Factors associated with persistent sequelae after fasciotomy for acute compartment syndrome

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ABSTRACT

Purpose. To determine factors associated with persistent sequelae after fasciotomy for acute compartment syndrome.

Methods. Records of 57 men and 3 women aged 8 to 84 (mean, 31.9) years who underwent fasciotomy of the lower (n=48) or upper (n=12) limbs for acute compartment syndrome following limb trauma were retrospectively reviewed. 58 of the fasciotomies were therapeutic and 2 were prophylactic. The mean follow-up was 3.9 (range, 1–8) years. Patients were assessed through a telephone survey for persistent sequelae (parasthaesia, dysasthaesia, and/or motor weakness), using a scale of one to 4 to indicate asymptomatic, mild, moderate, and severe, respectively. Associations of persistent sequelae with the aetiology, mechanism of injury, site of fasciotomy, time to fasciotomy (from admission to anaesthesia induction), number of operations, method of closure, time to closure, and perioperative complications were assessed.

Results. 18 patients were asymptomatic and 42 reported having persistent sequelae including motor weakness (n=26), parasthaesia (n=28), and dysasthaesia (n=30). In terms of severity, these sequelae were mild (n=10), moderate (n=12), or severe (n=20). Persistent sequelae were associated with higher number of operations, post-fasciotomy complications, closures with skin grafting, and increased time to closure.

Conclusion. To reduce the risk of persistent sequelae after fasciotomy, careful preoperative planning and meticulous perioperative care is needed to avoid multiple operations and post-fasciotomy complications. Patients whose wounds healed by secondary intention showed the best outcome.

Key words: compartment syndromes; complications

INTRODUCTION

Acute compartment syndrome may result from external compressive forces or internal expansion within an enclosed fascial compartment, for which
prompt decompression by fasciotomy is advised in order to avoid irreversible damage. Increases in compartment volume can be caused by fractures, haemorrhage, crush injuries, rhabdomyolysis, and massive intravenous fluid resuscitation. External compression may be caused by burns, splints, casts, and military antishock trousers, as well as prolonged intra-operative lithotomy positioning. Most compartment syndromes are due to fractures, particularly tibial diaphyseal fractures. Risk factors of compartment syndrome include high-velocity injuries, presence of an associated vascular injury, patients with an underlying bleeding diathesis and anticoagulant therapy. Most such patients are males, probably owing to their larger muscle mass within the fascial compartment.

For upper limbs, decompression can be achieved via a volar or dorsal approach or both. For lower limbs, 4-compartment decompression can be achieved by a single or double incision technique, with the latter being the treatment of choice. Thigh compartment syndrome is less common owing to the large volume required to increase the interstitial pressure. Decompression of the thigh can be achieved via a medial or lateral incision, depending on the area of injury or suspected haematoma.

Complications of the fasciotomy include infection, iatrogenic nerve or blood vessel injury, and muscle damage. Contractures of the skin and soft tissue may arise from the initial procedure or secondary to wound closure. The complications associated with the fasciotomy scars include paraesthesia, pruritis, and pain. We therefore assessed factors associated with persistent sequelae after fasciotomy for acute compartment syndrome.

MATERIALS AND METHODS

Records of 57 men and 3 women aged 8 to 84 (mean, 32) years who underwent fasciotomy of the lower (n=48) or upper (n=12) limbs for acute compartment syndrome following limb trauma (Table 1) between June 2001 and July 2008 were retrospectively reviewed. The diagnosis of compartment syndrome was based on clinical features; intra-compartmental pressure was not taken into consideration. 58 of the fasciotomies were therapeutic and 2 were prophylactic. This study was approved by the local ethics committee.

The mean follow-up was 3.9 (range, 1–8) years. Patients were assessed through a telephone survey for persistent sequelae (paraesthesia, dysasthaesia, and/or motor weakness), using a scale of one to 4 to indicate asymptomatic, mild, moderate, and severe, respectively. Associations of persistent sequelae with the aetiology, mechanism of injury, site of fasciotomy, time to fasciotomy (from admission to anaesthesia induction), number of operations, method of closure, time to closure, and perioperative complications were assessed.

