

Case Report

Premonitory hypoxia as an early indicator of perioperative fat embolism syndrome following closed tibial fracture: a case report

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ABSTRACT

Fat embolism syndrome (FES) is an uncommon but potentially life-threatening complication of long-bone fractures. Early diagnosis is challenging due to subtle and nonspecific initial manifestations, particularly in isolated injuries. We report a case of a young adult with an isolated closed tibial shaft fracture who developed unexplained preoperative hypoxia followed by rapid postoperative deterioration consistent with FES. A 24-year-old male developed hypoxia (SpO₂ 89% on room air) on the third day following injury without any clinical respiratory symptoms. After undergoing reamed intramedullary nailing, he developed acute respiratory distress, fever, thrombocytopenia, and bilateral pulmonary infiltrates. Infective causes were ruled out, and a diagnosis of FES was established using Gurd and Wilson's criteria. The patient was managed with noninvasive ventilation and supportive care, resulting in gradual recovery over 10 days. Unexplained preoperative hypoxia may represent an early manifestation of FES. Early recognition and vigilant perioperative monitoring are essential to prevent rapid deterioration and improve outcomes.

Keywords: Fat embolism syndrome, Tibial fracture, Hypoxia, Intramedullary nailing, Acute lung injury

INTRODUCTION

Fat embolism syndrome (FES) is a rare but potentially serious complication most commonly associated with long-bone fractures, particularly of the femur and tibia. It is classically characterized by the triad of hypoxia, neurological impairment, and petechial rash, although not all features are present in every patient, making early diagnosis difficult.¹

The underlying pathophysiology involves both mechanical obstruction of pulmonary vasculature by fat globules and a subsequent inflammatory response.² Clinical manifestations typically develop within 12-72 hours following injury; however, delayed and perioperative presentations have also been reported.³

Although FES is more commonly associated with high-energy trauma, it may also occur in isolated fractures in otherwise healthy individuals. This highlights the importance of maintaining a high level of suspicion even in apparently low-risk cases.

We report a case of FES following an isolated tibial shaft fracture, notable for the presence of unexplained preoperative hypoxia as an early warning sign, followed by rapid postoperative deterioration.

CASE REPORT

A 24-year-old male presented with pain, swelling, and deformity of the right leg following a fall from a height of approximately 15 feet. He was hemodynamically stable with no associated head, chest, or abdominal injuries.

Radiographs revealed a midshaft tibial fracture with minimal displacement and an associated fibular fracture (Figure 1).

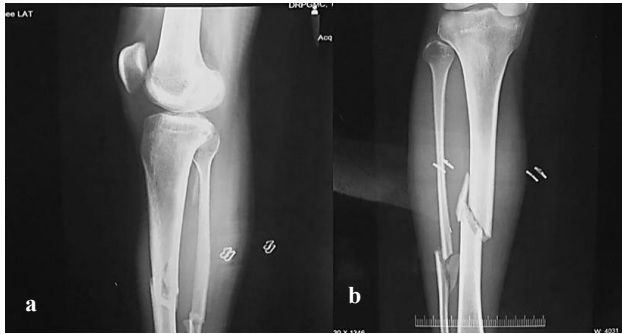


Figure 1 (a and b): Anteroposterior and lateral radiographs of the leg demonstrating a midshaft tibial fracture with minimal displacement associated with an ipsilateral fibular shaft fracture.

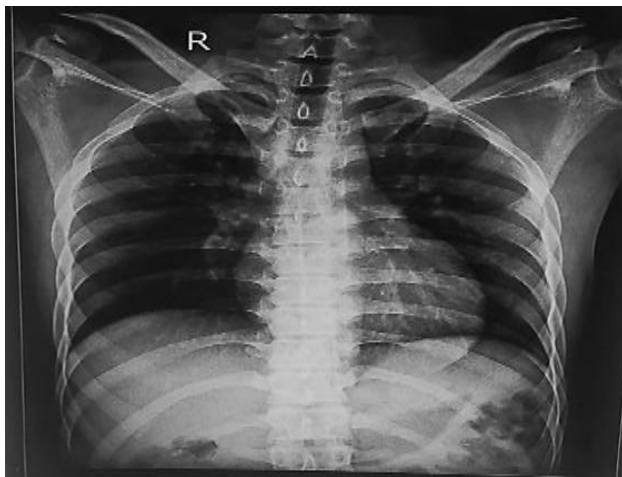


Figure 2: Anteroposterior chest radiograph taken at the time of admission showing no evidence of pulmonary infiltrates, effusion/other abnormalities.

Baseline investigations, including chest radiography, were normal (Figure 2). The patient was planned for intramedullary nailing.

