CQ26 Can blood hypostasis or blood clots found in the cardiovascular system in postmortem images be distinguished from thrombosis?

Grades of recommendations: C2

Postmortem images show postmortem changes such as blood hypostasis reflecting erythrocyte sedimentation due to circulatory arrest, and postmortem CT show horizontal plane formation with high attenuation on the gravity side and low attenuation on the non-gravity side. At the same time, antemortem thrombus is also recognized as a high attenuation area in the cardiovascular lumen. Pulmonary thromboembolism is a condition that may cause death, and its diagnosis is important both medically and socially. However, at present, it is difficult to exactly diagnose the intravascular high attenuation observed in postmortem CT since it may be any of the following: an antemortem thrombus, a clot that occurred as a postmortem change if there was no sudden death, and blood hypostasis as a postmortem change.

Explanation----------

Background

Pulmonary thromboembolism causes sudden death, and its diagnosis is medically and socially important. At the same time, blood hypostasis and postmortem clots, which appear as general changes after death, may present findings similar to those of antemortem thrombi. Therefore, it is important not to misdiagnose postmortem changes as pathological thrombi.

Postmortem changes in the heart, large blood vessels, hypostasis, and blood clots

In general, in the case of sudden death, postmortem clots that occur in the heart and large blood vessels due to circulatory arrest are known to be rapidly thawed by the blood activation of plasminogen activator released from vascular endothelial cells. This keeps the blood fluid [1, 2] (CQ2). Since serum is distributed on the non-gravity side and blood cells are distributed on the gravity side according to gravity (the relative high/ low position), postmortem CT show liquid level formations with high attenuation on the gravity side. In general, blood hypostasis appears about 30 minutes to 2 hours after death and is completed within 12 hours after death. For postmortem CT images recorded within 2 hours after death it has been reported that half of the cases had cardiovascular luminal blood hypostasis [3]. In the case of sudden death, it has here been pointed out that the emergence of blood hypostasis may be accelerated due to increased fluidity of the blood.

