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Review Article

Virtopsy: A New Innovation for Forensic Science

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Abstract

Modern cross sectional imaging techniques can supplement and may even partially replace traditional autopsy. The century old techniques are still being used, Virtopsy is one step ahead. The aim of the Virtopsy is to validate new approach by systematically comparing the radiologic and surface scanning findings with those obtained at traditional autopsy. Virtopsy consists of body volume documentation and analysis using CT, MR imaging, and micro-radiology; and 3D body surface documentation using forensic photogrammetric and 3D optical scanning. The new method should be able to help determine whether death was the result of natural causes, accident, suicide, or homicide. This paper is aimed to discuss a few points that to what extend Virtopsy is beneficial in the field of Forensic Science.

Keywords: CT; MR Imaging; 3D Surface Scanning; Virtopsy; Autopsy**.**

Introduction

Virtopsy is a portmanteau of virtual and autopsy. Word virtual is originated from the Latin word virtus, (means "useful, efficient, and good") and Autopsy is combination of the classical Greek terms autos ("self") and opsomei ("I will see"), means "to see with one's own eyes". Thus Virtopsy is stand for the innovative combining of the power of the virtual world in the form of graphics and the usefulness to researchers and forensic science of the autopsy into a powerful technique to help investigators determine the circumstances surrounding an individual's death[14]. Virtopsy, the name of the process registered by the research team in Bern, Switzerland, is a scalpel-free procedure, latest technology to provide a complete three-dimensional view of the inside and outside of the body [7]. Currently manner of death can be determined by Virtopsy whereas cause and mechanism are potential possibilities as the technology improves. Vitropsy which combines very powerful scanning and radiographic technology with the power and resolution of modern computing, is a promising tool that complements the information and discoveries of investigators, doctors, and forensic pathologists when used in combination with traditional autopsies to help identify the manner and cause of death in individuals, more quickly and effectively discover important clues without the need to physically dissect the cadaver.

The aim of Virtopsy is to establish an observer independent, objective and reproducible method using modern imaging technology, leading to minimally invasive "Virtual" autopsy analogous to "Keyhole Surgery" in clinical medicine.

Digital autopsy is a software based procedure utilising the power of imaging and visualization to conduct autopsy on a digital body generated using raw data from whole body scanning by Multislice Computerised Tomography (MSCT) and high performance computing system. Virtopsy has a

scientific and technological background. It is scientific because of autopsy and related forensic medicines and technological due to virtual or digital characteristic.

The Virtopsy laboratory consists

- Photography and 3D Optical Scanner Scanning
- Multi-slice CT and MRI
- Dentistry and fingerprinting
- Heart lung machine and CT Angiography
- Image-guided Dissection and Robotic Image-guided biopsy
- Histopathology and Cytology
- Toxicology, Biochemical and Molecular Studies

Virtopsy Process

The first step in performing a Virtopsy is to prepare the body for imaging. The markers are used by the computer processors to calibrate the surface scan of the corpse and match it to the later internal imaging processes. After the markers are placed the Virtibot takes a 3D colour model to the body. This scan uses stereoscopic cameras to capture the colour image and a projector to cast a mesh pattern on the body. The resolution of the cameras is 0.02 millimetres [10]. Once this image is created the picture can be manipulated on a computer screen so the researchers or investigators can turn it and identify tattoos or other surface marks. Virtibot has replaced the need of having human operators place tripods and cameras at various points around the body. This is because the robot glides over the body creating a 3d image. This process, using Virtibot, takes as little as 10 seconds.

After the surface scan the body is brought to the Computed Tomography and MRI labs usually double-wrapped inside a blue bag through which X-rays can easily pass and laid on the sliding table of the CAT, MRI and MRS equipment. The bag will remain closed while the body is scanned both to respect privacy of the dead, maintain cleanliness of the surroundings and not to disturb any non-forensic personnel in the room [11]. The body then undergoes a computed tomography (CT) scan, a process which takes about 20 seconds and creates up to 25,000 images, each one a slice through the body. After this it is also subjected to MRI and MRS scans. The information from all the internal and external scans is fed to powerful desktop computers where the data is combined and rendered using CAD-style programs and ultra-powerful graphics processors.

