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Case Report

Postmortem angiography in computed tomography and magnetic resonance imaging in a case of fatal hemorrhage due to an arterio-venous malformation in the brain ☆

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ABSTRACT

Autopsy is the traditional gold standard for determining the cause and manner of death in a forensic death investigation. However, postmortem imaging plays an ever-growing role in preliminary examination, even replacing conventional autopsy in some cases. This case report presents a case of massive intra-axial brain hemorrhage due to an arterio-venous malformation. The cause and manner of death were exclusively determined by postmortem radiology. Based on radiological findings, the autopsy was considered redundant and cancelled by the public prosecutor.

1. Introduction

Postmortem computed tomography (PMCT) and magnetic resonance imaging (PMMR) have become important elements of forensic radiology. These techniques are widely used in routine postmortem forensic investigations, supporting or in some cases even replacing conventional autopsy [1–6]. Based on radiological data of the deceased, forensic pathologists and radiologists are provided with valuable and rapidly acquired information on the cause and manner of death [6,7].

Postmortem computed tomography angiography (PMCTA) was recently introduced to forensic investigations [8,9]. It provides a detailed presentation of the vessel system of the entire body for diagnoses of hemorrhages, vessel ruptures, stenosis, aneurysms and dissections [9–12].

Whereas the feasibility and potential of PMCTA have been largely explored, postmortem magnetic resonance angiography (PMMRA) has been mostly neglected to date, though the literature indicates that the technical quality of PMMRA images is approximately equivalent to PMCTA [13].

Vascular malformations are the most common cause of intracerebral hemorrhage in young people. The average annual bleeding risk due to malformation is estimated to be approximately 2% in previously unruptured arterio-venous malformation (AVM) cases, and a high rate of morbidity and mortality [14–17] is noted. The risk of death in the case of brain hemorrhage is 10–15% [18].

So far, direct comparison of CT/CT angiography and MRI/MRI angiography is only described in few clinical cases [19–22]. To our knowledge, in postmortem imaging this case represents the first of its kind where both PMCT(A) and PMMR(A) were applied.

2. Case

2.1. Case history

A 42-year-old man did not arrive at work and was found dead at home 1 day later. The flat was normally locked. The lock was drilled to allow access by the police. The deceased was found lying on his bed in a supine position. Stomach content was located on the pillow beneath the head. External examination of the body

☆ Nothing to disclose.

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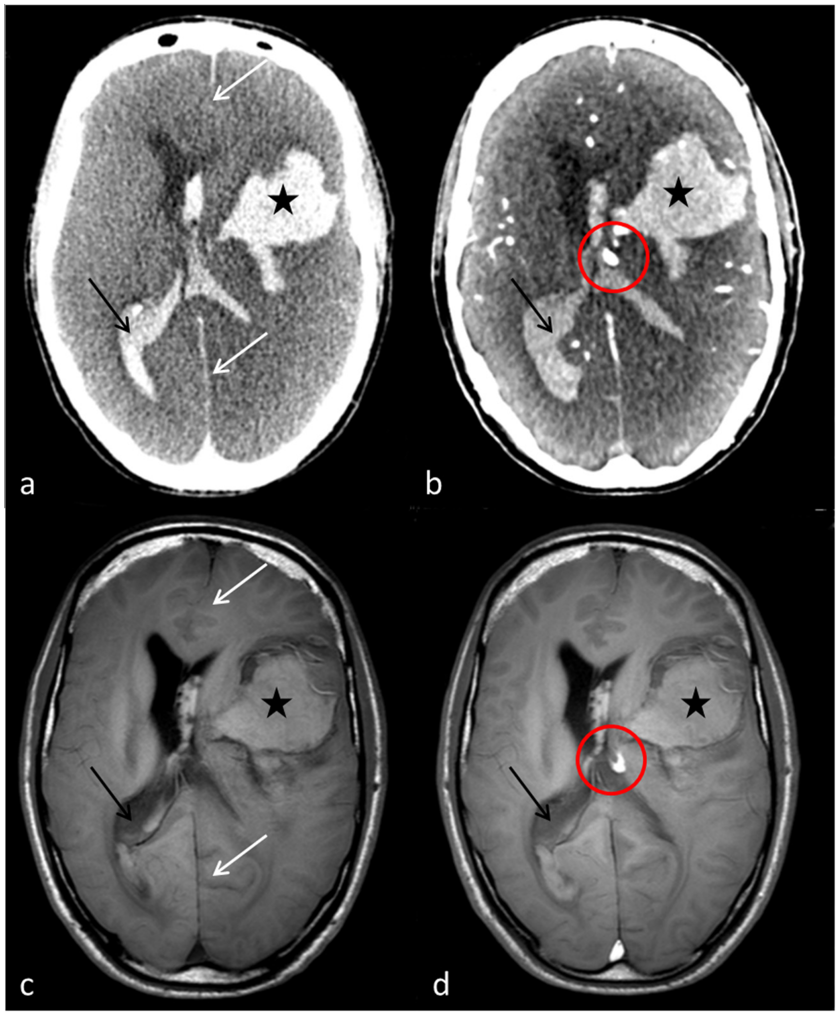

