

**CQ29 Is it possible to interpret the bloody cardiac tamponade that causes death in postmortem CT?**

**Grades of recommendations:**

**B for evaluating the condition**

**C1 for determining the cause of death**

If hyperdense armored hearts are observed in which there is a high attenuation image of the pericardial space surrounding the heart, it is considered that a bloody cardiac tamponade has affected the cause of death. If only the fluid-fluid level is observed in the pericardial space, postmortem blood leakage may occur. If more than 200 ml of pericardial hematoma (intrapericardial hematoma) is seen on postmortem CT, it is considered that the cause of death was pericardial hematoma. However, cardiopulmonary resuscitation may have modified the appearance.

**Explanation-----**

Pericardial hematoma is a condition in which the hematoma is identified in the pericardial space [1, 2]. Cardiac tamponade is considered to cause clinical symptoms such as hypotension due to an increase in intrapericardial pressure caused by either of the following: serious (heart failure), fibrous (infectious disease, collagen disease, uremia), and bloody (malignant tumor, infectious disease, hemorrhagic diathesis, trauma, iatrogenicity) [3].

Pericardial hematomas are caused by rupture of the aortic system or the wall of the heart into the pericardial space, resulting in increased pericardial pressure, suppression of atrial/ventricular dilatation, higher than diastolic intracardiac pressure, and resulting in circulatory failure and death [1, 2].

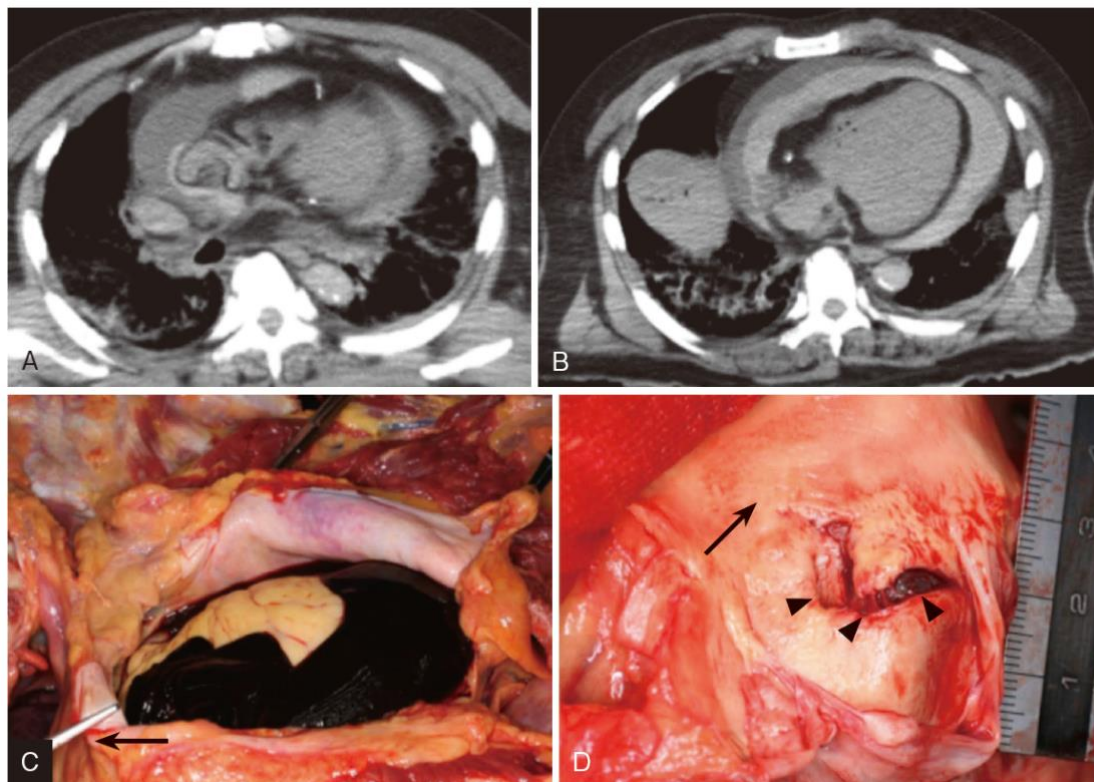
**Image findings of bloody cardiac tamponades**

In reports of pericardial hematomas for cases of acute death, it is considered that a pericardial high attenuation image suggesting a volume of more than 200 ml is required to determine the cause of death [1, 2]. It has been reported that a cardiac tamponade develops due to rapid pericardial hematoma formation even with a volume of 100 ml or less [3]. There is also a report that pericardial hematomas of 300 to 400 ml or more were confirmed by autopsies [4]. Since the hematoma is affected by postmortem medical practice, caution should be paid in determining the cause of death based solely on the amount of blood involved.

