Fat Embolism, ARDS and Critical Care Aspects in Trauma

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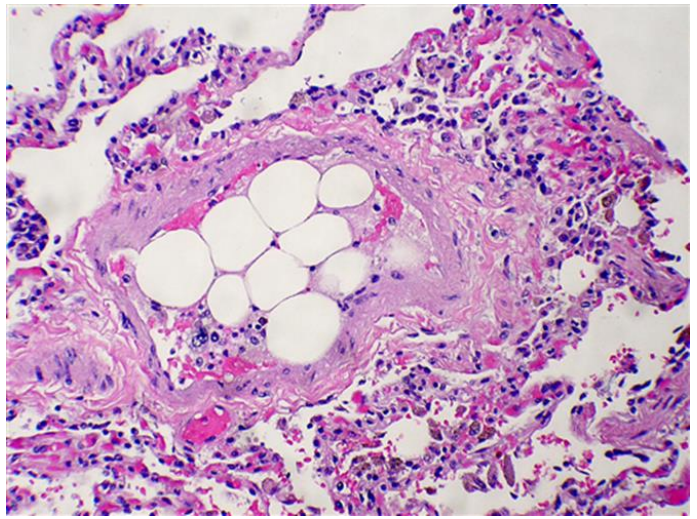


Case

- 21 M
- No significant medical history
- Admitted following RTC (motorcycle vs car)
- ABC stable on admission
- Trauma CT
  - No intracranial, intrathoracic or intraabdominal injury
- Left femoral fracture (closed + NV intact)
- Left tib fib fracture (closed + NV intact)
- Single system – admitted under T+O

Next Day

- Patient preoperatively stable
- Hb 120, normal U+Es, observations within normal r

- Left femoral IM nailing + left tibial nailing
  - 2 units transfused perioperatively
  - VBG – Hb 100 post transfusion
  - Haemodynamically stable on transfer back to ward
  - SEWS 1 (on 2L O2)

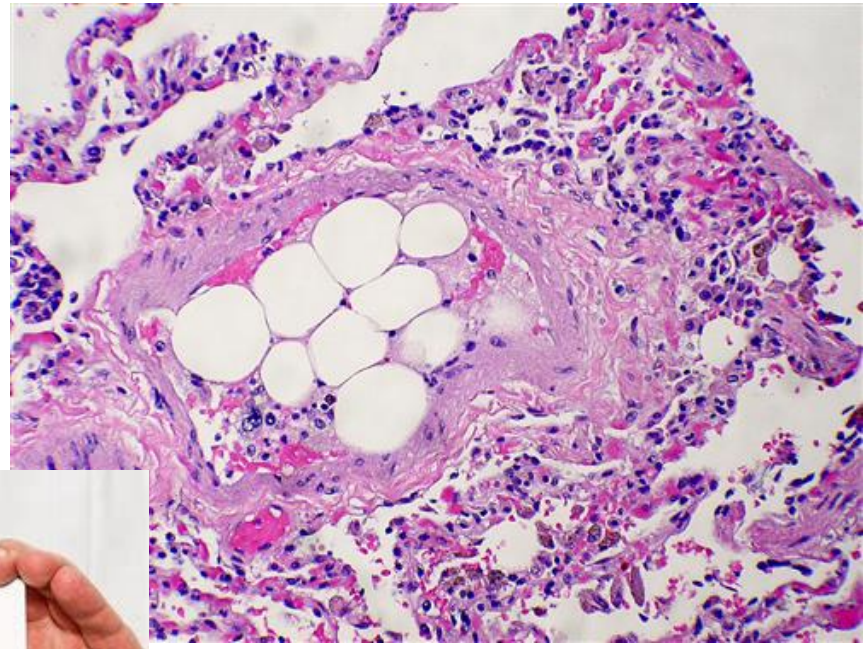
2 Hours later…..

