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Case Report

Shoe-Lace Technique Hasten Delayed Primary Closure In Fasciotomy Wound For Forearm Compartment Syndrome

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Abstract— **We report a case of acute compartment syndrome of the forearm in a 51-year-old man with open fracture distal third radius (Gustilo I). Decompressive fasciotomy was performed promptly. Complete progressive closure of the wound without split-thickness skin grafting was achieved using a shoe-lace technique: silastic vessel loop were interlaced held together with skin staplers placed at the edge of the fasciotomy wound and were then tightened daily. Delayed primary closure of the fasciotomy wound was performed after 8 days post fasciotomy with complete opposition of skin edges without tension. Shoelace closure is a good option for atraumatic fasciotomy wound closure with good cosmesis result.**

Keywords— **forearm ; compartment syndrome ; shoelace closure.**

I. INTRODUCTION

Compartment syndrome is a painful condition resulting from increased pressure in an osteo-fascial compartment to a critical level. Abnormally elevated compartmental pressure will have a detrimental effect on the circulation and myoneural component in the particular osteo-fascial compartment. Upon clinical diagnosis of an acute compartment syndrome, an emergency fasciotomy will be performed promptly to relieve the increasing intra-compartmental pressure, thus preventing further sequalae of adverse events.

II. CASE REPORT

A 51-year-old man had a fall while climbing a guava tree and was admitted to the hospital with open fracture distal third left radius (Gustilo 1) and closed fracture left medial malleolus. Examination of the left upper limb revealed left forearm deformity with marked swelling and a puncture wound at volar aspect of left wrist. Vascular and neurologic examination of the upper extremities was normal. Capillary refilling time (CRT) was less than 2 seconds. Both radial and ulna artery was palpable. Radiological examination showed a comminuted fracture of the volar cortex distal left radius with DRUJ disruption. Compartment pressures could not be measured objectively because the intra-muscular measuring device was

not available at the time. Operative intervention for the patient was performed under general anaesthesia 15 hours post injury. In the operating theatre, pre-operatively we observed the left hand and forearm was swollen and tense with CRT of around 4 seconds. No blistering of the skin noted. We perform fasciotomy over dorsal aspect of left hand and volar aspect of left forearm using the Henry approach with buttress plating of left radius. Upon fascial release, the muscles of the proximal flexor compartment bulged out and oedematous but viable and contractile. Post fasciotomy, all compartments are soft and CRT is less than 3 seconds. Shoe-lace closure using two vessel loops were applied to the skin edges and anchored to the skin edges using skin staplers. Following operation, the shoe-lace were progressively tightened once daily by the attending surgeon during wound dressing. At day 8 post fasciotomy, we managed to achieve complete opposition of skin edges and secondary suturing was performed subsequently.

At follow up the patient did not have any features suggestive of Volkmann's ischaemic contracture.

III. DISCUSSION

The main causating factor for this case is clear cut. Although patient did not present with signs and symptoms of compartment syndrome during the initial presentation, this condition will develop over time and needed close observation. The risk factors for developing compartment syndrome includes local trauma and soft tissue injury. Open wound such as in this case do not preclude compartment syndrome from the initial diagnosis merely strengthening the suspicion of increased intracompartmental pressure due the high impact nature of the injury. Intracompartmental pressure measurement can confirm the diagnosis in suspected cases. Whitesides [1] suggests that the perfusion of the compartment depends on the difference between the diastolic blood pressure and the intra-compartmental pressure. Ischemic injury begins when tissue pressure is 10 to 20 mm Hg below diastolic pressure. Therefore, fasciotomy generally should be done when tissue pressure rises past 20 mm Hg below diastolic pressure. Mubarak et al [2] in 1978 stated that 30 mmHg intra-compartmental pressure for more than 6 hours will lead to irreversible muscle necrosis.

