**CQ30 Is it possible to identify aortic aneurysm rupture and aortic dissection with postmortem images?**

**Grades of recommendations:**
**C1 for evaluating the condition**
**C2 for determining the cause of death**

Aortic ruptures caused by aortic dissection and ruptures of aortic aneurysms may be a cause of death by inducing hemorrhagic shock and can be diagnosed by postmortem CT.
The direct cause of death can easily be diagnosed by a single lesion. However, if traumatic injury of the aorta is suspected, the severity of other findings should also be assessed.

**Explanation----------**
**Background**

**1) Aortic aneurysm**

An aortic aneurysm is defined as "a part of the wall of the aorta is circumferentially or locally (diameter) enlarged or protruded". Generally, when a part of the aortic wall expands locally to form an aneurysm, or the diameter exceeds 1.5 times the normal diameter (45 mm in the chest and 30 mm in the abdomen) (in a spread-like enlargement), it is called an "aneurysm".

**2) Aortic dissection**

Aortic dissection is a condition in which the inner layer of the aorta is torn and blood surges through the tear, causing the inner and middle layers of the aorta to separate. When treated conservatively as a Stanford type A aortic dissection that extends to the ascending aorta, 20% of patients die within 24 hours after onset, 30% within 48 hours, 40% within 1 week, and 50% within 1 month. Most of the causes of death are cardiac tamponades due to the rupture of the pericardium [1-8]. There is also a report that the diagnosis was made by postmortem CT angiography [9].

**What findings can be seen on postmortem images?**

The presence of a lethal hemorrhagic lesion has the following findings.

① Retention of high attenuation fluid (hematoma) around large blood vessels [1-8]
② Intrapericardial hematoma [7]
③ Hemorrhagic pleural effusion, ascites

The following findings will be helpful in identifying the bleeding site.

④ Presence of mural thrombus, false cavity
⑤ Deformation of arterial wall, deformation of the aneurysm
⑥ Rupture of arterial wall in an aneurysm

**What findings can be interpreted as the cause of death?**

Presence of any of the above ① - ③ would allow an interpretation as the cause of death. However, an intrapericardial hematoma alone may not be distinguishable from a left ventricular rupture due to myocardial infarction. In other situations, hemorrhagic pleural effusion may be caused by the rupture of the pericardium after chest oppression in cases of left ventricular rupture caused by myocardial infarction [9]. Also, in a ruptured abdominal aortic aneurysm, bleeding occurs not in the peritoneal cavity but the retroperitoneal cavity.

