

# FAT EMBOLI

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## Background:

- Fat emboli can cause pathology through direct mechanical blockage of vessels, or through an inflammatory reaction secondary to fatty acid breakdown. The former results in ischemia, while the latter results in local tissue injury.
  - Fat embolism syndrome is diagnosed based on clinical and laboratory findings. Fat emboli can be found systemically, especially in the lungs, brain, kidneys, and skin causing respiratory symptoms with hypoxia and tachypnea, disturbances of consciousness, acute renal failure, and petechiae in the skin.

## Quick Tips at Time of Autopsy

### Clinical History

- Fat emboli occur in the context of tissue destruction (adipose tissue, or adipose containing bone marrow). Fat emboli should be considered in any cases of tissue break down, especially
  - Trauma: bone fractures, soft tissue trauma, burns
    - Of note, **cardiopulmonary resuscitation (with fat emboli secondary to rib fractures) is a very common (and commonly missed) diagnosis at autopsy**
  - Natural disease: osteomyelitis, hemorrhagic pancreatitis, alcoholic fatty liver disease, sickle cell disease (secondary to bone necrosis), and massive hepatic necrosis with fatty liver
  - Therapy: corticosteroid therapy, parenteral lipid infusion
- Pre-mortem CT angiography has been suggested as an alternative method for detection of fat emboli, but its sensitivity is much less than histology

### External examination

- Dermal petechiae are seen in fat emboli/fat emboli syndrome.

- Prior studies have suggested that fat emboli are evenly distributed throughout lung parenchyma and therefore representative lung sections constitute appropriate sampling.

### **Gross examination**

- The source of emboli (trauma, natural disease, etc.) should be documented and sampled appropriately.
- Macroscopic findings are usually limited to the brain and include prominent petechial hemorrhages in the *white matter* with sparing of the gray matter.

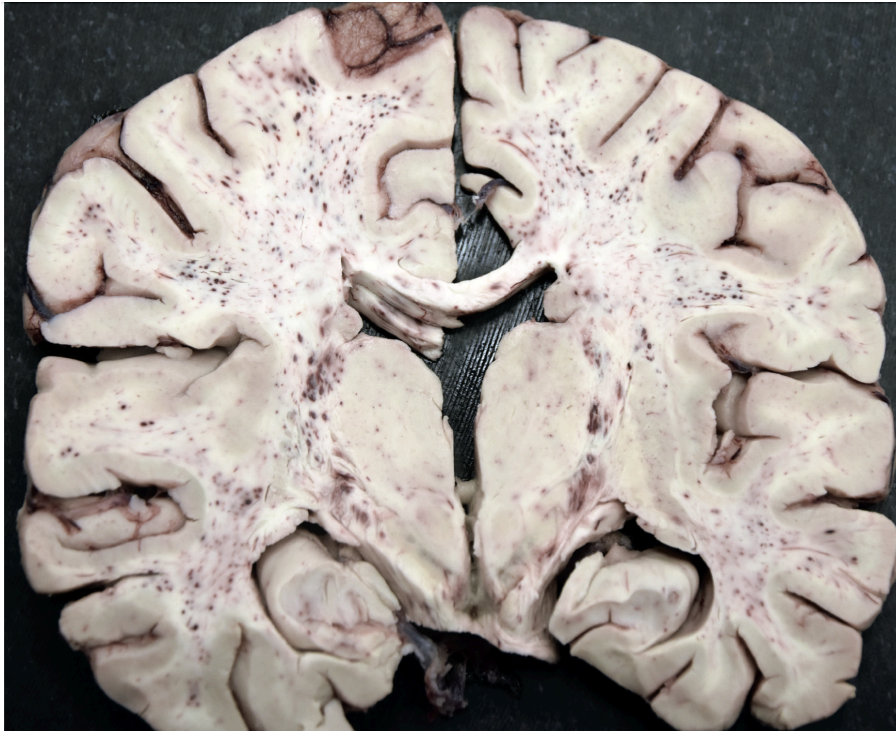


Image description: fat embolization syndrome presenting with diffuse white matter petechiae. (Image credit: Milroy 2019)

### **Ancillary Testing**

- Fresh frozen tissue or formalin fixed (but not paraffin embedded) is preferable to detect fat emboli using special stains (Oil Red O, Sudan Black). On a practical note, preparing such sections is often practically easier on fresh frozen tissue than that which is already formalin fixed. If unavailable, osmium staining can be done on FFPE tissue.

### **Quick Tips at Time of Histology Evaluation**

- In the lungs, lipid droplets can be found intravascularly or in the alveolar walls. As in other areas, fat globules are released into the bloodstream and travel to the pulmonary capillaries. These fat globules can lodge in the small blood vessels of the lungs, causing endothelial damage and triggering an inflammatory response. This inflammation can lead to the uptake of lipids by alveolar macrophages and other cells in the alveolar walls, resulting in intracellular lipid accumulation.

