



The Value of the Medical Autopsy as a Quality Improvement Tool in Modern Diagnostic Medicine

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Abstract. The quality of healthcare is an emerging concern worldwide. In any health care process, adverse events resulting from errors are inevitable. The role of the medical autopsy is evolving yet it remains a cornerstone in the progress of healthcare quality and diagnostic medicine. Although the autopsy has been instrumental in understanding disease processes for the past 3000 years, there has been a concerning decrease in autopsy rates. This trend is influenced by barriers pertaining to resources, consent, and medicolegal hesitations. Reversing the trend in falling autopsy rates will require recognition of the role of the medical autopsy as an essential feedback mechanism in healthcare quality improvement. The autopsy has shaped the current state of medicine and with appropriate implementation, support, and collaboration will continue to guide the path forward.

Keywords: Autopsy · Quality improvement · Diagnostic accuracy · Post-mortem imaging · Medical education · Pathology

1 Introduction

The autopsy has been used as a diagnostic tool for more than 3000 years [1]. Today, autopsies continue to play an essential role in understanding disease and improving the diagnostic process. The medical autopsy is widely regarded as the gold standard in identifying pathologies and identifying cause of death. By providing a gold standard of cause of death to compare clinical diagnoses to [2], autopsies have allowed for the measurement of medical error as well as the monitoring of changes over time [3]. However, the rate of autopsies continues to decline, from approximately 60% in the 1960s to less than 10% in the past decade [4]. For example, some institutions have recently experienced as much as a 30% decrease in autopsy rates within a 5-year period [5]. This established quality assurance tool will bring to light diagnostic discrepancies

and will play an important role in contributing to new clinical knowledge, medical education, and quality assurance programs [6].

2 Barriers and Challenges

Barriers exist to conducting medical autopsies. The cost of an autopsy has been found to range between \$1250–\$2500 USD per autopsy [7, 8]. It has been found that approximately 10% of administrators felt that autopsy is unimportant important [9]. There is often a reluctance on the part of the relatives to request and consent to medical autopsies [10]. Barriers that have contributed to the decline in autopsy rates include limited financial resources, medicolegal hesitations, and workforce shortages [9] as well as lack of minimum autopsy rate requirements for hospital accreditation, and limited exposure to autopsies for medical trainees [4].

There are numerous requirements to make autopsy a valid quality monitor. These include sufficiently high autopsy rates, and thorough autopsy procedures [11]. The gradual decrease of medical autopsy rates in North America and across the globe has been described as a tremendous missed opportunity to gain understanding into how to reduce deaths attributable to medical errors [12]. Reversing the trend in falling autopsy rates will require recognition of the role of autopsy in quality improvement, support from governing bodies, and provision of information to families and the communities.

3 Imaging Techniques

In the present landscape of healthcare, imaging studies cannot yet reliably replace the medical autopsy [13] but may be an appropriate adjunct in certain circumstances. However, concerns have been raised regarding over-reliance and blind trust in imaging techniques as well as the premature movement to implement these modalities as a substitute for autopsies [5, 14]. Post-mortem computerized tomography (CT) scans have certain advantages over autopsies in recognizing fractures and free gas. Post mortem magnetic resonance imaging (MRI) and CT scans have been found to be more advantageous in detecting pneumomediastinum, pneumopericardium and pericardial effusions than traditional autopsies [15]. Post-mortem CT scans have also found to be a supplement to forensic autopsies cases of lethal lesions in craniofacial trauma or gunshots as well as skeletal lesion [16] but perform poorly in detecting organ damage [14]. Autopsy remain superior in the detection of diaphragm injuries, heart lesions and hemomediastinum [15]. A meta-analysis of 118 articles concluded that post-mortem CT and MRI studies have not yet reached consistently high enough performance quality standards to provide a meaningful supplement to the clinical autopsy [17].

The decision to use autopsy or imaging modalities should take into consideration if the death was of natural causes, if autopsy is appropriate in the given circumstances of the case, and if the finding will be used in a meaningful way. It is also important to consider if the cause of death is of acceptable standard and certainty to inform health-care planning [18]. Despite advancements in CT and MRI imaging, these modalities cannot yet provide the level of detail or quality required to serve as an alternative for

the medical autopsy. There is approximately a 30% discrepancy rate between imaging and the gold standard autopsy [19]. When used appropriately, autopsies can provide insights into the accuracy and limitations of imaging modalities [20] and together these tools can guide the improvement of healthcare quality.

