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Case Report

Identification of aortic injury site using postmortem non–contrast computed tomography in road traffic accident ☆

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ABSTRACT

In high-speed motor vehicle accidents, it is necessary to investigate the manner of death. Postmortem computed tomography (PMCT) provides important information on the mechanism of death, but identification of the aortic injury is still challenging on non–contrast PMCT. A man in his 50s had multiple injuries on the face and chest in the high-speed motor vehicle accident. The traumatic aortic rupture was clearly depicted on thin-slice and multiplanar reformation PMCT images. Traumatic aortic disruption was confirmed by forensic autopsy. The high contrast between the aortic wall and the lumen visualized the traumatic rupture in the distal aortic arch. For the evaluation of aortic rupture on PMCT, it may be important to trace the continuity of the high-density aortic wall by reviewing thin-slice CT and multiplanar reformation images.

Introduction

There were more than 1 million road traffic deaths globally, and fatal aortic rupture is one of the common and important causes of rapid death [1]. Investigation into the manner of death is necessary to clarify whether the accident caused death or whether an acute life-threatening disease caused the accident. The mechanism of death is usually assessed through a combination of external examination and autopsy. However, autopsy rates have been declining globally for several reasons, for example, overstretched workforce and budgetary

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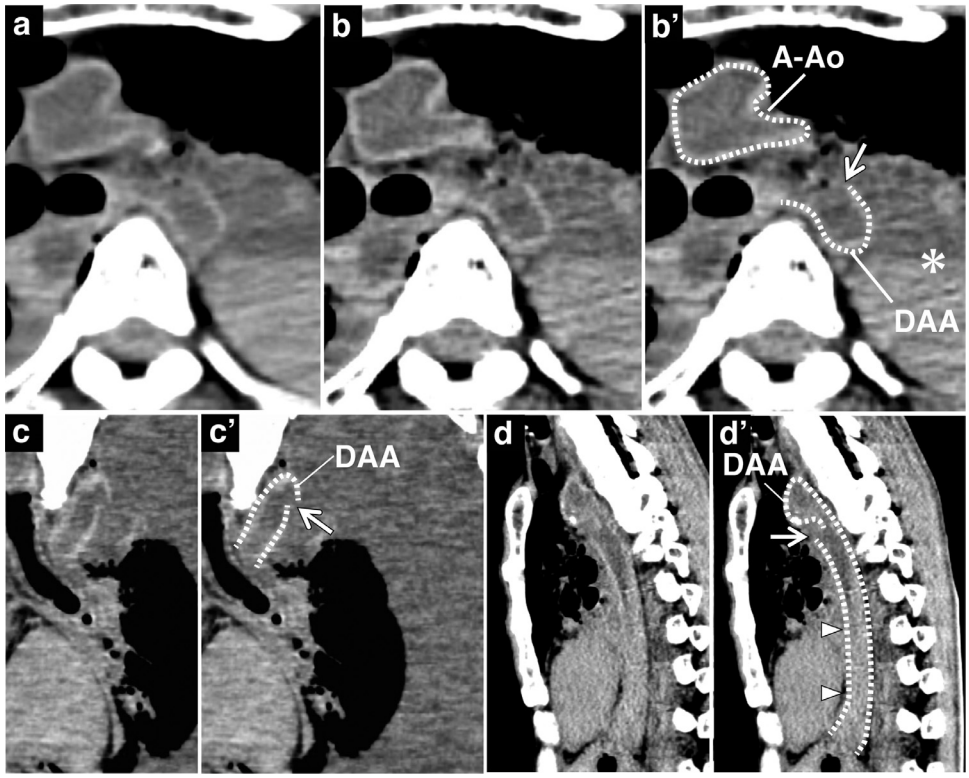

Fig. 1 – Traumatic aortic rupture as cause of death on postmortem CT. Although the rupture site is difficult to be identified on conventional axial CT image (5-mm section thickness) (A), it is depicted on thin-section axial CT image (1-mm section thickness) (B). A schematic of thin-section CT image (B') shows the rupture site of the distal aortic arch (arrow) as "open-ring" appearance. There is left sided massive hemothorax (asterisk). The rupture site of the distal aortic arch (arrow) is clearly visible on coronal- (C and C') and sagittal-view MPR images (D and D'). The density in the lumen of the mid-to-descending aorta shows a higher density than the aortic arch to the proximal descending aorta (D and D') (arrowheads). A-Ao, ascending aorta; DAA, distal aortic arch; MPR, multiplanar reformation.

constraints [2]. Recently, postmortem computed tomography (PMCT) imaging has become an important alternative or supportive tool for autopsy [3,4]. PMCT is particularly useful for the detection of fractures, air embolism, and intracranial hemorrhage. However, it is difficult to detect an injury without displacement and/or horizontal lesions not visualized the between slices [5]. In particular, aortic injury, which is often the cause of death, is frequently missed by PMCT [5].

We present a case report of a middle-aged driver with autopsy-confirmed traumatic aortic rupture, which was clearly depicted on thin-slice CT and multiplanar reformation (MPR) images.

Case report

A male driver in his 50s with multiple injuries on the face and chest following a motor vehicle accident at high speed died at the scene. The corpse was delivered to the Department of Legal Medicine at our institution for PMCT imaging and forensic autopsy to clarify the manner of death. The Department of Legal Medicine has a dedicated CT scanner for postmortem imaging.

