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Case Report

To see or not to see – Ambiguous findings on post-mortem cross-sectional imaging in a case of ruptured abdominal aortic aneurysm

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ABSTRACT

We present a case of a ruptured abdominal aortic aneurysm (AAA) with ambiguous accessory findings on post-mortem computed-tomography (PMCT), post-mortem magnetic resonance (PMMR) imaging, and PMCT-angiography (PMCTA) suggestive of thoracic aortic dissection. The diagnosis of ruptured AAA was confirmed by autopsy; however, there was no aortic dissection. The imaging findings that mimicked the presence of aortic dissection might have been an atypical presentation of post-mortem clotting or sedimentation. This case is an ideal example to illustrate benefits, limitations, and challenges of post-mortem cross-sectional imaging. It serves as a reminder that both, training as well as correlation of imaging findings with autopsy are fundamental to improve our understanding of radiologic findings on post-mortem cross-sectional imaging.

1. Introduction

Post-mortem cross-sectional imaging has become an important element of forensic investigations over the last decade [1]. In cases of suspected natural deaths, imaging is used to search for occult trauma and identify findings related to the cause of death [2]. The presence of ruptured abdominal aortic aneurysm (AAA) or aortic dissection (AD) may often be diagnosed by post-mortem computed tomography (PMCT) prior to autopsy. Typical findings of AAA include dilatation of the abdominal aorta, extensive hemorrhage, and a secondary collapse of the aorta [2,3]. AD may be more difficult to detect, but inwardly displaced intimal calcifications or intimal flaps in the aortic lumen are markers of aortic dissection on non-contrast CT [4]. In clinical radiology, CT-angiography (CTA) is the favored modality to diagnose AD because of its high sensitivity and specificity [5]. Post-mortem CTA (PMCTA) has also proved to be useful in diagnosing AD [6]. The use of both, post-mortem MR (PMMR) and PMMR-angiography (PMMRA) in cases of AD has been reported, but to this date, the full potential of PMMR imaging has not yet been fully investigated [7,8]. Here, we report a case of a ruptured AAA with ambiguous accessory findings of the thoracic aorta on PMCT, PMMR, and PMCTA.

2. Case report

A 72-year-old male was found dead, lying on his left side on the kitchen floor in his apartment. According to the family physician, the decedent had suffered from coronary artery disease and hypertension and had been under life-long treatment with blood-thinners. The corpse was delivered to our institute for post-mortem forensic examination.

2.1. Post-mortem imaging and forensic autopsy

PMCT and PMCTA were performed using a dual-source CT scanner (Flash Definition, Siemens, Forchheim, Germany). Scan parameters were as follows: tube voltage 120kVp; automatic dose modulation software (CARE dose 4D, Siemens, Forchheim, Germany); slice thickness 1.0 mm; increments 0.5 mm. PMCTA was adapted from techniques described by Ross and Grabherr [6,9]. A solution of polyethylene glycol (PEG 200; Schaerer and Schlaepfer, Rothrist Switzerland) and iopentol (Imagopaque 300; Amersham Health, Wädenswil, Switzerland), mixed at a ratio of 15:1 was

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injected using a pressure-controlled pump (Virtangio®, Fumedica AG, Muri, Switzerland). PMMR was performed on a 3T MR scanner (Achieva 3.0 TX, Philips Medical Systems, Best, The Netherlands) using a 16 channel SENSE torso XL coil. The sequences relevant to this study were: axial turbo spin echo (TSE) T2-weighted (T2W) sequence with a repetition time (TR) of 8220 ms, echo time (TE) of 60 ms and a slice thickness of 3.0 mm, and a axial TSE T1-weighted (T1W) sequence with a TR of 694 ms, TE of 6.85 ms, and a slice thickness of 3.0 mm. Post-mortem imaging was read by three radiologists and one forensic pathologist (with three, five, six, and three years of experience in post-mortem forensic imaging). Forensic autopsy was performed by two forensic pathologists (with 30 and one year of experience, respectively).

