

## Minimizing Mistakes in Clinical Diagnosis

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**ABSTRACT:** It would be quite reasonable for us to expect the progress made in diagnostic technology to be accompanied by a parallel improvement in diagnostic accuracy. In reality, however, the frequency of misdiagnoses remains the same, despite the fast progress which has been made by medical technology in the last 30 years.

Autopsy is the best source of information on diagnostic accuracy. According to one hypothesis, an increase in the number of autopsies performed and the follow-up on them could reduce the number of diagnostic mistakes. In recent times, however, the number of autopsies in comparison with the registered number of deaths has been declining steeply.

We studied the autopsy reports for 1997, kept at the archive of the Institute for Forensic Medicine. We only took into account the deaths which occurred within 24 h of admittance to the emergency wards of the Ljubljana University Hospital, including those patients who died subsequently as a consequence of accident or injury. We also included cases of sudden deaths which occurred during operating or within 24 h after it. Following selection, we analyzed 444 out of the total of 921 autopsy reports, for each of which we carried out a comparison between the postmortem diagnosis and the clinical diagnosis, contained in the medical report on the death and the causes of death, which is modeled on WHO recommendations, i.e., the International Classification of Diseases (ICD), and in the medical documents, if any were submitted. Data are entered in these by using the ABC system where: A) direct cause of death, B) are circumstances that influenced the occurrence of death, and C) is original cause of death.

The findings were then organized into five groups, depending on the degree to which the clinical diagnosis agreed with the post-mortem diagnosis. The first group is comprised of the cases where the clinical and postmortem diagnoses agree completely; the second group is comprised of the cases of partial disagreement on the direct cause of death; the third group is comprised of the cases of disagreement on the original disease; the fourth group, of complete disagreement between the clinical and postmortem diagnoses. The fifth group is comprised of those cases where, under the ABC standards on the classification of diseases, injuries and causes of deaths as specified by the WHO, the documentation was incomplete.

A complete agreement between the diagnoses was established in 48.87% of cases; partial disagreement in 22.74%; and total disagreement in 13.5%. 9.68% of cases were classified as falling into group 5.

For the three diseases that are among the most common causes of death, we established the percentage of agreement, the percentage of overdiagnosis and the percentage of underdiagnosis. The most frequently underdiagnosed disease (in 61% of cases) was pulmonary thromboembolism; in 15% a thromboembolism was confirmed in autopsy. In 24%, a myocardial infarction was not diagnosed clinically and in 60% the clinical diagnosis of a myocardial infarction was confirmed in autopsy. In 33% a heart failure was not diagnosed during the clinical stages but only in autopsy, in 66% the clinical diagnosis of a heart failure was confirmed in autopsy.

**KEYWORDS:** forensic science, forensic pathology, death, diagnosis, incorrect clinical diagnosis, autopsy, clinical pathology

Doctoring must be very easy to do since the doctors always bury their mistakes. Fred Raber, Summerdale, Alabama, 1947 (1).

Clinical diagnostics is an imperfect science. In order to be able to make a diagnosis, the doctor requires information on the history, physical examination, and laboratory tests. Once this data has been gathered the doctor forms a diagnostic hypothesis. He then requests that certain tests or treatment be carried out through which he tries to confirm or treat the medical condition. He carefully observes the patient, fresh symptoms, signs, response to treatment, i.e., everything which may confirm the diagnosis.

Errors may occur during any of the stages of diagnostic procedure (2). Sometimes the knowledge and experience that the doctor has of a particular medical condition may be fairly modest. The history and physical examination may lead to misdiagnosis if incomplete, poorly executed or incorrectly interpreted. Laboratory tests can carry risks as well. An excessive degree of trust in the test results may cause confusion and delay the identification of the disease. Random monitoring of the patient, rather than monitoring on a permanent basis, may also contribute its share.

With all the progress made in medical technology we might justifiably expect diagnostic accuracy to grow alongside the growing diagnostic opportunities. This, however, is not the case, as it has recently been noted that the progress made by diagnostic technology has not reduced the number of misdiagnoses (3). The frequency with which these are made remains unchanged. 10% of patients receive inappropriate clinical treatment (4,5). Some quite surprising data has also emerged: in more than 45% of the cases, the main clinical diagnosis was not confirmed by the autopsy findings (6).

Cabot was among the first to do so when, in 1912 (7), he tried to assess the extent of diagnostic inaccuracy. He established a similar 40% discord. Twenty-five years later, Gall established approximately the same percentage within the same institution (8). In 1960 Gall established the same percentage of clinical diagnostic inaccuracies for a new group of patients (8). Others arrived at similar results concerning diagnostic inaccuracies, which range between 15 and 40% (9-12).

For comparative purposes, it is sensible to use only the results of those studies which applied similar criteria in order to establish diagnostic inaccuracy.

