A Lethal Case of Fat Embolism Syndrome in a Nine-Year-Old Child: Options for Prevention

Pascal H.E. Teeuwen¹, Pim C.E.J. Sloots¹, Ivo de Blaauw², Rene Wijnen², Jan Biert¹

Abstract
We report a lethal case of fat embolism syndrome in a nine-year-old child after a direct blunt trauma leading to a pelvic fracture. On the second day, signs of bowel perforation and septic shock led to an acute aggravation of the pulmonary symptoms, cardiac arrest and death. Fat embolism is seldom thought to occur in pediatric trauma patients; however, this case illustrates it can lead to disastrous sequela. Since there is no specific treatment for it, prevention by early fracture stabilization is the only option.

Key Words
Abdominal trauma · Fracture care · General trauma · IC treatment · Management of skeletal injuries in trauma · Pediatric trauma · Pelvic fractures · Trauma management and education

Introduction
Fat embolism syndrome (FES) is a potential lethal condition threatening severely injured patients. Younger patients are especially at risk in the first 48 h after admission [1, 2]. Most children recover; however, complications from fat embolism can influence physiological compensation mechanisms that operate in response to shock, sepsis or pulmonary trauma. We describe a pediatric case in which trauma from a large impact led to a pelvic fracture with a lethal cascade of complications.

Case Report
A nine-year-old boy was referred to our tertiary trauma center after blunt injury to his abdomen and pelvis due to a falling tree. He presented with a patent airway and adequate breathing. Chest radiography was normal. Circulation improved after a fluid challenge. Abdominal ultrasound showed a retroperitoneal hematoma. His pelvis was tender, with a compression injury observed on plain X-ray (Figure 1). The dorsal ligaments of the sacroiliac joints were assumed to be intact, reflecting a type B lesion. Instability of the pelvis was limited. A T-Pod was applied to provide temporary stabilization. Head-to-toe examination revealed a bruise on the head, although an intact neurological outcome was obtained. He was awake and had a maximal Glasgow coma scale. Computed tomography scans of the pelvis and abdomen showed a dislocated pelvic fracture consisting of a left-sided ilium fracture and bilateral fractures of the superior and inferior frami of the pubic bone, retroperitoneal hematoma, intact retroperitoneal vessels, and no intraperitoneal free fluid or air. The pediatric trauma score was 11 and the injury severity score (ISS) was 29. The patient was admitted to the pediatric intensive care unit. Pelvic reconstruction was planned for the third day; however, the patient’s condition deteriorated on the second day. He was in mild shock and complained of abdominal pain. Physical examination showed signs of peritonitis and the patient was transferred to the operating theater for laparotomy with the suspicion of bowel perforation. There was a rise in CO₂ level from 4.8 to 6.3 kPa. At laparotomy, a perforation of the terminal ileum was found, with only minor abdominal contamination. A wedge resection and...
anastomosis was performed. After the wound had been closed and the boy transferred into bed and to the ICU, his oxygen saturation dropped and severe bradycardia occurred, necessitating cardiopulmonary resuscitation. Unfortunately, the CPR was unsuccessful and the boy expired. Autopsy showed massive bilateral pleural effusion and, on microscopic examination of the lung biopsy, signs of fat drops in the vessels (Figure 2). The diagnosis of FES was confirmed post mortem.

Discussion
The association between fracture of a long bone and respiratory insufficiency in the form of FES, fat globules in the lung with arterial hypoxemia, mental changes and skin or retinal petechiae was classically described by Peltier [3]. Clinical FES typically involves multiple organ systems; however, pulmonary, neurological, hematological and dermatological systems involvement is most common. Diagnostic criteria are proposed that consist of at least one major (respiratory insufficiency plus bilateral signs with positive radiological changes, cerebral signs and petechial rash) and at least four minor (tachycardia, pyrexia, retinal fat or petechiae, urinary fat globules or oligoanuria, sudden drop in Hg level, sudden thrombocytopenia, high erythrocyte sedimentation rate, fat globules in sputum) criteria as well as fat macroglobulinemia (Gurd’s criteria) [4, 5]. In pediatric patients, the diagnosis of FES can be made when one of three signs are present: retinal embolism, positive skin, lung or kidney biopsy, or histological findings at autopsy. The incidence of FES in children is said to be up to 100 times lower than in adults. It has been postulated that this is due to different compositions of bone marrow fat; children’s bone marrow contains less olein and more palmitin and stearin, and more hematopoietic tissue than fat. However, the incidence could be higher if signs and symptoms were to be carefully sought [2].

The signs of fat embolism syndrome arise from fat globules liberated from the long bones, embolizing...