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Discrepancies between clinical and postmortem diagnoses in critically ill patients: an observational studyGavin D Perkins¹, Danny F McAuley², Sarah Davies³ and Fang Gao⁴¹Specialist Registrar, Intensive Care Unit, Birmingham Heartlands and Solihull NHS Trust (Teaching), Birmingham Heartlands Hospital, Birmingham, UK²Specialist Registrar, Intensive Care Unit, Birmingham Heartlands and Solihull NHS Trust (Teaching), Birmingham Heartlands Hospital, Birmingham, UK³Pre-Registration House Officer, Intensive Care Unit, Birmingham Heartlands and Solihull NHS Trust (Teaching), Birmingham Heartlands Hospital, Birmingham, UK⁴Consultant in Anaesthesia and Intensive Care Medicine, Intensive Care Unit, Birmingham Heartlands and Solihull NHS Trust (Teaching), Birmingham Heartlands Hospital, Birmingham, UKCorrespondence: F Gao, f.g.smith@bham.ac.uk

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Critical Care 2003, **7**:R129-R132 (DOI 10.1186/cc2359)This article is online at <http://ccforum.com/content/7/6/R129>© 2003 Perkins *et al.*, licensee BioMed Central Ltd (Print ISSN 1364-8535; Online ISSN 1466-609X). This is an Open Access article: verbatim copying and redistribution of this article are permitted in all media for any purpose, provided this notice is preserved along with the article's original URL.**Abstract**

Introduction The autopsy has long been regarded as an important tool for confirming the clinical cause of death, education and quality assurance. Concerns surrounding informed consent and the retention of organs have heightened clinicians' anxieties in requesting permission to perform an autopsy. The present study was conducted to determine whether the autopsy still has a role to play in extending knowledge about the cause of death in a group of patients who died while receiving intensive care.

Method We retrospectively investigated trends in postmortem examination rates and discrepancies between premortem clinical and postmortem diagnoses in a population of critically ill patients admitted to a 13 bed, general medical/surgical intensive care unit between January 1998 and June 2001. Agreement between diagnoses before death and postmortem findings were compared using the Goldman system.

Results Out of total 636 deaths, 49 (7.7%) underwent postmortem examinations. Of these, 38 (78%) cases were available for review. We found that postmortem findings were in complete agreement with predeath diagnoses in fewer than half of the cases ($n=17$, 45%). Major missed diagnoses were present in 15 cases (39%). Myocardial infarction, carcinoma and pulmonary embolism represented the most frequently missed diagnoses.

Conclusion Postmortem examinations remain a useful tool in confirming diagnostic accuracy and should be considered in all patients who die in the intensive care unit. Recognition of the diagnoses missed before death may improve outcome or avoid unnecessary prolongation of life where terminal disease is present.

Keywords autopsy, clinical diagnosis, critical illness, death, intensive care

Introduction

The postmortem examination has been recognised as an important tool for confirming the clinical cause of death. The rate of postmortem examination, however, is declining [1,2].

Technological advances in diagnostic tests and imaging methods have led to the value of the postmortem examination being challenged. This, along with concerns surrounding informed consent and the retention of organs, has made

clinicians reluctant to request a postmortem examination. However, previous studies in patients admitted to intensive care have shown that premortem clinical diagnoses are frequently incorrect, and in **up to 27% of patients a treatable condition that might have altered outcome, had it been recognised, is identified at postmortem examination** [3]. The aim of the present study was to determine the trends in postmortem examination rate and establish the diagnostic accuracy of clinical diagnoses in patients who died on an intensive care unit (ICU) in the UK. We found that, despite a declining post-mortem examination rate, **important discrepancies between clinical diagnoses before death and postmortem findings were present in a significant number of cases.**

Method

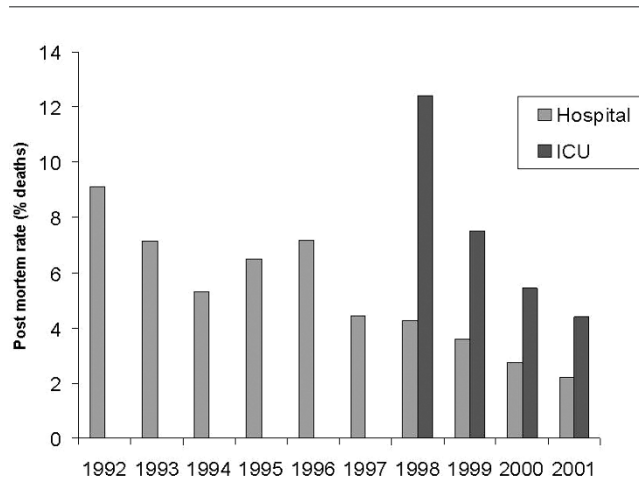
The retrospective review of clinical records and postmortem results was approved by the local research ethics committee and HM Coroner for Birmingham District. The study was undertaken in patients who died and underwent postmortem examinations after admission to a 13 bed general medical/surgical ICU in a university affiliated hospital. The hospital offers most major medical and surgical specialties, and is a regional centre for thoracic surgery. Neurosurgery, cardiac surgery and organ transplantation, including bone marrow transplantation, are not performed at the hospital.

