

Case Conference

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Discussion

1. Complication of femoral shaft fracture
2. Fat embolism syndrome
3. Prevention of fat embolism

Complications of femoral shaft fracture

- The most common complications:
 - ☞ Infection
 - ☞ malunion (femur heals at an abnormal angle)
 - ☞ delayed union (no sign of healing at three months)
 - ☞ nonunion (no sign of healing at six months)
 - ☞ pain associated with orthopedic hardware

Complications of femoral shaft fracture – less common

- Neurovascular injury:
 - ☞ The most commonly injured nerve is the pudendal nerve, followed by the sciatic nerve
 - Pudendal nerve injury usually presents as numbness of the penis and scrotum or labia
 - Symptoms resolved completely within 1 to 11 weeks
 - ☞ Arterial injury is documented in < 2 % of femoral shaft injuries. Penetrating injuries (particularly of the medial thigh) are the most common cause.

Complications of femoral shaft fracture – less common

- Compartment syndrome of thigh: rare, because of the large volume of the thigh compartments
- Pulmonary complications:
 - ☞ pulmonary embolism
 - ☞ fat embolism
 - ☞ acute respiratory distress syndrome (ARDS)
 - ☞ pneumonia

Fat embolism syndrome

- Larger series involving 3000 to 17,000 patients have reported an incidence of 0.3% to 1.3% in patients with fractures.
- FES typically manifests 24 to 72 hours after the initial insult, but may rarely occur as early as 12 hours or as late as two weeks after the inciting event.

Risk factor for FES

Table 2
Risk factors for fat embolism syndrome

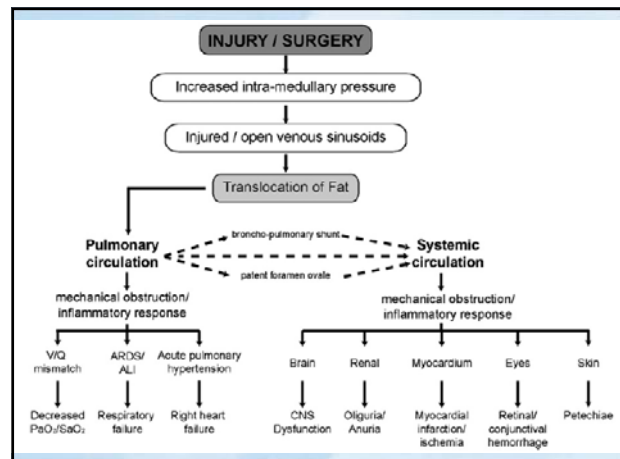
General factors	Males Age 10-39 y Posttraumatic hypovolumic state Reduced cardiopulmonary reserve
Injury-related factors	Multiple fractures Bilateral femur fractures Femur shaft fractures Lower extremity fractures Traumatic fractures Concomitant pulmonary injury

Pathophysiology of FES

- mechanical hypothesis:
 - intramedullary pressure \uparrow \rightarrow fat into the circulation via the open venous sinusoids \rightarrow obstruction of the small pulmonary vessel
- biochemical hypothesis:
 - Fat globules are acted on by lipoprotein lipase, \rightarrow release of free fatty acids \rightarrow direct injury to the pneumocytes and lung endothelial cells \rightarrow ARDS

Fat emboli access to the systemic circulation

- patent foramen ovale (PFO) or right to left shunt
- 但是仍有 heart echo normal的病人，發生 systemic fat embolism?
 - acute elevation of right heart pressure forces the deformed fat globules through the pulmonary capillaries into the systemic circulation.
 - Intrapulmonic pulmonary-bronchial shunt



Classic triad of FES

- Hypoxemia, dyspnea, and tachypnea
- neurologic abnormalities:
 - after the development of respiratory distress
 - Confusion, altered level of consciousness and seizure
 - transient and fully reversible in most cases
- petechial rash: 20 ~ 50%

Diagnostic criteria for fat embolism syndrome

FES: One major and four minor criteria and fat macroglobulinemia are required for diagnosis.	
Major	Respiratory symptoms, signs, and radiographic changes
	Cerebral signs unrelated to head injury or other conditions
	Petechial rash
Minor	Tachycardia over 110 beats per minute
	Pyrexia $>38.5^{\circ}\text{C}$
	Retinal changes of fat or petechiae
	Renal changes
	Jaundice
	(Laboratory):
	Acute fall in hemoglobin
	Sudden thrombocytopenia
	High ESR
	Fat macroglobulinemia

Prevention of FES

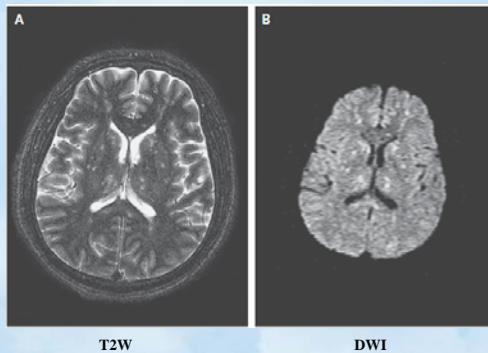
- Early stabilization of the fracture involving the pelvis or long bones is probably the single most important prophylactic measure
- Early rigid fixation of fractures decreases the recurrent bouts of fat embolism.
- 但是已有FES症狀的病人 → prefer external fixation
- preventative pharmacologic therapies → no evidence of benefit

Data of Taiwan

- The incidences of FES, less than those reported in the literature, were 0.15% in fracture of the tibia, 0.78% in fracture of the femur and 2.4% in multiple fractures.
- The mortality rate of FES was about 7.7%.
- All cases were less than 35 years old, except for 1 70-year-old male.
- Fat embolism occurred within an average of 48.5 hours after long bone fracture.
- 11 patients: Hb ↓ 4.2 g/dL on average. Nine presented with thrombocytopenia, and 10 patients had platelet dropped 140,000/dL on average.
- Two had cerebral sequelae without recovery at the last 48-month follow-up.

Fat Embolism Syndrome in Long Bone Fracture—Clinical Experience in a Tertiary Referral Center in Taiwan
J Chin Med Assoc 2010;73(8):407-410

Brain MRI (from NEJM)



Thank you for your attention !