International Journal of Research in Orthopaedics
Kumar SK et al. Int J Res Orthop. 2023 Nov;9(6):1274-1278
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20233277

Case Report

Floating knee with early onset fat embolism: a case report

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Received: 01 May 2023
Accepted: 12 September 2023

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ABSTRACT

Fat embolism syndrome in young adults is most commonly associated with the long bone fractures most commonly femur and tibia. Its concomitance with floating knee is reported scarcely in reviewing the literature. Though it has been proposed that onset of fat embolism presents following an asymptomatic interval for about 24 to 72 hours, our patient developed onset within 8 hours following trauma. This case report is of first in this kind ever reported in the literature. We present a case of 26 year old male patient with floating knee Fraser type 1 and Early Onset Fat Embolism syndrome who developed within 8 hours of injury underwent staged intramedullary nailing of femur and tibia with an excellent functional outcome without any sequelae of fat embolism at 2 year postoperative followup. Appropriate clinical judgement and awareness to suspect fat embolism syndrome and timely immobilisation with proper supportive care and serial reassessment and planned surgery preferably intramedullary nailing in young patient would benefit the patient in toto in case of floating knee with early onset fat embolism.

Keywords: Fat embolism, Floating knee, Early onset

INTRODUCTION

Condition fat embolism was diagnosed initially by Zenker in 1862 in a patient who died from thoracolumbar crush injury. The incidence of fat embolism in long bone fractures varies from 1-30%.[1,2] Mortality rate in fat embolism syndrome varies from 10-20%.[2] As per literature, onset of fat embolism is usually 12-48 hours after injury. The 3 most specific features of fat embolism are respiratory distress, neurologic manifestations and skin petechiae. Respiratory distress is the most common and is usually first manifesting feature in 75% of fat embolism syndrome followed by cerebral manifestation.[3] Criteria's used for fat embolism are Gurd and Wilson, Lindeque and schonfeld criteria.[3] The most reliable and widely used criteria for the diagnosis is Gurd and Wilson criteria which emerged in 1970.[4] Floating knee is another rare phenomenon was originally described by Blake and McBryde in 1975.[5] Later Fraser described a classification for the same.[6] As per reviewing literature concomitance of early fat embolism and floating knee is rare. We present here a case of long term followup with excellent outcome without any deficit in a case of early onset fat embolism as early as 8 h after injury with floating knee Fraser type 1 who underwent delayed staged nailing once general condition was stabilized.

CASE REPORT

A 26 year old gentleman otherwise an healthy individual with no comorbidities was brought within 2 hours of injury to the emergency department with history of road traffic accident when a travelling car collided against a JCB and sustained closed injury to his right lower limb. On receiving in emergency room and assessing vitals, all stable, following which patient subjected to radiological evaluation and was diagnosed as floating knee Fraser type 1 {closed right shaft of femur fracture (AO 32B3), (Figure 1 A) and right leg both bone fracture (AO 42A2), (Figure 1 B)}. Patient was planned for surgical fixation on next day-closed reduction and Intramedullary interlocking nailing of either femur/tibia / both based on hemodynamic stability and assessment intra-op. Hence temporarily patient immobilised and splinted in form of an extended

above knee plaster of paris slab with side supports. On admission random blood glucose was 416, the routine blood samples patient revealed HBA1C of 10.9 for which injection. Actrapid was titred and given for achieving glycemic control. His other inflammatory, blood and renal parameters were normal on admission.

Figure 1 (A and B): X-ray of right femur shaft fracture-AO32B3 and right leg both bone fracture-AO42A2.

Following admission and exactly 8 hours after injury, on reviewing the patient, he seemed lethargic and on further questioning and assessment, patient was dyspnoeic with fall in oxygen saturation (SpO_2) of around 92% in room air for which initially he was started on 4 L nasal O_2, during which the emergency team was called for and then further SpO_2 started to fall to 80% even with nasal O_2 8 litres and the patient was disoriented and had an episode of seizure, following which patient was shifted to the intensive care unit, In the course of Intensive care unit admission, patient developed petechiae over chin and the back of trunk. Patient developed a fever spike with maximum upto 103.6 F with falling hemoglobin upto 8.9 and platelet upto 61000 and constant tachycardia above 110/minute was present. A diagnosis of Fat embolism syndrome was made according to Gurd and Wilson criteria with all the major criteria and 3 of minor criteria/Schonfeld's score-16.

