

## **CQ 5: Is postmortem CT or MRI useful for detecting, quantifying, and characterizing internal fluid collections?**

### **Recommendation Grade: B**

Postmortem CT and MRI are effective for detecting fluid in body cavities and subcutaneous edema. In particular, T2-weighted MRI clearly visualizes internal fluid collections. The detection capability of postmortem CT and MRI may even surpass that of autopsy, except in cases of very small volumes, and allows for accurate assessment of the spatial relationship between fluid and adjacent organs. Postmortem CT can also be used to measure the volume of fluid. Moreover, using attenuation values (HU) on CT, it is possible to characterize blood within the body. However, the attenuation of fluids on postmortem CT may vary depending on postmortem changes and temperature. Special caution is needed in frozen bodies, as fluids may appear hypoattenuating (low-density) when frozen.

### **Explanation**

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#### **• Importance of Detecting Internal Fluids in the Postmortem Body**

The living body contains various types of fluids, including blood, cerebrospinal fluid, pericardial fluid, pleural effusion, urine, and other secretions. In postmortem bodies, the location and volume of these fluids can sometimes be related to the cause of death, making their detection and evaluation an important part of postmortem imaging interpretation.

#### **• Detection of Internal Fluid Using Postmortem Imaging**

Postmortem CT and MRI can detect fluid collections not only in body cavities such as the cranial cavity, pleural cavity, pericardial sac, and peritoneal cavity, but also in the subcutaneous tissues.<sup>1-7</sup> On T2-weighted postmortem MRI, fluids appear as high-signal areas, making them clearly visible.<sup>8-11</sup>

The fluid detection capability of postmortem CT and MRI may sometimes exceed that of autopsy. In particular, subcutaneous fluid accumulation is often more easily detected by postmortem imaging because its signal or attenuation characteristics differ from surrounding subcutaneous fat, allowing for better visualization than by autopsy.<sup>1 4 10</sup> However, very small amounts of fluid that can be found at autopsy may not be detected on postmortem CT.<sup>5 12</sup>

#### **• Localization and Quantification of Fluid Using Postmortem Imaging**

In autopsy, fluid may spill out during the procedure, making it difficult to accurately determine its original anatomical location. This is especially true for fluid in the larynx, pharynx, and trachea, which can easily escape due to body position changes during external examination or dissection.

In contrast, postmortem CT and MRI allow for clear visualization of fluid localization, and make it easier to assess the spatial relationships with surrounding organs.<sup>11 13</sup>

Quantification of fluid volume using postmortem CT has been performed since early in the

development of the modality.<sup>12</sup> There are several reports comparing the volumes of pleural, peritoneal, and pericardial fluid measured on postmortem CT with those obtained at autopsy.<sup>3 4 7 14</sup> For the pleural and peritoneal cavities, CT-based fluid volumes generally show good agreement with autopsy findings.<sup>3 4 7 14</sup> However, in the pericardial cavity, CT may indicate a larger volume than what is measured during autopsy.<sup>2 4 7</sup> This discrepancy may occur because a large amount of pericardial fluid can leak out during dissection, resulting in underestimation at autopsy.

● **Characterization of Fluid Based on CT Attenuation Values**

Several studies have evaluated attenuation values of fluids on postmortem CT. Blood typically shows attenuation values ranging from 40 to 90 HU (average ~60 HU), which are higher than those of cerebrospinal fluid (CSF), serous fluid, bile, and urine, allowing for differentiation between these fluids.<sup>15</sup> There have been reports of detecting intraventricular hemorrhage<sup>5</sup> and gastrointestinal hemorrhage<sup>16</sup> based on elevated attenuation values in the ventricles and GI tract, respectively. However, it should be noted that attenuation values can vary due to postmortem changes and temperature effects.<sup>15</sup> Fluids associated with putrefaction can range widely in attenuation from -130 to +80 HU (average ~30 HU), depending on timing and anatomical location.<sup>15</sup> In decomposed bodies, the presence of bowel gas or intra-abdominal gas may interfere with evaluation, making it difficult to characterize fluid based solely on attenuation values.<sup>17</sup> One study examining temperature effects on attenuation showed that serous fluid and CSF had values of approximately 30 HU and 20 HU at 4°C, but 20 HU and 10 HU at 40°C, respectively—a 10 HU difference.<sup>15</sup> When fluid is frozen, it tends to appear as low-attenuation.<sup>18</sup> In one case involving ruptured tubal pregnancy, postmortem CT performed 4 days after death following cold storage showed a high-attenuation blood clot in the pelvic cavity near the bleeding site, while a linear low-attenuation area under the diaphragm represented frozen fluid—allowing for retrospective estimation of the site of bleeding.<sup>19</sup>

For more on postmortem fluid changes and fluid in drowning cases, refer to CQ7 and CQ43, respectively.