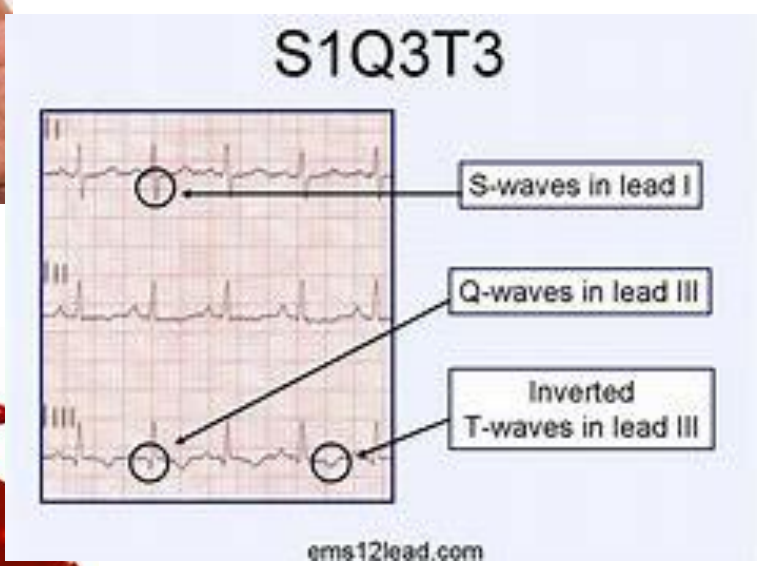
- ***FY1 Called to ward*** - Nurses concerned about patient
  - Drowsy
  - Short of breath

  - HR 125
  - RR 30
  - SaO2 92% on FiO2 80%
  - Temp 38.5
  - BP 110/70

Differentials

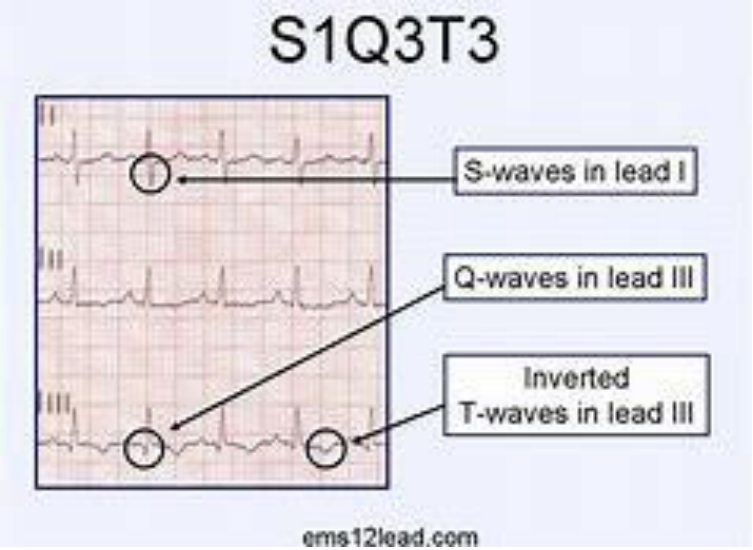
- Fat embolism syndrome
- PE
- Sepsis
- Haemorrhage
- Aspiration
- ARDS
- MI





Investigation

- **ABCDE approach**
- Oxygen
- Bloods (inc Cultures)
- ABG
- ECG
- Chest Xray
- CTPA
- **ESCALATE** - your reg, outreach, ITU




a
b

Pathophysiology

- Fat and marrow elements are embolized into the bloodstream during:
  - acute long bone fractures
  - intramedullary instrumentation
  - intramedullary nailing
  - (more rarely) hip & knee arthroplasty
- ***Mechanical theory***
  - Embolism caused by droplets of bone marrow fat released into venous system
- ***Metabolic theory***
  - Stress from trauma causes changes in chylomicrons (lipoproteins for fat transport)

- ***Prognosis*** - fatal in up to 15% of patients

Table 1: Gurd and Wilson criteria for the diagnosis of fat embolism syndrome [10]