Investigations

Blood parameters showed total count 16100/mm^3, D-Dimer 6.91 mcg/ml with CPK was 3840U/L on day 1, checked after shifting to intensive care unit. Urine for fat globules were negative.

Regular chest radiographs (Figure 2) were done which showed increased bronchovascular markings progressed to have bilateral ground glass opacities. CT pulmonary (Figure 3 upper right and left) angiography was done which showed bilateral pulmonary emboli and CT thorax (Figure 3 lower right and left) showed bilateral ground glass opacities with nodules. MRI brain (Figure 4) was done which showed (Non hemorrhagic infarcts over bilateral cerebral hemispheres). Echocardiogram showed no evidence of pulmonary embolism. Colour venous doppler of both lower limb showed no evidence of deep vein thrombosis. EEG was done which showed diffuse cerebral dysfunction.

Table 1: Investigations.

Blood parameters	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Hemoglobin (g/dl)	13.9	11.6	9	8.9	9	9	9.8
Platelets (lakh/mm^3)	2.6	0.92	0.65	0.61	0.75	1.10	2.94
Total count (cells/mm^3)	16100	10500	5800	13700	8700	7900	5600

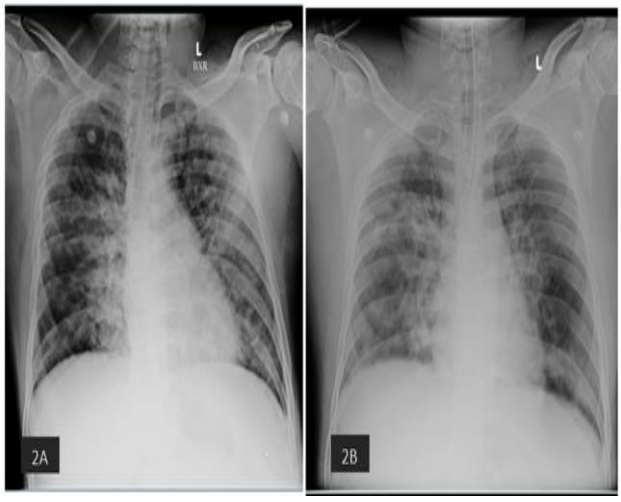

Figure 2 (A and B): Day-1 chest radiographs shows increased bronchovascular markings and day 2 chest radiographs shows bilateral ground glass opacities.

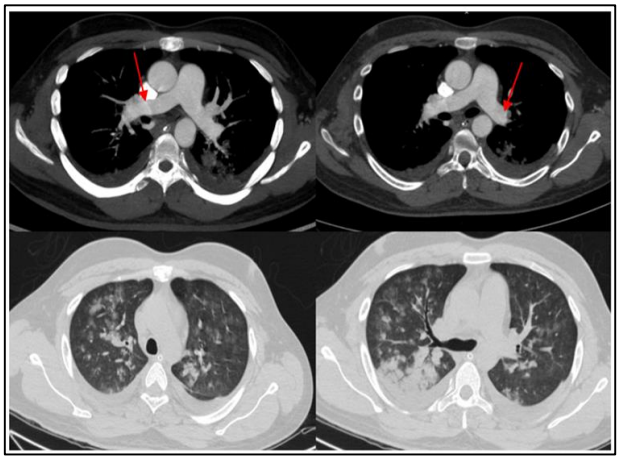

Figure 3: CT pulmonary angiography (Upper right and left) showing right and left pulmonary artery emboli (red arrows). CT thorax (Lower right and left) showing bilateral ground glass opacities with nodules.

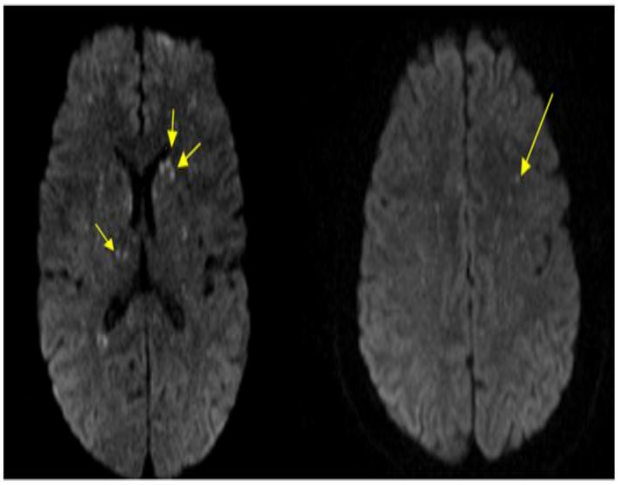

Figure 4: MRI brain shows non hemorrhagic infarcts (yellow arrows) over bilateral cerebral hemispheres.

