IJCRR
Section: Healthcare
ISI Impact Factor
(2019-20): 1.628
IC Value (2019): 90.81
SJIF (2020) = 7.893

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Double Trouble Post-Femoral Fracture – A Rare Case Report

Haniza Sahdi¹, Mohamad Zaki Mohd Amin², Denis Dian Lee³, Cassandra Ting⁴

¹Senior medical lecturer, Department of Orthopaedics, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak, Malaysia; ²Professor, Department of Orthopaedics, Faculty of Medicine and Health Sciences, University Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak, Malaysia; ³Orthopaedic Surgeon, Hospital Putrajaya, Jalan Pg, Presint 7, Wilayah Persekutuan Putrajaya, Malaysia; ⁴Medical Officer, Sarawak General Hospital, Jalan Hospital, 93586 Kuching, Sarawak, Malaysia.

ABSTRACT

Fat embolism syndrome (FES) and acute compartment syndrome (ACS) are common long bone fracture complications that have been discussed extensively. Nevertheless, the simultaneous manifestation of FES and ACS after a single long bone fracture has never been reported. FES results from the extensive inflammatory response to fat emboli in the systemic microcirculation. The diagnosis is made with a set of specific clinical criteria. Treatment of FES is supportive. ACS ensues when a closed Osseofascial compartmental pressure exceeds the capillary perfusion pressure, leading to microvascular compromise. Fasciotomy is the only proven mode of treatment. We present a case of an 18 year-old-gentleman with closed traumatic femoral fracture, who then developed tense swelling of the ipsilateral thigh, Type I respiratory failure and axillary petechiae. A diagnosis of concurrent fat embolism syndrome and acute compartment syndrome of the thigh was made. High index of suspicion is essential for prompt diagnosis of concurrent FES and compartment syndrome as multiple complications that arise can be overlooked by unsuspecting practitioners who may be sidetracked by the multitude of presentations.

Key Words: Compartment syndrome, Fat embolism, Femur, Fracture

INTRODUCTION

Compartment syndrome and fat embolism syndrome following a long bone fracture are nothing new in orthopaedic practice. Early detection and prompt treatment would be dealt out as the Damage Control Orthopaedics (DCO) doctrine dictate. However, the occurrence of both FES and ACS in a single fractured long bone is exceedingly rare.

Fat embolism syndrome (FES) is a manifestation of the extensive inflammatory response to systemic fat emboli within the microcirculation, resulting in respiratory, neurological, cutaneous and retinal presentations. FES remains a challenge as there is no consensus on the ultimate diagnostic criteria. The mainstay of FES treatment is supportive. According to Mubarak and Owen,¹ acute compartment syndrome of the extremities is an orthopaedic emergency arising from an increase in pressure within a closed Osseofascial compartment that exceeds the capillary perfusion pressure, causing microvascular compromise. Fasciotomy is definitive of treatment for ACS.²

This case is presented for its uniqueness and complexity of the concomitant complications. To date, no literature is available regarding FES and ACS coexisting together in a patient following a single long bone fracture. A high index of suspicion may lead to preventable mortality and morbidity.

CASE REPORT

An 18-year-old-man with no significant underlying medical illness presented to the emergency room with a closed fracture of the left femur following a road traffic accident (Figure 1). There was no evidence of chest, intra-abdominal, pelvic or other injuries. Vital signs were stable. The corresponding haemoglobin level and platelet count was 15 g/dL and $270 \times 10^3/\mu\text{L}$. At presentation, the left thigh compartment was soft without ecchymosis or erythema. Distal pulses and perfusion of the affected limb were good. High tibial skeletal traction was applied while awaiting definitive fracture fixation. Throughout admission, the thigh circumference increased gradually without a neurovascular deficit. He did not experience disproportionate pain.

