



## Case Report

# Case Report of Fat Embolism Syndrome – Sequelae of Encephalopathy from a Traumatic Humerus Fracture

Hojin Seo<sup>1</sup>, Bradley Wallace<sup>2\*</sup>

<sup>1</sup>College of Osteopathic Medicine, Rocky Vista University, Parker, Colorado, USA.

<sup>2</sup>Surgery, Memorial Central Hospital, UC Health, Colorado Springs, Colorado, USA.

\*Corresponding author: Bradley Wallace, Surgery, Memorial Central Hospital, UC Health, Colorado Springs, Colorado, USA.

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### Abstract

This case report details a rare and critical complication involving a fat embolism syndrome leading to a cerebrovascular accident (CVA) in a 62-year-old woman following a humeral fracture. The patient's initial presentation of a displaced right humeral fracture was planned to be managed during outpatient orthopedic follow-up. However, a subsequent return to the emergency department for altered mental status prompted diagnostic imaging, revealing acute multifocal infarcts consistent with fat embolism CVA secondary to the humeral fracture. Fat embolism syndrome (FES) is usually associated with orthopedic trauma of the femur or pelvis. This case highlights the importance of recognizing atypical presentations of fat embolism syndrome and necessitates a multidisciplinary approach for prompt intervention in managing patients with orthopedic trauma and complications.

**Keywords:** Fat Embolism Syndrome; Humerus Fracture; Encephalopathy; Cerebrovascular Accident; Corticosteroid

### Introduction

Fat embolism syndrome (FES) is a rare and potentially life-threatening complication that typically arises in the context of long bone fractures, with the most commonly implicated sources from femoral and pelvic orthopedic trauma [1]. The mechanical pathogenesis of FES proposes that fat from disrupted bone marrow enters torn venules following trauma [2]. These emboli then collect and obstruct the pulmonary vasculature, which may lead to right ventricular failure and obstructive shock. The fat emboli may also pass through a patent foramen ovale (PFO) and enter the systemic circulation [3]. While the majority of reported cases involve lower limb fractures, this case report explores a unique occurrence in a 62-year-old woman who developed FES after a displaced humeral fracture. This introduction sets the stage for an in-depth examination of the case's clinical details, management approaches, and implications, offering additional contributions to the understanding of FES beyond conventionally implicated long bone sites.

### Case Presentation

A 62-year-old female with no contributing past medical history presented to the emergency department after a mechanical fall over a gate, landing on her right side. She initially complained of right-sided neck, shoulder, and upper arm pain that radiated down her entire arm. She denied any weakness or numbness in these areas. On examination, she had an obvious deformity to her right humerus, with no gross or focal neurological deficits. Strength testing was limited in her right upper extremity secondary to the injury, but her sensation appeared intact over the ulnar, median, and radial nerve distributions in the right wrist and hand, with distal extremity strength and range of motion fully intact. X-ray of the right arm demonstrated a closed displaced spiral fracture of the humeral shaft (Figure 1). Due to her complaint of neck pain, a CT head and neck was ordered which showed no acute intracranial hemorrhage, acute territorial infarct, or mass effect, nor any acute traumatic injury involving the cervical spine. At her request, the patient was discharged with planned outpatient orthopedic follow-up.



**Figure 1:** Right Humerus Fracture

Two days later the patient returned to the emergency department with altered mental status and slurred speech, with the last known normal over 12 hours prior to arrival. She was admitted to the intensive care unit with an MRI demonstrating scattered areas of acute cerebral infarction throughout the right frontoparietal region, right occipital lobe, and bilateral cerebellar hemispheres. A transthoracic echocardiogram demonstrated a small right to left interatrial shunt consistent with a patent foramen ovale (PFO). Doppler studies of bilateral upper and lower extremities were negative for deep vein thromboses (DVT). She subsequently underwent an open internal fixation of the right humerus. Post-operatively she slowly improved her neurological deficits though continued to show a radial nerve palsy, with full resolution of her aphasia by discharge. She was discharged with ongoing therapy, neurology, and cardiology follow up additional to her primary care and orthopedic management.

**Discussion**

This case presents a unique scenario of Fat Embolism Syndrome (FES) manifesting secondary to a displaced humeral fracture in a 62-year-old woman. The distinction of this case lies in its departure from the conventional association of FES with lower limb fractures, particularly involving the femur and pelvis. Additionally, orthopedic complications of FES are highest in ages 10-40 and are more common in men rather than women [1]. Our patient did not fall into any of the high-risk categories.

The mechanical theory of FES involves the release of fat from disrupted bone marrow leading to emboli formation, which subsequently can occlude and compromise the pulmonary vasculature obstruction. However, this model fails to acknowledge the delay from the inciting event (i.e. orthopedic trauma) to the clinical presentation of FES [4]. A further model of biochemical pathogenesis theory extends the theory to include production of pro-inflammatory lipid mediators after the trauma, that degrade and agglutinate the fat, which may explain why FES symptoms often take several days to manifest [4]. Currently, there are no standardized diagnostic criteria for FES, nor is there a standardized treatment plan. As a result, most FES diagnoses are made clinically, and treatments directed towards the individual patient’s needs [5]. The most frequently cited diagnostic criteria are Gurd’s criteria, where 1 major criterion and 4 minor criteria need to be met for diagnosis (Table 1) [6].

<b>Major Criteria</b>
Respiratory insufficiency
Cerebral involvement
Petechial Rash
<b>Minor Criteria</b>
Fever
Tachycardia
Retinal Change
Jaundice
Renal changes
Anemia
Thrombocytopenia
Elevated ESR
Fat Macroglobulinemia

**Table 1:** Gurd’s Criteria

Regarding treatments, surgical timing and technique have been shown to play a role in FES. Patients who receive surgical intervention within 24 hours of the inciting trauma carry a lower risk of FES than those with delayed intervention [7]. For those who are poor surgical candidates, immobilization of the fracture may be a useful alternative, as it may help prevent the release of increased adipose cells into the circulation [8]. Steroid use is generally not recommended. Although corticosteroid use showed a reduction of FES and hypoxia in patients with long-bone fractures, there was no decrease shown in mortality rates [9].

**Conclusion**

In summary, this case report describes an unusual presentation of Fat Embolism Syndrome (FES) following a displaced humeral fracture in a 62-year-old woman, challenging

conventional associations with lower limb fractures. The patient is an outlier for typical FES demographics, emphasizing the importance of vigilance for early diagnosis and intervention even in atypical cases. Early signs should prompt further evaluation. Surgical timing and technique are crucial in FES risk minimization, with early operative interventions for fractures associated with decreased risk of fat embolism development. The absence of standardized diagnostic and treatment protocols underscores the need for continued study in refining approaches to optimize outcomes for patients with FES. As this case highlights, reliance on clinical judgment and multidisciplinary teamwork allows for individualized tailoring of treatment plans and management of any complications that may arise.

**Conflicts of Interest:** The authors have no conflicts of interest to report.

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