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BRIEF REPORT

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Characteristics of discrepancies between clinical and autopsy diagnoses in the intensive care unit: a 5-year review

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Abstract *Objectives:* To characterise discrepancies between clinical and autopsy diagnoses in patients who die in the intensive care unit. *Design:* Retrospective chart review. *Setting:* Ten-bed closed mixed adult intensive care unit in a tertiary referral teaching hospital. *Participants:* All the clinical notes and autopsy reports of 346 patients who died in the intensive care unit in 1996–2000. *Interventions:* Discrepancies between clinical and autopsy diagnoses were reviewed by two intensivists, a specialist in infectious diseases, a pathologist and an anaesthesiologist. New findings which would have changed current therapy in the intensive care unit were categorised as a Class I discrepancy, and those related to death but which would not have altered therapy as a Class II discrepancy. *Results:* Of 2370 patients admitted, 388 (16.4%) died. An autopsy was performed in 346 (89%) of the deceased patients. A Class I discrepancy was found in 8 patients (2.3%) and a Class II discrepancy in 11 patients (3.2%). Five of the eight (62%) Class I discrepancies were infections which occurred in patients already treated for another infections. *Conclusion:* Despite the availability of advanced diagnostic facilities, especially infectious complications seem to remain undiagnosed. Autopsy is a valuable tool with which to monitor diagnostic accuracy in these patients.

Keywords Autopsy · Critical care · Diagnostic errors

Introduction

Studies on the autopsies of patients who have died in the intensive care unit (ICU) have revealed a number of various new findings, including infections, pulmonary embolism and complications of medical procedures [1, 2]. A common limitation of most previous studies [3, 4] is the relatively low autopsy rate (Table 1), which renders the extent of new findings unclear. Also, an autopsy may be performed more frequently if the diagnosis is not considered to be completely clear [3]. The purpose of this report is to determine the frequency and nature of discrepancies between clinical and autopsy diagnoses in an academic tertiary referral ICU with a high autopsy rate.

Methods

The ICU at the Meilahti Hospital of the University hospital of Helsinki is a closed ten-bed mixed adult unit admitting mainly emergency patients without an active do-not-resuscitate order. Admission diagnoses include pneumonia, sepsis and complications after major surgery such as infections and renal failure. The unit is staffed with three senior anaesthesiologists certified in intensive care medicine and four anaesthesiologists in training, all of whom participate in the on-call coverage of the ICU 24 h a day. Other specialists consult as required, except for the consultant in infectious diseases who daily reviews all patients together with the staff anaesthesiologist. If the causative infectious agent is unknown, cultures from suspected foci are routinely drawn on the day of admission and the initial empirical broad spectrum antibiotic therapy is narrowed as soon as possible.

Some 450 patients are admitted annually, a third of whom are surgical. When a patient dies, the physician on duty verbally asks the relatives for consent for autopsy, explaining that this serves as

Table 1 Summary of recent studies comparing clinical and autopsy diagnoses. Some data are calculated from information provided in the individual papers (*ICU* intensive care unit, *Class I* finding related to death and would have changed current therapy, *Class II* finding related to death but would not have changed current therapy, *N/A* not applicable)

Study	Setting	Annual ICU admissions	Annual ICU mortality (%)	Annual ICU deaths	Autopsies studied (% of all deaths)	New findings	
						Class I	Class II
Fernandez-Segoviano et al. 1988 [8]	Mixed ICU	N/A	N/A	80	100 (51%)	7	15
Blosser et al. 1998 [9]	Medical ICU	N/A	N/A	130	41 (31%)	11	
Berlot et al. 1999 [1]	Mixed ICU	530	22	115	159 (45.9%)	8	33
Gut et al. 1999 [4]	Mixed ICU	190	26	50	40 (21.7%)	7	3
Mort et al. 1999 [3]	Surgical ICU	1630	6	95	149 (26.6%)	16	18
Roosen et al. 2000 [2]	Medical ICU	570	25	140	100 (71%)	22	14
Tai et al. 2001 [5]	Medical ICU	900	22	200	91 (22.7%)	8	10
Podbregar et al. 2001 [6]	Medical ICU	670	20	135	126 (46.6)	12	54
Present study	Mixed ICU	450	16	75	346 (89%)	8[a]	11

[a] Includes one patient whose diagnosis was not made at autopsy but categorised as Class I

an audit of diagnostic accuracy. This practice has always been emphasised in our unit and is supported by the pathologists. No permission is needed for medico-legal autopsies, which are required by law when a patient dies after trauma, other violent actions or within 24 h after surgery. State pathologists perform these autopsies at the department of forensic medicine. The attending ICU physician reviews the charts of the deceased and writes a clinical referral report to the pathologist stating the clinical cause of death. The certainty of the diagnosis is not addressed. All autopsy reports are returned to the ICU, reviewed and signed by a senior ICU physician. Major new findings are discussed at staff meetings.