It has been reported that examined cases of acute aortic dissection, 60% were observed to have a "hyperdense armored heart (HAH)" with a layered structure of high attenuation (blood cell component) and iso-attenuation (plasma component) on the epicardial space [5]. This indicates that

the heartbeat continued even when the pericardial space was bleeding, and it is considered that the formation of fibrin in the inner layer would have suppressed myocardial wall motion, resulting in the observation of plasma components on the outside [1, 5]. In addition, when the heartbeat has immediately stopped in animal experiments, the fibrin is not formed in pericardial space [6]. When a fluid-fluid level is observed in the pericardial cavity, it is a blood leak that occurs after death due to cardiopulmonary resuscitation with a sensitivity of 86% and a specificity of 96% [7]. It has been reported that it is possible to determine whether a hematoma caused antemortem cardiac tamponade, or whether postmortem blood leaked into the pericardial space and formed a blood pool in the pericardial space, and it is possible to make a determination based on image findings [7]. However, there are overlaps in the findings, and caution is required when making such determinations.

**Figure 1 Pericardial hematoma due to aortic dissection**



The patient was found tired in the driver's seat of a passenger car parked at the side of the road. The death was confirmed at the hospital which the patient was transported to. The car showed no evidence of any accident. Postmortem CT showed collapsed deformation of the ascending aorta (A), and hematoma retention in the pericardial cavity divided into high and iso-attenuation areas (B). Postmortem CT measurements showed that the pericardial hematoma was 425.8 ml. The autopsy showed an armored heart (C) (→ is the cephalad direction) and a position of the place of entry of the blood (D arrowhead) at the origin of the right coronary artery on the intimal surface of the ascending aorta. DeBakey II type aortic dissection was diagnosed, and the diagnosis was death by rupture of the pericardial space causing a pericardial hematoma.

It has been reported that flattened heart sign (FHS) findings in which the anterior wall of the heart is flattened are found in bloody heart tamponades, except for cases with blood loss [2]. However, there are also reports that FHS cannot distinguish blood leakage into the pericardial space before or after death [7]. When HAH and FHS are observed, it is possible, and can be pointed out that a bloody heart tamponade affected the cause of death with a high probability [2]. The prenatal haemorrhages occur when the absorption value in the pericardial cavity exceeds 61.8 HU [7]. By evaluating HAH and the fluid-fluid level, it is possible to determine with high probability whether bleeding into the pericardial cavity is antemortem or postmortem blood leakage [7]. After death, it is necessary to distinguish this from blood clots that are only attached to the heart. Postmortem MRI was able to visualize hematomas in the pooled blood in the pericardial space, but caution is required to make such an interpretation [1].

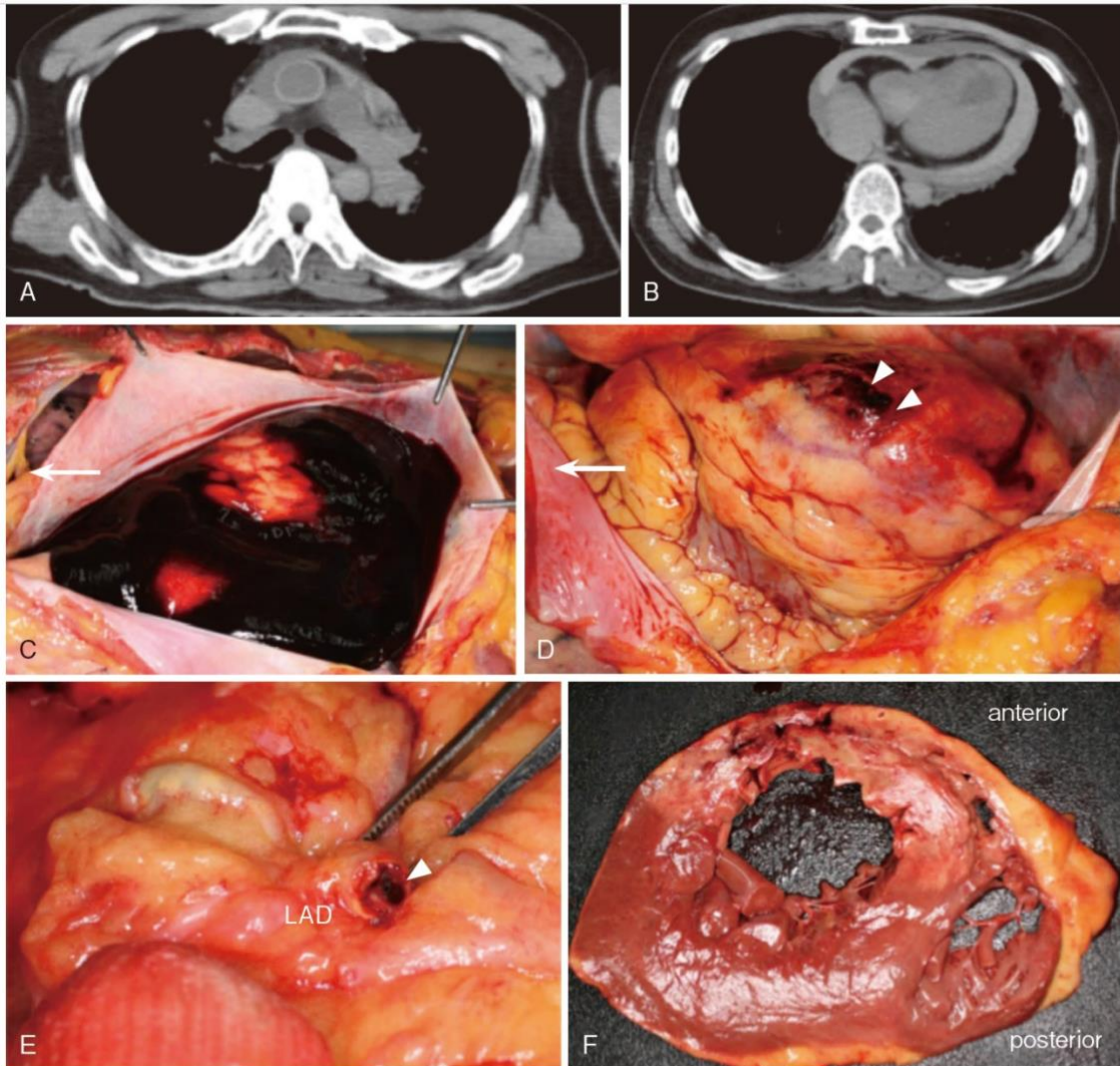
In the clinical image report, venous dilation (inferior vena cava, hepatic vein, renal vein) [9, 10], decrease in myocardial anterior and posterior diameter [11], and septal curvature [12, 13] were reported as coexisting findings with cardiac tamponade. There is a report that it can be considered that a severe bloody cardiac tamponade leading to death is caused if HAH is present with any of these findings on postmortem images [1].

