Autopsy Findings and Clinical Diagnoses: Retrospective Study of 3,117 Autopsies
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Aim. To determine the extent of agreement between clinical and autopsy findings.

Methods. A 14-year retrospective study (1982-1995) of autopsies from the Departments of Internal Medicine and Surgery was performed at the Zagreb University Hospital Center, Croatia. The autopsy findings were compared with the clinical diagnoses.

Results. The autopsy rate among hospital deaths ranged between 23% and 33%. The overall rate of major discrepancies was 11.6% for all autopsy reports. The most common cause of death were cardiovascular diseases (40.9%), followed by malignancies (25.2%) and infections (12.9%). Among all cardiovascular diseases, myocardial infarction was the most frequently diagnosed (17.9%) and was misdiagnosed by clinicians in 16.5% of the cases. Incorrectly diagnosed malignancies were found in only 5.7% of the cases; hematological and lymphoid malignancies (48.8%) were the most common neoplasms and were usually confirmed before death. Infections were found in 46.9% of all autopsies. Bacterial pneumonias and peritonitis were overlooked in 67.5% and 23.5% of the cases, respectively, in which they existed together with another serious condition.

Conclusion. Modern technology has not improved the overall accuracy of clinical diagnoses. When an autopsy should be performed is still a matter of discussion.

Key words: autopsy; cause of death; clinical pathology; death certificates; mortuary practice; pathology department, hospital; protocols, clinical

Interest in the autopsy and education activities of the hospitals is in decline (1,2). The autopsy rate in the United States has fallen from 50% in the 1940s to 15% in the 1980s (3). Factors contributing to this decline include diagnostic over-confidence among clinicians, difficulties in obtaining consent from families, and the cost. More recently, autopsy has come under attack from several directions. Clinicians consider that autopsy is inefficient, irrelevant, and unnecessary because of sophisticated new diagnostic tests. Pathologists complain it is time-consuming, disagreeable, thankless, and totally ineffective in changing the behavior of clinicians (4).

Autopsy aids in the discovery and definition of new diseases, and it is also important in the evaluation of new diagnostic tests, surgical techniques, implantable mechanical devices, and drugs (5-9). Moreover, autopsy records, unlike almost all other hospital records, are directly linked to tissue archives suitable for scientific research in numerous fields, including toxicology, medical genetics, and traditional morphological studies (10-12). Finally, autopsy studies may reveal the influence of environmental factors on diseases (13).

Several recent reports have emphasized the role of the autopsy in monitoring the quality of medical care for hospitalized patients (9,14-21). At autopsy, the clinician and pathologist have the opportunity to review clinical findings and compare them with morphological appearances. At its best, the autopsy enables the clinician to look back in the inquiry to identify the steps that led him to a correct diagnosis, and those that directed him along a false way to a wrong diagnosis (22).

The aim of this study was to determine whether routine autopsy yields any major unexpected findings, and to determine the extent of agreement or disagreement between clinical and autopsy findings in all studied cases.

Material and Methods
A total of 21,194 deaths occurred at the Zagreb University Hospital Center, Zagreb, Croatia, during the period from 1982 to 1995, and of these 11,804 (55.7%) deaths were from the Departments of Internal Medicine and Surgery. The autopsy protocols for all patients during that period were reviewed. A total of 4,169 autopsies were performed during that period, out of which 1,009 were pediatric and oncological autopsies and 3,160 were consecutive autopsies of patients from the Departments of Internal Medicine and Surgery. The latter were included in our study. The autopsy rate among deaths in that period ranged between 23% and 33% (Figure 1). Forty three cases were excluded from the study because of incomplete data.
The protocol contained a brief summary of the clinical data, including description of the final illness, results of laboratory tests, invasive and noninvasive diagnostic procedures, medications given, and operations performed. A short summary of the clinical diagnoses was given, together with an outline of the most important clinical findings. Final autopsy diagnoses, including gross- and histopathological findings, were recorded in the routine protocol. Less important findings listed in the autopsy report were disregarded.

