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Diagnostic value of unenhanced postmortem computed tomography in the detection of traumatic abdominal injuries

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Summary
Objective: To determine the diagnostic capabilities of unenhanced postmortem computed tomography (UPMCT) in detecting traumatic abdominal injuries.
Material and methods: Cases of traumatic death with both UPMCT and classical autopsy were collected retrospectively from our institution ''virtopsy'' database in a period of 5 years. Cadavers with gunshot injuries were excluded. Sensitivity, specificity, accuracy, negative (NPV) and positive (PPV) predictive values of PMCT globally and for hemoperitoneum, liver, spleen, pancreas and kidney injuries individually were estimated using the autopsy report as gold standard.
Results: Seventy-one cadavers were included. UPMCT had a sensitivity of 80% and a specificity 94%, with an accuracy of 83%, a PPV of 98% and a NPV of 59% for the diagnosis of traumatic abdominal injuries. The highest sensitivity was obtained for the detection of hepatic injuries (71%) and the lowest for pancreatic injuries (12%). UPMCT had a specificity of 100% for the detection of hemoperitoneum. A NPV of 98% was found for the detection of perihepatic hematomas.

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Conclusion: The low sensitivity and low NPV do not support the use of UPMCT as an alternative to conventional autopsy to diagnose and/or rule out traumatic abdominal injuries. Nevertheless, UPMCT remains a helpful tool as it helps detect hemoperitoneum and virtually exclude presence of perihepatic hematomas.

Imaging techniques are now implemented routinely as a part of the forensic investigations in some countries in Europe, in Australia and in the USA [1]. They facilitate and speed up the forensic investigation and provide objective storable data.

Among all the imaging techniques used in forensic medicine, unenhanced postmortem computed tomography (UPMCT) is the most widely used. This technique has already demonstrated contribution in many fields of forensic investigation [1,2]. Although not systematically performed, UPMCT is a useful tool in disaster victim identification and ballistics [2,3].

Regarding trauma victims, UPMCT is not inferior to autopsy in the detection of most of skeletal injuries, while conventional autopsy remains superior for detecting organ and soft tissue injuries in all body regions [4—7]. Nevertheless, no studies have determined the diagnostic capabilities of UPMCT in detecting traumatic abdominal injuries using a large sample size.

The purpose of this study was to determine the diagnostic capabilities of UPMCT in detecting traumatic abdominal injuries.

Materials and methods

Study population

The population of this study was collected retrospectively from the ''virtopsy'' database from November 2011 to October 2016 in a single institution.

Inclusion criteria were traumatic deaths who underwent both UPMCT and classical autopsy. Exclusion criteria were cases of gunshot injuries, as we consider that the skin wound or the presence of projectiles could eventually guide to the injured organ.

UPMCT acquisition

All UPMCT examinations were performed with a maximum delay of 24 h before autopsy. Total body scans were obtained in two helices, one for the head and another from the cranial base to the feet. All UPMCT examinations were performed without any administrated contrast media. The examinations were performed on either a Somaton Dual-Source Definition® (Siemens Healthineers, Erlangen, Germany) and an Optima® CT660 (General-Electrics Healthcare, Milwaukee, WI, USA). Examination started with an anterior—posterior and lateral scout views. Typical parameters were: number of detector rows, 64; slice thickness, 1 mm; pitch 1.375:1; gantry rotation time 1.0 s; tube voltage, 120 kVp; current intensity, 200 mA, specific field of view for the head and then, another specific field of view for the rest of the body from neck to feet. Images were then transferred to an Advantage Windows® workstation, where multiplanar software (Reformat®, General-Electrics Healthcare) was used to interpret and illustrate the most representative findings to help the forensic team.

UPMCT interpretation

UPMCT images were assessed by a forensic radiologist and a junior non-forensic radiologist. Both were aware of the context of death. Comparison between UPMCT and autopsy findings was performed retrospectively. UPMCT examination was reviewed first and then a comparison with the autopsy findings appearing in the report was made.

For each UPMCT examination, a qualitative evaluation of the liver, spleen, pancreas and both kidneys was performed. The presence or absence of hemoperitoneum was recorded. In order to detect the pathological alterations in the organs and differentiate them from normal postmortem findings, the four signs described in the semiology of post-traumatic abdominal injuries were used [6]. They included hematoma, parenchymal heterogeneity, parenchymal air and parenchymal foreign body.

Hematoma was defined as a hyperattenuating collection (with attenuation values ranging from 40—60 HU) in contact with the organ margins, without fatty interface. The presence of hyperattenuating free fluid, usually located in the paracolic gutters and Douglas pouch, was considered as hemoperitoneum. With regard to parenchymal alterations, intraparenchymal air was noted when air bubbles did not follow the vascular tree. Parenchymal foreign bodies consisted exclusively of bone fragments, as we excluded cadavers with gunshot injuries.

Autopsy

The autopsy report was considered as the standard of reference in order to calculate the sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) of UPMCT examination. Autopsies were routinely performed by a team of 15 forensic experts, aware of the most relevant radiological information prior to the autopsy. Anatomical dissection was carried out according to

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