Ordinal cumulative link models were used to examine associations between overall symptom rating and site (upper / lower limb), method of closure (primary, secondary, skin grafting), complications (some/none), number of operations, time to fasciotomy, and time to closure. The model made use of the proportional odds assumption.

RESULTS

18 patients were asymptomatic and 42 reported having persistent sequelae including motor weakness (n=26), paraesthesia (n=28), and dysasthaesia (n=30). In terms of severity, these sequelae were mild (n=10), moderate (n=12), or severe (n=20) [Table 2]. Persistent sequelae were not associated with the fasciotomy site (upper limbs vs. lower-limbs, 17% vs. 35%, p>0.05) and the time to fasciotomy (from admission to anaesthesia induction). The mean time to fasciotomy retrieved in 54 patients was 10 (range, 1–48) hours; 53% of these were <6 hours, 23% were 6 to 12 hours, 13% were 13 to 24 hours, and 11% were >24 hours.

Persistent sequelae were associated with higher number of operations (p=0.005, Table 2) and the type of closure (p<0.001). Healing by secondary intention (n=6) achieved best outcome, followed by delayed primary closure (n=39) and skin grafting (n=15). 83% of patients whose wounds healed by secondary intention were asymptomatic, whereas
only 26% of those with delayed primary closure were asymptomatic, and the remaining 25%, 26%, and 23% of patients had mild, moderate, and severe persistent sequelae, respectively. All patients with skin grafting had persistent sequelae, with 80% being severe. The mean time to closure after fasciotomy in the delayed primary closure and skin grafting groups was 4.7 (standard deviation [SD], 2.7; 95% confidence interval [CI], 3.9–5.6) days and 19.7 (SD, 22.4; 95% CI, 7.2–32.1) days, respectively. 37% of patients whose wounds were closed after 8 to 14 days reported severe persistent sequelae, whereas all patients whose wounds were closed after >14 days reported severe persistent sequelae.

12 patients had immediate post-fasciotomy complications, including wound infections (n=7), amputations (n=2), cardiac arrest (n=1), and haematomas necessitating evacuation (n=2). 10 of the 12 patients had persistent sequelae, with 80% being severe. Persistent sequelae were associated with immediate post-fasciotomy complications (p=0.004).

### DISCUSSION

Fasciotomy may result in problems associated with skin closure, soft tissue, bone infection, and amputation. Persistent sequelae (parasthaesia, dysasthaesia, and/or motor weakness) after fasciotomy affect patient’s quality of life and ability to return to work.

In our study, all patients with skin grafting had persistent sequelae, with 80% being severe. This may reflect the inherent complexity of the fasciotomy. Nonetheless, the rate of persistent sequelae was much lower in patients with delayed primary closure, which should therefore be used when feasible. The size of the wounds that were left to heal by secondary intention was not recorded; the better outcome with this method could be due to the wounds being smaller and the injury less complex. The use of vacuum-assisted closure devices reduces hospitalisation time and enables earlier rehabilitation following fasciotomy. Increased time to closure after fasciotomy was associated with increased frequency and severity of persistent sequelae.

Delayed fasciotomy was reported to be associated with higher immediate post-fasciotomy complications such as infections. Nonetheless, in our study the time to fasciotomy was not associated with persistent sequelae. A more objective result could have been obtained if the time to fasciotomy had been calculated from the time when the diagnosis of compartment syndrome was established.

A higher number of operations and more complex interventions such as skin grafting were associated with persistent sequelae. Minimally invasive techniques such as subcutaneous fasciotomy may result in inadequate decompression and recurrent compartment syndrome. Therefore, careful preoperative planning and meticulous perioperative is needed to avoid multiple operations and post-fasciotomy complications. Patients whose wounds healed by secondary intention showed the best outcome.

Prophylactic fasciotomy is not advised, owing to the high rate of persistent sequelae. Repeated clinical examination and intra-compartmental pressure measurements enable detection of an emergent compartment syndrome, while avoiding unnecessary fasciotomy. Some authors suggest early routine fasciotomy owing to the morbidity associated with a delayed diagnosis. However, prophylactic fasciotomy is also associated with morbidity and long-term complications in up to 75% of patients. In addition, a small percentage of patients undergoing prophylactic fasciotomy require revision fasciotomy later, which also increases the risk of post-fasciotomy complications.
REFERENCES