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Percutaneous Needle Decompression of Acute Compartment Syndrome of Leg

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ABSTRACT

Thirty patients with acute compartment syndrome of legs were managed with percutaneous needle decompression of compartments with help of size 18 gauge needle under aseptic technique. The recovery was quick and avoided complications of two fasciotomy incisions, Percutaneous needle decompression may be considered an alternative to open fasciotomies for acute compartment syndrome.

INTRODUCTION

Acute compartment syndrome occurs when the tissue pressure within a closed muscle compartment exceeds the perfusion pressure and results in muscle and nerve ischemia. It typically occurs subsequent to a traumatic event, most commonly a fracture.

The cycle of events leading to acute compartment syndrome begins when the tissue pressure exceeds the venous pressure and impairs blood outflow. Lack of oxygenated blood and accumulation of waste products result in pain and decreased peripheral sensation secondary to nerve irritation.

Late manifestations of compartment syndrome include the absence of a distal pulse, hypoesthesia, and extremity paresis, because the cycle of elevating tissue pressure eventually compromises arterial blood flow. If left untreated or if inadequately treated, the muscles and nerve within the compartment undergo ischemic necrosis, and a limb contracture, called a Volkmann contracture, results. Severe cases may lead to renal failure and death.

The incidence of compartment syndrome depends on the patient population studied and the etiology of the syndrome. In a study by Qvarfordt and colleagues, 14% of patients with leg pain were noted to have anterior compartment syndrome[1]; compartment syndrome was seen in 1-9% of leg fractures.

Compartment syndrome may affect any compartment, including the hand, forearm, upper arm, abdomen, buttock,[2] and entire lower extremity. Almost any injury can cause this syndrome, including injury resulting from vigorous exercise. Clinicians need to maintain a high level of suspicion when dealing with complaints of extremity pain.[3]

The definitive surgical therapy for compartment syndrome is emergent fasciotomy (compartment release), with subsequent fracture reduction or stabilization and vascular repair, if needed. The goal of decompression is restoration of muscle perfusion within 6 hours.

Compartment syndrome results primarily from increased intracompartmental pressure. The mechanism involved in the development of increased pressure depends on the precipitating event.

The compartment syndrome may follow operations for orthopedic fixation (e.g., open reduction and internal fixation). These cases may result from postoperative hematoma, muscle edema, or tight closure of the deep fascia. These risks can usually be minimized by releasing the tourniquet before wound closure to ensure that hemostasis is adequate and by closing only the subcutaneous tissues,

The anterior distal lower extremity is the most common studied site of compartment syndrome. Tibial fracture is the most common

precipitating event, accounting for 2-12% of all compartment syndrome cases, according to the literature. In a retrospective study by McQueen and Court-Brown in 164 patients with diagnosed compartment syndrome, 69% of cases were associated with a fracture, and half of those involved the tibia. In the study, compartment syndrome was diagnosed more often in men than in women. This finding likely represents selection bias, however, because most patients with traumatic injuries are male. In a 10-year study, McQueen et al studied 850 patients and concluded that continuous intracompartmental pressure monitoring should be considered following tibial diaphyseal fracture because these patients are at risk for acute compartment syndrome.[4]

The incidence of acute compartment syndrome varies depending on the inciting event. DeLee and Stiehl found that 6% of patients with open tibial fractures developed compartment syndrome, compared with only 1.2% of patients with closed tibial fractures.[5] The reported incidence of compartment syndrome may underestimate the true incidence because the syndrome may go undetected in severely traumatized patients.

The frequency of compartment syndrome is much higher in patients who have an associated vascular injury. Feliciano et al reported that 19% of patients with vascular injury required fasciotomy[7]; an incidence of 30% has also been suggested, but this figure is not well documented and is most likely an estimate. The true incidence of cases associated with vascular trauma may not be known because many vascular surgeons perform a prophylactic fasciotomy at the time of the vascular repair in high-risk patients.

Compartment syndrome outcome depends on both the diagnosis and the time from injury to intervention. Rorabeck and Macnab reported almost complete recovery of limb function if fasciotomy was performed within 6 hours.[8] Matsen found necrosis after 6 hours of ischemia, which currently is the accepted upper limit of viability.[9]

When fasciotomy was performed within 12 hours after the onset of acute compartment syndrome, Sheridan and Matsen reported that normal limb function was regained in 68% of patients.[10] However, when fasciotomy was delayed 12 hours or longer, only 8% of patients had normal function. Thus, little or no return of function can be expected when the diagnosis and treatment are delayed. Tendon transfers and stabilization may be indicated as late treatment for CS.