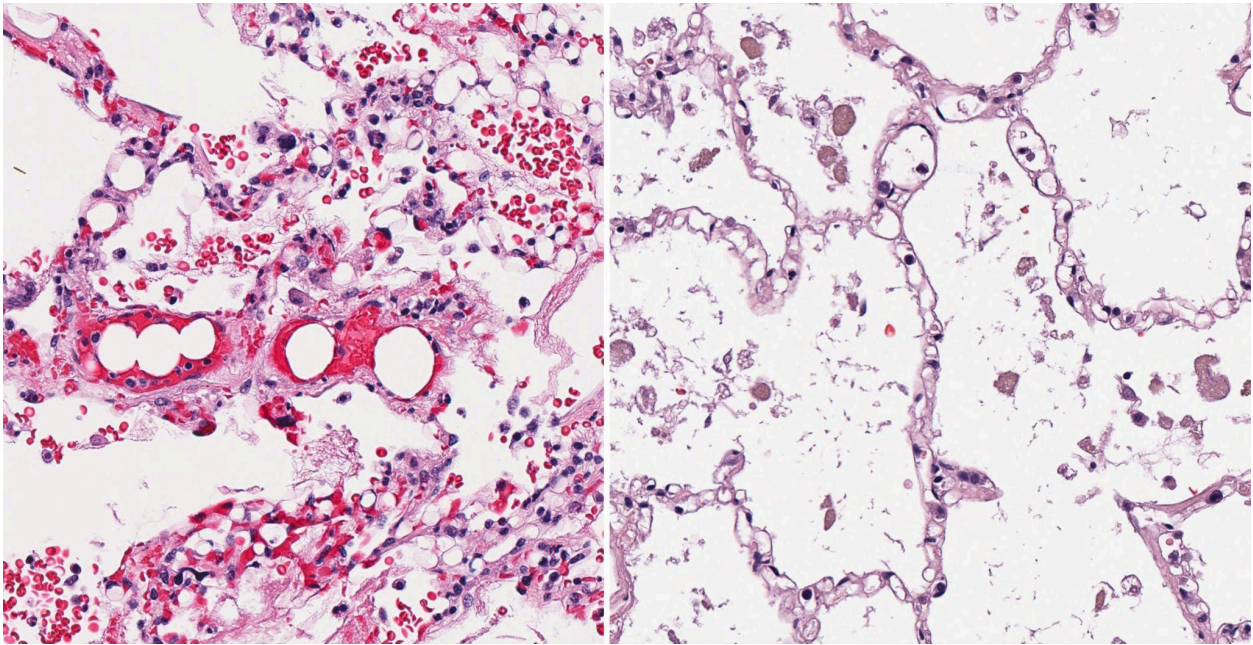


Image: Fat emboli in the lung are seen in the arteries as clear vacuoles (left) as well as in alveolar walls due to uptake of lipid secondary to endothelial damage (right). (Image credit: Lo Tamburro/University of Massachusetts Medical Center).

- In the brain, fat is seen as distending vessels with or without perivascular hemorrhage.

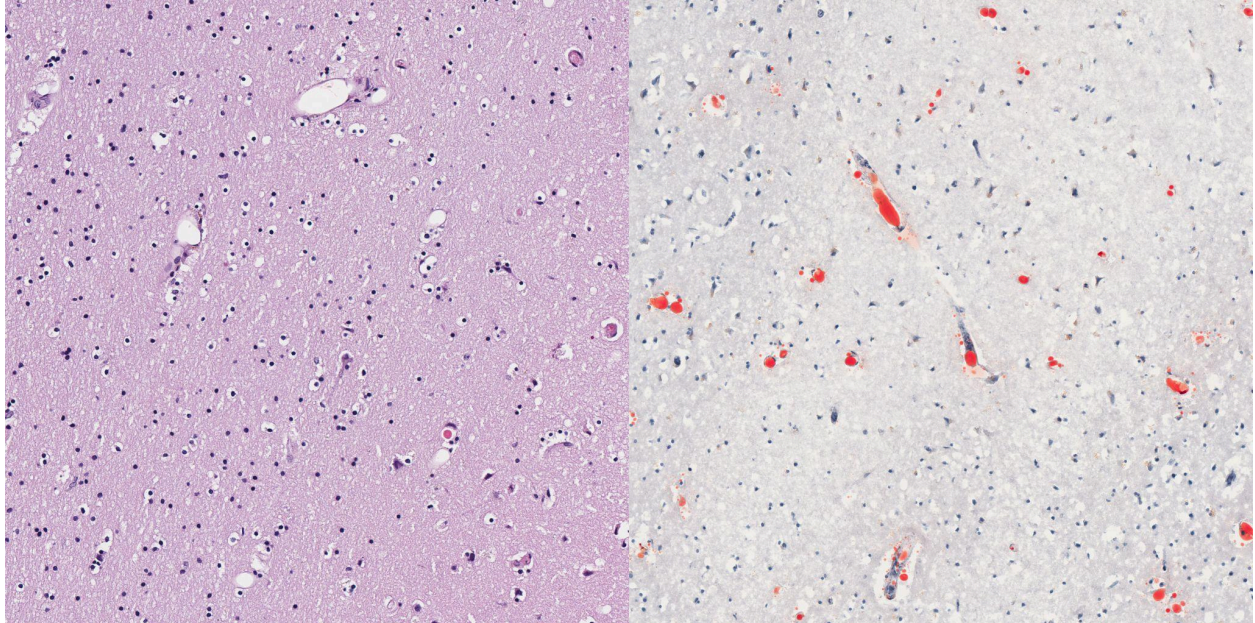


Image: Sections of the brain in a patient with fat embolism syndrome. There are clear spaces with a slightly distended profile in intraparenchymal vessels (left, H&E stain) which stain red on oil red O (right). (Image credit: Lo Tamburro/University of Massachusetts Medical Center).