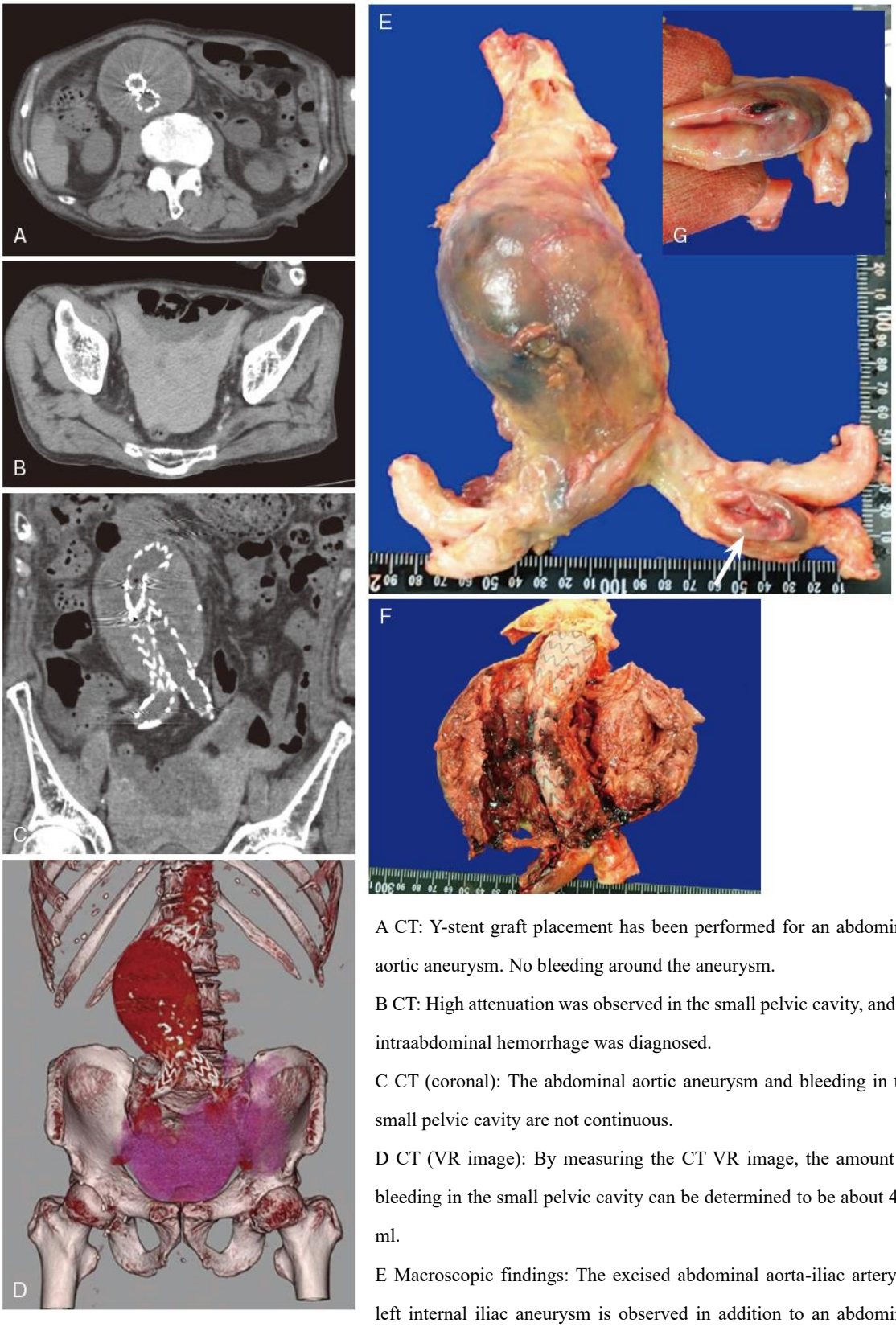
**What kind of image is useful for the interpretation? (CQ14)**

Reconstructed images such as sagittal images may be useful to identify sites of entry and re-entry of a dissection. This is also useful in establishing the site of the rupture.

**Diseases/illnesses to be distinguished**

① Traumatic aortic rupture (aortic isthmus)
② Traumatic heart rupture/pericardial rupture (in falls from high places)
③ Multiple chest injuries (pulmonary contusion, pneumothorax, intercostal arteriovenous injury)
④ Cardiac rupture/pericardial rupture due to chest compressions (cardiopulmonary resuscitation)
⑤ Rare cases: spontaneous pneumothorax and endometriosis

**Figure 1, Male in the 90s, Intraperitoneal bleeding after abdominal aortic aneurysm stent graft treatment (2 days after death)**




A CT: Y-stent graft placement has been performed for an abdominal aortic aneurysm. No bleeding around the aneurysm.

B CT: High attenuation was observed in the small pelvic cavity, and an intraabdominal hemorrhage was diagnosed.

C CT (coronal): The abdominal aortic aneurysm and bleeding in the small pelvic cavity are not continuous.

D CT (VR image): By measuring the CT VR image, the amount of bleeding in the small pelvic cavity can be determined to be about 480 ml.

E Macroscopic findings: The excised abdominal aorta-iliac artery. A left internal iliac aneurysm is observed in addition to an abdominal

aortic aneurysm. No rupture is observed in the abdominal aortic aneurysm, but collapse is observed in the iliac aneurysm.

F Macroscopic findings: Abdominal aneurysm. The stent graft was crimped to the aortic wall and was in a good graft condition, with no hematoma in the aneurysm.