Figure 1: Distribution of deaths and autopsy cases from the Departments of Internal Medicine and Surgery, 1982-95. Black columns, number of all autopsies; shaded columns, total number of deaths from these departments. [view this figure]

Important diagnoses that had a direct impact on the survival of the patient were labeled as major diagnoses. Those that were less important but that would affect prognosis if not treated were labeled as secondary or contributory diagnoses. Clinical data and autopsy diagnoses were then compared. According to the extent of agreement with post-mortem findings, clinical diagnoses were divided into four main categories as: completely correct, when there was agreement between clinical and autopsy diagnoses; partially correct, when one of major or secondary diagnoses or immediate cause of death was missed clinically; incorrect, when missed diagnoses were of major clinical importance with adverse or equivocal impact on survival; and unclassified diagnoses, when clinical diagnoses had been recorded by clinicians as probable or uncertain. An additional subcategory of excess diagnoses was introduced for clinical diagnoses that were mentioned in clinical diagnoses, but were not confirmed in the final autopsy findings.

Results
Of the 3,117 autopsies studied, there were 1,829 (58.7%) men and 1,288 (41.3%) women. Patient age ranged from 16 to 97 years. The distribution of these cases by age at death is shown in Figure 2.

Figure 2: Age distribution of autopsy cases at the Departments of Internal Medicine and Surgery, 1982-95. Black columns, surgery patients; shaded columns, internal medicine patients. [view this figure]

Table 1: Major causes of death determined by autopsy (N = 3,117) from the Departments of Internal Medicine and Surgery, 1982-95. [view this table]

The most common cause of death were cardiovascular (40.9%), neoplastic (25.2%), and infectious diseases (12.9%) (Table 1). Among all cases of cardiovascular diseases, myocardial infarction was the most frequently diagnosed (17.9%), followed by pulmonary vascular episodes, which include cases of thromboembolism and pulmonary infarction (11.2%), and cardiac arrhythmias (8.9%). The latter category was used when no major pathological finding was found, when arrhythmias were confirmed clinically (by ECG) shortly before death and where pathological findings of hypertrophy, and dilatation of the heart or myocardial fibrosis were present. Aneurysms, atherosclerotic and dissecting (2.9%), were the rarest among cardiovascular diseases (Table 1). Myocardial infarction, suspected by clinicians, were not found on autopsy in 78 cases. In 44 of these patients, pulmonary thromboembolism was found at autopsy, and in further 29 patients hypertophy and myocardial fibrosis was the only morphological finding. In 5 patients no myocardial changes were found.

Table 2: Type of malignant tumor as a major diagnosis determined by autopsy (N=788) from the Departments of Internal Medicine and Surgery, 1982-95. [view this table]

Table 3: Type of infection as a major or secondary diagnosis defined by autopsy (N=1,462) at the Departments of Internal Medicine and Surgery, 1982-95. [view this table]

Among malignant tumors (Table 2), leuk- aemias (32.7%) were the most frequent, followed by liver (8.7%), gut (7.9%), and lung (7.4%) carcinoma. Of all cases of hepatocellular carcinoma, the diagnosis was missed in 15 patients and in a further 9 patients was suspected by clinicians because
of concomitant cirrhosis. Similarly, carcinoma of the pancreas was not diagnosed in 7 patients. In one patient it was recorded by clinicians as suspect; the clinical diagnoses in these cases were acute pancreatitis, "acute abdomen", liver failure, and obstructive jaundice.

Infections confirmed by autopsy are listed in Table 3. Bacterial infections were found in 1,354 patients, and they were diagnosed clinically in 774 patients. Although bacterial pneumonia was the most common (58.5%), it was identified by clinicians in only 278 patients and it was one of the major diagnoses or the immediate cause of death in 112 patients. Peritonitis, usually secondary to surgical intervention, was found in 281 patients, and as the major diagnosis in 215 of those. Tuberculosis, pulmonary or disseminated, was found in 90 patients, and as the main disease in 36 of those patients. It was correctly diagnosed in 68 of the cases. In 6 patients in whom this condition was secondary to some other main disease, it was not recognized before the patient's death. Fungal infections, particularly aspergillosis and candidiasis, were detected in 82 patients, and all were found in hematological patients under immunosuppressive therapy. It was one of the major diagnoses or immediate cause of death in 31 patients. Viral hepatitis was the major cause of death in 12 patients, whereas cytomegalovirus infections were found in 7 immunosuppressed patients. Clinicians suspected leishmaniasis, leptospirosis, and histoplasmosis as the main cause of death. Other parasites, such as echinococcus (2 patients), ascaris and amoeba, were not recognized before autopsy.