Consent for a hospital postmortem examination is requested from the relatives at the discretion of the intensive care physician. When the cause of death was unknown or if the death was not due to natural causes, the postmortem examination was performed under the authority of HM Coroner, which does not require formal consent from the next of kin.

All patients who died between January 1998 and June 2001 were identified from a database of ICU admissions. From this list, patients who had undergone postmortem examinations were identified and their medical notes reviewed by two investigators who were blinded to the postmortem findings. Both investigators independently assigned clinical causes of death and then compared their results. Where there was disagreement, the notes were reviewed by both investigators and a consensus on the cause of death was agreed after discussion. Both the clinically diagnosed cause of death and other significant clinical diagnoses were recorded.

The clinical diagnoses were then compared with the findings at postmortem examination. The comparisons between premortem and postmortem results were classified as major and minor discrepancies or as complete agreement, in accordance with the **Goldman system** [1]. A **Goldman class I** discrepancy is a missed major diagnosis in which the principle, underlying causes of death was missed with **probable adverse impact on survival**. A Goldman class II discrepancy is a missed major diagnosis with equivocal impact on survival. Class III and IV discrepancies refer to minor missed diagnoses, either unrelated incidental findings or pre-existing

Figure 1



Trends in intensive care unit and hospital postmortem examination rates 1992–2001.

conditions thought not to have contributed directly to the patient's death. In class V there is a complete agreement between clinical and postmortem diagnoses.

Data are expressed as median (interquartile range). Fisher's exact test or Mann-Whitney U test was used to compare patients who underwent postmortem examinations with those who did not undergo postmortem examinations for continuous and categorical variables as appropriate. $P < 0.05$ was considered statistically significant.

Results

During the study period, 2213 patients were admitted to ICU. Of these 636 patients died, of whom 49 (7.7%) underwent a postmortem examination. Medical records were not obtainable in 11 patients, and therefore 38 patients were included in the study. Postmortem examinations were requested by the coroner in 19 cases, with the other 19 postmortem examinations requested by the intensive care medical team. The intensive care postmortem examination rate progressively declined over the study period, which reflected a progressive decline in the overall rate of hospital postmortem examination (Fig. 1). The median duration of ICU stay for patients who underwent a postmortem examination was shorter than for those who did not undergo autopsy (2 [1.2–7.2] versus 2.7 [1–10] days; $P = 0.038$). Additionally, surgical patients underwent a postmortem examination more frequently (Table 1).

In 15 (39%) cases there was a new class I or II missed diagnosis present. In 10 (26%) cases, knowledge of the post-mortem findings before death could have altered treatment and possibly improved outcome (Table 2). Five class II discrepancies were identified: four patients with undiagnosed malignancy (three thought to have pneumonia, one septic shock/multiorgan failure) and one patient with pneumonia

Table 1

Characteristics of the study population			
Characteristic	No postmortem examination (n=587)	Postmortem examination (n=49)	P
Age (years)	69 (55–75)	69 (62–74)	NS
APACHE II score	21 (17–24.5)	22 (19.5–27.5)	NS
Predicted mortality (%)	36 (25–53)	42 (29–60.5)	NS
Duration of ICU stay (days)	2.7 (1.2–7.2)	2 (1–10)	0.038
Surgical (%)	47	70	0.01

Shown is a comparison of patients who underwent and those who did not undergo postmortem examination. Values are expressed as median (interquartile range). APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit; NS, not significant.

who was receiving appropriate antibiotic treatment for presumed infection at another site (urinary tract). In contrast, only 17 (45%) cases showed complete agreement between clinical diagnoses and postmortem findings. The remaining six patients (16%) had only minor additional findings after postmortem examination and were classified as Goldman class III/IV discrepancies.

In patients with class I discrepancies the most frequently missed diagnosis was myocardial infarction. There was no relationship between the incidence of major missed diagnoses and age, Acute Physiology and Chronic Health Evaluation II score, or duration of ICU stay. In addition, there was no difference in the incidence of missed diagnoses between hospital postmortem examinations and coroner’s postmortem examinations.

