CQ 2: What findings indicate hypostasis or clot formation on postmortem CT or MRI?

Recommendation Grade:

Hypostasis: C1

Clot formation: C2

Typical postmortem CT findings of hypostasis include high attenuation in the intracranial dural venous sinuses, increased attenuation in the dependent areas of the lungs often accompanied by horizontal fluid levels, and high attenuation layering in the dependent portions of the heart and great vessels. Intracranial hypostasis can usually be distinguished from subdural hematoma by using multiplanar reconstructions. However, when cast-like blood clots are present in the pulmonary arteries or cortical veins, they may closely mimic antemortem pulmonary embolism or subarachnoid hemorrhage. Therefore, careful interpretation is essential to avoid misdiagnosis.

Explanation

● Postmortem hypostasis (=Livor mortis)

Hypostasis refers to the phenomenon in which, after circulation has ceased and the body remains in a fixed position, blood within the vessels settles toward the dependent (lower) parts of the body under the influence of gravity. This is one of the early postmortem changes that begins to appear shortly after death.[1] As described below, the appearance of hypostasis varies by organ on postmortem imaging. On postmortem CT, it is generally seen as high attenuation areas in the dependent portions of blood vessels. This increased attenuation is believed to result from the hemoglobin content of sedimented red blood cells, mainly due to its protein content, with iron playing only a minor role.[2] There have been attempts to estimate the postmortem interval based on the degree of hypostasis, but no widely accepted or practical method has yet been established.[3]

● Postmortem Blood Characteristics

In typical deaths, blood clot formation occurs naturally after the cessation of circulation. When death occurs gradually, blood clots are usually observed in the body during autopsy. In contrast, if liquid blood is found in the heart at autopsy, it may suggest sudden death. This has been attributed to excessive stress during the agonal phase—such as that seen in sudden cardiac death—as well as ischemia, and the release of adrenaline and histamine, which activate plasminogen activators from vascular endothelial cells. These activators increase plasmin activity, leading to fibrinolysis of previously formed clots and resulting in fluid (unclotted) blood.[1]

● Intracranial Findings

A representative finding of hypostasis in the intracranial space on postmortem CT is increased attenuation in the dural venous sinuses. A comparative study of antemortem and postmortem CT

showed that the posterior portion of the superior sagittal sinus increased in attenuation from an average of 42 HU before death to 49 HU after death.[4] Hypostasis can also be observed in the transverse sinuses, and any pre-existing asymmetry in venous size may appear as asymmetric hypostasis on postmortem imaging.[4] This postmortem high attenuation in venous sinuses may sometimes be mistaken for a subdural hematoma. However, it can be easily distinguished by evaluating multiple planes, including coronal sections, and using 3D reconstruction images.[5]

● Heart and Great Vessels

Hypostasis in the heart and great vessels typically appears on postmortem CT as high attenuation layering in the dependent portion of the lumen, often forming a horizontal fluid level.[6] The clarity of this layering varies between cases. One study reported that well-defined blood layering on postmortem CT was associated with elevated serum fibrinogen levels before death.[7] On postmortem MRI, hypostasis in the heart and great vessels is seen as a low-signal area in the dependent region on T2-weighted images.[8]

● Lungs

On postmortem CT, hypostasis in the lungs appears as increased attenuation in the dependent lung parenchyma. A ground-glass opacity forming a horizontal level is considered the typical finding.[9]
The angle of this horizontal level is influenced by the position in which the body was left after death. It results from the difference in attenuation between the air-filled regions and the regions with hypostasis. Hypostasis in the lungs may not be prominent immediately after death or in the early postmortem period, but it tends to expand over time. A study involving serial postmortem CT scans in the same body reported that the area of increased attenuation progressed from the dorsal to the ventral side as time passed.[10] [11] On postmortem MRI, hypostasis in both lungs can also be observed, showing high signal intensity compared to the lung parenchyma, which normally appears signal-void on MRI.[8] [12]

● Other Organs

Postmortem MRI studies have reported signal changes due to hypostasis in the liver parenchyma, splenic parenchyma, and myocardium.[8] [12] [13] In all these organs, the dependent regions appear hypointense on T2-weighted images, resembling the signal changes seen in intravascular hypostasis.

