Original Article

CLINICAL AND MORPHOLOGYCAL ASPECTS IN CASE OF FAT EMBOLISM SYNDROME

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Summary

Fat embolism is pathologically proved in 90% of individuals with severe skeletal injuries or traumas, and fat embolism syndrome /FES/ is found in only 0.5-5% of them. FES is fatal in 10-15% of cases. We present a case of a 78-year-old woman, admitted to the Intensive Care Unit of the University Hospital-Pleven with significant disturbances of conscience after trauma. X-rays revealed a fracture of right radial bone, and the CT-scan slight hypodense changes in the cerebellum. The patient was stable until day 3 of hospital admission, then fell into a deep coma with progressive deterioration of haemodynamics, respiratory and renal function, and died on day 7. The pathomorphological study proved severe cerebral oedema, scattered petechial haemorrhages and micro-infarctions in the white matter of cerebrum, as well as fat globules in microcirculation of the brain, lungs and kidneys. Fat embolism syndrome with manifestation of multiorganic insufficiency was identified as the cause of the death.

Key words: fat embolism, fat embolism syndrome, clinical and morphological aspects

Introduction

Fat embolism syndrome (FES) is an uncommon but well-described complication of skeletal traumas, and is characterised by systemic fat embolism. FES might include subclinical or mild clinical presentation, or might be fulminant with a fatal outcome. Fat embolism syndrome is a multi-systemic disorder with more severe damage of the lung and cerebrum. Respiratory disturbances vary from asymptomatic hypoxemia to respiratory distress syndrome, necessitating artificial ventilation. In cases with a prolonged course, secondary infections might superimpose. The syndrome is characterised by quantitative and qualitative disturbances of conscience that may progress to coma. Tachycardia is a typical symptom of FES, but it is also seen in patients with multiple traumas without FES. It is only useful for making the

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diagnosis when other diagnostic symptoms are present. A diffuse petechial rash, mainly on the skin of the back, upper trunk and cornea without thrombocytopenia is seen in 20 to 50% of cases. Retinopathy is present in the first 24 hours in 50% of the patients [1]. Fat embolism can be proved pathologically in approximately 90% of patients with severe skeletal injuries or traumas. Only 0.5-5% of trauma cases are associated with the appearance of FES about 24 to 72 hours following injury [2]. The outcome is lethal in 10-15% of FES cases [3]. The diagnosis of FES is difficult to make at autopsy, especially without clinical data. Fat globules only within pulmonary circulation are seen in deaths, related to fat embolism. In classical fat embolism syndrome, many fat globules are detected in microcirculation of most parenchymal organs but lung, brain and kidney are invariably affected [1, 4]. Routine staining visualizes fat emboli as spherical, clear spaces in the capillary network. It is necessary to use frozen sections and special fat stains to define the composition of the emboli.

Case presentation

A 78 year old woman was found in her home with quantitative disturbances of conscience and a right hand fracture. She was admitted to the Intensive Care Unit of University Hospital-Pleven and diagnosed with coma: Glasgow coma scale score = 6, blood pressure 160/100mmHg, and heart rate - 105 b.p.m. There was historical data of essential hypertension. CT examination of the head showed subtle unremarkable hyperdense changes in cerebrum and cerebellum, and the X-ray revealed fracture of the right radial bone. Blood tests showed leucocytosis ($23.6x10^9$); red blood cell count, hemoglobin and platelets were within t normal ranges. Lipid levels were normal. The patient was stable with spontaneous breathing until day 3 of hospital admission, and then fell into a deep coma (Glasgow coma scale score was 3) with no reaction of pupils to light. The haemodynamics became unstable and needed dopamine protection, the dyspnea worsened and required artificial ventilation. The renal function was disturbed (urea 51.1mmoll, creatinine 219 ìmol/l). Therapy included antibiotics, vitamins, diuretics and saline infusion. During the stay, the patient acquired pneumonia with Staphyloccocus aureus. The patient died on day 7.

Matterials and methods

Histologic examination was performed on the tissues at autopsy, which were fixed with 10% formalin solution, embedded in paraffin and stained with hematoxylin and eosin. Specimens of brain, lung and kidney were cut by freezing techniques and stained with Sudan red for lipids.

