CQ 7: Is it possible to differentiate antemortem pleural effusion from postmortem pleural fluid accumulation using CT or MRI?

Recommendation Grade: C2

Postmortem CT and MRI can be used to assess pleural fluid accumulation, which tends to appear and increase after a certain postmortem interval. The volume and extent of fluid may vary depending on the cause of death and postmortem interval, and is often greater in cases where resuscitation was performed. Currently, there are no established imaging criteria or reports that clearly distinguish antemortem pleural effusion from postmortem fluid accumulation in the pleural cavity.

Explanation

● Background

A small amount of pleural fluid is normally present during life, but it is not detectable on CT imaging. However, after death, pleural fluid accumulation may become apparent as part of late postmortem changes, especially after a certain postmortem interval has passed. Currently, no imaging-based criteria have been established to distinguish antemortem pleural effusion from postmortem pleural fluid accumulation.

● Imaging Findings

Among early postmortem changes, lung hypostasis has occurred, resulting in ground-glass opacities with increased attenuation. Hypostasis in the lungs begins in the early postmortem period and is reported to increase until approximately 30 hours after death.[1] Following this, fluid may pass through the pleura and accumulate in the pleural cavity, with postmortem pleural effusion increasing up to approximately 42 hours after death.[1] This phenomenon has also been confirmed in animal studies, although the onset and progression vary depending on the cause of death and environmental conditions in which the body is placed, requiring these factors to be taken into account during image interpretation.[2 3]

Postmortem MRI is more sensitive than CT for detecting small amount of pleural fluid, and may be superior for evaluating the presence or absence of effusion. In pediatric cases, pleural effusion is almost universally observed, and its association with postmortem interval has been reported.[4] In one study of 23 cases (1–23 days postmortem), two patterns were identified: one with rapid fluid increase, and another with a gradual increase.[3] In adults, the relationship between pleural effusion and time since death does not show a linear pattern, possibly due to the lower sensitivity of CT compared to MRI. In studies on electrolyte concentrations in drowning cases, no abnormalities are observed in pleural fluid within the first two days postmortem. However, electrolyte changes become apparent with increasing postmortem interval.[5] This suggests that pleural effusion increases not due to continuous leakage from

the alveoli, but rather after a certain period, when microscopic perforations may develop in the pleura.[1] [4] In hospital death cases, patients who underwent resuscitation were significantly more likely to show pleural effusion and perivascular edema around the portal vein.[6] Given the differences between adults and children, as well as between postmortem CT and MRI, further research is needed to clarify the timing and mechanism of pleural fluid accumulation. However, current evidence suggests that postmortem interval and resuscitation efforts both play key roles in this process.

Column: Difference Between Pleural Effusion and Postmortem Pleural Fluid Accumulation

"Pleural effusion" refers to the abnormal accumulation of fluid in the pleural cavity, or the fluid itself, and in forensic medicine, it is typically understood to refer to fluid present during life. When interpreting postmortem imaging, it is important to distinguish between "pleural effusion" (present antemortem) and "postmortem pleural fluid accumulation". When it is difficult to determine whether the fluid appeared before or after death, describing it simply as “pleural fluid accumulation” makes it possible to report the finding without needing to clarify the timing.

○ Literature Search Strategy and Selection (December 23, 2023)

【PubMed】

#	Search formula	Number of articles
1	Search(((((("postmortem CT")OR "postmortem MRI")OR "postmortem imaging")OR "post-mortem CT")OR "post-mortem MRI")OR "postmortem imaging"	1,091
2	Search(#1)AND "pleural effusion"	11
3	Search(#1)AND "postmortem change"	13
4	Search(#1)AND pleural	24
5	Search((#2)OR #3)OR #4	33

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

#	Search formula	Number of articles
1	(死後 mri/AL) and (PT=原著論文, 会議録除く)	21
2	(死後 ct/AL) and (PT=原著論文, 会議録除く)	266
3	((胸水/TH or 胸水/AL) or (胸膜腔/TH or 胸膜腔/AL) or (液体/TH or 液体/AL)) and (PT=原著論文, 会議録除く)	34,958
4	#1 and #3	2
5	#2 and #3	14

6	#4 or #5	16

●Additional Sources Not Captured by the Search Strategy

References［4］

■References

1) Hyodoh H et al：Time-related course of pleural space fluid collection and pulmonary aeration on postmortem computed tomography（PMCT）. Leg Med 2015；17：221-225（level 4b）

2） Hyodoh H et al：Postmortem computed tomography findings in the thorax：experimental evaluation. Leg Med 2016；19：96-100（level 4b）

3) Shimbashi S et al：Objective evaluation of chest findings in infants by postmortem computed tomography. Leg Med 2023；60：102178（level 4b）

4) Barber JL et al：Pleural fluid accumulation detectable on paediatric post-mortem imaging：a possible marker of interval since death? Int J Legal Med 2016；130：1003-1010（level 4b）

5） Yajima D et al：Diagnosis of drowning by summation of sodium, potassium and chloride ion levels in pleural effusion：differentiating between freshwater and seawater drowning and application to bathtub deaths. Forensic Sci Int 2013；233：167-173（level 4b）

6） Wagensveld IM et al：Total-body CT and MR features of postmortem change in in-hospital deaths. PLoS One 2017；12：e0185115（level 4b）