

## **Editorial- Educational**

### **Is It Time for a Virtual Autopsy Service in Bahrain?**

Eamon Tierney, FFARCSI, FJFICMI\* Wael Ebrahim, MSc, PhD\*\* Suhail Baithun, MB, BCh, FRCPath\*\*\* Martin Corbally, FRCSI, FRCSEd, FRCS, MRCPI (Assoc)\*\*\*\* Jaffar Albareeq, DLO, RCP, RCS (London)\*\*\*\*\*

Post-mortem examination, or autopsy, is known to have been first performed by the ancient Egyptians to prepare the deceased by embalming and other means for their journey into the after-life.

In the second century AD, Galen established the concept of autopsy in Rome, albeit mainly in monkeys; this was the first attempt to correlate the physical findings on post-mortem with the symptoms and signs experienced by the patient before death.

Autopsy appears to have then become unfashionable or undesirable until the time of the Renaissance and afterwards. In the mid-sixteenth century, Vesalius practiced autopsy and taught it to his students<sup>1</sup>. In about 1543 or 1544, he published *De humani corporis fabrica* on the composition of the human body based on his post-mortem studies, which is probably the most important anatomy textbook ever published<sup>1</sup>. Of interest to intensivists, he was the first to describe artificial ventilation by attaching a pair of bellows to a post-mortem trachea-lung preparation<sup>2</sup>.

In the nineteenth century, the study of the body post-mortem became more widespread. Doctors such as Rudolph Virchow (Virchow's node) in Germany described an organized technique of carrying out a post-mortem; and much of the progress in western medicine during that time can be attributed to the post-mortem study of Virchow and others. The practice of teaching anatomy using cadavers also became widespread during the nineteenth century.

---

\* Consultant and Director, ICU  
Associate Professor of Critical Care and Applied Physiology, RCSI-MUB  
\*\* Consultant  
Radiology Department  
\*\*\* Consultant Histopathologist  
Department of Pathology, Blood Bank and Laboratory Medicine  
\*\*\*\* Chief of Staff  
Consultant Pediatric Surgeon  
Professor and Chairman Department of Surgery, RCSI-MUB  
King Hamad University Hospital  
Email: eamon.tierney@khuh.org.bh

Since then, post-mortem science has progressed greatly. It is now possible to extract a healthy infant from the womb of a pregnant woman immediately after death, and it is even possible to harvest the spermatozoa of a dead man, either by the transrectal electro-ejaculation method or by collecting the contents of the epididymis immediately post-mortem.

It is important to remember that the harvesting of entire organs for use in transplantation takes place during post-mortem dissection, either with or without a beating heart.

The benefits of performing a post-mortem today include:

1. Discovery of the cause of death when the cause is unexplained.
2. As a quality marker, to assess whether the diagnosis and treatment were correct.
3. To assess the effect of treatment given.
4. To look for genetic conditions and give genetic counselling as a result.
5. Teaching medical students and trainee doctors.
6. Forensic purposes.

There are particular areas in a hospital where the availability of a post-mortem service is important. Clearly, a patient dying of multiple long-standing illnesses in a hospital medical ward would not usually merit a post-mortem, but a patient dying of a sudden unexplained illness in an emergency department or an adult Intensive Care Unit would need post-mortem investigation to determine the cause of death and to rule out foul play. In addition, neonates and older children dying of unexplained conditions need to have their cause of death investigated to satisfy the parents' unanswered questions and to establish the presence or otherwise an inherited cause of death. It has been a source of considerable frustration to the first author that no post-mortem study has been possible in patients where the cause of death has not been fully explained.

Different religions have different views on post-mortem study. No religion encourages it. Christianity tolerates it as a necessary aspect of science. However, Muslims, Hindus and Jews have similar views; all three religions object to post-mortem dissection on three grounds: first, the body should be moved as little as possible, second, the integrity of the body as a whole must not be compromised, and third, post-mortem delays burial (or cremation in the case of Hindus) as burial should take place quickly, preferably on the same day. It is probably reasonable to assume that all religions in olden times viewed corpses as a potent source of infection, and were anxious for burial or cremation to take place as soon as possible after death.

