



Case Report

Use of postmortem coronary computed tomography angiography with water-insoluble contrast medium to detect stenosis of the left anterior descending artery in a case of sudden death



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ABSTRACT

A 40-year-old man was found dead on a sidewalk in an expressway parking area one hour after he had entered the area on a motorcycle. A medicolegal autopsy was performed to reveal the cause of this sudden and unexpected death. Postmortem coronary CT angiography after introduction of 5% gelatin–barium emulsion as a radiopaque contrast medium into the heart demonstrated a significant arterial luminal filling defect in the left anterior descending (LAD) coronary artery. Macroscopic and microscopic examinations revealed that a thrombus had become deposited on ruptured plaque within the LAD artery, and that a small amount of the contrast medium was present between the thrombus and the vessel endothelium. These histological findings were consistent with incomplete occlusion of the LAD artery in the 3D reconstructed image. The cause of death in this case was definitively determined to be ischemic heart disease. Postmortem angiography played a role in screening of a vascular lesion that was subsequently verified by histology to have been responsible for sudden and unexpected death.

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1. Introduction

Recently, postmortem computed tomography (PMCT) has proved to be a useful tool for forensic examination, especially in cases involving trauma [1,2], and postmortem CT angiography (PMCTA) is also being used increasingly, mainly in forensic facilities and departments [3–8]. PMCTA techniques encompass angiography at the time of terminal cardiopulmonary resuscitation, whole-body angiography, and selective angiography including targeted coronary angiography. Whole-body angiography employing a modified heart–lung bypass machine and high volumes of contrast medium can demonstrate the systemic vascular circulation including coronary arteries, offering a non-invasive or minimally invasive alternative to standard forensic autopsy [4,6]. Postmortem selective CT angiography is now being developed as a new and effective adjunct in the field of forensic pathology for investigating vascular lesions, although it does not allow detailed mapping of the entire vascular system. Targeted coronary angiography can be conducted using two injection routes: selective coronary angiography

involving injection of a contrast agent into the aorta prior to autopsy [5,7], and direct introduction into a coronary artery after removal of the heart at autopsy, complementary to macroscopic and microscopic examinations [3,8]. These methods can reduce the time required for investigation of coronary arteries when they reveal coronary artery narrowing or obstruction. Using the direct injection approach, Rah et al. have reported postmortem three-dimensional (3D) visualization of the entire coronary arterial circulation by electron-beam CT with a radiopaque silicone contrast medium [3]. Recently, Makino et al. reported postmortem coronary CT angiography using X-ray CT with Omnipaque[®] as a contrast agent to complement standard autopsy [8]. However, water-soluble contrast media such as Omnipaque[®] have some limitations including transudation into surrounding tissues. Although silicone compounds can overcome this transudation problem, they do not remain in vessels after treatment with alcohol and xylol, and therefore the resulting histological views do not appear to coincide with 3D reconstructed images of the coronary arteries [8–10]. Here we describe a case of sudden, unexpected death in which postmortem coronary CT angiography using a water-insoluble contrast agent indicated stenosis in the left anterior descending (LAD) coronary artery, and subsequent macroscopic and microscopic examinations

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revealed the presence of thrombus and a small amount of the contrast medium within the vessel.

2. Case report

A 40-year-old man was found unconscious on the sidewalk of an expressway parking area one hour after arriving there on a motorcycle. He was transferred to a hospital but declared dead, although the cause of death was not determined. Five days before, he had complained of chest discomfort, which had persisted for one hour, but did not consult a doctor thereafter. He had no clinical history of any significant disease. A medicolegal autopsy was performed to clarify the sudden and unexpected nature of his death.

Prior to autopsy, a native CT scan was carried out as described previously [11], but this revealed no significant findings that could have been associated with his death, including any obvious calcification of the coronary arteries (Fig. 1A). At autopsy, which was performed on the day after death, the body measured 178 cm and weighed 63.8 kg. External examination revealed only a few traces of the previous medical treatment, which had included injections and respiratory support. Internal examination demonstrated typical findings associated with sudden death, such as fluidity of the cadaverous blood, petechiae of the conjunctiva, and congestion in organs including the lungs, spleen, kidneys and liver. Postmortem coronary CT angiography was performed by a method similar to those described previously [12–15]. Using a 10-mL plastic syringe connected to a digital manometer (HT-1500NS, HODAKA, Japan) to sustain the infusion pressure at 80–140 mmHg, manual injection of 5% gelatin–barium emulsion radiopaque contrast medium into the left and right coronary arteries was carried out until the anterior and posterior descending arteries were obviously filled with the white emulsion. It took approximately ten minutes to complete selective cannulation into the coronary arteries and introduction of the contrast agent mixture, followed by fixation of the heart in 10% phosphate-buffered formalin solution. Five days after the autopsy, X-ray exposure was performed using the following scan parameters: field of view 18 cm, collimation 0.5 mm, reconstruction interval 0.5 mm, 120 kVp, 150 mA, 0.75 s/rotation and pitch factor 0.75. Postmortem coronary CT angiography data were viewed and reconstructed on a workstation (Vincent, Fujifilm, Tokyo, Japan). Additionally, curved multiplanar reformat (MPR) images were reconstructed on another workstation (ZIOSTATION, Amin Corporation, Japan). The use of postmortem CT images and autopsy findings was approved by the ethics board of our institute.