Discussion

The present study found that the overall rate of postmortem examination is low and falling. The incidence of 7.7% of all deaths is much lower than that in other published studies [3–7]. This finding probably represents the increasing reluctance of many clinicians in the UK to ask for permission to undertake a postmortem examination. This is further illustrated by the finding that a compulsory postmortem examination requested by the coroner represents 50% of all postmortem examinations undertaken in the study period, which is much higher than reported in other series [8]. There is an urgent need to reverse the decline in the rate of postmortem examinations. Despite concerns that relatives will be unwilling to give permission for a postmortem examination, a recent study has reported that if they are approached sensitively up to 46% of relatives may agree [9]. Additionally, recommendations to increase postmortem examination rates can be successfully implemented and such guidelines should be put in place [10].

Table 2

Class I discrepancies	
Clinical cause of death	Postmortem findings
Pneumonia	Myocardium infarction
Pneumonia	Pulmonary oedema/ischaemic heart disease
Pneumonia	Pulmonary embolism
Pneumonia Post-oesophagectomy	Tracheogastric fistula
Aspiration pneumonia Multiorgan failure	Bleeding oesophageal varices
Multiorgan failure	Myocardial infarction
Septic shock	Myocardial infarction
Multiorgan failure	Bowel infarction
Hepatitis	Inferior vena cava thrombosis
Multiorgan failure ?Lymphoma	Sepsis/perirenal abscess

Shown are the findings in the 10 patients with class I discrepancies. Class I discrepancies represent major missed diagnoses in which knowledge of the postmortem findings might have altered treatment and/or prolonged survival.

This study has demonstrated poor agreement between the clinical diagnoses before death and postmortem findings in a group of patients who died while in the ICU. This finding is consistent with recent European and American studies that highlighted that even with modern diagnostic techniques discrepancies between clinical diagnoses and postmortem findings continue to occur [4,6,8,11]. Although it has been proposed that the duration of stay in the ICU is associated with the number of unexpected findings at postmortem examination [6,12], this was not confirmed by the present or previous studies [4,5,13].

Myocardial infarction represented the most frequent major missed diagnosis. It is notable that an electrocardiogram was performed in only 55% of patients undergoing postmortem examinations at any stage of the ICU stay. This suggests that the index of suspicion for ischaemic heart disease is inappropriately low and should be considered as a diagnostic possibility in the critically ill patient. The incidence of missed disseminated infection was lower in our patients than in previous studies [6,8,11,14]. It is possible that the daily multidisciplinary microbiology review conducted in our unit may reduce the possibility of unrecognised occult infection. It may also reflect a difference in case mix; unrecognised infection is seen more commonly in immunocompromised patients [6,11], who are not represented in our patient population. The finding of undiagnosed carcinoma and pulmonary embolism is consistent with previous studies, emphasizing the importance of maintaining a high index of suspicion for these diagnoses in the critically ill [3,5,15]. These findings emphasize the need for adequate diagnostic algorithms for these

frequently unrecognised conditions to be established in order to reduce the incidence of missed diagnoses.

Certain limitations of the present study should be recognised. It is retrospective, and the data for 11 patients were not available because of incomplete or missing charts. Given that this is a small study with a low postmortem examination rate, it is difficult to determine how representative the extent of the new findings at postmortem examination are of the overall population of patients dying in the ICU. Selection bias of patients for postmortem examination at the discretion of the intensive care physician might also have influenced the incidence of discrepancies in the patients studied. Given that a postmortem examination is more usually requested when diagnostic uncertainty exists, it may be more likely to identify unexpected findings, leading to a falsely high incidence of missed diagnoses. However, there is evidence that clinical diagnostic certainty does not predict postmortem findings, indicating that the incidence of missed diagnosis may in fact be accurate [3,14,15]. Finally, the diagnostic work-up of each individual was not critically reviewed, and it is possible that variability in investigation influenced the incidence of missed diagnosis.

The low incidence of postmortem examination in this study may explain, at least in part, the high incidence of major missed diagnoses. In a recent study with a high rate of postmortem examination [8] the incidence of major missed diagnoses was low whereas, consistent with our findings, in studies with a lower rate of postmortem examination [3,6,7] the incidence of major diagnostic error was higher.

Conclusion

This study found significant discrepancies between clinical diagnoses before death and postmortem findings. This reinforces the importance of the postmortem examination in detecting otherwise unexpected diagnoses, even in patients under the close investigation and scrutiny that follows ICU admission. It should encourage clinicians to remember the value of the postmortem examination, which should be considered in every patient who dies in the ICU.

Competing interests

None declared.

Key messages

- Postmortem rates after death on ITU were low
- Major missed diagnoses were present in 39% of patients in this study
- Myocardial infarction, carcinoma and pulmonary embolism were the most frequently missed diagnoses
- Clinicians should review their threshold for requesting a postmortem following death on the ITU

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