Major Criteria	Minor Criteria
Petechiae in a vest distribution	Tachycardia (heart rate 110 beats per minute)
Hypoxemia with PaO_2<60 mm Hg, FiO_2≤0.4	Pyrexia (temperature 38.5°C)
Central nervous system depression disproportionate to hypoxemia	Emboli visible in retina
Pulmonary edema	Fat in urine
	Fat in sputum
	Unexplained drop in hematocrit or platelet count
	Increasing erythrocyte sedimentation rate

2 major + 1 minor criteria

Or

4 minor criteria

=

Diagnostic

ARDS

- = ***fluid accumulation in the lungs not explained by heart failure***
- Typically a response to acute injury to the lungs (eg trauma /inflammation/mechanical stress)
  - Release inflammatory mediators secreted by local epithelial and endothelial cells

- Causes flooding of the alveoli
- Neutrophils + T-lymphocytes migrate into the inflamed lung tissue
- ***Histology*** - diffuse alveolar damage (DAD) and hyaline membrane formation in alveolar walls

2012 Berlin Classification

- ***Lung injury*** of **acute onset**, within 1 week of an apparent clinical insult
  - and with progression of respiratory symptoms
- ***Bilateral opacities*** on chest imaging (XR/CT) not explained by other lung pathology
- ***Respiratory failure*** not explained by heart failure or volume overload

- ***Decreased PaO2/FiO2 ratio***
  - (Decreased PaO2/FiO2 ratio indicates reduced arterial oxygenation from the available oxygen)
    - Mild ARDS: 201 – 300 mmHg (≤ 39.9 kPa)
    - Moderate ARDS: 101 – 200 mmHg (≤ 26.6 kPa)
    - Severe ARDS: ≤ 100 mmHg (≤ 13.3 kPa)

- Requires minimum positive end expiratory pressure (PEEP) of 5 cmH2O

Management of ARDS

- Supportive, usually in ITU
- Goal = to maintain acceptable gas exchange to meet the body's metabolic demands

- Early stages - ***NIV***
- Later stages – ***Intubation + ventilation***
- Even later – ***ECMO***
  - **Extracorporeal membrane oxygenation**

PEEP

- Positive end-expiratory pressure (PEEP)
  - = alveolar pressure above atmospheric pressure that exists at the **end of expiration**

- In ARDS, three groups of alveoli:
  - ***normal alveoli*** -always inflated and engaging in gas exchange
  - '***flooded***' alveoli which can never, under any ventilatory regime, be used for gas exchange
  - atelectatic or ***'partially flooded'*** alveoli that can be "recruited"

- Extrinsic PEEP can be used to 'recruit' alveoli and improve oxygenation in ARDS
- Some alveoli can only be opened with higher airway pressures than are needed to keep them open
- Recruitment manouvre
  - PEEP is increased to very high levels for seconds to minutes before dropping the PEEP to a lower level

- Adverse effects – hypotension (decreased venous return)
  - overdistension of alveoli and barotrauma ->DAD

What do Anaesthetists and Intensivists want us to do differently ?

- Pre operative optimisation – Consider electrolytes, CK, lactate, Hb, coagulation, renal function
- Avoid ‘the unclaimed patient’ in resus
- Beware the young fit trauma patient
- Know what you are asking for when contacting ITU/anaesthetics

What Does ITU DO??

- ***Primarily: Organ Support***
  - Airway support
  - Ventilatory support (NIV/invastive ventilation)
  - Circulatory support (Vasopressors)
  - Renal replacement therapy
  - Ecmo (in some places)

  - In many cases a combination of the above!

Referral to ITU

- Do the basics – ABCDE
- Know patient – give SBAR style summary
- Have info re:
  - Treatment to date
  - Medical history
  - Drugs/allergies
  - Functional status (current and pre admission)

- Be clear about what you want from them