Journal of Forensic Radiology and Imaging 9 (2017) 47–50

Contents lists available at ScienceDirect

Journal of Forensic Radiology and Imaging

journal homepage: www.elsevier.com/locate/jofri

Identification of discrete vascular lesions in the extremities using post-mortem computed tomography angiography – Case reports

Wieke Haakma[a,b,c,*], Marianne Rohde[a], Lars Uhrenholt[a], Michael Pedersen[b], Lene Warner Thorup Boel[a]

[a] Department of Forensic Medicine, Aarhus University, Aarhus, Denmark
[b] Department of Comparative Medicine Lab, Department of Clinical Institute, Aarhus University, Aarhus, Denmark
[c] Department of Radiology, University Medical Center Utrecht, Utrecht, The Netherlands

ARTICLE INFO

Keywords:
Forensic radiology
Post-mortem computed tomography angiography
Vascular lesions
Extremities

ABSTRACT

In this case report, we introduced post-mortem computed tomography angiography (PMCTA) in three cases suffering from vascular lesions in the upper extremities. In each subject, the third part of the axillary arteries and veins were used to catheterize the arms. The vessels were filled with a barium sulfate based contrast agent using a syringe. A CT scan was performed before and after filling of the vessels. Partial PMCTA provided information about the exact location and the severity of lesions. In one subject, partial PMCTA was essential to identify the cause of death. The substantial benefit of partial PMCTA is that the procedure is easily performed using standard clinically available CT systems without the use of pumps or other advanced equipment. These findings demonstrated the feasibility of PMCTA for identification of vascular lesions in the upper extremities. We expect that partial PMCTA can be of great value in cases where the subjects are suspected to have lesions in the extremities.

1. Introduction

Post-mortem computed tomography (PMCT) is widely used in forensic sciences as a complimentary method to examine conditions such as bone fractures, major tissue injuries and pathological gas development [1]. Acquired data are storable and accessible to, for example, external reviewers [2]. PMCT provides structural information with accurate dimensions and introduction of contrast agents can reveal major vascular lesions such as aortic rupture [3], which can be important for medicolegal cases. Further, the acquired images are suitable to display evidence in court. Several research groups have used PMCT in combination with angiography (PMCTA) by introducing a contrast agent in the vessels to display vascular structures [4–7]. For example, Grabherr et al. developed a method using a multiphase approach consisting of an arterial, a venous and a so-called dynamic phase [8]. By cannulating the femoral artery and vein and connect these to a modified heart lung machine a contrast agent can be pumped into the vascular system while pressure and flow are monitored. In this way it is possible to visualize the vascular system. The application of PMCTA to the extremities has been demonstrated both with a modified heart-lung machine [9] and with manual injection [10]. Another study investigated lower extremity varicose vein rupture with PMCTA [11]. In this case report, we investigated the use of PMCTA to visualize the upper extremities (partial PMCTA) in three cases.

2. Case reports

2.1. Case 1

A 53 year old man with known end-stage renal disease was found dead at home in a pool of blood and traces of blood in several rooms, after missing a dialysis appointment. He was treated with anticoagulants and was last seen at the previous dialysis 2 days earlier. A family member notified the police that the victim had bled after dialyses from the place of puncture 1.5 months earlier. A crime scene investigation revealed no evidence of violence against the victim.

2.2. Case 2

A 49 year old man was found dead at home covered in blood, with a large blood pool and a knife next to him on the floor. He had previously expressed suicidal thoughts and was known to be psychologically distressed. He had a history of cerebral apoplexy and an excessive use of drugs and alcohol.

* Correspondence to: Department of Forensic Medicine, Aarhus University, Palle Juul-Jensens Boulevard 99, 8200 Aarhus N, Denmark.
E-mail address: whaa@clin.au.dk (W. Haakma).

http://dx.doi.org/10.1016/j.jofri.2017.04.001
Received 10 March 2017; Received in revised form 13 April 2017; Accepted 27 April 2017
Available online 09 May 2017

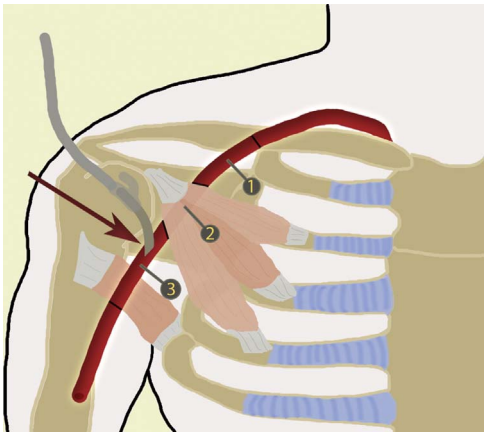

Fig. 1. Schematic overview of the anatomy of the upper thorax and site of contrast insertion (indicated with an arrow) of the catheter during partial post-mortem computed tomography angiography (PMCTA). (1) First part of the axillary artery, (2) second part of the axillary artery, and (3) third part of the axillary artery.

2.3. Case 3

A 45 year old man was found dead at home in the bath tub with his 2-year-old son lying dead (drowned and strangled) on top of him, and a suicide letter was found in his car. The walls were sooted as he presumably attempted to start a fire.

