Autopsy Case Reports

Editorial

Minimally invasive autopsies: a promise to revive the procedure

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Since ancient times, the autopsy has been a relevant source for the improvement of technical and scientific knowledge in the health area. From the first anatomic studies in the Middle Ages to the use of modern molecular techniques for the study of physiopathological processes, the autopsy has proven to be a very rich source of material and inspiration for the advancement of scientific knowledge. However, in recent decades, there has been a marked decline in medical autopsies—a situation that has important implications in research as well as education in medical sciences. For instance, the decline in the number of autopsies makes it difficult to apply the modern techniques of molecular biology and pathology in certain diseases of organs where tissue sampling is very difficult or not possible during life. Dementia and the characterization of the toxic effects of chemotherapy on the heart are classical examples of this situation. Also, systemic diseases that do not need a biopsy to achieve the diagnosis, such as obesity and metabolic syndromes, have become epidemic nowadays and could be better explained if researchers have access to adipose tissue sampled from different locations; for example, coronary and carotid arteries as well as pancreatic tissue, a situation rarely indicated during life.

Another aspect is the important role of autopsies in medical education. They provide a unique situation to observe the systemic manifestations of different diseases, giving a basis for the solid integration of medical knowledge. Further important aspects of autopsies include monitoring the quality of clinical service, identifying new diseases or new manifestations of already known diseases, evaluating the effectiveness of therapy strategies, and establishing causes of death.

One possible reason for the decline of conventional autopsies is the advance in imaging techniques that could theoretically provide in vivo diagnoses without the necessity of an autopsy to confirm them. For instance, angiographies performed in vivo may provide more detailed information on vessel structural alterations than a routinely performed autopsy. Another supposed reason for autopsy denial is that families do not like the invasiveness of the procedure.

Some forensic institutes have taken advantage of image techniques like computed tomography (CT), x-rays, and angiography to perform non- or minimally invasive autopsies: the so-called virtopsies (or virtual autopsies). There is accumulating evidence that for forensic autopsies, virtopsies are equally satisfactory when compared to conventional autopsies. In such situations where it is important to accurately detect fractures and hemorrhages, the combination of post-mortem CT and angiography is being substituted for the conventional autopsy. At the same time, the progressive development of technologies in medical imaging techniques has resulted in an increase in spatial, contrast, and functional resolution to deal with medical diagnoses. There is also a need to validate these new technologies on clinical and pathological bases. Although it seems logical that the increased capacity to observe biological alterations results in better correlation, validations are, in general, conceptually performed on a daily basis with equipment use, but without in-depth studies of clinical correlation, and

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notably, histological validation. There are few medical research centers to carry out this very necessary validation in the world..

In spite of several scientific contributions[1-3], the volume of post-mortem studies in the literature is small, as it is difficult to obtain specimens on a routine basis. Recently, our group managed to get funding from *Fundação de Amparo à Pesquisa do Estado de São Paulo* (FAPESP) and *Universidade de São Paulo* (USP) to assemble a world-class center designed to apply state of the art medical imaging in autopsies.

For non-forensic medical autopsies, the role of imaging techniques to substitute conventional autopsy is not yet clear. In 2012, Roberts et al.[4] published an important validation study in the Lancet. They performed autopsies in 182 cases referred by the local coroners (mostly sudden deaths) and concluded that the discrepancy for the cause of death was 30% when combining the radiological report of magnetic resonance imaging, CT, and clinical autopsy. The most common imaging errors in the identification of the cause of death were ischemic heart disease, pulmonary embolism, pneumonia, and intra-abdominal lesions.[4] The authors proposed that post-mortem angiographies and needle biopsies could overcome these flaws.

Wichmann et al.[5] conducted a study of intensive care unit deaths that occurred in an academic hospital in Hamburg, Germany. They studied 47 cases comparing virtual autopsy (images by multidetector CT: MDCT) and conventional autopsies, and 116 with virtual autopsy only. Diagnoses were coded according to the International Classification of Diseases (ICD-10) and classified using the Goldman criteria[6] in major/minor findings. There was 88% of concordance between clinical and virtual autopsy diagnoses. Virtual autopsy missed some important diagnoses, such as myocardial infarcts, pulmonary embolism, cancer, and deep venous thrombosis. Conventional autopsies also missed some diagnoses, such as rib fractures, smaller pleural or pericardial effusions, and pneumothoraxes. These authors suggested that larger studies using angiographies and minimally invasive techniques for histological assessments are needed to test the possibility that virtual, minimally invasive autopsy could be a solution when a conventional autopsy is not possible.

The use of MDCT coupled with MDCT-angiography for the investigation of sudden cardiac death related to atherosclerotic coronary artery disease was tested by Michaud et al.[7] The authors concluded that MDCT-angiography was better than a conventional autopsy to map coronary lesions and that MDCT was of limited value to ischemic heart disease. They have proposed MDCT-angiography as a complementary method to the conventional autopsy.

The use of fine needle biopsies in minimally invasive autopsies (MIA) has been tested in some feasibility studies in small groups of patients or in cases of selected pathologies (acute cardiovascular deaths). One group tested the diagnostic performance of MIA for detecting the common causes of death using fine needle biopsies and CT scans.[8] The authors concluded that MIA has a high diagnostic performance for the detection of common causes of death such as pneumonia and sepsis, but fails to demonstrate acute cardiac diseases. Two prospective studies, one with 20 patients with natural deaths[9] and the other with 20 patients that died due to cardiovascular disease[10], used MDCT, MDCT-angiography, and fine needle biopsies, and showed a high concordance level related to the cause of death between MIA and traditional autopsies.

At the Faculty of Medicine of the University of São Paulo we started a large study focusing on the application of modern image techniques in autopsy. The project was called BIAS (Brazilian Image + Autopsy Study) addressing the feasibility of MDCT + MDCT-angiography + image-guided fine needle biopsies in a large subset of patients. We also aim to test, in an academic setting, whether MIA is equally satisfactory to answer important questions that can be provided by a conventional autopsy, such as quality of care and adequacy of diagnostic/therapeutic interventions.

Our hypothesis is that the concordance level of MIA and conventional autopsy is high for many different pathologies, and that MIA could be an alternative option to increase the autopsy rates. We hypothesize that conventional autopsies might provide more (major/minor) diagnoses than MIAs, but that MIAs are superior to map cardiovascular alterations, hemorrhages, and misuse of medical devices. We also expect that for coroner autopsies, MIAs will be able to detect the cause of death in the majority of cases and thereby decrease the economic burden of a full, conventional autopsy in such a large service. Finally, at the end of our study, we hope that the use of autopsy

could be "revived", and that, again, death can teach us to better manage the life of our patients.

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