G60 Limitations of Metal Fragment Analysis on Postmortem Computed Tomography (CT)

Howard T. Harcke, MD, 3205 Coachman Rd, Wilmington, DE 19803; Reed Selwyn, PhD, USUHS, 4301 Jones Bridge Rd, Bethesda, MD 20814; and Charles Allen, and Edward Mazuchowski, MD, PhD, AFMES, 115 Purple Heart Dr, Dover AFB, DE 19902*

After this presentation, attendees will understand the technical limitations of extended scale Computed Tomography (CT) measurements of density Hounsfield Units (HU) as applied to metallic ballistic fragments.

This presentation will impact the forensic science community by stressing that as postmortem CT is incorporated into medicolegal death investigations it will become necessary to carefully define standards for determination of metal fragment characteristics. If extended scale CT is to be used to determine whether fragments in a body are of the same material or to predict the composition of metal fragments based on density (relative to samples of known composition), the influence of Region of Interest (ROI), size, and placement must be appreciated and standardized techniques developed.

A logical forensic application of postmortem CT is the characterization of ballistic fragments present in the body at the time of medicolegal death investigation. Density measure has the potential to determine if fragments in a body are of the same material and to predict the composition of metal fragments based on density relative to samples of known composition. The purpose of this study was to evaluate the application of standard ROI analysis to extended CT scale measurements of density HU. The goals were to determine the influence of ROI size and placement on the density measure of gunshot fragments.

Postmortem CT imaging of gunshot wound victims was performed on a CT scanner with extended scale. Analysis of imbedded metal fragments was made on a radiology workstation using the standard software tools for measuring HU's from regions of interest. ROI placement and size were varied in assessment of metal fragment density while in the body and repeated in air after recovery at autopsy. Sample rounds of known origin were scanned in water and air for comparison and effects of kVp and mA were evaluated.

Both recovered fragments and bullets of known composition showed highly variable estimates of density depending on ROI area and placement. Tested fragments ranged from 1,200 to 30,000 HU. Values were varied for ROI size and location whether a fragment was scanned longitudinally or transaxially. Fragment measurements in the body produced densities approximately 50% lower than values measured in air. Lower scan kVp produced higher HU values (air measurement). Because of the wide variation in extended scale HU measurements occurring within and between fragments it was not possible to conclude whether fragments, were from the same source material or to distinguish composition of higher density fragments such as lead, steel, and copper.

ROI size and placement affect the CT measurement of density (HU's) in metallic ballistic fragments to such a degree that extended scale determination of density should not be used in forensic analysis without further investigation. Scatter and beam hardening artifacts occurring with present CT algorithms are responsible for these variations. New algorithms or correction of existing algorithms should be considered.

Postmortem CT, Ballistic Fragments, Metal Analysis

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