# Fat Embolism Syndrome Secondary to Short Bone Fracture: Case Presentation

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**ABSTRACT**

**Introduction:** We present the clinical case of a 15-year-old male who sustained fractures to the short bones of his right foot as a result of a traffic accident. After 24 hours of evolution, he was admitted for dyspnea, desaturation, an objective febrile peak, and the development of respiratory failure. Given the clinical suspicion of fat embolism syndrome, pulmonary CT angiography was requested, which confirmed the diagnosis. This is a rare finding in patients with this type of fracture. The initial treatment included close monitoring in the intensive care unit, supportive measures such as supplemental oxygen, respiratory therapy, and surgical fracture management. The patient's clinical progression was adequate, and the respiratory condition resolved completely. **Conclusion:** Fat embolism syndrome resulting from short bone fractures is a rare condition; therefore, it is necessary to have a high level of diagnostic suspicion, not only in the most common scenarios, but also in these unusual and challenging contexts, which allows for its early detection and, as a result, timely management, which has a positive impact on clinical outcomes and reduces the risk of long-term sequelae.

**Keywords:** Fat embolism; bone fractures; respiratory insufficiency.

**Level of Evidence:** IV

**Síndrome de embolia grasa secundario a fracturas de huesos cortos: Presentación de casos**

**RESUMEN**

Se presenta el caso clínico de un varón de 15 años con fracturas de huesos cortos del pie derecho como consecuencia de un accidente de tránsito. Tras 24 h de evolución, ingresa con disnea, desaturación, pico febril objetivo y posterior desarrollo de insuficiencia respiratoria. Ante la sospecha clínica de síndrome de embolia grasa, se solicita una angiotomografía pulmonar que confirma el diagnóstico. Se trata de una entidad inusual en pacientes con este tipo de fractura. El tratamiento inicial consistió en vigilancia estrecha en la unidad de cuidados intensivos, medidas de soporte con oxígeno suplementario, terapia respiratoria y manejo quirúrgico de las fracturas. La evolución clínica del paciente fue adecuada y el cuadro respiratorio se resolvió por completo. **Conclusiones:** El síndrome de embolia grasa secundario a fracturas de huesos cortos es un cuadro infrecuente; por lo tanto, es preciso tener un alto grado de sospecha diagnóstica, no solo en los escenarios más comunes, sino también en este tipo de contextos inusuales y retadores, que permita su identificación temprana y, de esta forma, implementar un manejo oportuno y generar un impacto favorable en los desenlaces clínicos y en la disminución del riesgo de secuelas a largo plazo.

**Palabras clave:** Embolia grasa; fracturas; insuficiencia respiratoria.

**Nivel de Evidencia:** IV

## INTRODUCTION

Fat embolism is the presence of fat globules in the systemic circulation, mainly in sites of increased vascularization, such as the lungs and brain, while fat embolism syndrome refers to the clinical manifestations that appear as secondary complications of fat embolism.[1]

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Fat embolism is much more frequent and, in general, its course is benign compared to that of fat embolism syndrome, which can generate high morbidity and mortality. It is more common in men between 10 and 40 years of age, and the estimated incidence ranges from 1% to 30%, depending on the diagnostic criteria used, pathological history and clinical context. It is not commonly associated with orthopedic trauma, particularly fractures of long bones such as the femur and tibia, but it has been reported in patients with fractures of short bones as well as cases of non-orthopedic ailments or contexts such as pancreatitis, sickle cell anemia crisis, bone marrow transplantation, or aspiration and liposuction.[2]

Due to its heterogeneous presentation and non-specific symptoms, the diagnosis is complex and exclusionary, relying on a combination of physical examination findings, laboratory testing, imaging studies, and the use of multiple scales as diagnostic aids.[3]

Treatment focuses on implementing prophylactic behaviors, such as immobilization and early surgical fixation, or, if that fails, managing the underlying cause, symptom control, and supportive measures, such as ventilatory support.[4]

The aim of this case report is to highlight the high diagnostic suspicion of fat embolism syndrome in this scenario, manifested as respiratory failure in an atypical context, such as short bone fractures of the foot, and its timely therapeutic approach provided by early surgical treatment associated with clinical care, hemodynamic and supportive measures with adequate evolution and complete resolution of the picture.

## CLINICAL CASE

A 15-year-old male, student, with no significant medical history, suffered a motorcycle accident and sustained trauma to the right lower limb. Initially, he was taken to the local low complexity hospital, where he underwent debridement of the wound in the right foot, and was left under clinical observation for pain control. Twenty-four hours after the trauma, he had tachycardia, fever and desaturation.