Table 4: Classification of clinical diagnoses (N=3,117) by accuracy at the Departments of Surgery and Internal Medicine, 1982-95. [view this table]

Table 4 shows the classification of the clinical diagnoses according to the extent of discrepancy with the autopsy findings. The percentages of correct or partially correct diagnoses from the Department of Internal Medicine and Surgery were similar (82.5% vs. 81.2%, respectively), but there were more correct diagnoses made by surgeons. On the other hand, there were more unclarified diagnoses at the Department of Surgery. Excess diagnoses were found in 396 cases (12.7% of all autopsies); and of these 358 (90.4%) cases were from the Department of Internal Medicine and 38 (9.6%) cases from the Department of Surgery.

Discussion

Clinicians commonly attribute the decline of the autopsy rate to technological advances in clinical diagnoses. Each new diagnostic modality is presumably an avenue to the clinical truth, and as diagnoses become increasingly accurate, the autopsy becomes less rewarding or even unnecessary (23).

In an autopsy study, Goldman et al (24) found no appreciable difference in the discrepancy rate during three academic years and suggested that modern technology had not improved the overall accuracy of clinical diagnosis. In all three decades, 8% to 12% of autopsies showed major missed diagnoses for which appropriate treatment would have been expected to result in a cure or prolonged survival. An additional 11.7% of the autopsies revealed missed major diagnoses that, in retrospect, should have been made clinically, and that had an equivocal impact on survival (24). Similar results were reported by other authors (7) who correlated clinical and autopsy diagnoses of tumors in patients who died between 1962 and 1965 and between 1982 and 1985, and concluded that the value of autopsy has not been reduced in the contemporary medicine.

In our study, the autopsy rate ranged between 23% and 33% and despite an increase of diagnostic procedures the autopsy rate in the 1990s was actually high. The main reason is that the clinician who treats a patient decides whether autopsy should be performed. Haque et al (16) reported high autopsy rates from 45% in 1981 to 59% in 1995, with the largest number of autopsies (32.6%) from the Department of Internal Medicine.

The acute decline in the autopsy rate is accompanied by highly significant increase in missed major diagnoses (25). The overall rate of major clinical errors in our study was 11.6%. In similar studies the range of the total rate of clinical errors, or the rate of major diagnostic errors, varied from 4 to 68% (2,4,14,23,26-28). The variations in accuracy from one study to another might reflect variations in the quality of the work in different institutions, considering that autopsies are the best measure of the quality of clinical care (25). Goldman et al (24) reported that the number of missed diagnoses at autopsy was high in adults younger than 40 and in those older than 65 years.

The category of unclassified clinical diagnoses reflects the confidence of clinicians in the accuracy of their findings. In our study it was more frequent at the Department of Internal Medicine (8.2%). This could be due to the fact that there was not sufficient time for diagnosis because the patient died soon
after the admission to the hospital. This also resulted in more excess diagnoses that were not confirmed at autopsy. Cameron and McGoogan (27) reported that a relatively high degree of accuracy between clinical and pathological diagnoses among patients who die acutely within the first 3 days of admission results partly from a preponderance of cases of acutely fatal disease. In our study, surgeons had many partially correct diagnoses because the protocols from the Department of Surgery contained only the main disease and type of operation.

More than 77% of the patients were in the 50 to 90 years age group. Similar findings were reported by Battle et al (14) who analyzed 2,067 autopsies from 32 US university and community hospitals of various sizes. In contrast to this, the highest proportion of autopsied patients in India comes from younger age group, probably because of the higher incidence of infectious diseases (28).

Cardiovascular diseases were the most common major diagnoses, constituting 40.9% of all autopsies of this study, compared to 50% to 69% in the US, and 17.1% in India (18,24,28).

Myocardial infarction was correctly diagnosed in 22% and was partially correct in 47.2%, similar to other studies (25,29). Furthermore, the majority of infarctions suspected by clinicians but not revealed at autopsy, were pulmonary thrombo-embolism. Cameron and McGoogan (27) indicated that conditions, such as acute abdominal and pulmonary thromboembolism, that most frequently mimicked infarction, produced similar clinical features (acute pain, shock, or a combination of the two).