The present study covers all patients admitted to the ICU between January 1, 1996, and December 31, 2000. The department's clinical study nurse retrospectively obtained the medical records and pathologists' reports of all patients who died in the ICU during this period. She reviewed the records and compiled a list of the clinical causes of death, as stated by the referring ICU physician, and the pathologists' autopsy diagnoses. Admission diagnoses were not listed. One author (TS) then reviewed the complete records of those patients with a discrepancy between the listed clinical and autopsy diagnoses; the ones without new diagnoses were not reviewed. Using a similar classification as that described by Tai and co-workers [5], he categorised the findings as Class I or Class II discrepancies. Class I was a major finding that would have altered therapy had the diagnosis been made before death (e.g., intestinal perforation in a patient with pneumonia). A Class II discrepancy was defined as an unsuspected diagnosis related to death, but it would not, however, have changed immediate management (e.g., myocardial infarction in a patient needing massive inotropic support in multiple organ failure). Minor new findings (e.g., occult cancer) irrelevant to the ICU treatment or immediate death were not categorised. Finally, a panel consisting of an intensive care physician, an anaesthesiologist, a physician specialised in infectious diseases medicine and a senior pathologist reviewed all cases with discrepancies and agreement between the reviewers on categorisation into Classes I and II was reached. In case there were several new findings, the most severe one was considered.

The study protocol was approved by the Internal Review Board of the hospital. Regarding statistical analysis, all data were analysed with the Mann-Whitney test using the SPSS 10.1.3 statistical package (SPSS, Chicago, IL).

Results

During the 5year study period, there were 2453 ICU admissions of 2370 patients. Altogether 388 patients (16.4%) died in the ICU. The records of one patient were not retrievable. The median length of stay in the ICU of the patients who died was 3 days (interquartile range 2–7 days). Their mean age was 57.0±14 years (median 58 years; interquartile range 48–68 years). An autopsy was performed in 346 of the deceased patients (89%). In the remaining 41, there was no autopsy because of relatives' refusal. The mean age (55 years) and the median length of stay (3 days) of the patients without autopsy was similar to that of the patients who underwent autopsy (57 years and 3 days, respectively).

A medical autopsy was performed in 225 (65% of autopsies), and a medico-legal autopsy in 121 (35%), of the deceased patients. Autopsy results were unavailable in three cases. All autopsies were complete, including histopathological examinations.

In 94% of the patients, autopsy confirmed the clinical cause of death. In 18 patients (5%), there was a new Class I or II finding at autopsy not included in the clinical notes (Table 2). Furthermore, in one patient the causative infectious agent was not diagnosed before death. This finding is included as a Class I discrepancy.

Discussion

In this study, 62% of Class I discrepancies were found in patients with pneumonia or other already known infections as the clinical cause of death. This observation has also been made by other investigators [2, 3, 6] and emphasises the difficulty of diagnosing unexpected or new pathogens in patients with already manifest infections. For example, the number of Legionella infections in Finland is very low, 6–12 cases annually, as is the incidence of tuber-

Table 2 Discrepancies between clinical and autopsy diagnoses (*ICU* intensive care unit, *Class I* finding related to death and would have changed current therapy, *Class II* finding related to death but would not have changed current therapy, *St.p.* status post, *ARDS* acute respiratory distress syndrome)