2.2. Findings

PMCT revealed a ruptured AAA with a partially calcified wall and extensive intra-abdominal hemorrhage. In addition, there were several gas collections residing in posterior areas of the abdominal aorta. Intravascular gas collections are a frequent finding in post-mortem imaging. However, gas collections always ascend to the anterior, non-dependent portion of a vessel. The unusual distribution of gas collections trapped in posterior areas of the vessel suggested the presence of overlapping layers, such as in the presence of a ruptured and collapsed aortic aneurysm. PMMR confirmed this diagnosis and provided additional detail regarding the layered appearance and size of the collapsed aneurysmal sac. PMCTA was able to indicate that the aneurysmal sac had ruptured on the left site of the aneurysm and featured extensive extra luminal intra-abdominal leakage of contrast medium. These findings were all confirmed at autopsy (Fig. 1). In addition to these abdominal findings, PMCT of the descending aorta seemed to reveal a partially complete intimal flap, or doubled lumen, which was also visible on PMMR and PMCTA (Fig. 2). This finding was suggestive of thoracic aortic dissection. However, the aortic root and aortic arch were intact and there was no inwardly displaced intimal calcification on imaging. Based on these seemingly contradictive findings it was proposed that the apparent double lumen was only the result of atypical intravascular sedimentation and post-mortem clotting rather than of an AD. However, radiologists and pathologists involved in image interpretation were unable to reach a consensus regarding the presence or absence of aortic dissection prior to autopsy. Autopsy revealed that there was no thoracic AD but uncovered a large ulcerated atherosclerotic plaque in the descending aorta at the level of the pulmonary arteries (Fig. 3).

3. Discussion

This case illustrates benefits, limitations, challenges of post-mortem cross-sectional imaging. PMCT was sufficient to detect both the ruptured AAA and fatal internal bleeding. In addition, PMCT was able to exclude the presence of traumatic skeletal injuries. These findings were sufficient to confirm a natural cause of death. In other words, the manner and cause of death were diagnosed in a non-invasively on non-contrast PMCT.

Based on PMCT findings, both PMMR and PMCTA were performed to further analyze the ruptured AAA and to evaluate the apparent intimal flap in the descending aorta. The presence of a double lumen or intimal flap on CT is a typical sign of aortic dissection [5]. Even in retrospect, the imaging findings in this case are very suggestive of aortic dissection. Nevertheless, the integrity of the aortic root and the aortic arch as well as the absence of internally displaced intimal calcifications cast doubt over the suggested diagnosis of AD. The ambiguity of these findings serves as a reminder that established diagnostic signs from clinical radiology may not always be transferred to post-mortem radiology [10]. It is conceivable that the apparent double-lumen was in fact an atypical presentation of post-mortem clotting or sedimentation [11,12]. The recognition of normal post-mortem findings and their differentiation from pathologic findings is a perpetual challenge in forensic sciences [13]. Post-mortem changes of blood may be particularly challenging to interpret [11,12,14].

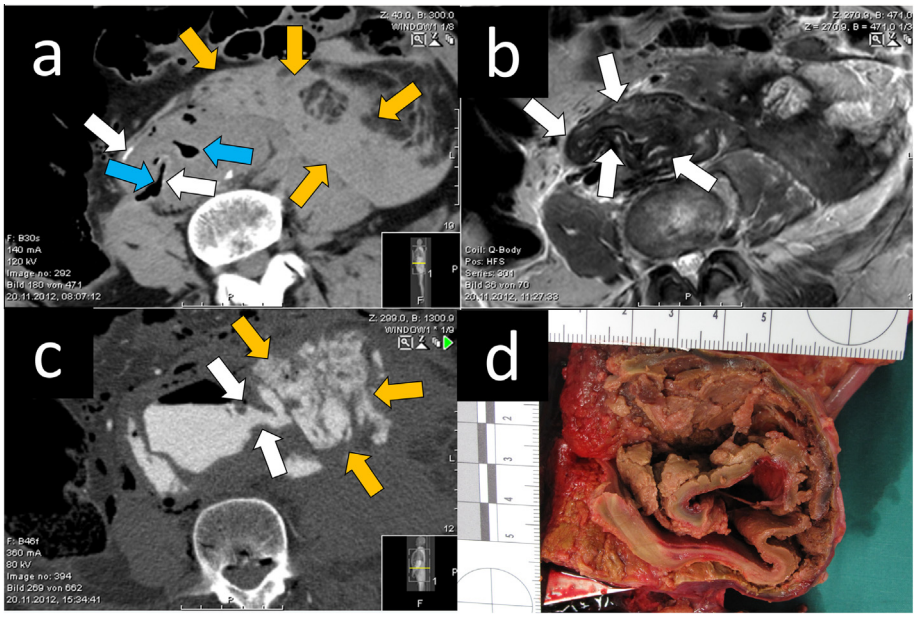

Figure 1. Ruptured abdominal aortic aneurysm. (a) PMCT revealed a ruptured abdominal aortic aneurysm with a partially calcified wall (white arrows) and extensive intra-abdominal hemorrhage (orange arrows). The presence of a collapsed aneurysmal sac was suggested by small collections of trapped gas in the posterior areas of the abdominal aorta (blue arrows); (b) PMMR confirmed this diagnosis and provided additional detail regarding the layered appearance (white arrows) and size of the collapsed aneurysmal sac; (c) PMCTA was able to indicate that the aneurysmal sac had ruptured (white arrows) on the left site of the aneurysm and featured extensive extra luminal intra-abdominal leakage of contrast medium (orange arrows); and (d) macroscopic autopsy specimen.