Autopsy remains the best source of information on diagnostic accuracy (6,13,14). There are a number of studies where the comparisons between autopsy results and clinical diagnoses have been carried out using various methods.

In general, the number of autopsies per number of deaths is on the decline (3,23). For example, in 1959 the University Clinical Hospital of Kiel, Germany, conducted autopsies on 88% of all de-

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ceased, in 1969 on 82%, in 1979 on 36% (3). The number of autopsies fell by over 50% (3).

There are multiple reasons for the decline in the number of autopsies (15–17). The two most important reasons that apply to clinical doctors are: a high degree of confidence in themselves, and a lack of awareness of the value of autopsy. A number of doctors believe that modern diagnostic approaches make postmortem identification of symptomatic changes redundant (2). They often believe that everything which could be known about the deceased was known. Cameron and colleagues established that the same percentage of diagnostic mistakes (15%) was made in cases where clinicians were unsure of their diagnosis and requested an autopsy as in the cases where they did not investigate the autopsy results because they were so confident in the accuracy of their diagnosis (18).

The fear among doctors that their professional reputation may be tarnished or that they may be branded as inexperienced is also among the reasons why fewer autopsies are being requested (19). If medical students and ward doctors were familiarized with autopsy results this would help them to become accustomed to the fact that mistakes do occur and help them to make profitable use of experience in the development of methods aimed at reducing the levels of inaccuracy and mistakes made in diagnosing a disease (20–22).

The most common diagnostic errors include: pulmonary embolism, pneumonia, myocardial infarction, malignancies, and septic shock (24,25). The percentage of diagnostic errors is significantly higher in elderly patients (25,26).

## Methods

The Institute for Forensic Medicine is part of the Ljubljana Faculty of Medicine. Ljubljana is the capital city of Slovenia and has 300,000 inhabitants. The central office of the Institute for Forensic Medicine in Ljubljana reviewed 921 autopsy reports from 1997. All cases of deaths which occurred outside hospitals were excluded. We were left with 444 cases of deaths occurring within 24 h of the patient being admitted to the University Hospital or one of its external branches (Jesenice general hospital, Izola general hospital), or of those who died during operations or within 24 h after operating.

In 444 out of the 921 autopsy reports, we compared the clinical diagnoses with the autopsy diagnoses. For those who died of natural causes, the direct causes were examined. Subsequently they were classified into categories according to the latest International Classification of Diseases, 10th edition. First we organized clinical diagnoses under the ABC classification (A: direct cause of death, B: circumstances that influenced the occurrence of death, C: original cause of death) and then divided them into five groups as follows:

- complete agreement of the clinical and autopsy diagnoses;
- partial agreement (direct cause of death does not agree with the autopsy diagnosis);
- partial agreement (disagreeing on the original disease);
- complete disagreement of the clinical and autopsy diagnoses;
- comparison not possible. Clinical diagnoses could not be classified under the criteria: original disease; circumstances that influenced the occurrence of death; direct cause of death.

For the following three groups of diseases: pulmonary embolism, myocardial infarction, and heart failure, we also identified the share of clinical underdiagnosis, clinical overdiagnosis, and ac-

curate clinical diagnosis. A clinical underdiagnosis means that the doctor did not clinically diagnose the disease which was then established during the autopsy. A clinical overdiagnosis means that the doctor diagnosed a disease that was not confirmed in the autopsy. An accurate clinical diagnosis of the disease is made when the clinical diagnosis is confirmed by the autopsy.

## Results

A total agreement of the clinical and autopsy diagnoses was established in 48.87% of cases; partial agreement was established in a total of 27.92% of cases; disagreement on the direct cause of death in 22.74%; and on the original disease in 5.18%. In 13.5%, we established that the disagreement between the clinical and autopsy diagnoses was complete (Table 1). 9.68% of the cases could not be classified owing to incomplete death certificates or reports on the causes of death.

Of the total 444 autopsy reports on patients who died within 24 h of being admitted to the hospital, 54% died of natural causes, 34% died as a result of accident or injury, 12% died during the preparations for an operation, the operation, or immediately following an operation.

We established that among deaths from natural causes, most, or 76.5%, of our cases fall into the 9th group (Diseases of the circulatory system). This is probably the case because only the autopsies that were performed at the Institute for Forensic Medicine in 1997 were included in the study, i.e., autopsies on those who died within 24 h of being admitted to the hospital. The majority of deaths were sudden and unexpected, which is why one of those diseases which under the latest ICD fall into the 9th group (Diseases of the circulatory system), such as the failure of a strongly enlarged and dilated heart, infarctus anaemicus cordis, haemorrhagia intracereberalis, tromboembolia art. pulmonalis, aneurysmatis aortae dissecantis aortae ascendentes, tamponade cordis, exangvinatio, were among the causes of death.