4 Education

Low rates of autopsy create a potential for selection bias and overconfidence in diagnostic accuracy. Autopsies tend to be ordered for clinically challenging cases [21] and cases of diagnostic uncertainty [3]. However, findings by Cameron *et al.* suggest that clinician certainty in the diagnosis and clinical judgement of the need for autopsy and had little influence on the rate of discrepancies [10]. More specifically, among cases where the clinician felt certain of the diagnosis the discrepancy rate was 12%, compared to the rate of 15% for all levels of certainty. Among cases where the clinician would normally have ordered an autopsy the discrepancy rate was 15% whereas among cases, compared to 14% among cases for which an autopsy would not have been [10]. In this way autopsies serve as an essential quality measurement and feedback tool that allows for the calibration of diagnostic processes [22].

The medical autopsy guides improvements in new diagnostic technology [12] and is an important tool in education and research [6]. It remains an important quality management tool that allows us to better understand the challenges in interpreting clinical signs and investigations [20]. The widespread decline in autopsy rates suggests a ubiquitous underestimation of the value of the medical autopsy as a feedback mechanism and educational tool to reducing diagnostic error [10]. The underutilization of a gold standard of diagnosis represents missed opportunities to reflect as a medical profession and to measure changes in medical error over time.

5 Contribution to Quality Improvement

The medical autopsy has four key contributions to quality improvement. These include education, advancing understanding of disease, improving safety through detecting infectious diseases and allowing for comparisons between clinical and autopsy diagnoses [9], and providing closure for both physicians and bereaved relatives [5]. From an epidemiological perspective, post-mortem examinations provide more accurate disease mortality data and can detect emerging and infectious diseases. Post-mortem examinations continue to play an important role in major role in detecting missed infectious diseases and provide insights into the sensitivity and specificity of clinical means of detecting diseases such as TB, endocarditis, bronchopneumonia [23].

Autopsy reports continue to serve as an invaluable source of data for the assessment of the current state of diagnostic medicine. Comparisons between clinical diagnoses and autopsy findings allow us to measure rates of medical error and identify areas in which healthcare can be improved. For example, our preliminary results show that across a 5-year period (2006–2011), the autopsy rate in the Saskatoon Health Region was 6.0% [4]. There was an overall discordance rate of 15% between clinical and

autopsy diagnoses and in 10.2% of cases, knowledge of the diagnosis pre-mortem would have changed treatment to prolong disease or cure disease. These findings are well aligned with previous findings on medical error. Meta analyses have shown that between 45% and 76.5% of autopsies reveal at least one unexpected finding by Roulson *et al.* [24] and that in approximately 40% of cases the unexpected finding contributed to the death of the patient [25].

Lower autopsy rates are associated with higher rates of diagnostic errors. More specifically, for every 10% increase in autopsy rates was associated with a 12.4% decrease in major medical errors [3]. It has been suggested that if autopsies were performed on all deceased patients, then the missed major diagnoses rate would be as little as 4% [12]. This illustrates the important educational value of autopsy examinations in progressing medical diagnostics [21].

6 Communication and Collaboration

Collaboration is an essential component of the appropriate utilization of autopsies as a quality improvement tool. The appropriate implementation of autopsies relies on effective communication and knowledge dissemination of post-mortem findings. However, a lack of communication and information exchange between clinicians and pathologists has been found to be prevalent in healthcare today [5, 6]. The median rate of autopsy requests which have a specific question was 72.7% [26]. In almost 50% of cases, clinicians were never informed of the results of the autopsy [6]. Strengthening consultation between clinicians and pathologist before and after the procedure will ensure that clinical context is provided and that lessons learned from the autopsy contribute to the improvement in quality of healthcare.

Lower autopsy rates have subsequently been associated with higher rates of diagnostic errors. This area of work contributes to the field of diagnostic medicine by enhancing accuracy, knowledge of disease [21, 24] and providing more accurate epidemiological mortality data [27]. The medical autopsy is a necessary quality assurance tool in clinical and pathology practice [5, 28]. Through education, communication, collaboration and health advocacy the value of the medical autopsy can be recognized and properly utilized to advance our understanding of the practice of medicine as it has done for the past 3000 years.

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