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EDITORIAL

Hospital autopsy audit: discordant primary clinical diagnoses are found in 20% of cases in a reducing autopsy case load. Selection bias or significant findings?

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The post-mortem examination is an effective tool that provides insight into a patient's medical care and assists in auditing clinical decision making.[1,2] Thus, post-mortems have the potential to improve quality of care, educate the medical community, ensure accurate epidemiological health statistics and assist bereft relatives in coming to terms with end of life issues.[1–8]

The post-mortem examination, also known as autopsy or necropsy, became an influential medical procedure in the Middle Ages that significantly advanced our understanding of human disease.[7] Standardised by Virchow, 'the dissection of the dead body to determine, through direct observation, the cause of death or the nature of the disease' was common place and an integral part of medical curricula until the mid-twentieth century.[3–5,7,9]

However, Australian and international hospital autopsy rates have declined in recent decades, due in part to advances in diagnostic technologies and possibly an unfamiliarity of their value among doctors with little exposure to autopsies.[1,3–5,8–13] Comprehensive Australian data from the mid-2000s reported that the nation's hospital autopsy rate declined from 21% to 12% over a 10 year period.[1] Similar observations have been made elsewhere, including in the USA, UK, Europe, Hong Kong and China.[2,4,8,9] Despite this decline, discrepancies between clinical and autopsy diagnoses continue to be found in limited studies published over the last 15 years.[2,6,8,10,11,14–18] A meta-analysis of autopsy studies by Roulson *et al.* found that discrepancies in major diagnoses and potentially treatable conditions occurred at rates of 15–41% and 10–44%, respectively.[8] Therefore, many authors contend that the autopsy remains a relevant and valuable tool with the potential to inform and educate the medical community.[1,4,6,8,15,19]

Advances in diagnostic technologies are understandably a factor that has contributed to the decline.[6,11] Other reasons include unfavourable public attitudes, restrictions placed on the extent of examination by next-of-kin, lack of resources, poor training of medical staff in autopsy consent, time-consuming consent processes and unfamiliarity among the medical community of the value of autopsy.[1–6,9,12,13]

As far as the authors are aware, hospital autopsy data have not been published from Australian sources for a decade.[1] Therefore, we undertook an audit of non-coronial autopsies between August 2011 and August 2013 at a major Australian tertiary centre for trauma and heart-lung transplantation to examine concordance of clinical and autopsy findings.

Using retrospective data from death certificates, hospital records and autopsy reports, the clinical cause of death (COD) and major co-morbid diagnoses were compared with autopsy findings for all hospital post-mortems performed across a 2 year period (August 2011–August 2013). Cases referred to the coroner were excluded from the study. In every case a death certificate was completed by the clinical team prior to the autopsy being conducted. The type of autopsy (partial or full) was recorded for each case and a comprehensive microscopic examination was carried out where possible within the limitations of consent.

Based on the autopsy findings, the death certificate and clinical diagnoses were assessed as either correct or discordant. Significant missed diagnoses that may have impacted clinical care were also noted.[8,20,21] Minor discrepancies that were considered not to have impacted on the patient's acute episode of care were excluded from the final results.[20,21] Thus, a discordant autopsy was one where the autopsy findings were considered a substantially different pathological process contributing to death when compared to the death certificate and major ante-mortem diagnoses. The findings were then rated in accord with past studies.[1,2,6,8,10,14–19,21]

Of 1298 hospital deaths between August 2011 and August 2013, 86 patients were referred for autopsies (autopsy rate 6.6%). Full autopsies accounted for 70% (60/86) and partial for 30% (26/86). Ages ranged from 14 to 91 (mean age 61). Male cases accounted for 52% (45/86) and organ transplant recipients for 29% (25/86).

Cause of death was assessable at post-mortem in all but one partial autopsy. In the latter case the COD (multiple myeloma) was unable to be fully evaluated since the next-of-kin consented only to examination of the heart, in which amyloid of the myocardial vessels was diagnosed.

Of conclusive autopsies, correct diagnoses were made in 80% (68/85) while discordant diagnoses accounted for 20% (17/85).

The most common correct causes of death were infections in 20% (17/85), respiratory aetiologies in 20% (17/85) and cardiovascular conditions in 16% (14/85) (Table 1).

The most common missed COD was an infective aetiology (frequently fungal) occurring in 9% of cases (8/85), of which half were transplant patients. Respiratory and cardiovascular causes each accounted for 4% of cases (3/85). In 12% (10/85) the discordance was a major change from one body system to another (Table 2).[15] Examples of discordant diagnoses are shown in Fig. 1–4.