In Islam, autopsy was practiced by some famous Muslim physicians such as Rhazes and Avicenna in the 10<sup>th</sup> and 12<sup>th</sup> centuries; although, this practice was avoided by their contemporary Ibn Alnafis because he considered it religiously unacceptable<sup>3</sup>.

The head of the Islamic School of Jurisprudence stated in 1952 that "Necessity permits the forbidden" thus allowing autopsies in cases of criminal death or suspected deaths.

This was followed by another legal opinion committee (fatwa) in 1982 which found the advantages of autopsy greater than the disadvantages if it serves justice. Autopsies are now accepted by Islam when they are deemed to be useful<sup>4</sup>.

There is a need to balance the religious and cultural views of a population with the need of a family or society to learn the feasible cause of death. Knowledge regarding the cause of death might help future generations of a family, as well as contributes to the progress of medicine in the society as a whole. A possible answer as to how these conflicting demands can be satisfied simultaneously lies in the concept of a virtual autopsy, whereby non-invasive means are used to examine a patient post-mortem. The term "Virtopsy" describes the concept well.

It is a mixture of the words “virtual” and “autopsy” and was first used and copyrighted by researchers led by Professor Richard Dirnhofer at the Institute of Forensic Medicine in the University of Bern in Switzerland in 2006<sup>5</sup>.

There are many ways in which a virtual autopsy can be carried out. These means would include:

- Thorough visual inspection of the body.
- Examination by palpation and percussion, as in standard clinical examination.
- Plain x-rays.
- CT scans with or without contrast.
- Magnetic Resonance Imaging.
- Ultrasound scans.
- Ultrasound-guided fine-needle biopsy e.g. of the liver<sup>6</sup>.
- Aspiration of pathological fluids such as pleural effusions.

All of these investigations would retain the bodily integrity of the deceased, satisfying cultural, religious and family requirements, which would hopefully allow doctors to improve the treatment of their future patients by learning more from the deceased. In addition, use of these investigations would ensure that images, both radiological and histological could be retained indefinitely for research and study purposes. Investigations such as liver biopsy that had not been possible before death due to coagulation abnormality for example, would be feasible after death.

Of course, it will never be the case that virtual autopsy will be as accurate as an actual post-mortem, just as radiological and pathological studies will never replace the diagnostic laparotomy. In a study comparing virtual and actual autopsy in 182 unselected cases, Roberts et al found a good correlation between the two techniques in 70% of cases and that a major discrepancy existed between real and virtual autopsy in determining the cause of death in the remaining 30% of cases. In addition, Roberts et al found that computerized tomography (CT) was better than Magnetic Resonance Imaging (MRI) in identifying the cause of death<sup>7</sup>.

Certain problems, both technical and organizational, would have to be overcome to introduce such a service. Clearly, the infection control aspects of a virtual autopsy service would be paramount. In addition, radiography and radiology staff would need special training in the management of deceased patients, especially in techniques such as post-mortem angiography. Great care would have to be taken in ensuring that the investigations were done quickly and efficiently in order not to alienate the family by delaying burial. The transport of the deceased to and from the radiology department would have to be carried out in a manner that would not upset other patients in the radiology waiting rooms and elsewhere.

We feel that the establishment of a virtual autopsy service in Bahrain for non-forensic purposes is both feasible and desirable. We recommend that a virtual autopsy service be established as a co-operative effort between the radiology and pathology departments in each of the major hospitals in Bahrain. The service would need a dedicated coordinator to liaise with families and to ensure that all aspects of the service run smoothly. This would not replace but rather complement the existing forensic post-mortem service and would give the people of Bahrain a service they both need and deserve; an effective system that determines, as much as possible, the illnesses causing the death of their loved ones while at the same time respecting cultural and religious traditions.