Fig. 1. (a) PMCT, (b) PMCTA, (c) PMMR, T1w IR TSE sequence and (d) PMMRA, T1w IR TSE sequence. A slight midline-shift to the right side (white arrows) is noted due to an expansive intra-axial hemorrhage (black asterisk) with perifocal edema and an intra-ventricular hemorrhage (black arrow). The feeder (red circle) originated from the right posterior cerebral artery and crossed to the contralateral side, supplying the AVM. Note the small sidled vessels on PMMR (imaging is therefore superior to PMCTA) and the distinct perifocal edema surrounding the intra-axial hemorrhage.

by a local physician revealed no external injuries. The time of death was roughly estimated to the night before. The cause of death and manner of death could not be defined. The body was therefore transported to the Institute of Forensic Medicine for further investigations including postmortem imaging and autopsy.

2.2. Materials and methods

The responsible justice department approved this examination.

For postmortem imaging the body was wrapped in two impermeable body bags to prevent contamination of the equipment. All scans were performed with the body in a supine position.

2.2.1. Postmortem computed tomography (PMCT) and angiography (PMCTA)

Unenhanced PMCT and PMCTA were performed using a dual-source computed tomography scanner (SOMATOM Flash Definition, Siemens Medical Solutions, Forchheim, Germany). The general scan parameters were as recommended in literature [7]: 120 kVp (PMCT) and 100 kVp (PMCTA) tube voltage, 350 mAs effective tube current–time product; 1.0 mm slice thickness; 0.5 mm increment; and reconstructions in soft and medium-hard kernels. The contrast agent consisted of a solution of viscous poly ethylene glycol (PEG 200, Schaerer and Schlaepfer AG, Rothrist, Switzerland) and water-soluble ioversol (Optiray 300, Guerbet, Paris, France) at a ratio of 20:1 (radiodensity 350–400 HU). The flow was 600 ml/min and the volumes were 1200 ml (arterial injection) and 1500 ml (venous injection). Primary image review and 3-dimensional reconstructions were performed with a CT workstation (Leonardo, Siemens Medical Solutions, Forchheim, Germany). For radiological assessment, a PACS workstation was used (IDS7, Sectra AB, Linköping, Sweden).

2.2.2. Postmortem magnetic resonance imaging (PMMR) and angiography (PMMRA)

PMMR imaging was performed using a 3.0 Tesla MR scanner (Achiva, Philips Healthcare, Best, Netherlands). A SENSE-Head-8 coil was used. The scanning parameters for unenhanced PMMR were as follows: T2 turbo spin echo (TSE) axial (TR: 3000 ms; TE: 80 ms); T1 IR (inversion recovery turbo spin echo) axial (TR: 2000 ms; TE: 20 ms); VenBold (susceptibility-weighted imaging) (TR: 16 ms, TE: 22.5 ms); FLAIR 3D (TR: 4800 ms, TE: 273 ms); T2 3D (TR: 2500 ms, TE: 232 ms); DWI (diffusion weighted imaging) (TR: 3693; TE: 94 ms); and DTI (diffusion tensor imaging) (TR: 7376 ms; TE: 83.3 ms).