

Autopsy as on Outcome and Performance Measure: Three Years of Hospital Autopsy as an Instrument of Clinical Audit

S. D'Errico^(✉), M. Martelloni, S. Niballi, and D. Bonuccelli

Department of Legal Medicine, Azienda USL Toscana Nordovest Lucca, Lucca, Italy

stefano.derrico@uslnordovest.toscana.it

Abstract. An extensive literature documents a high prevalence of errors in clinical diagnosis discovered at autopsy. Multiple studies have suggested no significant decrease in these errors over time. Despite these findings, autopsies have dramatically decreased in frequency in the United States and many other countries. In 1994, the last year for which national U.S. data exist, the autopsy rate for all non-forensic deaths fell below 6%. The marked decline in autopsy rates from previous rates of 40–50% undoubtedly reflects various factors, including reimbursement issues, the attitudes of clinicians regarding the utility of autopsies in the setting of other diagnostic advances, and general unfamiliarity with the autopsy and techniques for requesting it, especially among physicians-in-training. The autopsy is valuable for its role in undergraduate and graduate medical education, the identification and characterization of new diseases, and contributions to the understanding of disease pathogenesis. Although extensive, these benefits are difficult to quantify. This review of the last three years of hospital autopsy in Lucca studied the more easily quantifiable benefits of the autopsy as a tool in performance measurement and improvement. Such benefits largely relate to the role of the autopsy in detecting errors in clinical diagnosis and unsuspected complications of treatment. It is hoped that characterizing the extent to which the autopsy provides data relevant to clinical performance measurement and improvement will help inform strategies for preserving the benefits of routinely obtained autopsies and for considering its wider use as an instrument for quality improvement.

Keywords: Hospital autopsy · Performance measure · Clinical audit

1 Introduction

There exists a general perception that necropsies are no longer necessary as antemortem diagnosis identifies the principal cause of death and other clinically significant diagnoses in the vast majority of cases. This perception has undoubtedly contributed to the progressive decline in necropsy rates over the past 30–40 years. In most jurisdictions, including the UK, Australia, France and US 10% or fewer of all natural deaths undergo necropsy [1–3]. These average rates reflect a wide range of institutional necropsy rates, with a small number continuing to performing relatively frequent necropsies but many

performing almost none. Consequently, many clinicians, radiologists, and others involved in the antemortem diagnostic process never have the opportunity to learn of major missed diagnoses among patients who died under their care. Consequently, the number of important missed diagnoses among non necropsied deaths could approximate or even exceed the number observed at necropsy. In conditions where misdiagnosis confers substantial short term mortality, conventional estimates of diagnostic performance may substantially overstate diagnostic performance because they do not take into account the possibility of missed cases among non-necropsied deaths. The major reason for the decline in hospital post mortems is unclear. The rates of approach following death are not recorded and the willingness of medical staff to address post-mortem examination may be affected by changing social perceptions. There may be confused thinking over gaining the trust and permission from families to agree to post-mortem examination, following media attention surrounding inappropriate organ retention after death. Predictably, the need for post-mortem examination comes at a time when the clinician may be unsure of the reaction of the families at this juncture. Clinicians may be increasingly reluctant to discuss the subject of a post mortem. Identifying a missed diagnosis is a reason for physician's reluctance to seek post mortem, this is an obvious reason for declining rates. Only one study has addressed the issue of litigation following post mortem findings [4]. A review of 176 post mortems identified only one litigation, but the intent to proceed to litigation was present even before the patients's death. It is very clear that if current trends continue hospital clinical post mortems could be a rarity in the future.

2 Hospital Autopsy as an Instrument of Clinical Audit for Diagnostic Performance

Since 2015, 2900 hospital deaths occurred (including all age groups), post-mortem examinations were carried out in 83 patients with a **necropsy rate of 0.028%** (Table 1). In more than 50% autopsies were performed on sudden unexpected deaths occurred in Emergency Room to confirm clinical diagnostic suspects.

