

Prikaz slučaja

Case Report

SINDROM MASNE EMBOLIJE –
DIJAGNOSTIČKI I TERAPIJSKI IZAZOV
(SINDROM MASNE EMBOLIJE)FAT EMBOLISM SYNDROME –
DIAGNOSTIC AND MANAGEMENT
CHALLENGE
(FAT EMBOLISM SYNDROME)

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Sažetak

Uvod: Sindrom masne embolije obično se manifestuje trijadom simptoma koji podrazumevaju respiratornu insuficijenciju, neurološke poremećaje i pojavu petehija. Najčešće je udružen sa prelomom dugih kostiju i karlice, češće se viđa kod zatvorenih u odnosu na otvorene prelome. **Prikaz slučaja:** U ovom radu ćemo prezentovati slučaj masne embolije kod pacijenta sa zatvorenim prelomom desnog femura i obostranim otvorenim prelomom potkolenice. **Zaključak:** Dijagnoza je uglavnom zasnovana na kliničkim karakteristikama ovog sindroma i isključenju drugih oboljenja. Ne postoji specifična terapija pa se tretman ovog sindroma zasniva na prevenciji, ranoj dijagnozi i adekvatnoj suportivnoj terapiji. Profilaktička primena kortikosteroida može smanjiti incidencu i težinu kliničke slike ovog sindroma.

Ključne reči: sindrom masne embolije; trauma; prelom femura; prelom potkolenice

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Summary

Introduction: Fat embolism syndrome (FES) is presented as a triad of respiratory insufficiency, neurological disorders and petechial rash. FES is associated with long bone and pelvic fractures. **Case report:** We present a case of 24 years old male with closed right femur fracture and bilateral open fractures of tibia and fibula. Surgical procedure was performed immediately. On the second postoperative day, patient was agitated (GCS 12), hemodynamically stable with spontaneous breathing. Several hours later, clinical status deteriorated, with loss of consciousness (GCS 5), pyrexia, tachycardia, dyspnea and hypoxemia requiring mechanical ventilation. Conjunctival petechial rash appeared 24 hours after ICU admission. Based on clinical signs developed postoperatively, FES was suspected. The chest computed tomography with pneumoangiography revealed focal area of ground glass (fat embolus) in the right pulmonary vessels with similar changes in bilateral basal segmental branches. Treatment included oxygenation and ventilation, reimbursement of blood and blood products, prevention of deep venous thrombosis and stress ulcers, and the patient state subsequently improved. Percutaneous tracheostomy was performed on day 8. Mechanical ventilation was terminated on day 14 and tracheostomy tube was removed on day 16. The patient remained in the ICU for 26 days and was discharged from the hospital three months later. **Conclusion:** FES is diagnosed on the basis of clinical features and the exclusion of other disease. Treatment for FES is supportive and includes adequate oxygenation and ventilation, and prophylaxis of possible complications. The key step in FES prevention, is fixation of long bone fractures within 24 hours.

Keywords: fat embolism syndrome; trauma; femur fracture; lower legs fracture

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Introduction

The term fat embolism refers to the presence of circulating fat globules in circulation and pulmonary parenchyma. Fat embolism syndrome (FES) is the clinical manifestation of fat embolism usually presented as a triad of respiratory insufficiency, neurological disorders and petechiae¹. Usually, FES is associated with long bone and pelvic fractures, more frequent in closed than in open fractures. The incidence increases with the number of fractures involved, and patients with a single long bone fracture have a 1–3% chance of developing the syndrome, but it has been reported in up to 33% of patients with bilateral femoral fractures². Cardiopulmonary resuscitation (CPR) is associated with a high incidence of fat embolism regardless of cause of death. 88% percent of nontrauma patients and 86% of trauma patients who received CPR had fat embolism³. Some non-traumatic conditions like diabetes melitus, pancreatitis, osteomyelitis, sickle cell haemoglobinopathies, alcoholic liver disease are also associated with fat embolism syndrome^{4,5}.

The source of fat emboli and mechanism of their activation are not clearly understood. So far, three theories have been suggested. According to the mechanical theory, fat globules from disrupted bone marrow or adipose tissue enter torn small veins and pass into the circulation⁶. Further, fat droplets are transported to the pulmonary vascular system resulting in the mechanical obstruction of the lung capillaries. Small emboli may pass to the systemic circulation causing neurological signs and petechiae on the basis of obstructive microembolism⁷. This theory cannot explain the 24–72 h delay in the development of symptoms⁸. The biochemical theory suggests degradation of embolized fat in plasma into toxic intermediaries (free fatty acids), as a mechanism of development of FES. The level of circulating free fatty acids increases in traumatic patients as well as in non-traumatic animal models of FES causing acute lung injury^{9,10,11}. C-reactive protein (CRP) is elevated in these patients. CRP may be responsible for lipid agglutination and may also participate in the mechanism of non-traumatic fat embolism syndrome¹². Production of these toxic metabolites can explain the delay in development of symptoms of FES. According to the coagulation theory, releasing of tissue thromboplastin with marrow elements of long bone fractures activates the complement system and extrinsic coagulation cascade, leading to the production of intravascular coagulation. These prod-

ucts, along with leukocytes, platelets and fat globules increase pulmonary vascular permeability, by direct damage of the endothelium and through the releasing of numerous vasoactive substances. These same substances cause platelet activation^{13,14}.

