatient rehabilitation facility for strength, endurance, and shoulder mobility improvement. At the 6-month follow-up, the patient showed successful healing with stable soft tissue coverage across the entire right upper extremity. Skin grafts on the arm and abdominal wall displayed excellent healing, nearing 100% viability. The shoulder and elbow had an approximately 45-degree range of motion, achieving objectives of stable coverage and maximal upper extremity length preservation, resulting in patient satisfaction with outcomes. (**See figure, Supplemental Digital Content 1**, which shows that at the 6-month follow-up, the patient demonstrated successful healing with stable soft tissue coverage throughout the entire right upper extremity. **http://links.lww.com/PRSGO/D167**.)

DISCUSSION

Inadequate management of upper extremity wounds can lead to amputation or permanent disability and is a major cause of psychological distress.[6] An optimal coverage should be stable, durable and resistant; allow free joint mobility; and have an aesthetically acceptable appearance.[6]

In general, the reconstructive ladder can be used to approach upper extremity soft tissue defects.[7] Although local and regional flaps may be used for coverage of smaller soft tissue defects, larger defects will usually require a free tissue transfer.[7]

Microsurgery has limited the use of pedicled abdominal flaps, but some indications persist. Wagner et al[5] reviewed these indications for hand and forearm reconstruction. Free tissue transfer may not be viable due to patient health or concurrent injuries, previous vessel use, vessel damage, and large resurfacing wounds.[5]

A retrospective study of 212 patients using pedicled flaps for posttraumatic upper extremity soft tissue defects reported a 98% overall success rate.[8] Flaps included thoracoabdominal, paraumbilical, random abdominal, and groin flaps.[8] The main complication was marginal flap necrosis in 15% of patients, predominantly managed with local wound care.[8]

Soft tissue coverage of the upper extremity with distant pedicled flaps has been found to have several limitations, including prolonged immobilization, need for a secondary surgery for flap division and subsequent flap contouring, stiffness, and contracture due to immobilization.[9] Additionally, these flaps have been critiqued for their donor-site cosmesis.[9] Refinements in the execution of the flap can prevent many of these disadvantages.[10]

CONCLUSIONS

Although free tissue transfer is currently the gold standard for large soft tissue defects of the upper extremities, abdominal flaps are a good, reliable option when a free tissue transfer is contraindicated or fails. It is imperative that plastic surgeons have these techniques in their armamentarium to provide a service to patients with complex upper extremity wounds.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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