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Reconstruction of deep cubital fossa defects with exposure of brachial artery due to high tension electrical burns and treatment algorithm☆

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Abstract

In this paper, we selected eight patients who had cubital fossa electrical burns with exposure or damage of the brachial artery, during the period 2000 to 2004 and formulated an algorithm to salvage upper limbs. We demonstrated the effectiveness of the algorithm to rescue the extremity from amputation and to restore the functional ability combined with coverage of the defects.

After initial management with decompression and debridement of the nonviable tissues surrounding the brachial artery, we used local fasciocutaneous flaps or pedicled latissimus dorsi (LD) muscle/musculocutaneous flaps immediately to cover and also to avoid the perforation of this artery with a mean of 5.5 operations and with an amputation rate of 12.5%. When perforation or necrotic focus was seen on the arterial wall without viable tissue around the brachial artery, circulation was restored with vein grafts. Deep defects in the cubital fossa with exposure of the brachial artery should be covered with well-vascularized tissue as soon as possible after serial debridements. If the necrotic focus is seen on the wall of the artery, it often requires a venous graft with flap coverage. In the presence of viable tissue around the artery, however, fasciocutaneous flaps are useful and they reduce the operation time and duration of hospital stay.

We treated deep defects with exposure of the brachial artery in the cubital fossa according to our established algorithm. Adherence to this approach precluded dilemmas in the selection of flap types for the management of bulky tissue defects.

Keywords: Brachial artery; Electrical burns; Treatment algorithm; Reconstruction

1. Introduction

Most of the high voltage electrical injuries occur at the workplace in adults and playing near high voltage power supply lines, where the current is usually higher than 1000 V, in children [1–3]. High voltage electrical injuries are often destructive with the upper extremities being frequently involved [4]. Although tremendous advances have been made in the treatment of electrical injuries, the amputation and disability rates still remain high [5].

Mainly, arc injuries that can generate high temperatures up to 5000 °C are usually responsible for the severe thermal injuries [1]. The antecubital fossa and wrist are the most common sites in the upper limbs for the arcs and deep defects [6,7]. In experimental studies, the flexor group of muscles in the upper extremity has been shown to bear the largest fraction of the total current and highest temperature values observed in muscles of small cross-sectional diameter [7]. Usually, deep defects and exposure of vital structures with infection are seen and require multiple operations and prolonged hospitalization [8].

Isolated upper limb injuries are not frequent and they are rarely lethal but can lead to loss of the involved extremity and/or functional complications [3,9]. Usually, deep defects and exposure of vital structures with infection are seen and require multiple operations and prolonged hospitalization [8].

Exposure of the vital structures leading to long-term morbidity, generally require transfer of viable tissue such as local fasciocutaneous, pedicle muscle flaps or microvascular free flaps [9]. The condition of the defects does not allow for skin graft coverage. Conservative treatment with serial debridements often results in progressive necrosis. Furthermore, many surgical techniques are available for the

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reconstruction of these severe defects. The type of wound coverage is determined by the local conditions in the wounds. Thorough and early attempts to reconstruct lead to best results in terms of functional and cosmetic benefits [10]. Despite the numerous techniques in flap coverage, the achievement of an applicable technique for each patient can only be accomplished if it provides for the functional restoration of the damaged limb.

In microvascular or pedicled musculocutaneous flaps, the pectoralis major island flap, latissimus dorsi (LD), rectus abdominis, gracilis, parascapular, and scapular flaps have been used [9–14]. In the selection of the coverage critical points to consider include the thickness of the flap, width, depth and the localization of the defect [9,13,15]. The latissimus dorsi is a reliable distant pedicle flap for functional transfer [14]. With the loss of flexor muscles in electrical burn injuries, the LD muscle or musculocutaneous flaps have been used to restore elbow flexion, a method often described as transposition of LD muscle or musculocutaneous flap [16]. In such injuries, the anatomic continuity and functional ability is more important than the appearance.

In the surgical treatment of electrical burn wounds with damaged brachial artery in the cubital fossa flaps with combination vein grafts provide the maintenance of the distal circulation of the forearm while avoiding amputation. With no viable tissues around the wound, vascular structures are more susceptible to medial necrosis, aneurysm formation and rupture [1].

2. Materials and methods

In this series, eight cases, referred to our burn intensive care unit with cubital fossa defects due to electrical injury between 2000 and 2004, were included.

All patients who suffered from high-voltage electrical injuries, were male, between 11 and 35 years of age with an average of 25.1 years. The average body surface area burned was 11%. Three of the patients were construction workers, three electrical technicians, and two field workers (Table 1). Patients were transferred to our hospital emergency service according to protocol, all from the southeastern parts of Turkey. Hospital stay was 2 months on the average.

Except for one case, Doppler signals were heard over the distal arteries with motor and sensory deficits observed. Prior to reaching our hospital, four upper limbs had been decompressed, three of them advanced and the other four fasciotomies were performed by us.

In our series, all patients underwent serial debridements and all necrotic and devitalized tissues were excised prior to application of the flaps. In two cases, sufficient viable tissue was obtained over the brachial artery. Two fasciocutaneous local flaps and six pedicled LD muscle and musculocutaneous flaps were used to reconstruct the deep cubital region defects with exposure of the brachial artery. Fasciocuta-

Table 1
Distribution of patients according to operation procedure and feature of age, sexuality, burn

Case	Sex and age	Operation number	Size of burn (%)	Fasciotomy	Vein graft	Source of vein graft	Length of vein graft (cm)	Coverage	Hospital staying (month)	Follow-up (month)
1	M/35	7	12	advanced	+	Saphenous vein	10	Pedicled LD muscle flap	2	13
2	M/26	6	14	Two upper limbs decompressed	+	Basilic vein	5	Pedicled LD muscle flap	3	24
3	M/28	8	15	Right upper limb decompressed	+	Saphenous vein	15	Pedicled LD muscle flap	2.5	14
4	M/11	6	10	Right upper limb decompressed	–	–	–	Pedicled LD muscle flap	2	7
5	M/26	4	16	Advanced (two upper limbs)	–	–	–	Pedicled LD myocutaneous flap	2	40
6	M/18	3	5	–	–	–	–	Local fasciocutaneous flap	1	5
7	M/31	5	3	Advanced	+	Saphenous vein	8	Pedicled LD myocutaneous flap	1.5	3
8	M/26	5	10	–	–	–	–	Local fasciocutaneous flap	2	11