The Virtibot consist of:

*Heart Lung machine used for post-mortem angiography with an artificial circulation,

*MSCT scanner with Fluoroscopy, MRI machine and two external network connected workstations,

*3D surface scanner – an optical measuring machine based on the principle of triangulation,

*CT-image guided biopsy system–the radiological imaging has to be supplemented by careful tissue sampling to facilitate further examination,

*The anonymity of the deceased is preserved by wrapping the corpses in artefact free body bag.

Advantages and Disadvantages of Virtopsy

There are powerful positive and significant negative elements to discuss. Among the positive aspects of Virtopsy are the process allows a pathologist to detect internal bleeding, bullet paths, and hidden fractures that are currently difficult to isolate. The CT and MRI scans Highlight emboli- air bubbles that obstruct blood vessels. This evidence can vanish as soon as the pathologist slices open a vein or organ and have had pathologist call for underwater autopsies so they can see the air escaping. Magnetic Resonance Spectroscopy (MRS) combined with MRI might be helpful in determining the time of death [5,8,12]. The Virtopsy scan makes it easier to detect as pirated or inhaled water and blood in the lungs. These sings tell a pathologist that a victim was alive when he entered the water or sustained the injury. The scan also allows the pathologist to efficiently find bullet or other fragments in the body as the scans show exactly where they are located without having to cut open the body and search for them [4]. Uniform documentation of findings will increase the quality of the evidence presented in court by experts. Increased understandability- the availability of 2D and 3D reconstructions will impressively improve the clarity and will play an important role in the acceptance of the evidence. Virtopsy reduces the stress of the deceased person's family members and friends. Alternatives for cultures where conventional autopsy is forbidden virtual autopsy will allow medical legal examinations in cultural circles. The method could be useful in the examination of highly infectious bodies. No scalpel method, no hazard of infections from the blood and other tissue fluids. No mutilation of the body, so, can be examined again without any autopsy artefacts.

Use of imaging data in forensic autopsies

MSCT and MRI useful for; severe crushing, decomposition, bullet paths, vascular injuries, drowning, gas embolus, foreign bodies, lung and brain, trauma documentation, dissection planning, limited autopsy.

Post mortem imaging (hospital death)

The Virtopsy makes sense from a forensic standpoint, identification of victims/ remains, firearm deaths(location and retrieval of projectiles), child abuse/ non accidental injuries(skeletal surveys), barotraumas or suspected air embolism, traumatic subarachnoid haemorrhage and other complex cases where the examination and interpretation are compromised by destruction of the body. Studies of child abuse victim confirm the sensitivity of post mortem MRI for contusion shearing injuries and subdural hematoma. There is a great future for non-destructive analysis of visceral pathology, such as cardiac (including Coronary), pulmonary and hepatic disease.

On the other side it has a number of troubling limitations. The Virtopsy is inadequate to the task of diagnosing natural causes of death, poisonings, infections or heart failure and difficult to differentiate ante-mortem or the post mortem wounds. Small tissue injuries may not be seen. The equipment is prohibitively expensive. The scans cannot determine infectious agents or tumour types. We cannot establish colour of organs and detect discharge from the vascular system. Another problem is more complicated, specific software for MRI and MSCT.

Conclusion

The present day subjective protocoling of autopsy findings can be replaced by a uniform and observer-independent radiological documentation. This will increase the Forensic medicine reconstruction of an event is only possible by means of the exact determination of findings, head to toe, accompanied by precise geometric ordering that is understandable to lay people. Moreover, and very importantly, Virtopsy is useful in situations of religion, the law or cultural mores that prohibits invasion of the body without upsetting or angering a family. One very important use of the technology will be in the quality of evidences presented in courts by experts as the expert witnesses discuss evidence found on bodies of crime victim bloodless and likely less graphic way [11].

Nevertheless it is a new development in the field of investigation of death, but still it has a long way to go to establish itself as an alternative to the conventional autopsy. In near future, we all will be accustomed to some kind of virtual autopsy which will be beneficial for the court as well as the autopsy surgeons and the relatives of the deceased.

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