Patient	Class	Age (years)	Duration of illness	In hospital before ICU (days)	In ICU (days)	Clinical diagnoses	Autopsy diagnoses
1	I	57	Days	3	5	Pneumonia. Acute myocardial infarction	Suspected miliary tuberculosis. Myocardial infarction
2	I	56	Weeks	7	10	Pneumonia. St.p. endocarditis	Right ventricular abscess. Pneumonia
3	I	65	Days	8	3	Septicaemia. Multi-organ failure	Pulmonary tuberculosis. Pneumonia
4	I	52	Days	18	6	Septicaemia	Systemic candidosis. Pancreatitis
5	I	59	Years	11	8	Crohn's disease. Multi-organ failure	Aortic dissection. Crohn's disease
6	I	70	Years	2	2	Cardiac insufficiency. Pneumonia	Thrombosis of mitral valve. Pneumonia
7	I	51	Days	1	23	Pancreatitis. Multi-organ failure	Pancreatitis. Myocardial infarction
8[a]	I	73	Weeks	19	2	Bacterial pneumonia	Legionella pneumophila pneumonia
9	II	50	Weeks	1	4	Pneumonia	Pneumonia. Acute myocardial infarction
10	II	65	Acute	1	1	Septicaemia. Acute renal failure	Pneumonia. Acute myocardial infarction
11	II	55	Years	39	8	Fibrosing alveolitis	Asbestosis
12	II	58	Acute	1	16	Hepatic cirrhosis	Hepatic cirrhosis. Acute myocardial infarction
13	II	58	Weeks	3	4	Hepatic cirrhosis	Cirrhosis. Metastatic hepatic carcinoma
14	II	56	Weeks	6	13	ARDS	Fibrosing alveolitis. ARDS
15	II	79	Years	6	4	Cardiac insufficiency. Acute renal failure	Coronary artery disease. Acute myocardial infarction
16	II	51	Weeks	12	3	Cardiac insufficiency	Myocarditis
17	II	45	Weeks	2	3	Pneumonia. Carcinoma of tonsillae	Pneumonia. Acute myocardial infarction
18	II	69	Days	1	1	Rupture of oesophagus. Mediastinitis	Mediastinitis. Volvulus of sigma
19	II	79	Weeks	6	4	sARDS	Pneumonia. Acute myocardial infarction

[a] Includes one patient whose diagnosis was not made at autopsy but categorised as Class I

culosis (10.4/100,000 in year 2000) [7]. These findings contrast with those reported in previous studies, where Class I discrepancies have occurred mainly in transplant patients [2, 3]. Although it has been proposed that the length of stay in the ICU is associated with the number of unexpected findings at autopsy [3], this was not confirmed by the present, nor by some previous, studies [5, 8]. This may be explained by the case mix specific to the ICUs.

The majority of the Class II discrepancies were non-massive myocardial infarctions (Table 2). All of these patients died after progressive haemodynamic deterioration despite massive inotropic support. The infarction may have been an adverse effect of these drugs, or caused by end-stage hypotension and hypoperfusion, or a combination of these causes. Neither the pathologists nor the panellists considered these infarctions in multi-organ failure as the immediate cause of death in this study.

When we compare our findings with those of others, it is notable that there were no cases of pulmonary embolism, previously reported as one of the major findings in patients who die in the ICU [1, 5, 9]. We routinely administer low-molecular weight heparin prophylaxis to all patients, but whether this treatment prevents pulmonary embolism in the ICU is undetermined.

The reported clinical causes of death of the patients (11%) who did not undergo autopsy were quite similar to those of the autopsied patients. However, a recent paper shows that the level of clinical diagnostic certainty does not necessarily predict pathological findings [6]. Although one causative agent was identified in those patients with infections, another unidentified pathogen may also have been involved. We found that autopsy of patients who died because of infections yielded the proportionally largest number of new findings.

There are several limitations of this study. First, it is retrospective and the data of four patients were lost due to missing files. Furthermore, the true causes of death of the 41 patients without autopsy remain unknown. Second, the original list of clinical and autopsy diagnoses was compiled by a nurse and only those with new findings were then reviewed. There may have been errors in copying the stated diagnoses, but the interpretation and categorisation of them was made by an ICU physician. Third, these findings reflect the observations from a single academic centre and may not be generalised as such. Several factors specific to our institution may contribute to the relatively few unsuspected findings. For example, the ICU is directed by full-time ICU physicians, which previously has been shown to influence outcome positively [10]. The tradition of immediate and continuous consultation with specialists from all fields is considered to have a beneficial impact, too.

These findings raise the question whether we still need autopsy as a tool to monitor diagnostic accuracy in our unit. Putting the cost charged for a complete autopsy (EUR 370) in relation to that of a 1day stay in the ICU (EUR 2.350) suggests that this investment for feedback is not overwhelming. Based on these findings, we are intensifying diagnostic efforts, especially in patients with infectious problems, and we still regard the autopsy as a valuable tool to monitor this diagnostic accuracy.

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