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## Acute compartment syndrome in lower limb trauma: Treatment and results

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### Abstract

**Introduction:** Acute compartment syndrome is a surgical emergency. If not treated properly it may lead to irreversible changes in function and viability of the limb, and cause death to patient.

**Methods:** Retrospective study of a group of patients with diagnosis of acute compartment syndrome treated in a single trauma center from 2008 to 2018. We collected the data using patient files and clinical assessment. We studied the mechanism of lesion, anatomic area damaged, Injury Severity Score, time elapsed from the injury to the final diagnosis, hospital length of stay, viability, and function of the limb.

**Results:** Nine patients were identified (eight male) with mean age of  $44,8 \pm 17,5$  years old. Four patients were transferred from another institution for definitive care. The acute compartment syndrome was related with high energy trauma in seven patients. Five patients had tibial fractures with comminution. In eight cases the localization of acute compartment syndrome was in the leg. Mean hospital length of stay was  $48,7 \pm 29,5$  days.

**Discussion and Conclusion:** High energy trauma in young patients should make us very alert to the possibly of developing acute compartment syndrome. However, it is necessary a high index of suspicion in older age patients with history of monotrauma.

**Keywords:** Acute compartment syndrome, fasciotomy, high energy trauma

### Introduction

Acute compartment syndrome (ACS) is a surgical emergency. It is characterized by the increase of pressure within an osteofascial compartment, compromising the capillary perfusion and endangering limb function and viability <sup>[1, 2]</sup>. The leg is the most common anatomic area involved in ACS <sup>[3]</sup>.

The diagnosis of ACS is mainly done by clinical assessment. In unclear cases, it may be helpful to take measurements of intracompartmental pressure <sup>[4]</sup>.

In context of trauma the diagnosis is challenging, but early recognition of ACS is extremely important since the outcome seems to be dependent on the time elapsed between the inaugural injury and proper treatment <sup>[5]</sup>.

Once the diagnosis is established, prompt surgical decompression of the compartment by fasciotomies should be warranted. Successful decompression less than eight hours after the inaugural hit will produce better results <sup>[6, 7]</sup>.

In this article, we sought to analyze the outcomes in a series of cases of ACS in context of trauma of the lower limb.

### Methods

We conducted a retrospective analysis of a group of patients with diagnosis of ACS treated in a single trauma center from January 2008 to December 2018. Patients managed with fasciotomies for ACS in context of lower limb trauma were included. Patients with ACS involving other anatomical areas or not associated with trauma were excluded (Fig. 1).

The data was collected using patient files and clinical assessment. Patient variables including age, gender, mechanism of lesion, anatomic area injured, Injury Severity Score (ISS) at hospital arrival, time elapsed since inaugural trauma until final diagnosis, limb function and viability, length of hospital stay.

In all but one case the diagnosis was based on clinical assessment. Intracompartmental measurements was performed in an unclear case. When the lower leg was involved, patients were treated with fasciotomies using two incisions. When the thigh was

injured, patient was treated with a single lateral incision. To assess intracompartmental pressure, a pressure transducer was used associated with normal saline injection and standard manometer [8].