After 30 h, he was transferred and admitted to our high complexity institution, with vital signs and the following parameters: blood pressure 114/67 mmHg, heart rate 123 beats/min, respiratory rate 21 breaths/min and oxygen saturation of 82%, so he was administered supplemental oxygen by nasal cannula and reached saturation goals >90%, with no clinical signs of respiratory failure.

The initial physical examination revealed edema on the dorsum of the right foot, mostly in the region of the first metatarsal to the distal phalanx of the hallux, with a wound on the medial aspect and no active bleeding or distal neurovascular deficit. There was no evidence of traumatic brain injury, thoracoabdominal trauma, or other trauma-related symptoms or pathology findings.

Basic laboratory tests revealed no anemia, leukocytosis, renal failure, or electrolyte imbalance, and arterial gases were free of acidosis, hypoxia, or hyperlactatemia.

Radiographs were requested to define the bone involvement, and a closed intra-articular fracture of the distal phalanx of the hallux, a comminuted open fracture of the first metatarsal, and an avulsed bone fragment in the dorsum of the navicular were discovered (Figure 1). Consequently, he was immobilized with a short leg splint and received antibiotic therapy with cefazolin 2 g intravenously every 8 hours for 72 hours, as per the institutional protocol. The Orthopedic Service physicians scheduled a cleaning, debridement and surgical correction of the fractures.

On the same day, he was evaluated by the Internal Medicine physicians who, in view of the clinical picture, requested a pulmonary CT angiography. The official report from Radiology ruled out pulmonary thromboembolism, consolidating foci, contusions, pulmonary lacerations, pneumothorax, pleural effusion or atelectasis, but noted patchy ground-glass opacities, some of nodular appearance, mainly involving the left upper and right lower lobes and, to a lesser extent, the subpleural region of the right apex, confirming fat embolism (Figure 2).

Within 12 hours of admission, the patient displayed clinical deterioration, increased oxygen requirement, desaturation, and hypoxemic respiratory failure, so it was indicated to continue support management with oxygen therapy and respiratory incentive. The patient was immediately transferred to the Intensive Care Unit, and an immediate surgical procedure was authorized, which was performed without complications and involved cleaning and debridement of the wound in the foot, bone curettage, and open reduction and osteosynthesis of the right first metatarsal (Figure 3).

**Figure 1.** Anteroposterior, lateral and oblique radiographs of the right foot showing a closed intra-articular fracture of the distal phalanx of the hallux, a comminuted fracture of the first metatarsal and an avulsed bone fragment on the dorsum of the navicular bone.