Results

Autopsy revealed scattered petechial hemorrages in the white matter of the cerebrum, cerebellum and brain stem (Fig.1, 2). Findings in internal organs were associated with pneumonia. There was hypertrophy of the myocardium of left heart ventricle, without patent foramen ovale. The kidneys had normal macroscopic appearance. Microscopically, widespread fat globules were seen in the microcirculation of the lung, brain and kidney, stained in orange color with Sudan red (Fig. 3, 4, 5, 6). Well-expressed globules were found in the brain

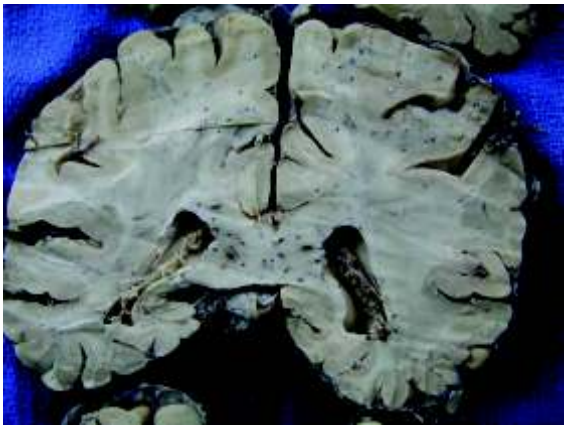

Fig. 1. Macroscopic petechial hemorrages in white mater of cerebrum.

stem microcirculation (Fig. 7).

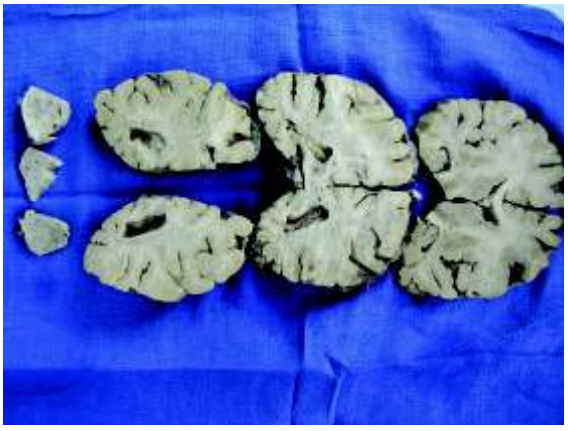

Fig. 2. Macroscopic view of petechial hemorrages in cerebrum.and brain stem.

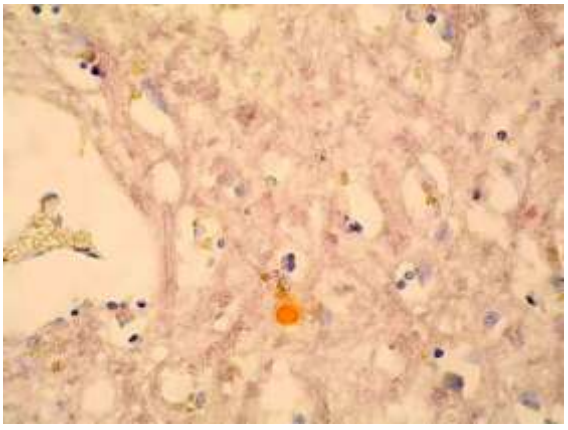

Fig. 3. Fat globules in brain capillaries, Sudan III, 400x.

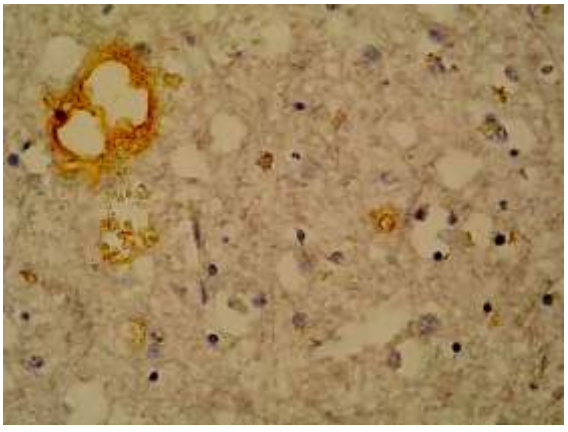

Fig. 4. Fat infiltration in brain capillary walls, Sudan III, 400x.

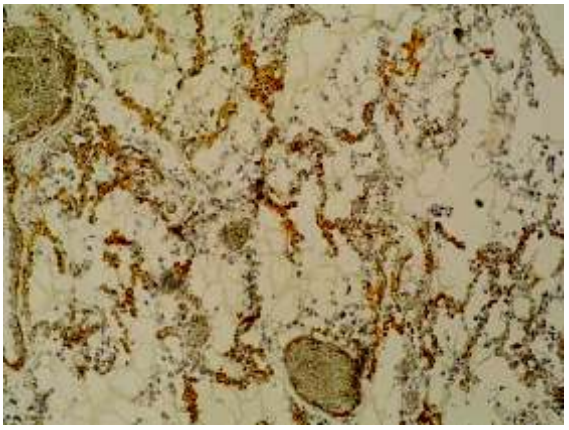

Fig. 5. Fat globules stained in orange in lung microcirculation, Sudan III, 200x.