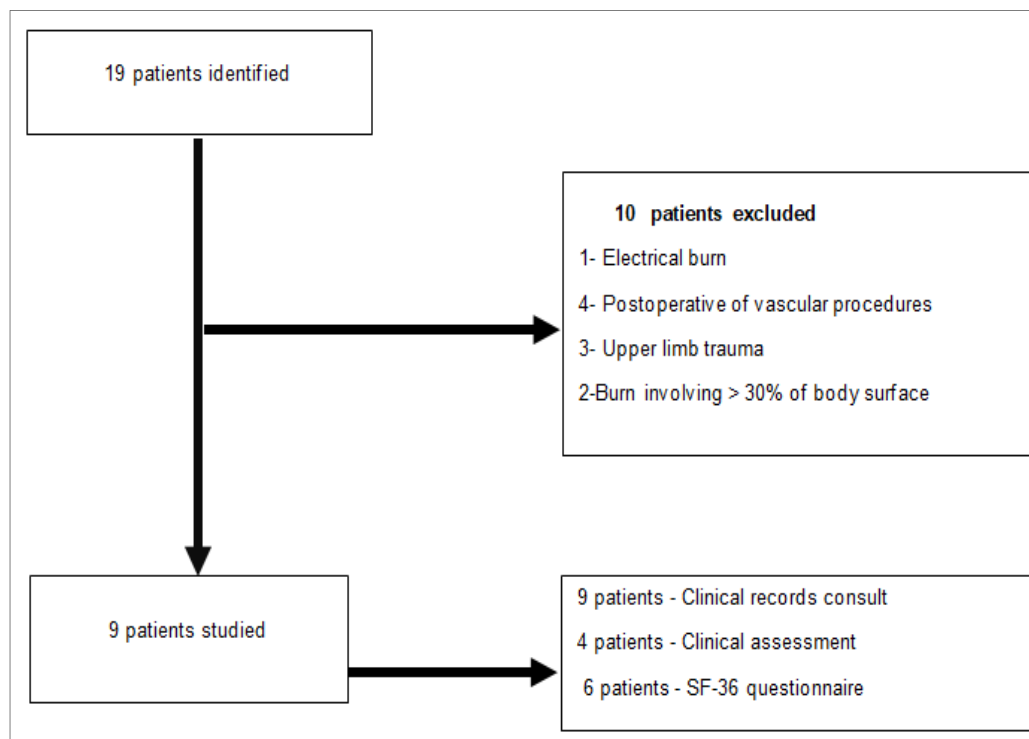
**Table1:** Sample characterization

Case	Age/Gender	From	Mec. of lesion	Anatomical area/side	Main lesion (OTA)	Other fractures	Other Systems
1	28/ M	Transferred	Fall from height > 1m	Leg/R	Tibial Fracture (41-C2)	0	0
2	42/M	Transferred	Gunshot wound	Leg/R	0	0	0
3	64/M	Transferred	Fall from own height	Thigh/R	Contusion	0	0
4	80/ F	EMS	fall from own height	Leg/R	Contusion	Lumbar Spine	0
5	28/M	EMS	Road traffic accident	Leg/L	Tibial Fracture (41-C3)	Fibula	0
6	24/M	Transferred	Road traffic accident	Leg/R	Tibial Fracture (43-C3)	cont.* femur. both radios. pelvic ring	Perineum laceration; femoral vein injury
7	52/M	EMS	Road traffic accident	Leg/L	Knee ligament	0	0
8	36/M	EMS	Road traffic accident	Leg/R	Tibial Fracture (42-B2)	Femur; cont.* bimaleolar ankle	Pulmonary contusion, SAH
9	49/M	EMS	Road traffic accident	Leg/L	Tibial Fracture (42-B2)	Thoracic and lumbar spine. acetabulum	Neurological injury

**Results**

Out of 19 patients of our search, nine met inclusion criteria. Eight patients were male. The average age in this group was 44,8±17,5 years old. Three patients were under 30 years old. In seven patients SCA was associated with high energy trauma. The most prevalent mechanism of lesion was road traffic accidents. Eight patients developed ACS in the leg. In

one other patient, the thigh was involved. Five patients had tibial fractures with comminution. One patient had ACS associated to gunshot wound. Table 1 depicts the demographics of the population, mechanism of lesion, anatomical area of ACS and involvement of other organs/systems.



**Fig 1:** Case selection

The average ISS at hospital admission was ISS 18,8±17,6. The average length of hospital stay was 48.7±29.5 days. Five patients had other fractures in addition to the main ACS-related injury. Three patients had injuries involving other organs or systems.

During hospitalization, it was necessary to perform 28 additional surgical intervention on six patients. A patient had limb amputation above the knee.