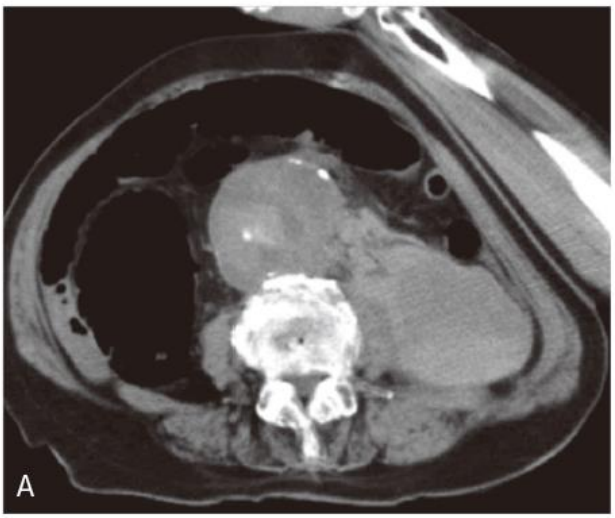
G Macroscopic findings: Left internal iliac aneurysm. There is a rupture opening, and the hematoma is squeezed out from the inside.

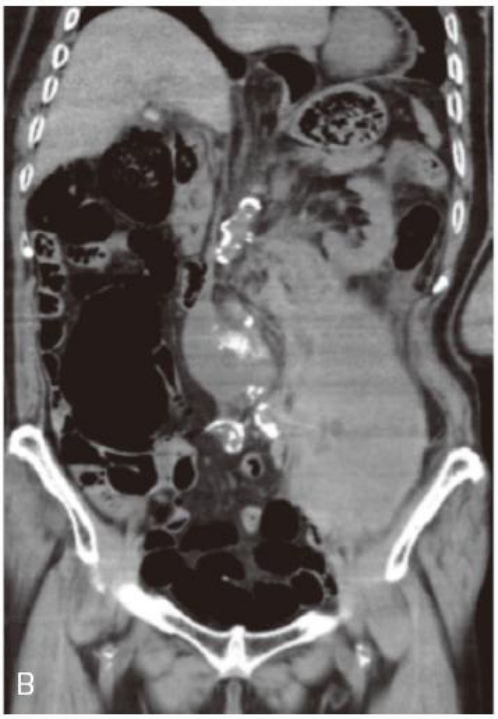
Death after a medical procedure (in this case, aortic stent-graft placement) may be suspected to be an iatrogenic cause of death. Recorded postmortem images may prove that appropriate medical procedures are being performed. Accidental illness may cause death and caution in the reading of the signs is advised.

**Figure 2 Thoracic aortic aneurysm rupture (A axial, B coronal)**


There is a high attenuation area with a clear shape in the thoracic abdominal cavity, and there is iso-attenuation surrounding it. The high attenuation is a blood clot formed in the pleural space. The mediastinum shows a marked deviation to the right. By interpreting a combination of axial, coronal, and sagittal images, it becomes easier to understand the overall image of the lesion. A markedly expanded aneurysm wall can be observed in the aortic arch, and a calcified layer of the artery wall was discontinuous. However, postmortem images alone cannot accurately locate the rupture site.

**Figure 3 Abdominal aortic aneurysm rupture**




It was discovered that the deceased had fallen at a dressing room in the bathroom. Although diagnosed with an abdominal aortic aneurysm, it was diagnosed as out-of-surgery (impossible to correct with surgery) considering the general condition, and the patient was under observation at home. The postmortem CT shows an abdominal aortic aneurysm and widespread retroperitoneal hemorrhaging on the left side.

Literature search formula and literature selection (2019/ 6 /5)

PubMed

| # | Search formula | Number of documents |
|---|---|---|
| 1 | (((((((("postmortem") OR "post-mortem") AND "post mortem")) AND "imaging")) OR (((((("postmortem") OR "post-mortem") AND "post mortem")) AND "CT")) OR (((((("postmortem") OR "postmortem") 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") | 4,196 |
| 2 | #1 and Aortic aneurysm | 33 |
| 3 | #1 and Aortic dissection | 31 |

**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)