Pulmonary thromboembolism and infarctions are rare in India (28), but in the West and in our country are one of the major cardiovascular diseases found among autopsied patients (18,22, 24,25).

Goldman et al (24) found that the number of cases of clinically diagnosed fatal pulmonary embolism decreased significantly between 1960s and 1980s, whereas the number of missed diagnosis did not significantly change.

Bauer and Robbins (30) reported that about 30% of tumors were incorrectly diagnosed between 1955 and 1965. Similar results were found by Goldman et al (24) but they also suggested that the diagnostic advances have reduced that rate in 1980s. The diagnostic error rates for malignancies reported in the literature are similar, between 26% to 44% (19,25,28,31,32). These findings indicate that the development of new diagnostic methods has not greatly improved the accuracy of cancer diagnosis. Low rate of incorrect diagnoses of malignancy in our study can be explained by the fact that hematological and lymphoid malignancies were the most common malignant neoplasms in our autopsy population and that they were confirmed before death. All patients received adequate therapy, such as immunosuppressive therapy or bone marrow transplantation. Unfortunately, fungal infections were serious complication of the immunosuppressive treatment. Landefeld et al (18) reported that 50% of major infections in a University Hospital were fungal and were major unexpected findings in over half of the cases. In our study, the prevalence of fungal infections as a cause of death was low, but they were frequently overlooked. Their unusual clinical manifestations and the masking of signs and symptoms by another serious condition also contributed to misdiagnosis. Boon et al (33) noted a significant rise in the number of cases of invasive aspergillosis between 1980 and 1989 in immunosuppressed patients and indicated that without autopsy data, much of this disease would remain undetected, giving rise to serious underestimation of its incidence and importance.

High percentage of misdiagnosed liver or pancreatic cancer are similar to the results of Cameron and McGoogan (22) who found that the diagnosis of the carcinomas of liver was not advanced in spite of the evidence that might have suggested it.

Infections were found in almost a half of the autopsies. Similar finding was reported by Frederici and Sebastian (34). The degree of the clinical accuracy concerning various infections noted in literature varies considerably. Goldman (35) reported that bacterial pneumonias were never misdiagnosed in the period after 1970. However, Frederici and Sebastian (34) noted that in 16% of the cases of inflammatory disorders requiring treatment were not recognized, and that pneumonia was the most common among them. Several investigators (25,27) found that in the cases of infections, 67% to 81% of all diagnoses were not anticipated clinically. In our study, bacterial pneumonia was overlooked in 67.5% and peritonitis in 23.5% of the cases in which they existed together with another serious condition and were thus a secondary diagnosis. In these cases, the clinical outcome would not have been changed even if the infection had been diagnosed correctly, because survival was dependent on the main disorder. Infections in our study were estimated as one of the major diagnoses in most of the cases because of their adverse impact on survival in such cases. Furthermore, proper diagnosis and treatment of infections are necessary, regardless of the fact that they usually appear later in the course of disease as a complication of the main disorder.

The incidence of tuberculosis is high in India (11.2% of all autopsied patients), but the data from western countries are similar to our findings, ranging from 1% to 3% of autopsies (22,25,28). Unlike the findings of other studies (25,28) this condition was accurately diagnosed in 75.6% of the cases. This could be explained in part by the fact that tuberculosis has been a focus of attention of our
Health Public Service for decades, especially now, when its incidence is on increase. Whereas parasitic infections are still the major health problem in India (28), in our study they constituted only 0.1% of all autopsies. The types of infections seen in our autopsy material are a reflection of their prevalence in our population.

Our findings suggest that the current high autopsy rate is unnecessary because most of the autopsied patients were in the older age group with chronic diseases that were already diagnosed. This is also true in the majority of patients with proven malignant disease when the spread of the disease was confirmed by X-ray, CT or scintigraphy. Autopsies are expensive and time-consuming procedures, and usually take place without the attendance of clinicians, so their importance as an educational role for the clinicians is questionable. We propose that selected autopsies should be performed when the clinical diagnosis is unknown and uncertain, and in rare and interesting entities that are valuable for the education of pathologists.

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