

CQ 34 Is it possible to detect aortic aneurysm rupture or aortic dissection using postmortem imaging?

Recommendation Grade:

Assessment of condition: C1

Determination of cause of death: C2

Aortic rupture due to conditions such as aortic aneurysm rupture or aortic dissection can lead to fatal hemorrhagic shock and is detectable on postmortem CT. When such lesions occur in isolation, determining the direct cause of death is relatively straightforward. However, in cases involving traumatic injury, it is necessary to assess the severity of other coexisting findings in conjunction with the aortic lesion.

Explanation

● **Background**

1. Aortic Aneurysm

An aortic aneurysm is defined as a localized or generalized dilation or protrusion of a portion of the aortic wall. The term "aneurysm" is generally used when a segment of the aortic wall expands locally to form a bulge, or when the diameter increases to more than 1.5 times the normal diameter—typically over 45 mm in the thoracic aorta or over 30 mm in the abdominal aorta.

2. Aortic Dissection

Aortic dissection is a condition in which a tear in the aortic intima allows blood to enter the media, separating the inner and outer layers of the media. In Stanford type A dissections, which involve the ascending aorta, conservative management is associated with high mortality rates: 20% within 24 hours, 30% within 48 hours, 40% within one week, and 50% within one month. In most fatal cases, the cause of death is cardiac tamponade due to rupture into the pericardial cavity¹⁻⁸. There are also reports that postmortem angiographic CT has been effective in diagnosing this condition⁹.

● **What findings are observed?**

The following findings indicate the presence of a fatal hemorrhagic lesion:

1. High-attenuation fluid collection (hematoma) surrounding major vessels¹⁻⁸
2. Hemopericardium⁷
3. Hemorrhagic pleural or peritoneal effusion

The following findings are helpful in identifying the site of bleeding:

4. Presence of mural thrombus or false lumen
5. Deformation of the arterial wall or aneurysm
6. Disruption of the arterial wall at the site of an aneurysm

● **What findings support interpretation as the cause of death?**

If any of the findings listed in 1–3 above are present, the condition can be interpreted as the cause of death. However, hemopericardium alone may not allow differentiation from left ventricular rupture due to myocardial infarction. Even in cases with hemorrhagic pleural effusion, there are reports of left ventricular rupture due to myocardial infarction followed by pericardial rupture from chest compression⁹. In ruptured abdominal aortic aneurysms, bleeding is more frequently observed in the retroperitoneal space than in the peritoneal cavity.

● **What imaging techniques are useful for interpretation? (See also CQ13)**

Reconstructed images, such as sagittal views, may allow identification of entry and re-entry sites in aortic dissection. Similar techniques may also help localize the rupture site in cases of aneurysm.

● **Differential Diagnoses**

1. Traumatic aortic rupture (e.g., at the aortic isthmus)
2. Traumatic cardiac rupture or pericardial rupture (e.g., from high falls)
3. Multiple intrathoracic injuries (e.g., pulmonary contusion, pneumothorax, intercostal vessel injury)
4. Cardiac or pericardial rupture due to chest compression during cardiopulmonary resuscitation
5. Rare conditions such as spontaneous pneumothorax or thoracic endometriosis

○ Literature Search Strategy and Selection (as of July 30, 2023)

【PubMed】

#	Search formula	Number of articles
1	((((((("postmortem") OR "post-mortem") AND "post mortem")) AND "imaging")) OR (((("postmortem") OR "post-mortem") AND "post mortem")) AND "CT")) OR (((("postmortem") OR "post-mortem") AND "post mortem")) AND "computed tomography")) OR (((("postmortem") OR "post-mortem") AND "post mortem")) AND "MR")) OR (((("postmortem") OR "post-mortem") AND "post mortem")) AND "magnetic resonance")	5,761
2	(#1)AND(Aortic aneurysm)	38
3	(#1)AND(Aortic dissection)	32

【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)	5,049
#2	(死亡時/AL)and((FT=Y)PT=原著論文,会議録除く CK=ヒト)	958
#3	((画像診断/TH or 画像診断/AL))and((FT=Y)PT=会議録除く CK=ヒト)	360,122
#4	((X線CT/TH or X線CT/AL))and((FT=Y)PT=会議録除く CK=ヒト)	142,701
#5	((MRI/TH or MRI/AL))and((FT=Y)PT=原著論文,会議録除く CK=ヒト)	113,956
#6	#1 or #2	5,716
#7	#3 or #4 or #5	371,578
#8	#6 and #7	1,474
#9	((大動脈瘤/TH or 大動脈瘤/AL))and((FT=Y)CK=ヒト)	19,867
#10	((大動脈解離/TH or 大動脈解離/AL))and((FT=Y)CK=ヒト)	7,331
#11	#9 or #10	20,482
#12	#8 and #11	51