In our case, the clinical diagnosis of compartment syndrome diagnosis was made in the operating theatre by the operating surgeon. Patients who are unconscious at the time of presentation or under general anaesthesia poses a great dilemma in clinical diagnosis of compartment syndrome. High index of suspicion, accurate evaluation, and prophylactic treatment will guide the physician to intervene in a timely manner and prevent irreversible damage [1]. Measurement of intra-compartmental pressure is a good modality to have in such cases according to some [2] but this still remains controversial. The pressure level necessitating fasciotomy of the forearm is unclear in the literature [2]-[4] with values ranging from 15mmHg to 50mHg have been proposed. Information obtained from compartment measurements may helpful for diagnosis, but clinical examination still remains essential in the decision-making process, especially in the presence of tense swelling of the forearm. We did not manage to measure the intra-compartmental pressure in our case as the measuring device was not available in our centre. Tense swelling of the muscles and reduced capillary refilling time is often the red flag sign and by these findings alone we made the diagnosis and performed the fasciotomy, because early clinical symptoms such as pain, paraesthesia and paresis cannot be detected in a ventilated and sedated patient.

Fig. 1 Post operative day 1- shoe lace closure for flexor compartment syndrome

Early fasciotomy for compartment decompression is vital because the morbidity caused by fasciotomy in a borderline compartment syndrome is far outweighed by the morbidity associated with an undiagnosed and untreated compartment syndrome. The final clinical outcome of an untreated compartment syndrome is the replacement of muscle with scar tissue. This produces a severe fibrous contracture and a neuropathy of any peripheral nerve traversing the compartment, leading to serious dysfunction due to Volkmann's ischaemic contracture. Once this stage is reached, it is never possible to restore normal function. In our case, fasciotomy of flexor compartment of the forearm was done by extending the Henry approach proximally until the antecubital fossa in a curvilinear fashion. Curvilinear incision is preferred because it allows exposure of all major nerves, arteries, and the mobile wad. After performing the volar fasciotomy inline as the skin incision, compartment pressure is assessed clinically by manual palpation to ascertain that all deep flexor muscles have been decompressed. During surgery there was noticeable contusion of the brachioradialis muscle. After volar decompression, pressure measurements of the volar compartment, mobile wad, and dorsal compartments should be repeated. According to Kostler et al [4], both volar & dorsal compartments must be relieved in the forearm, by two incisions placed at 180 degrees to each other. In upper extremity, need to decompress deep volar compartment (FDP &FPL) & perform epimysiotomy is not clear in the literature available.

Fig. 2 Day 8 post fasciotomy with good opposition of skin edges.

Fig. 3 Post secondary suturing

Closure of the fasciotomy wound remained open to debate as to which method is the best. Primary closure is not an option owing to tissue retraction and edema. There is often concern before and after performing fasciotomy about the cosmetic appearance and prolonged hospital stay if split skin grafting is required to cover the skin defect [5]. Split-thickness skin grafting leaves a thin, insensate and unaesthetic patch of skin [6]. The shoe-lace technique has been used with success for several years to close open fasciotomy wounds [5]. This technique for gradual closure involves running a silastic vessel loop through skin staples placed at the skin edge along the initial fasciotomy incision. Daily tightening of the shoe-lace permits gradual reapproximation of the skin edges until complete closure is attained. The method is simple to perform and atraumatic to the patient [6]. Our patient didn't complaint of any pain or requires any additional analgesia during daily tightening of the silastic loop. Closure is then possible in 5 to 10 days. In a study by Saini and Sharma [7], all the fasciotomy wounds were closed within an average of 8.3 days. Average duration of hospital stay was 12.3 days, which is significantly shorter duration as compared to skin grafting. Skin closure was obtained at an overall average of 4 tightening sessions which allowed re-examination the wounds and redo debridement when necessary [8]. Primary closure was achieved in 80% cases [9]. The advantages over split-thickness grafting include avoidance of donor-site morbidity and better cosmesis. This technique is useful for fasciotomy wounds on forearms or legs, Shoe-lace closure approximation technique generally have low costs, as they use inexpensive materials that are generally readily available [10]. Morbidity and cost associated with skin graft or secondary closure were avoided with shoe-lace technique.

Recognition of the signs and symptoms of acute compartment syndrome is essential. Morbidity can be avoided if a high level of suspicion is maintained and fasciotomies are performed early. Monitoring of intra-compartmental pressure should be made routine in unconscious, sedated and uncooperative patients. If the compartment pressure remains less than 30 mmHg, in the presence of clinical signs urgent fasciotomy should be performed to preserve the function of the limb. Performing a timely fasciotomy for compartment syndrome prevents ischaemic injury to muscles and nerves.

IV. CONCLUSIONS

Shoelace closure is a good option to expedite fasciotomy wound closure of the forearm and avoiding skin grafting with all its associated morbidities.

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CONSENT TO PARTICIPATE

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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