Indications for autopsy were identified and ante mortem and post mortem diagnosis in hospitalised medical patients compared. Results were shared with all physicians requesting hospital autopsy to discuss about concordance rate of clinical and post mortem diagnosis, causes of misdiagnosis. **Concordance between ante-mortem and post-mortem diagnoses was seen only in 45.7%**. The most common correct causes of death were cerebral haemorrhage, pneumonia, tumors and sepsis. Discordance between ante-mortem and post-mortem diagnoses was seen in patients who died in Emergency Room. Acute coronary syndrome, acute myocardial infarction, acute pulmonary embolism and aortic dissection were underestimated or undersuspected. Unsuspected medical conditions relevant to death were suggested by post mortem examination and were not recorded as known during life (i.e. structural cardiomyopathies) (Table 2).

Table 1. Demographic characteristics of hospital autopsies performed in 2015–2018

Years	Hospitalised medical patient (n)	Emergency room	Medical units	Surgical units
2015	7	7	-	-
2016	14	9	4 - Medicine (2) - Infective disease (1) - Intensive care (1)	1 - General surgery
2017	40	24	15 - Medicine (5) - Neurology (1) - Cardiology (1) - Pneumology (1) - Intensive care (7)	1 - ORL
2018 (jan–may)	22	12	8 - Medicine (1) - Cardiology (1) - Nephrology (2) - Intensive care (4)	2 - Orthopedics - Neurosurgery
	83	52	27	4

Table 2. Hospital autopsy and missing diagnosis

Post mortem diagnosis	Discordance rate (%)
ACS & AMI	62%
Pulmonary embolism	75%
Aortic dissection	50%
Pneumonia	20%
Tumor	-
Mechanical bowel obstruction	-
Digestive haemorrhage	-
Cerebral haemorrhage	-
Sepsis	12.5%
Thrombosis	-
Structural cardiomyopathies	100%

After auditing results, most of physicians asked to participate, in the future, to hospital autopsies and declared to be much more motivated to compare clinical diagnosis of death and post mortem diagnosis as an opportunity to enhance diagnostic accuracy, improve knowledge of disease and, finally, assist relatives with grieving and knowledge of potentially heritable diseases. They concluded that autopsies can be considered beneficial when findings are concordant by providing feedback on treatment decisions as well as educating young doctors but complains persist about the possibility of legal claims in case of misdiagnosis or diagnostic errors.

3 Discussion

The decline in the number of hospital autopsies ultimately reflects a simple fact: hospital autopsies as currently performed and used are for the most part viewed as less important than the other services pathologists provide, and just not worth their costs and effort. If the practice of autopsy is to remain (or perhaps become) relevant to the current practice of medicine, it must demonstrate that it clearly and objectively contributes to knowledge in ways that can inform and/or change medical practice. Discrepancies between ante-mortem and post mortem diagnosis are well known and have been documented repeatedly in the literature. Numerous studies document substantial rates of major clinically unsuspected diagnosis detected at necropsy including missed diagnoses that probably affected outcome [5–10]. The discrepancies are usually classified according to the Goldman criteria. A class I error is a major missed diagnosis, with potentially adverse impact on survival, that would have changed management. A class II error represents a missed major diagnosis, without potential impact on survival, that would not have changed therapy. The class III and IV errors are missed minor diagnoses not related to the cause of the main disease. Clinicians have generally attributed these persistent and roughly unchanged discrepancies between antemortem and postmortem diagnoses to selection bias, arguing that cases sent for necropsy are precisely those in which there is diagnostic uncertainty. Despite its plausibility, this view is not supported by the available evidence. If rates of clinically important diagnoses first detected at necropsy largely reflected case selection by clinicians, one would expect studies with high necropsy rates to report substantially lower error rates. A British study in which only 8% of decedents underwent necropsy reported clinically important missed diagnoses in 39% of cases [11]. Literature reported an inverse correlation between the post mortem rate and misdiagnosis rate (lower post mortem rates show higher error rates due to selection bias). One study suggested four kinds of errors that could lead to diagnostic inaccuracy, namely omission, premature closure, inadequate synthesis and wrong formulation. Omission and inadequate synthesis were negatively correlated with the degree of training of the treating physicians and led to false negative diagnoses. But premature closure was independent of clinical experience and correlated with overconfidence in findings. However despite the highest level of clinical skill and multiple diagnostic support, it would be unrealistic to expect no error in ante-mortem diagnoses. The aim of our study was to compare ante-mortem and post-mortem diagnoses in hospitalised medical patients. **Concordance between ante-mortem and post-mortem diagnoses was seen only in 45.7%**, which is consistent with other studies reported in the literature. Discordance between ante-mortem and post-mortem diagnoses was seen in patients who died suddenly in Emergency Room. Acute coronary syndrome, acute myocardial infarction, acute pulmonary embolism and aortic dissection were underestimated or undersuspected. Unsuspected medical conditions relevant to death were suggested by post mortem examination and were not recorded as known during life (i.e. structural cardiomyopathies). After auditing results, most of physicians asked to participate, in the future, to hospital autopsies and declared to be much more motivated to compare clinical diagnosis of death and post mortem diagnosis as an opportunity to enhance diagnostic accuracy, improve knowledge of