PMCT imaging was performed using a helical 16-row multidetector CT (Aquilion Lightning, Canon Medical Systems, Otawara, Japan) with the following parameters: detector collimation, 16 × 1 mm; gantry rotation time, 0.5 s; beam pitch, 0.938; tube voltage, 120 kVp; tube current, 130-230 mA (auto exposure control). Auto exposure control was adopted to PMCT scanning to conserve the X-ray tube. The images were generated using the following reconstruction techniques: (1) conventional axial CT images of 5-mm section thickness; and (2) thin-section axial CT images of 1-mm section thickness and MPR images (coronal and sagittal view images). All CT image series were reconstructed with iterative reconstruction (adaptive iterative dose reduction 3D enhanced, Canon Medical Systems). The interval of time between the death and scanning was 2.5 days.

PMCT revealed left massive hemothorax and rib fractures with no evident mediastinal hematoma around the thoracic aorta. Further, aortic wall had a high density compared to the lumen on PMCT. The tear of the aortic wall was hardly noticeable on conventional axial CT images (5-mm slice thickness) (Fig. 1A). On the other hand, the contour of the aortic wall was clearly traced, and the tear of the aortic contour could be identified distinctly in the distal arch on thin-section axial CT (1-mm slice thickness) (Fig. 1B) and MPR images (Fig. 1C

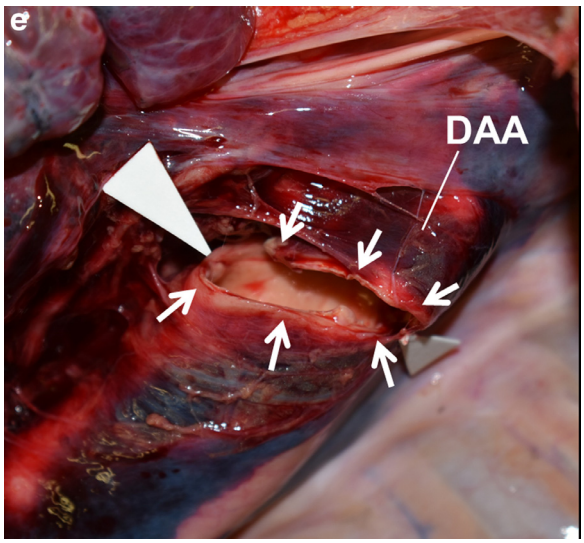

Fig. 2 – Photograph of forensic autopsy. The rupture of the distal aortic arch (arrows) is consistent with postmortem CT images.

and D), suggesting that the aortic wall ruptured directly into the pleural cavity. Forensic autopsy confirmed rupture of the distal aortic arch, penetrating the left pleural cavity (Fig. 2), and the cause of the death was judged as the trauma by the accident.

Discussion

In our report, it was possible to identify the site of aortic wall disruption on non–contrast PMCT. The site of the aortic wall disruption was located in the distal aortic arch (aortic isthmus), and there was sufficient contrast between the aortic wall (high density) and lumen (low density) on non–contrast-enhanced PMCT images (Figs. 1A-D). On the other hand, the contrast between the aortic wall and lumen was unclear in the mid- to distal descending aorta because the density of the aortic lumen was higher than that of the ascending aorta to the proximal descending aorta, resulting in poor contrast between the wall and lumen (Fig. 1D). In the supine position on the imaging table of the CT scanner, the level of the ascending- to proximal descending aorta is higher than that of the mid- to-distal descending aorta in the direction of gravity. Cellular components were separated from serum and settled in the dependent parts [3], and the mid- to distal descending aorta showed higher density.

Acute traumatic injury of the thoracic aorta is common in deceleration accidents. According to previous studies, the most common site of traumatic aortic rupture is the aortic isthmus, that is, distal to the origin of the left subclavian artery, followed by the ascending aorta [6,7]. The pathophysiology of aortic trauma is complicated. The high frequency of aortic damage in the distal aortic arch may be associated with the anatomical position, which is fixed in the thoracic cage [6,8]. Our case report suggested that non–contrast PMCT may be useful for the identification of the aortic disruption site because the aortic wall contour can be traced in the ascending aorta and distal arch on PMCT. We should carefully trace the high density of the aortic contour in the ascending aorta to the proximal descending aorta on PMCT images. For the visualization of the aortic wall disruption, thin-slice CT images (1-mm section thickness) with MPR images, that is, coronal and sagittal views, were obviously superior to conventional CT images (5-mm section thickness). MPR was especially helpful for the reviewers' confidence in the interpretation of the PMCT images because MPR enabled visualization of the horizontal tear of the aorta. On the other hand, severe collapse of the aorta can affect the tracing of the aortic wall on PMCT images. To our experience, severe collapse of the aorta is common on PMCT in case with aortic rupture, although the degree of collapse may be mild to moderate in case without aortic rupture. Further studies are imperative to verify the usefulness of PMCT for the identification of aortic rupture.

In this case report, we report the case of a middle-aged driver with aortic injury in the distal aortic arch, which was clearly depicted by the non–contrast PMCT. We posit that the high contrast between the aortic wall and the lumen may provide helpful information regarding traumatic aortic rupture. For the evaluation of aortic rupture, it may be important to review thin-slice CT and MPR images.

Patient Consent Statement

The corpse in this case report was transferred to our university after death. It was also impossible to contact with the next to kin. Personal information was removed from the case report according to the privacy policy of Japanese Society of Legal Medicine.

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