3. Methods

The autopsies were initiated by a forensic pathologist before the partial PMCTA. During the autopsy the axillary arteries and veins were already exposed, after removal of the organs. In this way it was convenient to have access for the cannulation of the vessels. The third part of the axillary arteries and veins were used for cannulation during the examination of the arms (Fig. 1). Similarly, the femoral vessels were exposed and ready for cannulation but are not included in this paper. After autopsy the bodies in Cases 1 and 2 were moved to the CT table. In Case 3 the PMCTA was performed 2 days after the initial autopsy. A contrast agent was prepared, consisting of 22% barium sulfate, 20% PEG and 58% distilled water [12] and was used to fill up the extremities with a 100 ml syringe, using a constant manual pressure during a period of 20 s. CT was performed with a Siemens Somatom Definition 64-slices system. In Case 1 and Case 2 the arms were positioned next to the body. In Case 3 the arms were positioned above the head. Depending on the case, the arteries alone, or the arteries and veins were filled. A CT scan was obtained before and after each phase. CT scan settings were: slice thickness 0.6 mm, pitch 0.65, tube voltage 120 kV, and automatic exposure control using a reference of 350 mAs. Multiplanar reconstructions (MPR) and volume rendering technique (VRT) images were obtained. After PMCTA the bodies were moved back to the autopsy table. Each vessel lesion was subsequently re-examined using traditional autopsy techniques. CT images of the extremities were analyzed qualitatively based on consensus reading with the workstation software (Syngo CT2012B, Somaris VA44) and Amira 5.3.3 software (VSG, Richmond, Australia) by two observers (one pathologist with 9 years of experience, and one researcher with 2.5 years of experience).

4. Results

4.1. Case 1

Autopsy showed a punctuated lesion at the right upper arm covered with a blood clot. Macroscopically, it was a rounded lesion with sharp edges and about 1 mm in diameter. Furthermore, end-stage renal disease was confirmed at autopsy. Partial arterial angiography of the arm revealed accumulation of contrast agent in a large pouch, which initially was believed to be an arteriovenous fistula located at the anterior part of the right upper arm, 10 cm above the elbow, in the soft tissue just beneath the punctuated lesion (Fig. 2 and Supplemental material 1). The blood clot was easily removed, and the contrast agent poured out in large amounts (Fig. 2D). The cause of death was assumed to be exsanguination from the hemorrhage from the lesion which was consistent with the needle prick inflicted at the dialysis. The manner of death was presumed to be an accident.

Supplementary material related to this article can be found online at http://dx.doi.org/10.1016/j.jofri.2017.04.001.

4.2. Case 2

The autopsy revealed superficial and deep incisions on the left wrist. Partial arterial angiography of the arm revealed leakage of contrast agent in the distal part of the left arm, from the ulnar artery. Dissection of the deep incision on the wrist revealed a near complete (60–70%) transecting lesion of the ulnar artery (Fig. 3). The cause of death was assumed to be exsanguination due to this lesion. The presumed manner of death was suicide.

4.3. Case 3

The autopsy showed several minor and one deep incision in the front of the throat with complete transection of the trachea, and several incisions on the arms and legs including the right cubital fossa, where a venous lesion was found in the right median cubital vein. No arterial lesions were reported. Aspirated blood and soot were found in the airways, and there was foam around the nose and mouth. The carbon monoxide level in the blood was non-toxic (4.5%). The cause of death

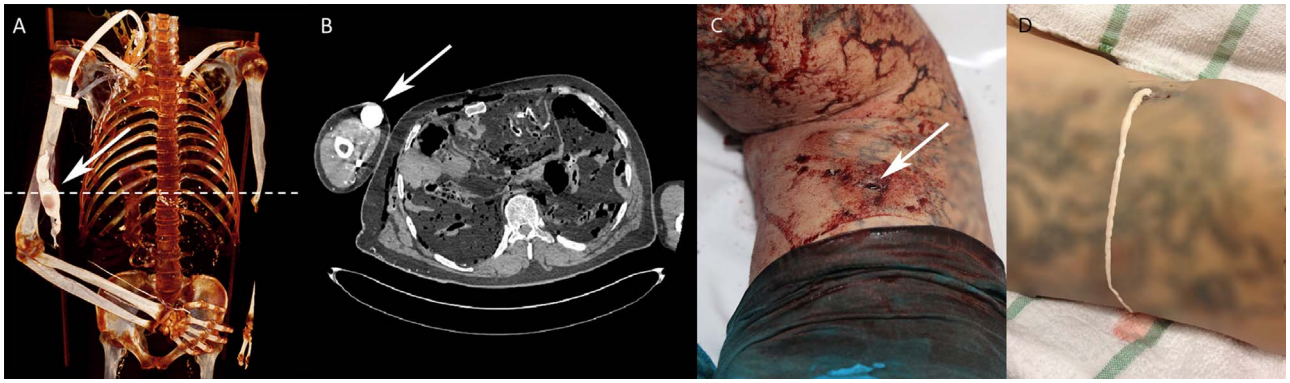

Fig. 2. Partial post-mortem computed tomography angiography (PMCTA) of the right arm of Case 1. (A) shows the reconstruction of the vasculature in the right arm. The dotted line (A) represents the level of the CT slice (B), (C) the white arrow indicates the wound observed during autopsy, and (D) shows the wound after injecting the barium sulfate and removing the blood clot. The contract agent accumulated in the fistula just beneath the lesion.