disease and, finally, assist relatives with grieving and knowledge of potentially heritable diseases. They concluded that autopsies can be considered beneficial when findings are concordant by providing feedback on treatment decisions as well as educating young doctors but complaints persist about the possibility of legal claims in case of misdiagnosis or diagnostic errors. We strongly suggest regular review of post mortem diagnosis as a new strategy of clinical audit to improve performance and outcome. We advocate that medical staff should consider the continuing practice of autopsy for select patients within their hospital communities as a valuable adjunct for clinical quality assurance and continuing medical education. Four conditions have been deemed to be essential for a post mortem to be a valid monitor of clinical performance: a high post mortem rate, standardised procedures during calculations of both sensitivity and specificity and an estimate of errors in post mortem diagnosis. The need for up to date facilities and the wider availability of diagnostic tools to bring post mortems to the same standard as clinical diagnostic has been recognised for a long time.

References

1. Burton JL, Underwood JC (2003) Necropsy practice after the “organ retention scandal”: requests, performance, and tissue retention. *J Clin Pathol* 56:537–541
2. Royal College of Pathologists of Australasia Autopsy Working Party (2004) The decline of the hospital autopsy: a safety and quality issue for healthcare in Australia. *Med J Aust* 180:281–285
3. Chariot P, Witt K, Pautot V et al (2004) Declining autopsy rate in a French hospital: physicians’ attitudes to the autopsy and use of autopsy material in research publications. *Arch Pathol Lab Med* 124:739–745
4. Nichols L, Aronica P, Babe C (1998) Are autopsies obsolete? *Am J Clin Pathol* 110:210–218
5. Shojania KG, Burton EC, McDonald KM, Goldman L (2005) Overestimation of clinical diagnostic performance caused by low necropsy rates. *Qual Saf Health Care* 14:408–413
6. Swaro A, Adhiyaman V (2010) Autopsy in older medical patients: concordance in ante- and post-mortem findings and changing trends. *J R Coll Physicians Edinb* 40:205–208
7. Saad R, Yamada AT, Pereira de Rosa FH et al (2007) Coronary artery disease. Comparison between clinical and autopsy diagnoses in a cardiology hospital. *Heart* 93:141–149
8. Gibson TN, Shirley SE, Escoffery CT et al (2004) Discrepancies between clinical and post mortem diagnoses in Jamaica: a study from the University Hospital of the West Indies. *J Clin Pathol* 57:980–985
9. Spiliopoulou C, Papadodima S, Kotakidis N et al (2005) Clinical diagnoses and autopsy findings. A retrospective analysis of 252 cases in Greece. *Arch Pathol Lab Med* 129:210–214
10. Sington JD, Cottrell BJ (2002) Analysis of the sensitivity of death certificates in 440 hospital deaths: a comparison with necropsy findings. *J Clin Pathol* 55:499–502
11. Perkins GD, McAuley DF, Davies S et al (2003) Discrepancies between clinical and postmortem diagnoses in critically ill patients: an observational study. *Crit Care* 7:129–132