Virtopsy is an alternative to standard autopsies for systemic examination of the deceased body. Standard autopsy is not favored by many cultures and religions, including Bahrain Muslims, who disagree with mutilating the body for the sake of autopsy. It is less time consuming, improves diagnostics, and gives respect to religious sentiments. Virtopsy is important in our culture to determine the cause of death for scientific purposes and in medicolegal cases<sup>8,9</sup>.

Martin Arroio in 1896 paved the way to virtopsy who used radiological imaging for identifying the cranial sinuses in a deceased for the first time<sup>9</sup>.

Virtopsy has the following advantages: it is more reliable in diagnosing charred body and damaged oral cavity, localizing foreign body, identifying fracture lines, entry and exit wounds, pathological gas collections, and gross tissue injury, estimating the time of death, retinal hemorrhage, electric injury to the skin, and age and sex determination<sup>9-12</sup>.

Virtopsy is not perfect and it has its own disadvantages, it is not feasible to use highly sophisticated techniques and devices in poor and less developed countries; in identifying the cause of death, second opinion is advised. Financial aspect should be considered in virtopsy if it has to be done privately<sup>9</sup>.

Finally, virtopsy has vast psychological and cultural advantage if it is practiced in Bahrain because most Muslims believe that the body and soul are inseparable and thus do not favor standard autopsy<sup>10</sup>. Although virtopsy does not involve mutilation of the body, one caveat has to be considered, the procedure could not be done without the consent of the close relatives or family consensus.

## REFERENCES

1. Vesalius A. *De Humani Corporis Fabrica Libri Septem*. Basileae: Ex Officina Joannis Oporini, 1544: 268.
2. Vallejo-Manzur F, Perkins Y, Varon J, et al. The Resuscitation Greats: Andreas Vesalius, the Concept of an Artificial Airway. *Resuscitation* 2003; 56(1):3-7.
3. Elfalwal MA. Sharia Law and the Judicial System. In: Payne-James J, Busuttil A, Smock W, eds. *Forensic Medicine: Clinical and Pathological Aspects*. 1<sup>st</sup> edition. London, UK: Greenwich Medical Media Ltd, 2003: 29-37.
4. Davis GJ, Peterson BR. Dilemmas and Solutions for the Pathologist and Clinician Encountering Religious Views of the Autopsy. *South Med J* 1996; 89(11):1041-4.
5. Virtopsy. Available at: <http://www.virtopsy.com/about-virtopsy.html>. Accessed in June 2014.
6. Cina SJ, Smialek JE. Postmortem Percutaneous Core Biopsy of the Liver. *Mil Med* 1999; 164(6):419-22.
7. Roberts IS, Benamore RE, Benbow EW, et al. Post-Mortem Imaging as an Alternative to Autopsy in the Diagnosis of Adult Deaths: A Validation Study. *Lancet*. 2012; 379(9811):136-42.
8. Tejaswi KB, Hari Periya EA. Virtopsy (Virtual Autopsy): A New Phase in Forensic Investigation. *J Forensic Dent Sci* 2013; 5(2):146-8.
9. do Rosário Jr. AF, Souza PHC, Coudyzer W, et al. Virtual Autopsy in Forensic Sciences and its Applications in the Forensic Odontology. *Rev Odonto Cienc* 2012; 27(1):5-9.

10. Thali MJ, Jackowski C, Oesterhelweg L, et al. VIRTOPSY - The Swiss Virtual Autopsy Approach. *Leg Med (Tokyo)* 2007; 9(2):100-4.
11. Dumbrava DP, Anitan S, Siserman C, et al. Virtopsy: An Alternative to the Conventional Autopsy. *Rom J Leg Med* 2010; 18:75-8.
12. Grabherr S, Cooper C, Ulrich-Bochsler S, et al. Estimation of Sex and Age of "Virtual Skeletons"--A Feasibility Study. *Eur Radiol* 2009; 19(2):419-29.