Long-term follow-up of patients who have undergone fasciotomies has shown good results, with a return to premorbid activity level. Pain also has been found to significantly improve.

In the lower leg, the results of fasciotomies for posterior compartment syndrome are not as good as those for the anterior compartment. A possible explanation is that it is difficult to do a complete decompression of the deeper posterior compartment, because of the morbidity associated with this procedure. In general, however, early diagnosis, with institution of the appropriate treatment, results in a good outcome.

With late diagnosis, irreversible tissue ischemia can develop in the acute setting. Thus, permanent muscle and nerve damage, along with chronic pain, may occur. In the lower leg, peroneal nerve palsy, in particular, may develop.

Volkmann contracture is the residual limb deformity that results over weeks to months following untreated acute compartment syndrome or ischemia from an uncorrected arterial injury. Approximately 1-10% of patients develop a Volkmann contracture.[11] Calcific myonecrosis of lower extremity muscles has been identified as an uncommon late complication of posttraumatic compartment syndrome.

Recurrent compartment syndrome has been reported in athletes. It is thought to be related to severe scarring and the subsequent closing of the initial compartment release.

Infection is a serious complication of compartment syndrome. In a retrospective review by Matsen et al, 11 of 24 extremities that had late surgical decompression developed infections, and 5 of these infections led to an amputation.[12]. Infection after fasciotomy may become chronic. Patients, especially those with multiple traumatic injuries, may die because of infections or metabolic complications. Renal failure or multiple organ failure may occur preoperatively or postoperatively. Most fatalities are due to prolonged intensive care admissions with sepsis and multisystem organ

failure.

The idea of this study was to find a simple way to treat compartment syndrome which may be replicated easily and should have least complications.

MATERIAL AND METHODS

Between February 2011 and June 2013, 30 patients with clinical diagnosis of fracture tibia fibula with compartment syndrome were included in this study. There were 25 males and 5 female. There were 15 open fractures and 15 closed fracture, Among 15 open fractures 5 were grade I and 6 were grade II and 4 were grade III. These four patients had firearm injury. Although the external wound were small, There was significant soft tissue damage.

The diagnosis of compartment syndrome was confirmed with intra-compartment pressure measurement with Whiteside[13] technique in 10 patients and in rest of patient, the diagnosis was clinical.

Under spinal or general anaesthesia, the compartment pressure was released within 6-12 hours of injury by performing 30 to 50 punctures with help of size 18 gauge needle under aseptic technique avoiding vital structures. The blood came out gradually by oozing from needle punctures, Aseptic dressing was applied and leg was elevated on pillow during post operative period. First dressing was changed after 12-24 hours and daily dressing was applied during post operative period.

The improvement was remarkable in most of patients within 24 hours. The intracompartmental pressure dropped below 30 mm using Whiteside technique. The follow-up was performed after discharge regularly for three months.

RESULTS

Out of 30 patients 3 lost for follow-up, in 23 patient, there was full or nearly full recovery, Four patient showed signs of residual ischemic damage in anterior or deep posterior compartment of leg.

Forty five years old male, presented with firearm injury distal leg with open fracture of tibia fibula with compartment syndrome (Fig. 1A,B), Debridement with undreamed closed intramedullary nailing was performed with decompression of compartment syndrome with multiple percutaneous needle punctures (Fig. 2A,B). There was smooth postoperative recovery and on tenth post operative day wounds healed sutures were removed (Fig. 3).

Fig. 1: A, Pre-operative x-ray; B, pre-operative clinical pictures.

Fig. 2: A, Percutaneous needle decompression; B, stabilization with interlocking nail.

Fig. 3: A, Tenth post-injury day, compartment pressure reduced.

DISCUSSION

There are several problems and complications associated with fasciotomy of leg for compartment syndrome. It is fairly invasive procedure and it take lot of time to make preparation of surgery and crucial time is lost. It is associated with morbidity and needs large dressings for many days to weeks. It

needs a second surgical procedure to close the wound or apply split thickness skin grafts. If patient has smooth recovery, there are ugly scars for rest of life on leg of patients.

Percutaneous needle decompression of compartment syndrome may be performed in emergency room under ring block using aseptic technique. It take much less time to do the procedure and after 72 hours, the oozing stops and needle pricks are hardly visible. It can be performed by junior residents easily.

If required, the procedure may be repeated after 24 hours.

We recommend that percutaneous needle decompression may be considered in patients with acute compartment syndrome of leg an alternate to two incision fasciotomy of leg.

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