- In the kidneys, emboli are found in glomerular capillary loops as well as renal artery branches.

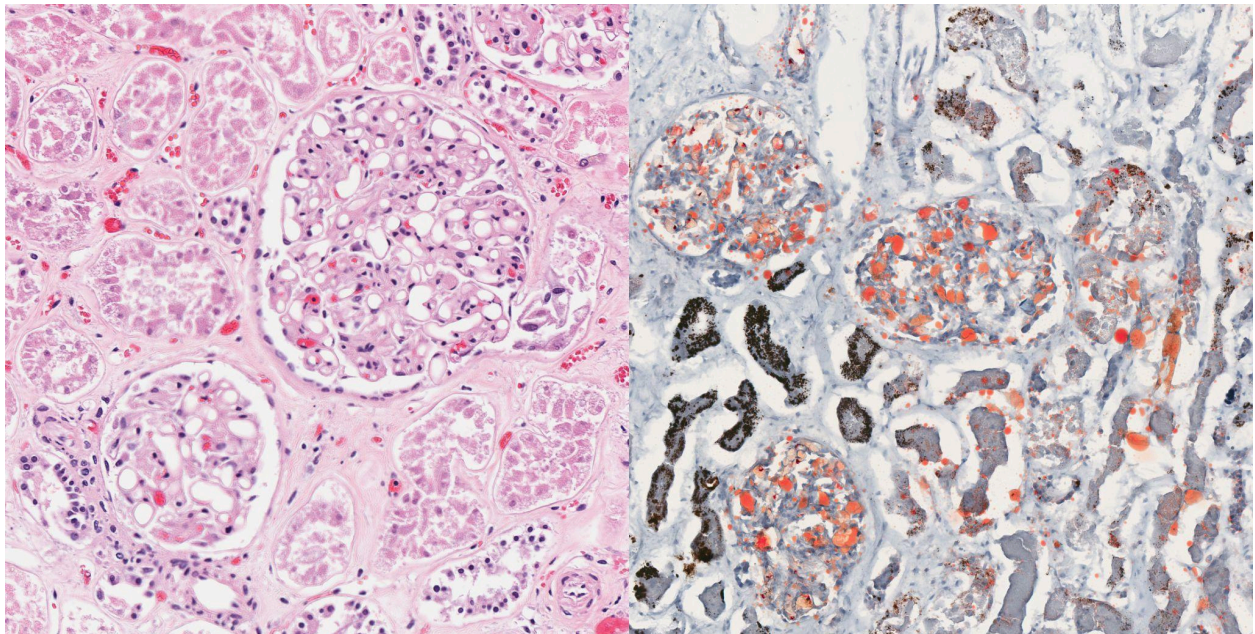


Image: Clear spaces with round profiles are seen scattered throughout glomeruli on H&E (left). These stain red on oil red O (right) consistent with lipid emboli. (Image credit: Lo Tamburro/University of Massachusetts Medical Center).

- In the skin they are found in small vessels with associated hemorrhage.
- The tissue reaction to fat emboli has been reported to be seen within the first 24 hours. This consists of an initial neutrophil reaction and increases up to 72 hours with eosinophils, lymphocytes, and plasma cells present. Emboli can show scalloping and gradually decrease in size and dissolve in 7 to 10 days. (Milroy 2019)

### **Quick Tips at Time of Reporting**

- The diagnosis of FES is a clinical diagnosis which can be corroborated at autopsy.
- From personal experience, this should be high on the differential of patients with [sickle cell disease](#) dying in a short time course with progressive respiratory failure.
- In many cases, fat emboli will be seen following cardiopulmonary resuscitation. As such, even in medical autopsies, documentation of all sternal and rib fractures remains especially important, as the presence of fat emboli may be explained by resuscitation, and not a separate pathologic process.
- Histologically, [Scully et. al](#), [Mason et. al](#) and [Jenssen et. al](#) have proposed scoring systems for fat emboli at autopsy, although these are not commonly used.
- Example cause of death statement: “Complications of fat embolization syndrome, including hypoxic respiratory failure, due open reduction internal fixation of internal femur fracture due to osteoporosis.”

### **Recommended References**

- Milroy CM, Parai JL. Fat Embolism, Fat Embolism Syndrome and the Autopsy. *Acad Forensic Pathol.* 2019 Sep;9(3-4):136-154. doi: 10.1177/1925362119896351. Epub 2020 Jan 31. PMID: 32110249; PMCID: PMC6997986.