We present a case of the patient with closed right femur fracture and bilateral open fractures of tibia and fibula who developed FES.

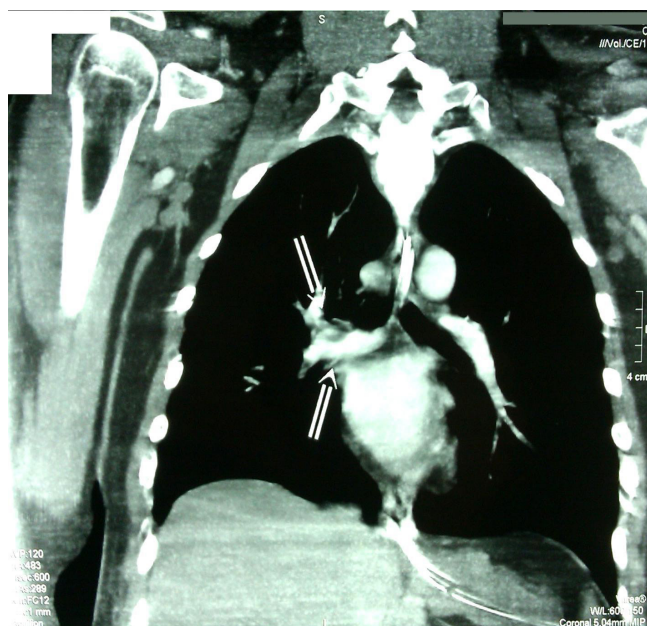
Case report

A 24-year-old male was transferred tertiary center, after a motorcycle accident. The patient suffered closed right femur fracture and bilateral open fractures of lower legs. Emergency surgical procedure was performed on the same day and included right femur osteosynthesis and bilateral crural osteotaxis. On the second postoperative day patient was transferred to our hospital. On the admission he was agitated GCS 12, hemodynamically stable, with spontaneous breathing and SaO₂ 94% on supplemental oxygen via face mask (6 L/min), with equal bilateral breath sounds. Abdomen was soft, without distension, tenderness or pain and normal bowel sound. Limbs were warm, with normal color and palpable pulses. Drainage on lower legs was 500 ml of haemorrhagic fluid. Chest radiography and arterial blood gas analysis showed normal finding. Parameters on admission were: TA 125/75 mm Hg, HR 110/min, T = 37.3, CVP 5, urinary output of 1000 ml. The laboratory findings showed lower red blood cell count (RBC = 3.27, Hb = 97.2, Htc = 28.3 and Plt = 105). Cerebral, cervical, thoracic, abdominal and pelvic CT scans were also performed, showing normal findings except for fracture of transversal processes of C7.

Nine hours after admission, his clinical status deteriorated, with loss of consciousness, pyrexia (38.2), tachycardia (130/minute), dyspnea, tachypnoea (35/min) and hypoxemia (PaO₂ = 53 mmHg, PaCO₂ = 28 mmHg, pH = 7.35), requiring mechanical ventilation (CPAP, FiO₂ 0.5). Twenty-four hours after admission he developed conjunctival petechial rash. Ophthalmology exam revealed initial macular edema and exudates on fundoscopy, which corresponded to Purtscher's retinopathy. Fat globules in urine were not detected. Diagnosis of FES was based on the combination of long-bone fracture, pyrexia, hypoxemia, tachycardia and petechial rash, within 72 hours after initial injury and surgery. The chest computed tomography (CT) with pneumoangiography revealed focal area of ground glass picture (fat

embolus) in the right pulmonary vessels with similar changes in bilateral basal segmental branches.

Picture 1. MSCT pneumoangiography.



With supportive treatment in the ICU which included adequate oxygenation and ventilation, good hydration, reimbursement of blood and blood products, prevention of deep venous thrombosis and stress ulcers, the patient subsequently improved. Percutaneous tracheostomy was performed on eight day. Mechanical ventilation was terminated 14 days after admission and tracheostomy tube was removed on day 16. The patient remained in the ICU for 26 days and afterward was transferred to the trauma department with adequate respiratory function and hemodynamically stable. He was discharged from the hospital three months later.

Discussion

Clinical presentation of FES is typically manifested 24–72 hours after initial trauma, with classic triad of symptoms-respiratory manifestations (95%), neurological features (60%) and petechiae (33%)^{15,16}.