On the third day post-injury, the patient had an oxygen saturation of 89% on room air before being transferred to the operating room. He denied any symptoms such as dyspnea, cough, chest pain, or fever. Clinical examination was otherwise unremarkable, and he had been cleared for surgery during pre-anesthetic evaluation.

After appropriate counseling regarding possible postoperative ventilatory support, reamed intramedullary nailing was performed under spinal anesthesia (Figure 3). The intraoperative course was uneventful.

In the immediate postoperative period, the patient developed acute respiratory distress, tachypnea (35/min), tachycardia (HR 124/min), and fever (38.5°C). Arterial

blood gas analysis showed severe hypoxemia (pO_2 29.7 mmHg). Chest auscultation demonstrated bilateral crepitations.



Figure 3 (a and b): Immediate postop anteroposterior and lateral radiographs of leg demonstrating satisfactory fracture reduction and stable fixation with an intramedullary nail.

Chest radiography revealed diffuse bilateral alveolar infiltrates, suggestive of acute lung injury (Figure 4). Laboratory investigations showed a considerable drop in hemoglobin (from 12.4 g/dl preoperatively to 7.9 g/dl), thrombocytopenia ($86,000/mm^3$), and an elevated ESR (80 mm/hr).

Further evaluation, including CT brain and echocardiography, was normal. Infective causes were ruled out, with negative blood cultures and COVID-19 testing.

A diagnosis of FES was made based on Gurd and Wilson's criteria, with the presence of major criteria (hypoxia, respiratory insufficiency) and minor criteria (tachycardia, fever, anemia, thrombocytopenia).⁴

Table 1: Serial laboratory and clinical parameters.

Parameters	Pre-operative	Post-operative	Peak
Hemoglobin (g/dL)	12.4	9.5	7.9
Platelets ($/mm^3$)	Normal	110,000	86,000
SpO₂ (%)	89	85	<85
pO₂ (mmHg)	-	40	29.7
ESR (mm/hr)	Normal	-	80

The patient was managed in the intensive care unit with noninvasive ventilation (CPAP), oxygen supplementation, blood transfusion, and supportive care. Over the next 10 days, his clinical condition gradually improved, with the resolution of respiratory symptoms and radiographic findings.

At discharge, the patient was stable, maintaining oxygen saturation above 97% on room air. At 3-month follow-up,

he had regained full functional mobility without residual complications.