● Postmortem clot formation (= cast-like blood clot)

Postmortem clots may appear on CT as high attenuation, cast-like structures within the cardiac chambers or blood vessels.[14] When such cast-like high attenuation areas are seen in the pulmonary arteries on postmortem CT, it can be difficult to distinguish between antemortem pulmonary thromboembolism and postmortem clot formation.[15] However, some studies have reported that unenhanced CT combined with MRI can help differentiate antemortem pulmonary embolism from postmortem clots.[16] [17] If the cortical veins are filled with clots and appear high attenuation, they may mimic subarachnoid hemorrhage, presenting a diagnostic challenge.[18] In forensic cases involving

burned bodies (including those who died from other causes before the body was burned), postmortem clots have been found within blood vessels, sometimes with air entering the space between the clot and the vessel wall, forming an air-crescent sign.[19]

So-called “chicken fat clots”—soft, dark red clots found in the heart chambers—have been shown to differ in composition depending on the cause and manner of death. Studies examining their histological features suggest that these clots vary between prolonged deaths, such as those from malignancy or inflammation, and sudden deaths, such as those from poisoning, fire, or asphyxia.[20]

○ Literature Search Strategy and Selection (January 10, 2024)

【PubMed】

#	Search formula	Number of articles
1	((((((((((postmortem)OR post-mortem)OR "post mortem"))AND imaging))OR(((((postmortem)OR post-mortem)OR "post mortem")) AND CT))OR(((((postmortem)OR post-mortem)OR "post mortem")) AND "computed tomography"))OR(((((postmortem)OR post-mortem) OR "post mortem"))AND MR))OR(((((postmortem)OR post-mortem) OR "post mortem"))AND "magnetic resonance")))OR(((((postmortem) OR post-mortem)OR "post mortem"))AND MDCT))OR((MSCT) AND(((postmortem)OR post-mortem)OR "post mortem")))	31,082
2	((hypostasis OR clot))AND #1	118

【医中誌 Ichushi-Web (Japan Medical Abstracts Society Database)】

#	Search formula	Number of articles
1	(死後 CT/AL or 死後 MRI/AL or（ 死亡時画像診断/TH or 死亡時画像診断/AL） or（ 死亡時画像診断/TH or オートプシーイメージング/AL)） and（ LA=日本語, 英語 and PT= 会議録除く）	793
2	(就下/AL or 凝固/AL）and #1	14

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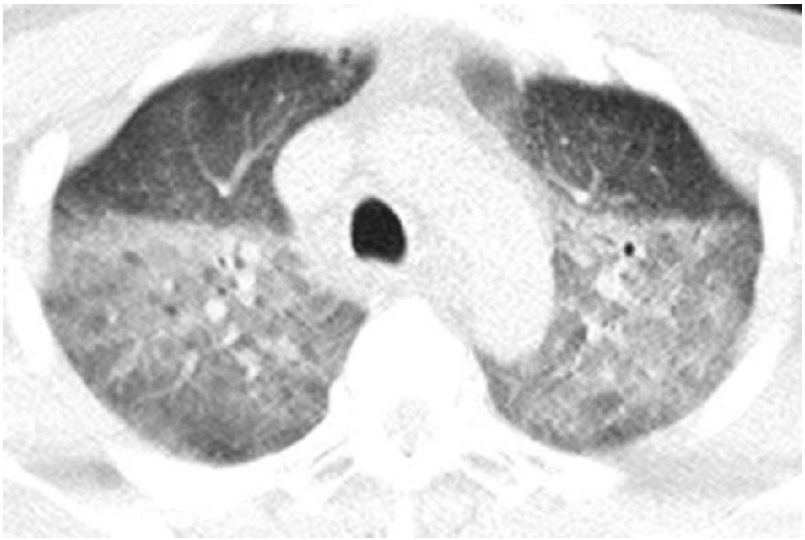

Figure. Male in his 50s – Acute Cardiovascular Event (2 Days Postmortem)

Postmortem CT shows bilateral ground-glass opacities predominantly in the dorsal lungs, with a horizontal fluid level at the level of the trachea. These findings are consistent with gravitational blood pooling.