

ORIGINAL ARTICLE

Fasciotomy in crush injury resulting from prolonged pressure in an earthquake in Turkey

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Objectives: The authors report on the patients treated in a clinic who were injured in the earthquake that took place in north western part of Turkey in 1999 and was reported to be measured at 7.4 on the Richter scale. This catastrophe killed over 16 000 people while injuring more than 23 000 people. The type of housing was varied and entrapment occurred in single, two or more storey buildings.

Methods: 35 patients were admitted to the plastic surgery department after the earthquake. The hospital is about 400 km from the disaster site. Although all the transported victims had intravenous lines, few had adequate volume replacement. Sixteen had an urgent fasciotomy at the time of admission. The procedures were performed between 8 and 21 hours after extrication. After fasciotomy, all non-viable muscle content was removed but an attempt was made to retain as much viable muscle as possible.

Results: Amputation was required on four patients (25%). Fasciotomy incisions were closed with skin grafting in eight cases, and with primary closure in four cases.

Conclusion: Prompt fasciotomy in earthquake victims will be both life saving and can prevent some of the severe and dangerous complications after crush syndrome.

After an earthquake the first priorities are to minimise further injury resulting from after shock, collapse of unsafe buildings, and to extricate those who may still be buried. Crush injuries to the extremities present a major challenge in such patients. This injury can easily put the victim's life in danger if it is not promptly managed, especially if compartment syndrome occurs. There is still some controversy about the management of compartment syndrome in these circumstances.^{1,2} Early fasciotomy is regarded by many to be life and function saving but some have challenged this view. Fasciotomy is a safe procedure in limb salvage and contributes little to the morbidity of patients with severe limb damage.³ In this report we describe the cases injured during Turkey's most severe earthquake and treated in the Department of Plastic and Reconstructive Surgery at Gulhane Military Medical School.

METHODS

Thirty five patients were admitted to the plastic surgery department after the earthquake. Of these 16 had an urgent fasciotomy at the time of admission. The patients' ages ranged from 10 to 70 years old, seven were women and nine men. The time delay from earthquake to extrication was between 6 to 18 hours (table 1). Emergency fasciotomy was performed 8 to 21 hours after extrication. After fasciotomy, all non-viable muscle content of the extremity was removed but an attempt was made to retain as much viable muscle as possible. Three patients had uncomplicated rib fracture and one had a vertebral fracture. Ten patients had no peripheral pulses. All of them had some degree of loss of sensation with swelling, pain, and fever.

RESULTS

In all the cases, when fasciotomy was performed, muscles dramatically burst out of their compartments. Amputation was required on four patients (25%) at different levels. Amputation was necessary because of intractable sepsis. In these patients the fever persisted as did the loss of sensation despite extensive fasciotomy and antibiotic therapy. In the other cases, fever, oedema, and sensation returned to normal values

in 4 to 12 days. Fasciotomy incisions were closed with skin grafting in eight cases, and with primary closure in four cases.

The most common complication was crush syndrome and the most severe complication was sepsis leading to amputation. Swollen limbs, prolonged limb compression, hypovolaemia, and myoglobinuria, were the signs indicating those patients sustained crush syndrome. Patients had myoglobinuria, hyperkalaemia (4.3–7.8 mEq/l), and increased serum creatinine (1.4–8.7 mg/dl) values. Crush syndrome was diagnosed in 13 patients, nine of whom had established acute renal failure and all responded well to treatment. In the patients on whom amputation was performed time to admission was comparatively longer, ranging from 11 to 21 hours (mean 15.75) and for those not requiring amputation was 8 to 18 hours (10.5).

During follow up period of 15 months, of the patients on whom fasciotomy was performed, eight gained almost normal function while four needed further rehabilitation and some degree of functional and sensory loss.

DISCUSSION

The treatment of crush injury is controversial. Fasciotomy is expected to reverse muscle necrosis by improving circulation, but also causes fluid loss from the wound and increases the risk of infection. Michealson suggests that the fasciotomy should not be performed in crush injury cases and the treatment should be conservative.¹ According to this author, when fasciotomy is performed, the injured muscles are more vulnerable to infection and this progress may later endanger the victim's life. Better and Stein also stated that fasciotomy made victims more vulnerable to the risk of infection.^{4–6} This hypothesis is partially true if correct precautions to prevent infection are inadequate and also since then, there have been significant improvements in antibiotics and in the management of trauma victims.

However, other authors state that immediate diagnosis and treatment of compartment syndrome is crucial for the management of severely injured extremity particularly after blunt trauma and entrapment. In mass injuries, usually there is no time for intracompartmental pressure readings. In these

Table 1 Patients' characteristic

Patient	Age	Sex	Effected extremity	Admission time/hour	Complication	Follow up
1	26	M	Lower right	8	N	Functionally OK
2	21	M	Lower right	10	N	Functionally OK
3	10	F	Lower left	11	Y	Amputated
4	70	M	Lower right	12	Y	Amputated
5	46	M	Upper right	10	N	Functionally OK
6	51	M	Upper left	11	Y	Both need rehabilitation
7	16	F	Lower right	12	Y	Functionally OK
8	24	F	Lower left	8	N	Functionally OK
9	37	F	Upper right	8	N	Functionally OK
10	45	F	Upper left	9	N	Functionally OK
11	49	M	Lower right	18	Y	Rehabilitation
12	27	F	Lower left	10	Y	Rehabilitation
13	20	M	Lower left	12	Y	Rehabilitation
14	51	F	Upper left	10	Y	Functionally OK
15	20	M	Lower right	19	Y	Amputated
16	20	M	Upper right	21	Y	Amputated

situations fasciotomy on clinical suspicion offers the best chance for optimal salvage of the extremity and plays an important part in the management of possible crush syndrome.^{3,7} In a series of patients with crushed extremities, the incidence of ischaemic contracture was found to be higher in extremities without fasciotomy than in those performed fasciotomy.^{7,8} The liberal use of prophylactic fasciotomy in the patients with vascular injury is advocated by some authors.⁹ However, in a study of the long term physical outcome of patients rescued from earthquake, no evidence was found showing that fasciotomy improved functional outcome and delayed interventions worsen the prognosis and physical outcome.¹⁰

In our study, only four patients required emergency amputation because of intractable sepsis even when necessary steps were taken to prevent serious infection. However, in the remaining cases, fasciotomy probably prevented extremity amputation. The amputation rate is somewhat higher compared with the rates of 11% to 21% reported in the literature.^{11,12} In our patients there was a longer time delay to admission with the limbs suffering compression for a considerable time period.

Infection secondary to fasciotomy is a real concern and opponents of early fasciotomy emphasise that an open wound after fasciotomy is more vulnerable to infection.¹ Fasciotomy sites should be inspected frequently to check for signs of inadequate fasciotomy or early infection. Any complications require prompt and effective care such as antibiotic treatment, further debridement, or even amputation.

This report supports fasciotomy in crush injuries resulting from continuous compression. In mass casualty situations the decision making is very difficult and sophisticated diagnostic methods may be time consuming. We recommend that under these conditions fasciotomy should be performed when there is a suspicion of compartment syndrome.

Contributors

Haluk Duman initiated and coordinated the primary study hypothesis, designed the protocol, and participated in collection of data and writing of the paper. Yalcin Kulahci collected the data, participated in analysis, and writing of the paper. Mustafa Sengezer, coordinated the study, participated in analysis and editing of the paper.

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