There is also a report that the volume of pericardial space was measured using postmortem CT, and a high correlation with the measured value has been reported [14, 15].

#### **Diseases/illnesses to be distinguished**

- ① Heart rupture after myocardial infarction
- ② Dissecting aortic aneurysm, rupture into the pericardium
- ③ Cardiovascular damage in the pericardium due to chest bruise
- ④ Cardiovascular damage due to chest compressions (cardiopulmonary resuscitation)
- ⑤ Leakage from the heart chambers due to postmortem puncture
- ⑥ Rare cases: pericarditis, coronary artery rupture, pulmonary artery dissection, iatrogenic (interventional procedure related complication)

**Figure 2 Pericardial hematoma due to rupture of the left anterior wall after myocardial infarction**



The patient was found lying on a sidewalk. Death was confirmed at the hospital after the transport. Only a small amount of exfoliation was observed on the fingers and face. Postmortem CT showed a hematoma in the pericardial space (A, B) with a volume of 398.0 ml. In the pericardial space, the heart was surrounded by a blood clot (C → shows the cranial direction), and extensive discoloration, bleeding, and dehiscence (D) (→ shows the cranial direction) were noted on the anterior wall of the left ventricle. The left coronary artery was occluded (E) by a thrombus at the origin of the anterior descending artery. On the myocardial plane, a widespread myocardial infarction lesion extending from the anterior wall of the left ventricle to the septum was observed to cause thinning and dehiscence of the myocardium (F).

Literature search formula and literature selection (2019/6/3)

PubMed

#	Search formula	Number of documents
1	Search((((("postmortem CT")OR "postmortem MRI")OR "postmortem imaging")OR "post-mortem CT")OR "post-mortem MRI")OR "postmortem imaging"	822
2	Search(#1)AND "cardiac tampomade"	161
3	Search(#1)AND "hemopericardium"	8
4	Search(#1)AND pericardium	12
5	Search(#3)OR #4	17

Ichushi (Medical Journal)

#	Search formula	Number of documents
1	(死後/AL)and((PT= 症例報告)AND(P T= 原著論文, 総説, 会議録除く)CK=ヒト)	4,780
2	(X 線 CT/TH or x 線 ct/AL)	284,448
3	(MRI/TH or mri/AL)	262,966
4	(心膜/TH or 心嚢/AL)	10,751
5	(心タンポナーデ/TH or 心タンポナーデ/AL)	5,060
6	#1 and #2	380
7	#1 and #3	312
8	#6 or #7	637
9	#8 and #5	9
10	(心膜液貯留/TH or 心膜血腫/AL)	3,074
11	#8 and #10	6
12	#9 or #11	14

References

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