Treatment

As soon as the seizure was observed, inj. Fosphenytoin loading dose was given and was shifted to intensive care unit, intubated and was put on mechanical ventilation. In view of suspected fat embolism injection methyl prednisolone 100 mg/day was started, given for three days. Appropriate blood products were transfused to improve the platelet count and the drop in hemoglobin. Higher antibiotics such as inj. piperacillin tazobactum 4.5 mg thrice daily was given as a prohylaxis for sepsis. Patient was put on inj. Heparin 0.6 cc once day and injection. Fosphenytoin 150 mg twice a day during the course. Insulin was given to maintain blood sugar level. After all these treatments patient improved and was extubated after 12 days and was maintained in continuous positive airway pressure (CPAP) ventilation for 2 days and then shifted to ward and was kept in observation for 10 days nasal O_2 for 5 days. Then the patient underwent right femur closed reduction and IMIL nailing (Figure 5 A and B) as first procedure with heedful reaming and after a week, right tibia closed reduction and IMIL nailing (Figure 5 C) was done with heedful reaming as second procedure to avoid the complication of excessive reaming. Patient was started Non weight bearing mobilisation of right lower limb and was discharged with metered dose Insulin for diabetic control and T. Aspirin 75 mg once a day for 3 months and T. Fosphenytoin 150 mg once a day for 1 month.

Outcome and follow-up

Patient had mild dis-orientation which was resolved 1 month after discharge. Patient was reviewed 6 weeks post operatively with radiographs (Figure 6 A and B) and was started on partial weight bearing of right lower limb. At 10 weeks post operative period, based on fracture healing evidence in X-ray patient was started on full weight bearing mobilisation. Patient had a loss of 30 degree flexion of knee at 10 weeks post-op for which physiotherapy (Continuous passive motion) was done to attain full ROM. Then the patient was reviewed at every 3 months interval and he achieved excellent radiological union (Figure 7 A-D) with no residual deformity (Figure 8) at the end of 2 year follow up. Patient is healthy at present with no neurological disturbance and no impairment in the activities of daily living.

Figures 5 (A-C): Immediate postoperative radiographs of IMIL nailing of femur and tibia.

Figures 6 (A and B): Weeks postop radiographs of femur and tibia with evident abundant callus.

Figures (7 A-D): Two years postoperative radiographs shows excellent radiological union of femur and tibia.

Figure 8: Two years post operative clinical images showing complete range of motion of right and knee without any residual deformity.

DISCUSSION

Fat embolism syndrome is most commonly associated with the long bone fractures in young adults. Its concomitance with floating knee is a rare phenomenon as per reviewing literature. It was not evident in literature to quote even a single case report emphasizing early fat embolism syndrome with floating knee. Risk factors for fat embolism are male gender, age 10-40 years, multiple fracture, inadequate fracture stabilization conversely movement at the fracture site. The mechanism of fat embolism is poorly understood. The theories proposed for fat embolism are

Mechanical theory, described by Gossling et al states that increased intramedullary pressure after an injury forces marrow to pass into injured venous sinusoids causing large fat droplets to be released into the venous system.[7] These fat droplets then travel to the lungs and occlude pulmonary capillaries and systemic vasculatures. They can also enter the arterial circulation via a patent foramen ovale or directly through the pulmonary capillary bed, causing the characteristic neurological and dermatologic findings of FES.

Biochemical theory, described by Baker et al states that the clinical manifestations of FES are attributable to a proinflammatory state.[8] Local hydrolysis of triglyceride emboli by tissue lipase produces glycerols and toxic-free fatty acids. These intermediate products lead to an injury to pneumocytes and pulmonary endothelial cells causing vasogenic and cytotoxic edema leading to a development of acute lung injury or respiratory distress syndrome. The biochemical theory helps explain the non-orthopaedic forms of FES.