Respiratory changes, usually the first clinical manifestation of FES, include dyspnoea, tachypnoea, and hypoxemia. These symptoms may progress to respiratory failure and acute respiratory distress syndrome (ARDS). Approximately one-half of the patients with FES develops severe hypoxemia and respiratory insufficiency and, therefore, require mechanical ventilation¹⁷. Neurological features often occur after respiratory distress development. The most

common presentation is an acute state of confusion, but focal neurological signs, including seizures, hemiplegia, aphasia, apraxia, visual disturbances and anisocoria. Almost all neurological deficits are transient and fully reversible¹⁸. Petechial rash is developed as a last part of the triad. The embolization of small dermal capillaries leading to extravasation of erythrocytes which produces a petechial rash in the conjunctiva, oral mucous membrane and skin folds of the upper body (especially the neck and axilla). The rash appears within the first 36 h and disappears completely within 7 days¹⁹. A number of FES minor features include pyrexia, tachycardia, myocardial depression, ECG changes, soft fluffy retinal exudates with macular edema (Purtscher's retinopathy), anemia, thrombocytopenia, coagulation abnormalities (which mimic disseminated intravascular coagulation) and renal changes presenting as oliguria, lipiduria, proteinuria, or haematuria^{20, 21}.

FES is often diagnosed on the basis of clinical features and the exclusion of other disease processes. The current diagnostic criteria for FES do not require the presence of all 3 aspects of the FES triad for diagnosis^{22,23}. Classification systems, including those by Schonfeld, Gurd and Lindeque, have been proposed for diagnosis of FES^{24,25,26}. According to Gurd's major and minor diagnostic criteria diagnosis of FES requires the presence of at least one major and four minor criteria.

Table 1. Gurd's criteria

Major criteria
Axillary or subconjunctival petechiae
Hypoxaemia PaO ₂ < 60 mm Hg, FIO ₂ = 0.4
Cerebral involvement unrelated to head trauma
Pulmonary edema
Minor criteria
Tachycardia < 110 bpm
Pyrexia < 38.5°C
Emboli present in the retina on fundoscopy
Fat globules present in urine
A sudden inexplicable drop in haematocrit or platelet values
Increasing ESR
Fat globules present in the sputum

The reliability of these criteria has been questioned and other schemes have been suggested based on the respiratory parameters. Schonfeld and Lindeque proposed a semi-quantitative measure to diagnose FES and, in both of them, score of more than five is required for a positive diagnosis.

Table 2. Schonfeld's criteria.

Sign	Points
Petechiae	5
Chest X-ray changes (diffuse alveolar infiltrates)	4
Hypoxaemia (Pao ₂ < 60mmHg)	3
Fever (> 38°C)	1
Tachycardia (> 120 bpm)	1
Tachypnoea (> 30 bpm)	1

Table 3. Lindeque's criteria

Parameters
Sustained PaO ₂ < 60mmHg
Sustained PaCO ₂ > 55 kPa or a pH < 7.3
Sustained respiratory rate > 35 bpm, despite sedation
Increased work of breathing: dyspnoea, accessory muscle use
Tachycardia and anxiety

There is no specific therapy for FES. The main treatment is supportive and includes adequate oxygenation and ventilation, stable hemodynamics maintenance, hydration, prophylaxis of deep venous thrombosis and stress related gastrointestinal bleeding and nutrition. Early fixation of long bone fractures within 24 h is a key step. Another strategy to prevent FES is to limit the elevation in intraosseous pressure during orthopedic procedures, in order to reduce the intravasation of intramedullary fat and other debris²⁷.

The prophylactic use of corticosteroids in patients with high risk of developing FES (patients with long bone or pelvic fractures, especially closed fractures) if administered as a low-dose regimen (methylprednisolone 1.5 mg/kg IV every 8 hours for six doses), may decrease incidence and severity of FES²⁸. Aspirin may also be quite helpful, especially if it is given before the fat embolism syndrome has become fully developed. A prospective study of 58 patients with uncomplicated fractures showed that the treatment of patients with aspirin resulted in significant normalization of blood gases, coagulation proteins, and platelet numbers when compared with controls²⁹.

Heparin is known to clear lipaemic serum by stimulating lipase activity and has been suggested for the treatment of FES. However, activation of lipase is potentially dangerous if increases in free fatty acids are an important part of the pathogenesis. There is also a possibility of increased risk of bleeding in patients with multiple trauma³⁰.

Post-treatment with N-Acetylcysteine annuls pathological modifications in lungs induced by fat embolism³¹.

Conclusion

FES is diagnosed on the basis of clinical features and the exclusion of other disease. Treatment for FES is supportive and includes adequate oxygenation and ventilation, and prophylaxis of possible complications. The key step in FES prevention is fixation of long bone fractures within 24 hours.

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