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FORENSIC RADIOLOGY IN POST-MORTEM INVESTIGATION

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A post-mortem (autopsy) examination, carried out on the body of a deceased person - conducted in cases of suspicious/unnatural deaths or MLCs (Medico-Legal Cases), is performed by doctors specialized in Forensic Medicine. It is conducted systematically and aids in:

- Determining decedent's identity
- Determining mechanism of death
- Determining medical history
- Correlating wounding and object producing the wounds
- Determining the time interval between wounds received and death
- Establishing the sequence of events
- Retrieving evidence and article(s) involved in death
- Obtaining specimens for toxicology and other relevant information

The conventional method of examination is carried out within 2-3 working days following death. There is no fixed time as to how long it will take. The full postmortem examination can be described in the following stages:

1. Receiving a request letter
2. Identification
3. External examination

4. Internal examination (inspection of internal organs of the body)
5. Special examinations/tests
6. An account of the findings

Modern imaging techniques are of increasing importance in post-mortem investigations due to multiple advantages; data can be stored digitally and accessed at any time; 3D images can be reconstructed and can explain complex cases to non-forensic persons. However, the limitations of the same depend on the technique employed.

Plain X-Rays

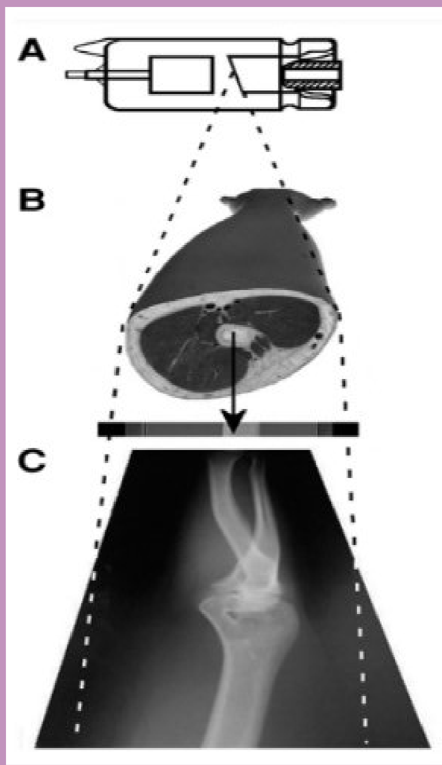

Fig. 1. Schematic diagram of a roentgenogram; the X-ray beam is produced by the cathode (A), focused through the tissue in question allowing differing densities of the tissue to produce a greyscale mosaic (B) When the plate is fully exposed, creates the roentgenogram, or “plain X-ray” (C). Photo via Forensic Pathology Reviews, Vol. 4.

The application of radiology in cases of medicolegal interest originated with Wilhelm Roentgen’s discovery of X-rays (1895). The radiological assessment of the body is produced by collimated X-ray beams (possessing wavelength in the range of 10–8m) focusing on the anatomical region in question, creating an image through the reaction between the beam and silver emulsion present on a photographic plate.

The reduced silver particles produce black areas (radiolucency), and the inability to penetrate tissues results in the absence of reduction and hence, a white (radiopaque) area. The result is a greyscale mosaic (the roentgenogram image) known commonly, although incorrectly, as an “X-ray” (Fig. 1). Plain X-rays have been used for the purpose of identification, determining the cause of death, evidence of non-accidental injury, and locating foreign objects. Another advantage includes the ability to produce multiple copies. A major disadvantage is that the image is 2D.

Fluoroscopy

Fluoroscopy is a mobile, rapid means of examining bodies, offering real-time examination. The units produce a continuous, low-power X-ray beam focused on the region in question, employed during cadaver examination, bone trauma, metal projectiles, fragments, etc. The fluoroscopic fields of view are however, narrow, have low resolution, and don’t have the ability to create “copies”.

Angiography

Angiography is a technique used to visualize the lumen of blood vessels and organs (with a particular interest in arteries, veins, and the heart chambers), done by injecting a radiopaque agent into blood vessels and imaging it using X-ray based techniques. However, images are difficult to interpret and may not provide any information that cannot be gleaned through CT (Computed Tomography)/MRI (Magnetic Resonance Imaging). The process is slow, time-consuming, and operator-dependent.

Ultrasonography

Like fluoroscopy, it allows real-time examination through the production of sound waves within the ultrasound range (3.5-7 MHz). When the wave contacts an interface between tissues of differing densities, the wave is reflected, refracted, or absorbed, received through a probe unit and processed to form an image. Although user-safe, portable, and inexpensive, the technique has only been applied in research and is superseded by MRI. It occasionally plays a role in forensic pathology.

Computed Tomography

CT was developed in 1972 as a means of radiologically producing thin transverse sectional images through a body. It requires a collimated X-ray beam to be passed and detected using a circular array of photomultiplier tubes. The narrower the scan diameters, the more accurate the image. The result is a rapidly-produced full body scan image (Fig 2). The disadvantages include radiological exposure risk, cost, and digital image streaking caused by the presence of metal in the body.

Fig.2.Scanograms -
rapidly produced body scan of large anatomical regions, produced through by the computed tomography scanner Photo via Forensic Pathology Reviews, Vol. 4

Magnetic Resonance Imaging (MRI Scan)
Developed in 1980 by P. Lauterbur and P. Mansfield, MRI utilizes the natural, rotational behavior of H+ ions and employs the application of two strong, perpendicular, external magnetic fields. The changes in frequency are detected, producing a magnetic resonance signal, forming the basis of the image.
The technique holds no radiation exposure risk, although it must be certain that the body examined does not contain metal. The degree of image resolution provided is excellent.

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