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Virtual Autopsy – Future of Forensic Medicine

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Abstract

During the last few years, modern cross-sectional imaging techniques have appeared in Forensic Medicine. Magnetic Resonance Imaging (MRI) and Multislice Computed Tomography (MSCT) are increasingly implemented in Post-mortem examination. These non-invasive techniques can augment and even partially replace traditional autopsy. With the use of these methods, a minimally invasive, objective and investigator-independent documentation of forensic cases can be realised to reach qualitative improvement in forensic pathological investigation.

Key Words: Virtual Autopsy, Computed tomography, Magnetic resonance imaging.

Introduction

The term 'Virtual' is derived from the Latin word 'virtus' which means 'useful, efficient and good.' The term 'Autopsy' is a combination of the Greek term 'autos' (self) and 'opsomei' (I will see). Thus Autopsy means 'to see with one's own eyes'. Sometimes, to eliminate the subjectivity implied by the term 'autos', the terms 'Virtual' and 'Autopsy' are merged – deleting 'autos' – to create the term 'Virtopsy'.

The main objectives of Forensic Medicine are to document, analyse and elucidate scientific medical findings in both living and deceased persons in a comprehensive way for court room presentation. In deceased persons, the main goals are to determine the cause and manner of death, to evaluate the sustained injuries and to develop a forensic reconstruction based on the findings. Other than DNA technology and toxicology – the areas in which 'high-tech' methods have already been incorporated – the documentation of forensic pathological findings is still based on the same autopsy techniques and protocols that have been used for centuries. The most commonly used tools are a scalpel, written documents and conventional 2-D photography. Forensic findings are thereby documented in a subjective (observer-dependent) way and the findings that have been documented are destroyed forever after the dead body has been disposed off.

For many years, the application of imaging methods for objective nondestructive documentation of relevant forensic findings has lagged far behind the technical development of imaging methods.

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Diagnostic imaging is still underused in forensic medicine, mainly due to unawareness of its potential and lack of teaching and experience.

The first application of Computed Tomography (CT) in forensic medicine was done by Wullenweber (1977) to describe the pattern of gun shot injury of the head[1]. Since 2000, Michael Thali and colleagues of the Institute of Forensic Medicine in Bern, Switzerland in collaboration with the Institute of Diagnostic Radiology, Bern have been developing a bloodless and non-invasive form of digital autopsy. 'Virtopsy' basically consists of a) body volume documentation and analysis using CT (Computed Tomography), MRI (Magnetic resonance imaging) and micro radiology; b) 3-D body surface documentation using forensic photogrammetry and 3-D optical scanning which can document wounds and compare them with the suspected weapon. The resulting data set contains high-resolution 3-D colour-encoded documentation of the body surface and 3-D volume documentation of the interior of the body[2]. Radiologists then create full 3-D visualization of the deceased to examine the condition of bones, tissues, organs and blood vessels for clues to the cause and manner of death. Thus virtual autopsy with the help of multi-slice CT (MSCT) and MRI provides the information as if the body is actually being dissected layer by layer although in reality the body remains intact[3].

To counter the lack of a sufficient vascular diagnosis based on cross-sectional imaging findings, a minimally invasive angiographic technique has been implemented that allows visualization of stenosis, occlusion or injuries of coronary arteries. With CT fluoroscopy, an image-guided biopsy can obtain a tissue specimen for histopathological examination. Similarly, gas samples from lungs and samples of stomach content, urine and blood can be obtained through percutaneous route for chemical analysis in suspected cases of poisoning.

MR Spectroscopy can detect certain metabolic products in a predefined region of brain which helps to assess the postmortem interval. MR microscopy has changed the concept of conventional histopathology. Whereas standard histological analysis displays only the isolated plane of tissues that has been sectioned, micro imaging can be used to obtain images of any plane of tissue through the specimen[4].

Discussion

Worldwide, nearly 1000 virtual autopsy have been done to date. Thali and his colleagues have already performed more than 100 Virtopsies, with each virtual autopsy confirmed by actual autopsy afterwards. He has claimed that virtual autopsy visualization enable pathologists to observe the conditions of the organs that may be difficult or impossible to detect by traditional means. At present, there are only a few institutions worldwide that have recognized the possible impact of cross-sectional imaging in postmortem investigation and have invested efforts in its implementation.

The advantage with virtual autopsy is that it does not destroy key forensic evidence which may be damaged during classic autopsy[5]. It can also be used in cultures and situations where autopsy is not tolerated by religious bias. The 3-D, non-subjective information that is stored can be easily presented to the Court. If necessary, the data can be sent via CD or e-mail to another forensic pathologist for a second opinion and it can be stored for years for future reference. The technology also offers promise to many medical centers equipped with CT and MRI machines but lacking forensic pathologists. Scans can be sent to pathologists who can conduct autopsy remotely. In addition, virtopsy promises to ease the burden of determining identity and cause of death of large number of victims following earthquakes or other natural disasters. Moreover, the technology can significantly

help forensic and law enforcement efforts to quickly and accurately pinpoint the chain of events after a bomb blast or other terrorist attack.

In recent years, virtopsy has been performed at US Armed Forces Institute of Pathology, Washington D.C. on the dead bodies of soldiers killed in Afghanistan and Iraq.

Unfortunately, the benefit of virtopsy has not been available in India as yet due to its high cost.

Conclusion

Virtual Autopsy is a newly developed procedure that will enhance the classic autopsy, giving it the capacity to achieve more reliable results. In some cases, it has also the potential to replace the normal autopsy. Research efforts studying the unique aspects of post-mortem radiology must, however, be undertaken to identify cases and validate its procedure. It is clear that the introduction of this reality based, high-tech method can have a big impact on the forensic medicine, the judicial system, the police and the general medicine in the future.

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