The 3D reconstructed images of maximum intensity projection (MIP) and MPR showed a significant arterial luminal filling defect in the LAD artery without collateral vessels (Figs. 1B, C and 2A–C). The short axis image of the LAD artery constructed from the MIP image also demonstrated a filling defect due to a space-occupying lesion in the LAD artery (Fig. 3D). These observations suggested severe coronary stenosis or thrombosis in the vessel. Although many arterial luminal filling defects with concave borders were observed in the right coronary artery and its branches (Fig. 1B and C), macroscopic examination did not demonstrate any occlusion in the arteries, consistent with our experience that similar arterial defects with concave borders had not been related to occlusion in many previous cases.

Macroscopic examination of the heart, which weighed 360 g, revealed occlusion of the LAD artery by grayish white deposits of thrombus, and a small amount of the white contrast agent had infiltrated between the thrombus and the endothelium (Fig. 3A and C). These findings were consistent with incomplete occlusion of the LAD artery in the 3D reconstructed images (Fig. 1B, C and 2A–C). Myocardial scars on the septum were evident in the territory of the LAD artery (Fig. 3A and B). Microscopic examination with hematoxylin and eosin staining revealed that the contrast medium was present with thrombus in the vessel (Fig. 4A and B). The presence of thrombus was also verified by Masson trichrome staining (Fig. 4C). Additionally, a small amount of hemorrhage was observed in the intima (Fig. 4A). Serial sections of the LAD artery demonstrated that the intima was thickened by fibrous tissue in which hemorrhage had occurred, and that the thrombus adhered to the vessel endothelium (Figs. 4 and 5). Thus, the thrombus could have been associated with rupture of plaque in the LAD artery. However, neither fresh muscle necrosis nor hemorrhage was observed in the heart. On the other hand, no stenosis was detected in the right coronary artery. Consistent with incomplete occlusion of the LAD artery, congestion, edema and heart failure cells were observed in the lungs. Considering myocardial scars on septum, it was likely that coronary insufficiency of the LAD artery could have resulted in successive occurrence of myocardial infarcts. Accordingly, it was plausible that the cause of death in this case was ischemic heart disease.

3. Discussion

Here we have described the usefulness of postmortem coronary CT angiography using water-insoluble contrast medium for

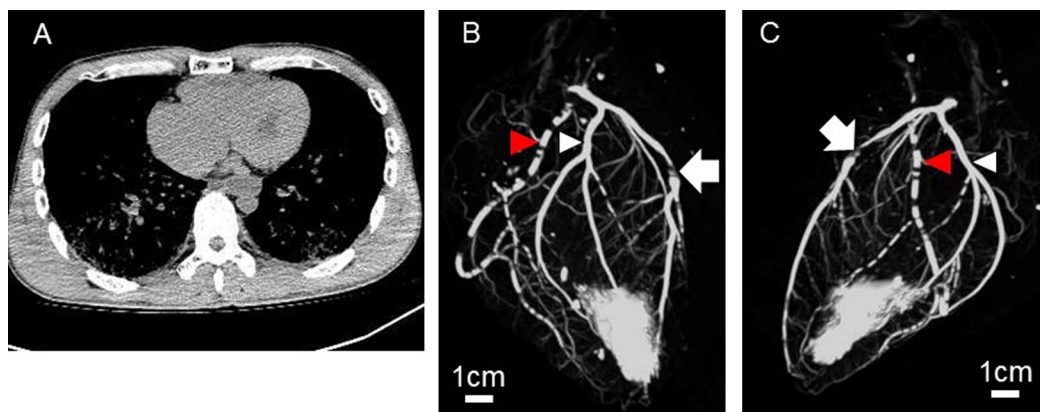


Fig. 1. Results of postmortem coronary CT angiography. (A) An axial view of the chest by native CT prior to autopsy. (B) An angiographic MIP image of a right lateral view of the coronary arteries. (C) An angiographic MIP image of a left lateral view of the coronary arteries. White arrow indicates significant narrowing of the LAD artery. The circumflex branch of the left coronary artery and the right coronary artery are indicated by white and red arrowheads, respectively. Panels B and C suggest some reflux of contrast medium through the aortic valve into the left ventricle.

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