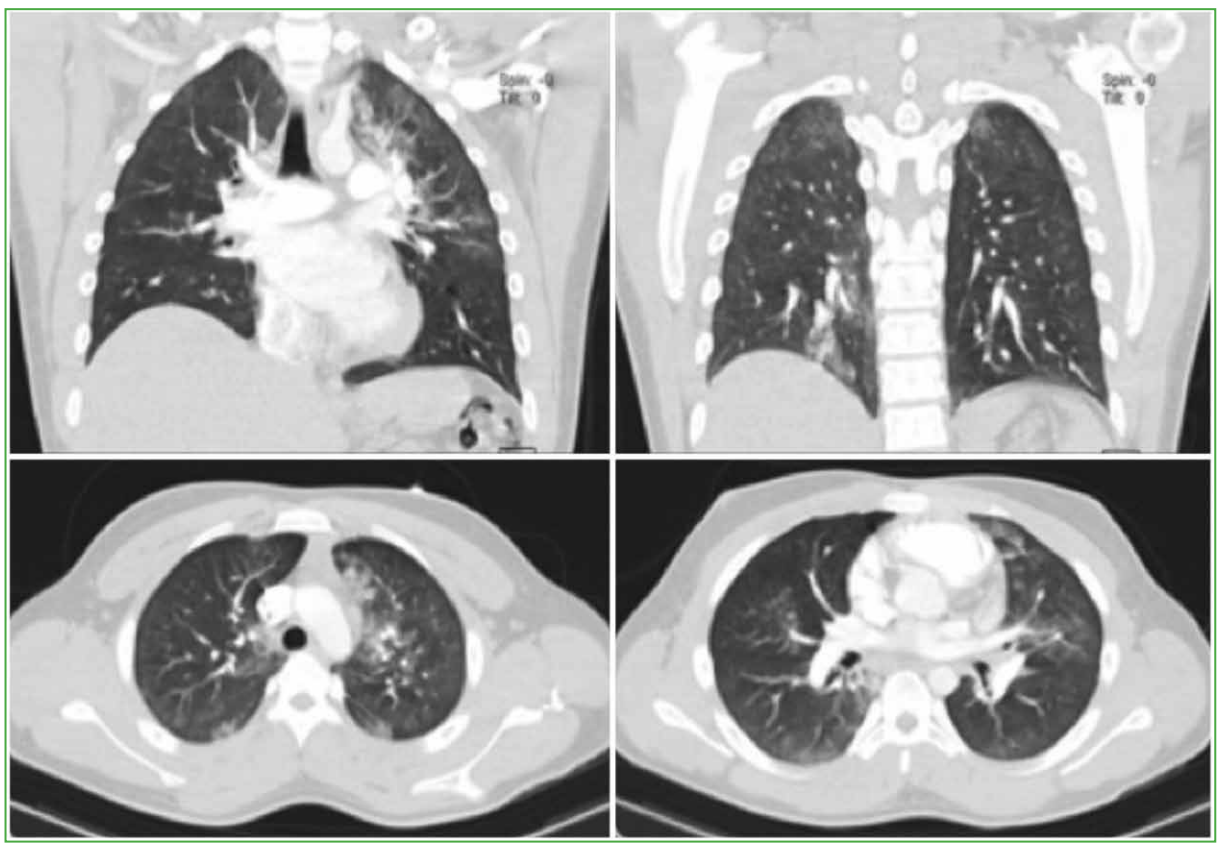

**Figure 2.** Pulmonary CT angiography with findings of fat embolism syndrome.

**Figure 3.** Anteroposterior and oblique radiographs of the right foot showing the postoperative outcome.

The patient evolved adequately following the operation. He continued with analgesia, which resulted in satisfactory pain control. He made progress with nutrition. He progressed with respiratory therapy and incentive, and oxygen reduction was initiated, with good tolerance until discontinuation was accomplished on day four.

The patient was transferred to a general ward without clinical or respiratory deterioration, with normal hemodynamic variables; symptoms resolved seven days after hospital admission.

## DISCUSSION

Fat embolism is frequent in patients with long bone and pelvic fractures, but most do not present with signs suggestive of fat embolism syndrome, which is considered a diagnosis of exclusion. It manifests with respiratory and neurological symptoms, as well as a skin rash, but its presentation is heterogeneous and non-specific, and not everyone develops this clinical triad, so other factors are considered, such as laboratory test results, imaging studies, and diagnostic criteria, while keeping in mind that no finding is pathognomonic of the disease.[5]

In this case report, it is demonstrated how only respiratory symptoms and pulmonary involvement evidenced by increasing hypoxemia until respiratory failure, as well as CT angiography findings, led to the diagnosis of fat embolism syndrome.

When examining the current identification criteria, none are standardized for systematic application or provide diagnostic confirmation, but the combination of the Gurd and Wilson criteria, as well as the Lindeque criteria, is widely accepted.[1]

In the literature review, only two meta-analyses evaluating the clinical characteristics of patients with fat embolism syndrome stand out: one limited to a specific subpopulation of patients who develop the entity after musculoskeletal trauma and another in which the disease manifests itself due to any cause. In both, it was concluded that, although it is a rare condition, it was more frequently associated with fractures of long bones, mainly of the femur and, secondarily, of the tibia and fibula. [6,7]

Likewise, there are some case reports that are anatomically close to our case. Ramirez and Dawkins published the appearance of the syndrome in a 36-year-old man with fracture-dislocation of the right talus and fracture of the head of the fourth and fifth right metacarpals due to a traffic accident. 48 h after admission, he began with dyspnea, desaturation, right pleuritic pain, tachypnea and tachycardia, without neurological deficit, so he was transferred to the Intensive Care Unit, where a thorax CT scan with contrast showed bilateral alveolar infiltrates of basal predominance suggestive of fat embolism. The patient had an adequate clinical evolution with supportive measures.[8]

In 2016, Gonzalez Murillo et al. described a 24-year-old patient with an open right calcaneal fracture caused by a gunshot wound. 24 h after the trauma, he started with fever, restlessness, tachypnea and desaturation, and it was decided to administer corticosteroids and oxygen therapy in a high dependency unit. The diagnosis was confirmed with a thorax CT scan that revealed a patchy, bilateral and diffuse ground-glass pattern, with small areas of alveolar and distal bronchiolar involvement, predominantly peripheral.[9]

In general, the pillars of treatment are similar and none is specific to the entity; they are based on early diagnosis, initial stabilization measures, hemodynamic and respiratory support, and correction and management of the underlying cause. In cases involving fractures, it is critical to execute behaviors such as immobilization, early surgical correction, and finally rehabilitation.[4]

## CONCLUSIONS

Fat embolism syndrome secondary to short bone fractures is a rare condition that requires a high degree of diagnostic suspicion, not only in the most common scenarios, but also in this type of unusual and challenging contexts. Its early detection and timely management generates a favorable impact on clinical outcomes and reduces the risk of long-term sequelae.

Conflict of interest: The authors declare no conflicts of interest.

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