**Table 2:** Sample characterization (continued)

Case	Age/Gender	Mec. Of lesion	ISS	From	Time until diagnosis (days)	Acute complications	Additional surgeries (N)	Length of stay (days)
1	28/ M	Fall from height > 1 m	9	Transferred	2	Fasciotomy infection	4	46
2	42/M	Gunshot wound	13	Transferred	2		1	21
3	64/M	Fall from own height	1	Transferred	1		0	11
4	80/ F	fall from own height	1	EMS	1	Skin healing problems	1	50
5	28/M	Road traffic accident	9	EMS	1	Fasciotomy infection	2	45
6	24/M	Road traffic accident	45	Transferred	1	Rhabdomyolysis; **	12 <sup>+</sup>	100
7	52/M	Road traffic accident	9	EMS	0,83		0	60
8	36/M	Road traffic accident	50	EMS	0,25		2	90
9	49/M	Road traffic accident	32	EMS	0,25		6	15

Four patients had acute complications related to ACS. Three of these had complications causally related to fasciotomies. Out of four patients transferred from other institutions, three came for definitive care of fracture lesion and one for management of vascular injuries associated to gunshot wound.

Only three patients had diagnosis in the first 24 hours after inaugural injury (table.2).



**Fig 2:** Fasciotomy of leg's compartment. a) Posterior; b) anterior and lateral

### Discussion

There is a much larger number of cases of male patients compared to female patients at a relatively young age. Many studies have linked the onset of ACS in patients under 35 years old and tibia shaft fractures [9-11]. Babak Shadgan *et al* [10] believe that fractures of the tibial shaft is a potential risk factor because of several muscles' attachments on this area. The same authors suggest that fewer muscles and more tendons in the distal third of the leg, may explain fewer incidence of ACS that area.

Although ACS is more commonly associated with tibial shaft fractures, the literature shows that other locations in the leg may also be associated with this serious condition as

demonstrated by Marco Stella *et al* [12]. In a study [10] published in 2014, the authors found 87 patients with tibial shaft fractures complicated by ACS. Out of these, 43 had fracture in middle third, 25 in distal third and 11 in proximal third. In our study five patients had tibial fractures; two in proximal third; two in middle third and one in distal third.

In seven out of nine patients in this study, ACS was related to mechanism of injury involving high energy trauma. Many researches point towards this direction [1, 6, 10]. However, in two patients, ACS was not related to this type of trauma. The patients who developed ACS with low energy trauma were 64 and 80 years old. We did not find on literature researches that relate ACS in older age and low energy trauma. We think that factors of the patients themselves such as medical comorbidities and usual medication, may explain the emergence of ACS in older age with low energy trauma.

According to several studies, better results have been reported when fasciotomies are performed less than eight hours after ischemic injury [5, 7]. In our study only three out of nine patients had diagnosis and early decompression in the first 24 hours after injury as shown on table 2. Those patients had no complications.

As it is a retrospective analysis, it is difficult to pinpoint causes of the delay on diagnosis. We believe that inter-hospital transfer of patients may have contributed to that delay. Many patients attend to the hospital emergency department several hours after inaugural insult. Since inter-hospital transfer process is not immediate, this may explain why many patients are clinically assessed by a surgical team far beyond of the eight hours after injury.

In trauma patients involving mechanisms of high energy, it is common that those patients may present with lesions in other organs and systems. Because of their complexity, those cases are difficult to manage and the diagnosis of ACS may be done late. All these factors contribute for a longer hospital mean stay (table 2).

Emergent surgical decompression may prevent disastrous consequences for function and viability of the limb; however, the diagnosis may not be clear. We must have in mind that fasciotomy is not a harmless procedure. It may be associated with acute and long term morbidity [13-15]. In our study three patients had complications causally related to the fasciotomies. Strategies such as continuous intracompartmental pressure measuring may reduce the need of unnecessary fasciotomies [16].

### Conclusion

High energy trauma in young patients involving the diaphyseal region of the tibia should make us very alert to

the possibility of developing ACS. This diagnosis should be always ruled out before inter-hospital transfer. It is necessary high index of suspicion in older age patients with history of monotrauma. Delay in diagnosis resulted in greater number of complications, surgical interventions and increase in hospital average stay.

### Limitations

#### Small sample

Absence of records of time elapsed since the diagnosis until execution of fasciotomies.

Impossibility to conduct proper statistical analysis because of little number of cases.

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