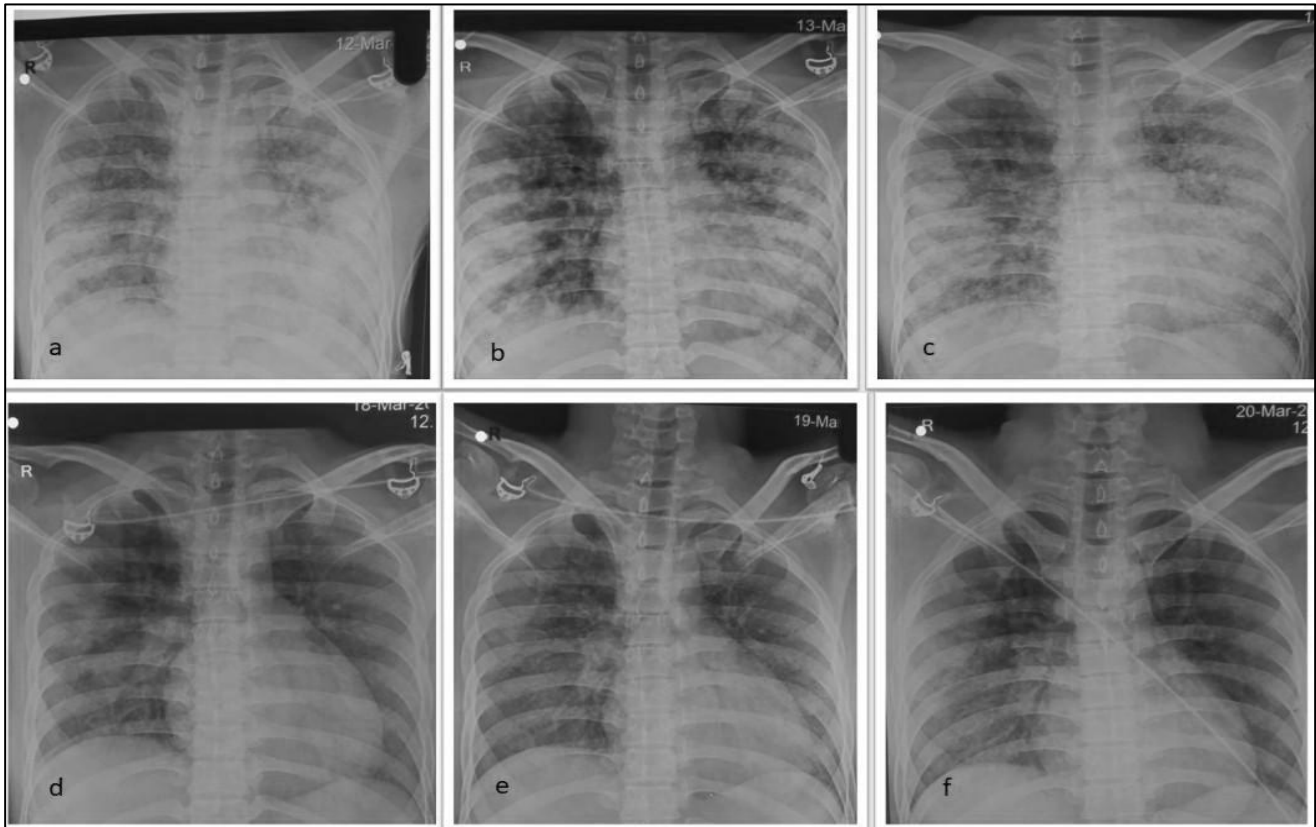


Figure 4: Serial chest radiographs taken in the ICU. (a-c) Progressive bilateral diffuse alveolar infiltrates in the immediate postoperative period, consistent with acute lung injury/ FES. (d-f) Gradual radiographic resolution over subsequent days with supportive management.

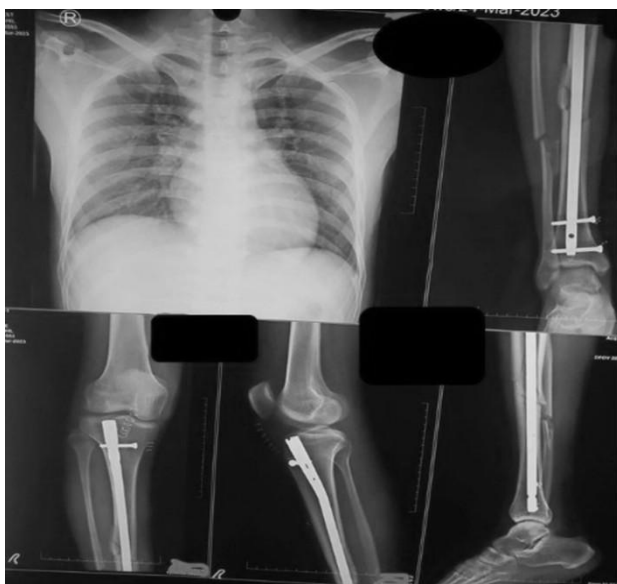


Figure 5: Radiograph obtained prior to discharge showing complete resolution of pulmonary infiltrates on chest X-ray, with a well-positioned intramedullary implant and satisfactory alignment of the tibial fracture.

DISCUSSION

FES remains a challenging diagnosis due to its variable and often subtle presentation. This case is particularly significant due to the presence of unexplained preoperative hypoxia, which likely represented an early or subclinical manifestation of FES.

Hypoxia is often the earliest and most sensitive indicator of FES. In this case, the presence of hypoxia without clinical symptoms before surgery highlights the importance of careful preoperative assessment and monitoring. Such findings may warrant increased vigilance or reconsideration of surgical timing.

Intramedullary nailing, especially with reaming, is associated with increased intramedullary pressure, which may lead to embolization of fat particles into the circulation. While reamed nailing remains the standard of care, it may increase the embolic load. However, FES has also been reported with unreamed techniques, suggesting that multiple factors contribute to its pathogenesis.⁵ Preventive strategies for FES remain controversial but include early fracture stabilization, careful intraoperative techniques to minimize embolic load, and close

perioperative monitoring. The role of corticosteroids remains controversial.⁶

This case stresses the importance of recognizing early warning signs such as unexplained hypoxia and emphasizes the need for preparedness for rapid clinical deterioration. Prompt supportive management in an intensive care setting continues to be the cornerstone of treatment and is associated with favorable outcomes.

This case is reported in accordance with CARE guidelines for case reporting.

CONCLUSION

FES is an uncommon but potentially serious complication that may present with subtle early signs. Unexplained preoperative hypoxia, even in asymptomatic patients, may represent an early manifestation of FES and should not be overlooked.

Early recognition, vigilant perioperative monitoring, and timely supportive management are essential to improve clinical outcomes.

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