■References

- 1) Sakamoto N et al : Interpretation of multi-detector computed tomography images before dissection may allow detection of vascular anomalies : a postmortem study of anomalous origin of the right subclavian artery and the right vertebral artery. Anat Sci Int 2012 ; 87 : 238-244 (level 5)
- 2) Vogt KM et al : Fluoroscopic angiography in the gross anatomy dissection laboratory : visualizing the aortic arch and its branches in a cadaver. Clin Anat 2011 ; 24 : 253-257 (level 5)
- 3) Ross SG et al : Sudden death after chest pain : feasibility of virtual autopsy with postmortem CT angiography and biopsy. Radiology 2012 ; 264 : 250-259 (level 5)
- 4) Shiotani S et al : Non-traumatic postmortem computed tomographic (PMCT) findings of the lung. Forensic Sci Int 2004 ; 139 : 39-48 (level 5)
- 5) Kasahara S et al : Diagnosable and non-diagnosable causes of death by postmortem computed tomography : a review of 339 forensic cases. Leg Med 2012 ; 14 : 239-245 (level 5)
- 6) Yamazaki K et al : Comparison between computed tomography (CT) and autopsy findings in cases of abdominal injury and disease. Forensic Sci Int 2006 ; 16 : 163-166 (level 5)
- 7) Shiotani S et al : Postmortem computed tomographic (PMCT) findings of pericardial effusion due to acute aortic dissection. Radiat Med 2004 ; 22 : 405-407 (level 5)
- 8) Makino Y et al : Can ruptured abdominal aortic aneurysm be accurately diagnosed as the cause of death without postmortem computed tomography when autopsies cannot be performed? Forensic Sci Int 2015 ; 249 : 107-111 (level 5)
- 9) Burke M et al : Management of medicolegal natural deaths from hemopericardium or hemothorax using postmortem CT scanning. Forensic Sci Med Pathol 2012 ; 8 : 367-372 (level 5)