In 1975, Blake and McBryde established the concept of the 'floating knee' to describe homolateral fractures of the femur and tibia, where the knee is disconnected from the rest of the limb.[5] Type I (71%) constitutes the true 'floating knee' in which neither the femoral nor the tibia fracture extends to the knee, instep or hip. Type II (29%) is a variant in which one or both fractures involve the knee. In 1978, Fraser classified type II according to knee injury type.[6] Type IIa (8%) is a tibia plateau fracture associated with a femoral shaft fracture, type IIb (12%) is an articular fracture of distal femur associated with a tibial shaft fracture and type IIc (9%) is a fracture of the tibia plateau and articular fracture of the distal femur.

Although it has been proposed an asymptomatic interval of fat embolism for about 24 to 72 hours, our patient presented in 8 hours. One case has been reported with manifestation of fat embolism as early as 6 hours as per literature. Hypoxia is the most common finding, presenting in 96% of patients.

Neurological manifestation is seen in 86% of patients.[2,4,9] Symptoms are usually nonspecific, for example, headache, acute confusion, convulsion, or as severe as coma. Dermatologic manifestation is usually seen within 24 to 36 hours and usually distributed in nondependent regions of the body such as conjunctivae, head, neck, anterior thorax. Other nonspecific symptoms include fever, thrombocytopenia, jaundice, lipuria, haematuria, and retinopathy.[2] In severe cases, FES can be complicated by disseminated intravascular coagulation, right ventricular dysfunction, shock, and death. There are no universal criteria for diagnosis of FES. Diagnosis is made by clinical suspicion and characteristic findings on imaging methods. However, there have been three previously proposed criteria by different authors: Gurd and Wilson, Schonfeld and Lindeque.[4,10,11]

Gurd's criteria are used most widely, and the diagnosis of FES requires at least two major criteria or one major criterion plus two minor criteria. In Schonfeld's criteria diagnosis of FES requires score>5. In Lindeque's criteria, FES can be diagnosed using respiratory parameters alone. Gurd and Wilson criteria is widely used to diagnose fat embolism on clinical grounds. Our patient had all the three major criteria and 5 minor criteria. The main stay of treatment given in our patient for fat embolism were oxygen, steroids and heparin, with proper immobilisation.[12] Early administration of steroids as soon as the fat embolism is suspected reduces the lung complications.[13]

The floating knee has to be stabilised with proper splintage or better the external fixator despite the presence of fat embolism or the timing of surgery. Ríos et al pointed out single incision dual retrograde nailing for floating knee prevents overall exposure, intervention and implant installation time.[14] Dahmani et al obtained better results using single knee incision technique for intramedullary nailing of both femur and tibia.[15]

In our case staged anterograde nailing one week apart was done for femur first followed by tibia to prevent further fat

emboli due to excessive reaming for both femur and tibia simultaneously. Early diagnosis of fat embolism in clinical grounds with appropriate investigations and timely intervention both medical and surgically gives extremely good results in the patients developing early onset fat embolism.

Employment of damage control orthopaedics vs early total care in case of polytrauma, floating knee stands as debate always. Early total care in floating knee with intramedullary nailing even in a stable young patient without lethal triad will worsen the pulmonary complications such as fat embolism syndrome that leads to second hit and worsen the outcome.[16,17] Damage control orthopaedics (DCO) as in our patient will always prevent the second hit and reduce the pulmonary complications and leads to better outcome in case of floating knee and polytrauma, hence DCO is suggested.

CONCLUSION

It is not necessary that the fat embolism occurs after 24 hours. Early onset fat embolism can occur as early as 12 hours also. All the young adults with long bone fractures should be carefully observed. Fat embolism should be suspected whenever the patient becomes dyspnoeic during hospital stay. Early prophylactic treatment with steroid methylprednisolone 100 mg intravenous once daily and heparin 5000 units intravenous or low molecular weight heparin (0.4 cc or 0.6 cc) should be started whenever fat embolism is suspected which decreases the disease severity. Appropriate glycemic control should be done and prophylactic broad-spectrum antibiotic should be used to prevent full blown sepsis. Neurological recovery will be complete in case of early diagnosis of fat embolism and appropriate treatment. Damage control orthopaedics should be followed in case of suspected or diagnosed fat embolism in case of floating knee.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Kumar SK, Deva, Thirunthaiyan. Floating knee with early onset fat embolism: a case report. Int J Res Orthop 2023;9:1274-8.