Corresponding Author:

Haniza Sahdi, Department of Orthopaedics, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak (UNIMAS), Jalan Datuk Mohammad Musa, 94300 Kota Samarahan, Sarawak, Malaysia; Tel: +6082581000; Fax: +6082665152; Email: hnizas@hotmail.com

ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 16.10.2020

Revised: 12.11.2020

Accepted: 14.12.2020

Published: 23.02.2021

At 23 hours post-trauma, the patient developed acute dyspnea with the sudden drop of oxygen saturation to 85%, spikes of the temperature of 38°C and tachycardia. Petechiae was noted on the chest and axillary area (Figure 2). He did not experience altered sensorium or change in behaviour. Auscultation revealed normal heart sounds and clear lungs. The thigh was tense and its circumference was significantly larger than the unaffected thigh. At this point, the patient complained of increasing thigh pain, worsened by passive flexion and extension of the knee. There was no numbness, paresthesia or muscle paralysis. Distal pulses were present and of symmetrical quality.

Figure 1: Plain radiograph of the patient's left femur.

Figure 2: Photograph showing petechiae over the chest and axillary region of the patient.

There was no evidence of right heart strain on electrocardiography. Arterial blood gases showed Type I respiratory failure with PaO₂ of 52 mmHg and PaCO₂ of 34.8mmHg. Repeated chest x-ray excluded pneumothorax or signs of Acute Respiratory Distress Syndrome (ARDS). There was a drop of haemoglobin and platelet count to 12g/dL and 118x10³/μl, respectively. Haematocrit at that point was 31% and coagulation profile was within the normal range. The diagnosis of fat embolism and impending compartment syndrome of the thigh was established after careful consideration of the patient's initial presentation and clinical course, along with the laboratory results and imaging studies. He was immediately taken to the theatre for fasciotomy and external fixation of the left femur. Upon the fascial release of the anterior and posterior compartments, the muscle tissues protruded from these spaces, suggestive of high intra-compartmental pressure. The muscles rapidly regained normal colour and perfusion once the fascia was released. The medial compartment of the left thigh was soft. No hematoma was found.

He was weaned off oxygen supplement on postoperative day two. Fasciotomy wound and pin sites were dressed daily. Secondary suturing and skin grafting of the fasciotomy wound was done 10 days later. The patient was brought to theatre two weeks after skin closure for intramedullary nail fixation of the left femur. Post-operative recovery was unremarkable.

DISCUSSION

The diagnosis of FES is challenging as it presents in a myriad of non-specific signs and symptoms with no pathognomonic features, although a triad of petechiae, respiratory and neurological symptoms was classically described. FES may reflect a multisystem pathology, resulting from the widespread inflammatory response to systemic fat emboli in the microcirculation.^{1,2} FES is often associated with orthopaedic related trauma, especially in closed pelvic and long bone fractures of the lower extremities.^{3,4} Risk factors of developing FES are male, age 10–40 years, multiple fractures and movement of unstable bone fractures³. The patient discussed here fulfilled two risk factors of FES, viz age group and movement of fracture fragments. The closed femoral fracture in this gentleman was initially immobilized with skeletal traction. The unsecured long bone fracture fragments had probably moved during patient transfer or patient nursing, causing thrombi formation with subsequent release of fat emboli showers into the circulation. Delayed definitive fracture stabilization leads to prolonged activation of the systemic stress response inflammatory types of machinery.

The differential diagnosis considered in this patient for his respiratory failure were FES, pneumothorax, ARDS and pulmonary embolism. Chest x-ray excluded the possibilities of

pneumothorax and ARDS. Pulmonary embolism was less likely due to the short duration of the event and lack of predisposing conditions. The most probable clinical diagnosis was FES.⁴⁻⁷ While there are several sets of diagnostic tools proposed for FES such as the Guard's, Schonfeld's and Lind-eque's criteria, the consensus on the universally accepted gold standard has yet to be reached. One should uphold a high degree of suspicion with the use of clinical criteria, substantiated with imaging methods. Treatment of FES mainly requires aggressive supportive care.