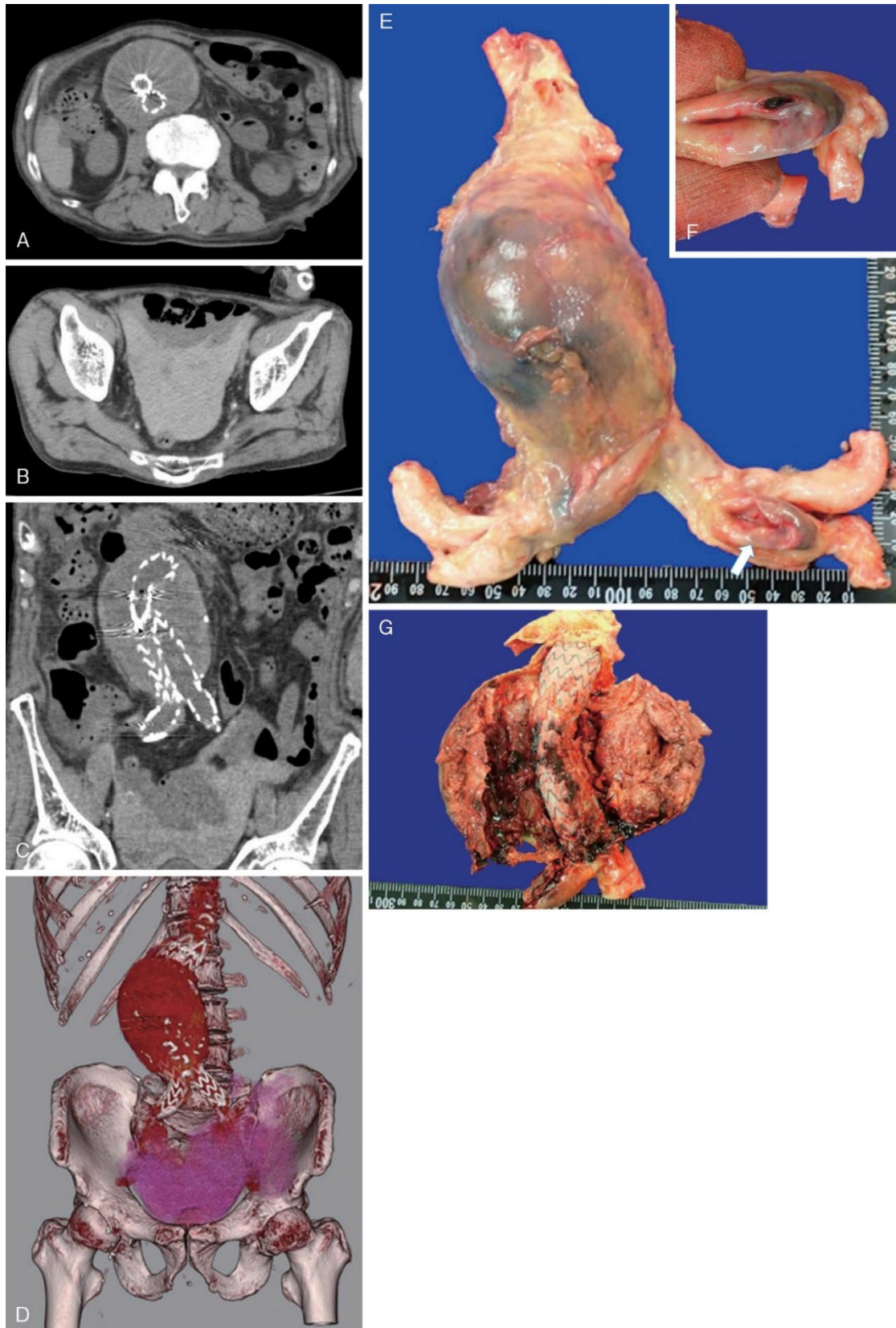


Figure 1. Intraperitoneal Hemorrhage After Endovascular Stent Grafting for Abdominal Aortic

Aneurysm in a Man in His 90s (Autopsy, 2 Days Postmortem)

A. CT: A Y-shaped stent graft has been placed in the abdominal aortic aneurysm. No hemorrhage is observed around the aneurysm.

B. CT: A high-attenuation area is noted in the pelvic cavity, indicating intraperitoneal hemorrhage.

C. CT (coronal view): No continuity is observed between the abdominal aortic aneurysm and the hemorrhage in the pelvic cavity.

D. CT: The use of volume-rendered (VR) images allows estimation of the hemorrhage volume in the pelvic cavity (approximately 480 mL).

E. Resected abdominal to iliac arteries: In addition to the abdominal aortic aneurysm, a left internal iliac artery aneurysm is observed. No rupture is noted in the abdominal aortic aneurysm, but the iliac aneurysm appears collapsed (⇨).

F. Left internal iliac artery aneurysm: A rupture site is present, and hematoma is seen extruding from within. When death occurs following medical intervention (in this case, stent graft placement), iatrogenic causes may be suspected. However, postmortem imaging can help demonstrate that appropriate treatment was performed. Accidental disease processes may be the actual cause of death, and careful interpretation is necessary.

G. Abdominal aortic aneurysm: The stent graft is well apposed to the vessel wall, and no hematoma is seen within the aneurysm.

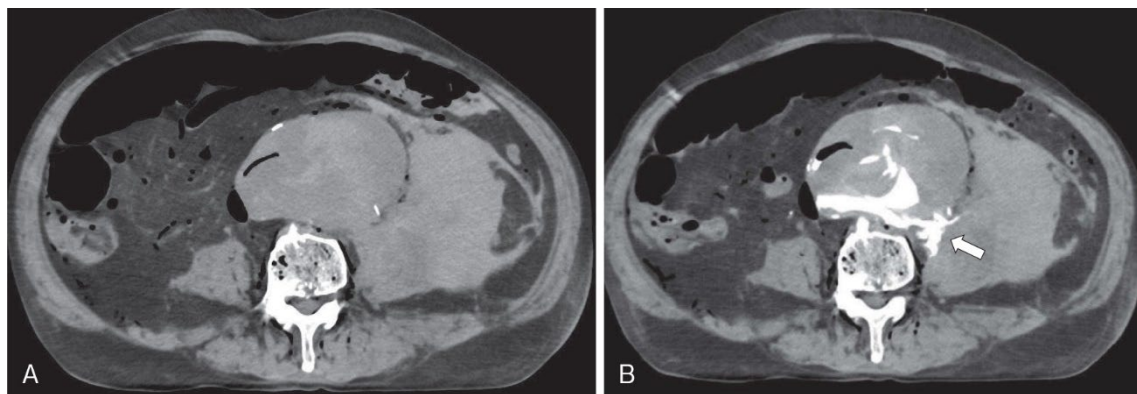


Figure 2. Ruptured Abdominal Aortic Aneurysm in a Man in His 70s

A. Pre-contrast B. Post-contrast

On pre-contrast postmortem CT, an abdominal aortic aneurysm and extensive hemorrhage into the left retroperitoneal space are observed. Administration of contrast medium confirms rupture from the left dorsal side into the retroperitoneal cavity (⇨).