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Table 1 Causes of death in assessable autopsies grouped by system

System	No. cases concordant	No. cases discordant
Sepsis	17	8
Respiratory	17	3
Cardiovascular	14	3
Gastrointestinal	9	2
Malignancy	2	1
Central nervous system	7	0
Genitourinary	1	0
Soft tissue	1	0
Total	68 (80%)	17 (20%)

Even when the mechanism of death was correct, a further 31% (26/85) yielded significant missed diagnoses that were valuable to the understanding of a patient's pathological process. For example, a 66-year-old male renal transplant patient was diagnosed with a ruptured abdominal aortic aneurysm during hospital admission for a surgical wound infection; a CT scan suggested mycotic aneurysm and the autopsy was able to confirm this diagnosis in the setting of disseminated aspergillosis. Another example involved a 52-year-old male whose death was attributed to right middle cerebral artery stroke; at autopsy he was found to have an intracerebral haemorrhage in the setting of undiagnosed intravascular large B cell lymphoma. Overall, at least one unsuspected diagnosis was revealed in 51% of cases.

Organ transplant recipients accounted for 29% (25/86) of all autopsies, including lung (16 cases), heart (6), renal (2) and bone marrow (1). The percentage of correct COD was similar between the transplant and general populations (77% versus 80%). Transplant patients with discordant diagnoses most commonly had an infectious aetiology (4/6), which accounted for half of discordant infectious diagnoses overall.

Several studies have shown that evaluating discrepancies between clinical and autopsy diagnoses may enhance diagnostic accuracy, improve our knowledge of disease and assist relatives with grieving and knowledge of potentially heritable diseases.[1–8] Equally, autopsies may be beneficial when findings are concordant by providing feedback on treatment decisions as well as educating clinicians and medical students.[4,6]

Fig. 1 Small and large bowel, 80-year-old male (macroscopic image). Clinical cause of death was possible abdominal sepsis and ischaemic heart disease. Autopsy revealed small bowel infarction secondary to sigmoid diverticular adhesion.

In our audit we found that clinical cause of death was incorrect in 20% of cases and that at least one unsuspected significant diagnosis was revealed in a further 31%. These rates appear consistent with those previously reported in the literature.[1,2,8,10,14–19,21]

The types of discordant diagnoses in our study are also consistent with other investigators in which pulmonary conditions and infectious diseases, especially nosocomial and opportunistic infections such as invasive aspergillosis, were found to be among the most common unexpected findings.[6,8,10,14,17,19,21] While other studies have found that infections occur often in the intensive care setting, our findings are likely to reflect the high proportion of immunosuppressed transplant patients.[10,21]

We acknowledge several limitations of our audit and other post-mortem studies.[22] Autopsy studies suffer inherent selection bias since post-mortems are frequently only requested in

Table 2 Comparison of discordant clinical and autopsy causes of death (COD) grouped by system

System (no. cases)	Clinical COD	Autopsy COD	System change (n=10; 12%)
Sepsis (8)	Bacterial pneumonia	Pulmonary angioinvasive aspergillosis	No
	Cardiac amyloidosis, multiple myeloma	Pulmonary angioinvasive aspergillosis	Yes
	Acute hydrocephalus, liver failure (presumed drug toxicity)	Intracerebral and pulmonary nocardiosis	Yes
	Ischaemic bowel	Aspergillus bronchopneumonia	Yes
	Brainstem infarct	Bronchopneumonia	Yes
	Ischaemic injury to liver and lung	Disseminated invasive aspergillosis	Yes
	Acute on chronic pancreatitis	Peri-common bile duct abscess (no pancreatitis)	No
	Mycobacterium pneumonia	Pulmonary angioinvasive aspergillosis	No
Respiratory (3)	Sepsis	Churg-Strauss syndrome with foci of pulmonary necrosis	Yes
	Septic shock, multi-organ failure	Pulmonary embolus	Yes
	Pulmonary allograft rejection	Diffuse alveolar damage secondary to parainfluenza	No
Cardiovascular (3)	Gastrointestinal bleeding	Acute myocardial infarction	Yes
	Acute lymphocytic myocarditis	Catecholamine-induced myocardial injury/toxicity and pulmonary haemorrhage	No
	Myocardial infarction	Lymphocytic myocarditis	No
Gastrointestinal (2)	Abdominal sepsis and ischaemic heart disease	Small bowel infarction secondary to adhesion	No
	Sepsis	Fibrosing cholestatic hepatitis	Yes
Malignancy (1)	Renal allograft failure, pulmonary oedema	Primary effusion lymphoma involving thoracic and abdominal cavities	Yes