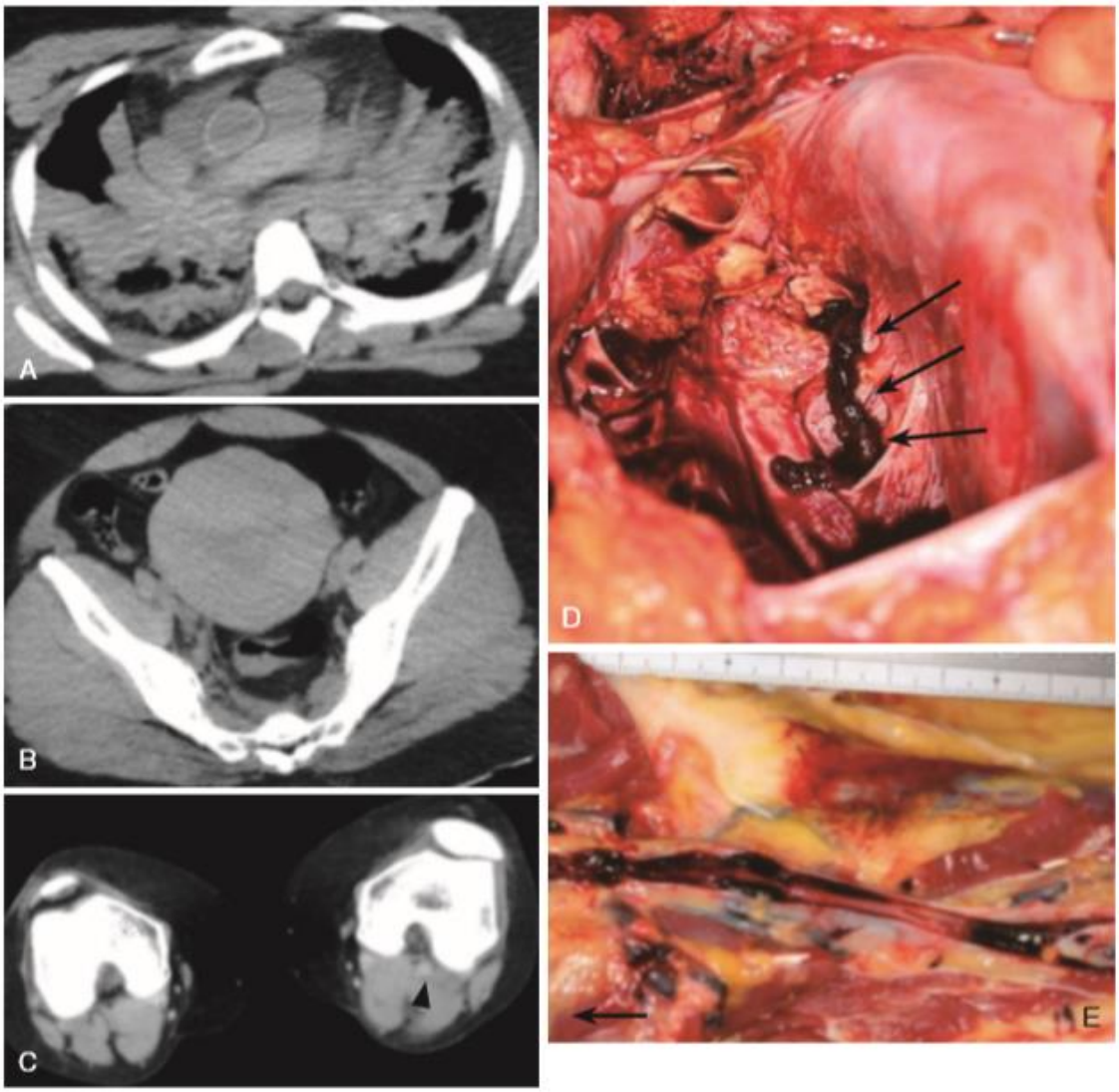
Differentiation from blood clots

In postmortem CT, it is difficult to distinguish blood hypostasis from blood clots directly and with

sufficient specificity because blood clots occurring in antemortem and postmortem blood hypostasis/clots show similar attenuations [4, 5]. Among the reports, many attempts have been made to specifically detect pulmonary thromboembolisms, and it has been reported that pulmonary thromboembolisms can be evaluated from the morphology and distribution of the high attenuation areas from the pulmonary trunk to the pulmonary artery and by edema of the lower limbs [6]. As an indirect finding, there is a report that the enlargement of the inferior vena cava diameter is associated with pulmonary embolisms [7, 8]. Both reports suffer from insufficient sensitivity and specificity, however, and further investigation is necessary. Furthermore, postmortem enhanced CT have attempted to detect pulmonary thromboembolism, and future investigation is expected to help resolve this [9-11].

There is also a report that pulmonary thromboembolism can be identified as a clot with a relatively uniform intermediate signal on T2-weighted images in postmortem MRI [12, 13]. At present, this is only reported for a case, and further cases and statistical analysis are awaited.

Figure: Pulmonary artery thromboembolism



Postmortem CT showing that the pulmonary artery was dilated compared to the aorta, but there were no findings suggesting a clot or embolus in the pulmonary trunk. A marked infiltrative shadow centered on the hilum of both lung fields (A). Uterine myoma is observed in the pelvic cavity (B). The left popliteal vein (C, arrow head) has a tighter and higher attenuation than the right popliteal vein (C). The autopsy showed thrombosis in the popliteal vein of the left lower extremity and the left intermuscular vein (E →bottom left arrow points to the head).

Hyperdense cast-like clot in the heart and great blood vessels

Postmortem CT may show hyperdense cast-like clots in the heart and great blood vessels. This corresponds to a blood clot (chicken fat clot), which is observed in the following cases: caused by prolonged agony, chronic diseases, burn deaths, and others. When postmortem CT show a hyperdense cast-like clot in the pulmonary artery, it is difficult to distinguish it exactly as either antemortem pulmonary thrombosis, clots that occur as postmortem changes due to prolonged periods of agony, or

blood hypostasis/coagulation from general postmortem changes [14].

Relationship with antemortem blood test

It has been reported that antemortem fibrinogen levels were significantly higher in cases where postmortem CT clearly showed blood hypostasis in the heart and great blood vessels [15]. However, there was no clear correlation between erythrocytes, hemoglobin, hematocrit, period of prothrombin, period of activated partial thromboplastin. From this, it is suggested that antemortem fibrinogen is high when the postmortem CT showed clear blood hypostasis in the heart and great blood vessels. In addition, it possibly suggests antemortem acute infections, malignant tumors, or necrosis.