ACS occurs when the interstitial pressure of closed Osseo-fascial compartment is increased to the point of causing microvascular compromise.¹ The most common cause of ACS is traumatic damage to the muscles and vessels within an Osseo-fascial compartment, leading to oedema. Yet, the encircling fascia restricts edematous distension of the compartment. This causes an increase in intra-compartmental pressure. Intracompartmental pressure that exceeds the capillary perfusion pressure will diminish blood supply to the nerves and muscles within the compartment. This vicious cycle if allowed to continue, will result in further insult to the circulation, more oedema, pressure build-up, ischaemia and tissue necrosis.⁵

ACS of the thigh is less common than ACS of the lower leg and forearm.⁶ This may be because the thigh compartments are larger in volume in comparison to the lower leg and forearm. The thigh compartments are encapsulated by thinner and more pliable fascia, thus allowing the thigh compartments to accommodate more expansion.⁷ In addition to that, the thigh compartments are anatomically connected with the hip and gluteal region, which provides extra room for fluid extravasation.⁸

Shakugan et al.⁹ found that younger patients have a significantly higher risk of ACS. They suggested that younger patients generally have larger muscle bulk than the elderly. The larger muscle mass confined in a tight fascia has a compartment that is less forgiving when pressure increases. Their study also showed that gender, mechanism of injury, type of fracture (open versus closed) and fixation method did not significantly influence the occurrence of ACS. Apart from the femur fracture and the young age, the gentleman mentioned in this case report did not suffer from other risk factors of thigh compartment syndrome such as crush injury, excessive thigh contusion or vascular injury.

In a study by Verwiebe, Kanlic, Saller and Abdelgawad,¹⁰ patients with acute compartment syndrome of the leg mainly presented with increasing leg pain, paraesthesia and motor weakness. On the other hand, the same study also reported that the presentation of ACS of the thigh may differ from ACS of the leg as the most consistent clinical findings for ACS of the thigh are tense and edematous thigh.¹⁰

ACS is mostly diagnosed clinically. However, most of the signs and symptoms cannot be elicited in obtunded or unconscious patients or patients who have been given regional block for anaesthesia. Hence, it is necessary to establish the diagnosis of compartment pressure with the help of devices in these patients. There are various invasive and non-invasive techniques and devices for the diagnosis of compartment syndrome. At present, surgical decompression by fasciotomy is the only proven model of treatment.²

CONCLUSION

Our case report represents a unique set of complications whereby FES and ACS of the affected thigh occurred simultaneously after a single long bone fracture. Although what may seem to be a simple presentation of a single long bone fracture, complications that arise can be easily missed, as unseasoned practitioners may be distracted with the multitude of presentations. Maintaining a high index of suspicion is crucial to establish the prompt diagnosis, following which appropriate management can be instituted promptly. Apart from the collective risk factors of FES and ACS in this patient; young age; male gender and long bone fracture that is treated conservatively, the occurrence of concurrent FES and compartment syndrome of the thigh in our patient remains elusive due to lack of a similar reported case. More studies are necessary to calculate the risk of concurrent FES and compartment syndrome.

ACKNOWLEDGEMENT

We would like to extend our gratitude to the family of the patient described here for allowing us to share his details and to the Director-General of Health, Ministry of Health Malaysia for permitting us to publish this case report. We acknowledge the immense help received from the scholars whose articles are cited and included in references to this manuscript. We are also grateful to authors/editors/publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Conflict of Interest: No

Funding: No

Author's Contribution

Haniza Sahdi is the main and author, took the lead to write the paper, wrote the paper with input from all of the authors, conceived and designed the write-up, collected the patient's details, took photographs and supervised the fourth author in the collection of data. Mohamad Zaki Mohd Amin wrote the paper and was in charge of the overall direction and planning. Denis Dian Lee wrote the paper and performed the

analysis of the patient's presentation and investigation results. Cassandra Ting conceived the original idea, collected the patient's details and took photographs of the patient. All authors read and approved the final manuscript.

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