H107 Virtopsy in Clinical Forensic Medicine: A Trauma Case Series With Clinical Emergency Computed Tomography (CT) Reconstruction Details

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Learning Overview: The goal of this presentation is to explain in detail how image quality and resolution of clinical emergency CT images serves to solve forensically relevant questions.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by illustrating how good emergency CT data is considering forensic analysis of even relatively small survived injuries.

Introduction: Emergency CT images have a therapeutic focus, and axial images have been the mainstay of their interpretation. That data has been regarded as inadequate for forensic questions as reconstructive forensic approaches also heavily employ Multiplanar Reconstruction (MPR), and 3D techniques demand sufficient resolution also of the third dimension (z-axis, slice distance). This case series provides examples of the forensic use of that data.[1]

Cases: Case 1 features blunt head trauma of a bicycle rider found with a nose bleed and visible facial injuries but no bicycle. The forensic question was to discriminate between blows against head and a fall. Case 2 features a sternal stab wound with the forensic question of why, as there were more than 20 mostly very superficial stab wounds allegedly delivered by a single person, there was no other fracture. Case 3 features a firearm injury to the head with the forensic question why the bullet exited with deformation, seeing as there was a straight line from entrance (right neck) to exit (left eye) that did not contain thick bone. Case 4 features multiple stab wounds to head and torso with questions as to how deep and how close to vital structures they were. CT scan details were accessed through Digital Imaging and Communications in Medicine (DICOM) -header tags.

Results: Resolution of clinical emergency CT scans was 0.35mm to 0.46mm inplane (x/y) and 0.5mm to 0.7mm (z) for head scans and 0.88mm to 0.97mm (x/y) with 1mm to 1.5mm (z) for thorax and abdomen scans. Anisotropy (percentage: z relative to x/y) was 141%±36%. The time required to acquire data to reconstruct a head CT at maximal z-resolution of 0.5mm was 26 seconds, not that different from a head scan with less z-resolution (such as 0.7mm), where the longest duration in this case series was 33 seconds. Thorax CT scans took 6 to 10 seconds with substantially larger image thicknesses.

In Case 1, burst fracture lines, some of them quite thin, showed a combined burst and impression fracture system to the face typical for severe blunt trauma, such as riding a bicycle into a street sign at relatively high speed, matching the victim's statement. In Case 2, features of both a sternal foramen and sharp force injury to the bone could be discriminated, explaining why a relatively superficial stab wound injury pattern was not a contradiction to a perforated sternum. In Case 3, the bullet track also containing a ricochet area at the orbital rim of the left eye containing a subtle hairline fracture could be visualized in detail. In Case 4, all deep stab injuries could be reconstructed to answer regarding their depth and proximity to vital structures.

Discussion: Clinical emergency CT uses similar machines as those used for Postmortem CT (PMCT), so they have no intrinsically lower data quality. In all these cases, visualizations were achieved that answered the forensic questions not only with plausibility but with confidence. While resolution of CT scanners generally is sufficient for many forensically relevant injuries, even limited resolution or quality of radiological images has been shown to be relevant in the context of forensic medicine in the past.[2,3]

Reference(s):

1. Molina, D.K. et al. The Sensitivity of Computed Tomography (CT) Scans in Detecting Trauma: Are CT Scans Reliable Enough for Courtroom Testimony? *J Trauma Acute Care Surg* 63.3 (2007): 625-629.
2. Thali, M.J. et al. Forensic Radiology With Cross-Section Modalities: Spiral CT Evaluation of a Knife Wound to the Aorta. *J Forensic Sci* 47.5 (2002): 1-5.
3. Kirkpatrick, R.C. The New Photography: With Report of a Case in Which a Bullet was Photographed in the Leg. *Montreal Medical Journal*, 1896.

Virtopsy, Clinical Forensic Imaging, CT Imaging