Relationship with hypothermia (CQ44)

In the case of sudden death, the blood in the heart and great blood vessels often remains fluid, but it has been reported that a significant number of blood clots were detected in cases of death due to hypothermia [16, 17].

Other high attenuation structures

Aortic dissection (CQ30) is recognized as a high attenuation area that divides the lumen of the blood vessel when the false lumen is largely open, and postmortem changes may make it problematic to distinguish it from blood hypostasis and clots [18].

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

PubMed

#	Search formula	Number of documents
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")))	23,683
2	“hypostasis” OR “livor mortis” OR “lividity”	182
3	“thrombosis” OR “clot”	209,140
4	(#1 and #2) or (#1 and #3)	840

Ichushi（Medical Journal）

#	Search formula	Number of documents
1	(死後 CT or 死亡時画像診断 or オートプシーイメージング)and(LA=日本語, 英語 PT=会議録除く)	523
2	(肺塞栓 or 血栓 or 凝血塊 or 血液就下)and(LA=日本語,英語 PT=会議録 除く)	69,114
3	#1 and #2	20

References

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[2] Takeichi S et al: Fluidity of cadaveric blood after sudden death: part II. mechanism of release of plasminogen activator from blood vessels. Am J Forensic Med Pathol 1985; 6: 25-29 (Level 4b)

[3] Shiotani S et al: Postmortem intravascular high-density fluid level (hypostasis): CT findings. J Comput Assist Tomogr 2002; 26: 892-893 (Level 4b)

[4] Christe A et al: Clinical radiology and postmortem imaging (virtopsy) are not the same: specific and unspecific postmortem signs. Leg Med 2010; 12: 215-222 (Level 5)

[5] Jackowski C et al: Postmortem imaging of blood and its characteristics using MSCT and MRI. Int J Legal Med 2006; 120: 233-240 (Level 4)

[6] Ampanozi G et al: Pulmonary thromboembolism on unenhanced postmortem computed tomography: feasibility and findings. Leg Med 2016; 20: 68-74 (Level 4b)

[7] Müller SL et al: Distended diameter of the inferior vena cava is suggestive of pulmonary thromboembo lism on unenhanced post-mortem CT. J Forensic Radiol Imaging 2015; 3: 38-42 (Level 4b)

[8] Ruder T et al: Evaluation of vascular diameter and cases of pulmonary embolism sudden death. J Forensic Radiol Imaging 2014; 2: 100 (Level 4b)

[9] Burke MP et al: Can forensic pathologists diagnose pulmonary thromboembolism on postmortem computed tomography pulmonary angiography? Am J Forensic Med Pathol 2014; 35: 124-131 (Level 5)

[10] Pichereau C et al: Post-mortem CT scan with contrast injection and chest compression to diagnose pulmonary embolism. Intensive Care Med 2015; 41: 167-168 (Level 5)

[11] Ross S et al: Postmortem whole-body CT angiography: evaluation of two contrast media solutions. AJR 2008; 190: 1380-1389 (Level 4b)

[12] Jackowski C et al: Pulmonary thrombembolism as cause of death on unenhanced postmortem 3T

MRI. Eur Radiol 2013; 23: 1266-1270 (Level 5)

[13] von Both I et al: Differentiation of antemortem pulmonary thromboembolism and postmortem clot with unenhanced MRI: a case report. Forensic Sci Med Pathol 2018; 14: 95-101 (Level 5)

[14] O'Donnell C et al: Post-mortem radiology: a new sub-speciality? Clin Radiol 2008; 63: 1189-1194 (Level 6)

[15] Ishida M et al: Hypostasis in the heart and great vessels of non-traumatic in-hospital death cases on postmortem computed tomography: relationship to antemortem blood tests. Leg Med 2011; 13: 280-285 (Level 4)

[16] Kawasumi Y et al: Hypothermic death: possibility of diagnosis by post-mortem computed tomography. Eur J Radiol 2013; 82: 361-365 (Level 4b)

[17] Takahashi S et al: Influence of cause of death and blood ethanol concentration on the coagulability of cadaveric blood. Leg Med 2009; 11 Suppl 1: S226-227 (Level 4b)

[18] Ishida M et al: Common postmortem computed tomography findings following atraumatic death: differentiation between normal postmortem changes and pathologic lesions. Korean J Radiol 2015; 16: 798-809 (Level 5)