○ Literature Search Strategy and Selection (November 9, 2023)

【PubMed】

#	Search formula	Number of articles
1	(((((("postmortem CT") OR "postmortem MRI") OR "postmortem imaging") OR "post-mortem CT") OR "post-mortem MRI") OR "postmortem imaging"	1,085
2	#1 AND liquid	11
3	#1 AND fluid	77
4	#1 AND effusion	33

5	#1 AND ascites	56
6	#2 OR #3 OR #4 OR #5	108

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

#	Search formula	Number of articles
1	(死後/AL) and ((FT=Y) PT=原著論文, 会議録除く CK=ヒト)	5,086
2	(死亡時/AL) and ((FT=Y) PT=原著論文, 会議録除く CK=ヒト)	977
3	((画像診断/TH or 画像診断/AL)) and ((FT=Y) PT=会議録除く CK=ヒト)	365,273
4	((X 線 CT/TH or X 線 CT/AL)) and ((FT=Y) PT= 会議録除く CK=ヒト)	145,030
5	((MRI/TH or MRI/AL)) and ((FT=Y) PT=原著論文, 会議録除く CK=ヒト)	115,576
6	#1 or #2	5,764
7	#3 or #4 or #5	376,814
8	#6 and #7	1,486
9	((液体/TH or 液体/AL)) and ((FT=Y) PT=原著論文, 会議録除く CK=ヒト)	7,988
10	(胸水/TH or 胸水/AL)	21,947
11	(心膜液/TH or 心嚢液/AL)	2,865
12	心嚢水/AL	859
13	(腹水/TH or 腹水/AL)	34,124
14	#9 or #10 or #11 or #12 or #13	63,102
15	#8 and #14	100

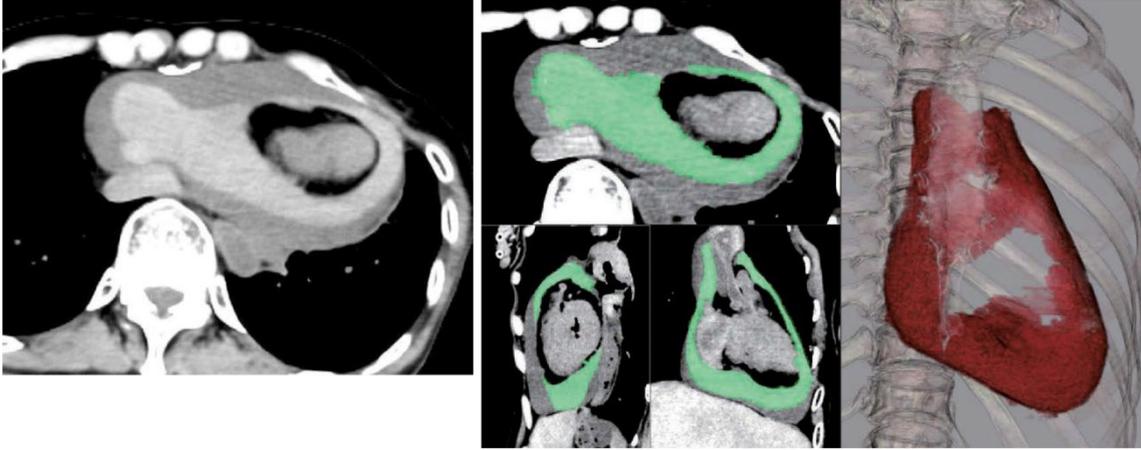
●Additional Sources Not Captured by the Search Strategy

References [12] , [14] , [17] , [18]

■References

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- 6) Palmiere C et al : Fatal hemorrhage following sacroiliac joint fusion surgery : a case report. *Leg Med* 2017 ; 26 : 102-105 (level 5)
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- 17) Poulsen K et al : Computed tomography as routine in connection with medico-legal autopsies. *Forensic Sci Int* 2007 ; 171 : 190-197 (level 4b)
- 18) Hyodoh H et al : Frozen (iced) effect on postmortem CT — Experimental evaluation. *JoFRI* 2015 ; 3 : 210-213 (level 4b)
- 19) O'Donnell C et al : Massive hemoperitoneum due to ruptured ectopic gestation : postmortem CT findings in a deeply frozen deceased person. *Leg Med* 2011 ; 13 : 245-249 (level 5)



**Figure. Male in his 60s – Hemopericardium**

Using the imaging workstation, the clotted portion of the hemopericardium was extracted and measured. Estimated volume: approximately 228 mL