In 10% of the cases covered by the study, the cause of death was a disease from the 11th group (Disease of the digestive system); in 8%, diseases from the 10th group (Diseases of the respiratory system); in 2.35%, a disease from the 2nd group (Neoplasms); and in 2%, diseases from the 1st group (Infectious and parasitic diseases).

The most common clinically underdiagnosed disease was thromboembolia of the pulmonary arteries, which occurred in 61% of the cases. In 23%, the clinical diagnosis of a pulmonary thromboembolia did not have a corresponding pathological-anatomic substrate. In just 15% the clinical diagnosis of a pulmonary thromboembolia was then confirmed by autopsy.

In 60% of cases, the clinical diagnosis of a myocardial infarction was confirmed by autopsy; in 24%, a myocardial infarction was not established clinically but only during the autopsy. In 16%, the clin-

TABLE 1—Classification into groups I-V.

Groups	Total Number	Percent (%)
I	217	49
II	101	23
III	23	5
IV	60	13.5
V	43	9.5
Skupno	444	100

TABLE 2—Shows the percentage of agreement between the clinical and autopsy diagnoses; the percentage of overdiagnosis; and the percentage of underdiagnosis for the three diseases: pulmonary thrombembolia, myocardial infarction, and heart failure. Agreement: the agreement of the clinical diagnosis and patho-anatomic diagnosis; Overdiagnosis: clinical diagnosis not confirmed in autopsy; Underdiagnosis: the disease was not diagnosed clinically, only during the autopsy.

	Pulmonary Thrombembolia	Myocardial Infarction	Heart Failure
Agreement	15%	60%	66%
Overdiagnosis	23%	16%	1%
Underdiagnosis	61%	24%	33%

ical diagnosis of a myocardial infarction was not confirmed by the pathological-anatomic substrata at the autopsy.

In 66% of the cases the clinical diagnosis of a heart failure was confirmed in autopsy, in 33% it was not established clinically, but only during the autopsy (Table 2).

The next group of most common diseases, identified during the processing of data on diagnostic failures, is comprised of the following: bronchopneumonia, rupture of aortic aneurysm, intracerebral hemorrhage, perforated stomach ulcer, and hemorrhaging from oesophageal varices.

## Discussion

The study established that clinical diagnoses and autopsy diagnoses completely agree in 48.87% of cases, which echoes the results of the Mercer and Talbot studies (24), where a complete agreement was established in 46.75% of cases.

The extent of the disagreement between the clinical and autopsy diagnoses in our study corresponds to the results arrived at by other authors (4,27,28), who concluded that the introduction of new diagnostic technologies does nothing to reduce the extent of the disagreement between the diagnoses.

For three groups of diseases we classified individual cases where the treated disease was the direct cause of death or where it contributed to the occurrence of death, into three groups: accurate; underdiagnosis (the diagnosis was not made in the clinical stage but postmortem); and overdiagnosis (clinically expected diagnosis was not asserted postmortem).

On the basis of the following three particularly common diagnoses: pulmonary thrombembolia, myocardial infarction and heart failure, we concluded, as others have done before us (23,29), that from a diagnostic aspect, pulmonary thrombembolia represents the greatest challenge.

In our study, we established that as much as 61% of pulmonary embolisms go unidentified, which strongly resembles the results of a similar study (30) where it was established that over the past 30 years 60% of pulmonary embolisms diagnosed in autopsies were not identified at the clinical stage, which emphasizes the fact that this particular clinical issue has been neglected.

The information showing that myocardial infarction was not diagnosed in 24% of cases, regardless of the fact that it was correctly diagnosed in 60% of cases, should be stressed (23) not only for analytical reasons but, first and foremost, for the purposes of preventive diagnostics.

According to our study, myocardial infarction was not diagnosed in 24% of cases which is similar to the percentage established by

McPhee. Over the last three decades, 19% of myocardial infarctions diagnosed in autopsies were not clinically diagnosed (30), which makes this issue, in view of the current problems associated with this civilizational disease, stand out in particular from among other issues in pathology.

A particular problem is presented by the backlog in writing death certificates and reports on the causes of deaths for the needs of the revised WHO classification, which amounts to at least two editions. *Paralysis cordis* is being used indiscriminately as the cause of death, and the WHO drew special attention to this fact.

We are left with the open question: will it be possible and, if so, by what measures, to reduce the number of diagnostic mistakes? It is almost certain that this will be practically impossible without the help of autopsies (2), which is why the current declining trend in the number of autopsies in the developed world is irresponsible and represents a cause for concern.

The significance and the role of autopsies continues to be: quality control of clinical diagnostics; exposing mistakes and causes of death; analysis of the national pathology; and the provision of statistical data for the needs of the WHO and Europe.

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