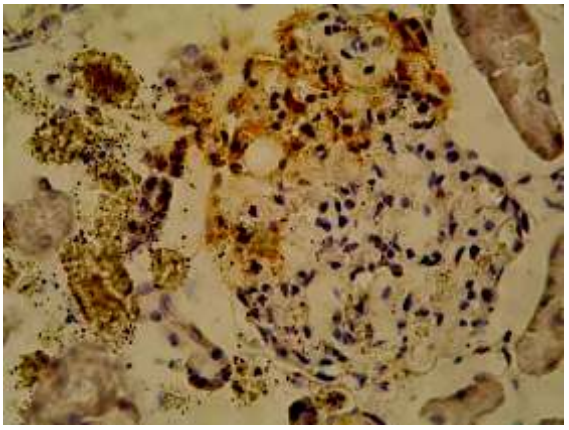

Fig. 6. Fat globules in kidney glomerules, Sudan III, 400x.

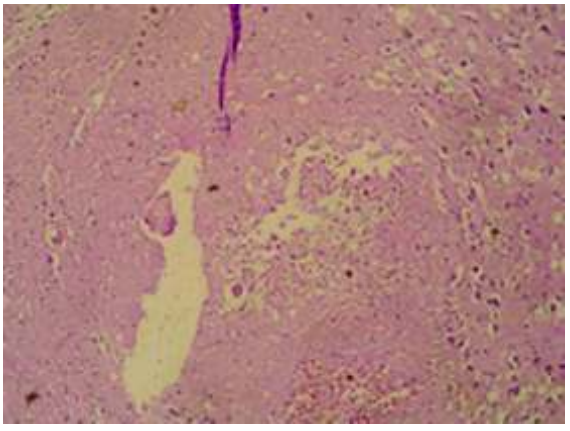

Fig. 7. Microinfarction in brain stem, HE, 200x.

Discussion

Fat embolism and fat embolism syndrome are serious and potentially life-threatening complications in cases with long bone

fractures. FES can occur in unrelated conditions such as diabetes, burns, severe infections, sickle-cell anaemia, cardio pulmonary bypass, systemic lupus erythematodes, and pancreatitis [4, 5, 6, 7]. The risk of FES is highest in patients with multiple injuries, especially those with fractures of the femur and other long bones [5]. Peltier et all. have reported cases of FES in 1% to 2.2% in patients with fracture of the tibia and femur [8]. More recent studies have established significantly higher rates of FES 19% in tibial fractures, and 75% in femoral fractures [9].

The etiology and pathogenesis of fat embolism syndrome is still far from being fully understood, since it is complex and probably multi-factorial. A variety of mechanical and biochemical theories are widespread. The mechanical theory proposes that fat particles from medullary canals of long bones can enter the venous circulation at the fracture site and then embolise into the lung. They can reach the major vessels of the cardiovascular system through the pulmonary circulation of a patient with patent foramen ovale. The biochemical theory suggests that the phenomenon of posttraumatic fat embolism is a result of a change in the droplet size in endogenous plasma lipids. After trauma, chylomicrons and very low-density lipoproteins are aggregated in fat macroglobules that embolise. Elevated plasma levels of the fatty acids and lipoprotein complexes place these patients in the group with increased risk of developing fat embolism syndrome [10, 11, 12]. In our opinion, the case presented is interesting with the diagnostic difficulties in interpreting neurological symptoms in cases with cranial brain traumas and FES.

In cases when the diagnosis of FES is made, the following facts are presented:

- bone fracture;
- quantitative disturbances of conscience at onset, with stable haemodynamics and no respiratory failure, and absence of data indicating brain trauma;
- progressive deterioration of conscience to deep coma with evidence of respiratory failure.

Conclusions

Fat embolism syndrome is a multi-factorial and multi-systemic disorder with high risk of death, and mortality is mainly related to the degree of pulmonary and brain dysfunction. For establishing a diagnosis of FES in clinical practice, it is important to compare non-specific symptoms, and deviations from normal found by laboratory tests and neuroimaging [2, 3, 7]. Magnetic resonance imaging is the study of choice for early evaluation of brain lesions in cases with FES in patients at high clinical risk and progressing neurological symptoms.

Fat embolism syndrome should be considered when making the differential diagnosis in patients with quantitative and qualitative disturbances of conscience after fracture of long bones, joint prosthesis and soft tissue trauma.

It is worth mentioning and discussing the fact that, in old patients, the fracture of small bones can be complicated with fat embolism syndrome, as presented in our case.

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