Original article

Discordance between clinical and post-mortem diagnoses at a tertiary hospital

Medicine, Science and the Law
2020, Vol. 60(1) 11–15

DOI: 10.1177/0025802419878314
journals.sagepub.com/home/msl
SAGE

Milenko Bogdanović[1], Adi Hadžibegović, Aleksandar Medarević[2], Miloš Babić[3], Dragan Ječmenica[1] and Đorđje Alempijević[1]

Abstract

Advances in modern medicine and more accurate and precise diagnostic procedures have been considered to be the main reason for the reduction in autopsy rates. However, there is still a discrepancy between clinical and autopsy diagnoses. This retrospective study, designed as a cross-sectional study, included a sample of 931 patients who died at the Clinical Hospital Centre 'Zemun'. We analysed sex, age, length of hospitalisation and clinical and post-mortem diagnoses, including the discrepancies between them. In 314 (34%) cases, there was complete agreement between the clinical and autopsy diagnoses, complete disagreement in the same percentage and incomplete agreement in 303 (32%) cases. In people aged >60 years, the risk of misdiagnosis was 2.5-fold higher than in the those aged <60 years (odds ratio (OR)=2.522, $p<0.001$), while the influence of sex on the risk of misdiagnosis was not statistically significant (OR=0.981, $p>0.05$). An increase in the number of autopsies would be one of the best methods to make discrepancies between clinical and post-mortem diagnoses visible, and a good method for continuous evaluation of diagnostic tests, as well as for providing a wider perspective on presentations of different clinical conditions.

Keywords

Clinical diagnosis, post-mortem diagnosis, discordance, forensic

Introduction

The significance of autopsy in everyday clinical practice has often been a subject of discussion, and especially during the recent years, it has been related to a marked decline in autopsy rates.[1–4] For illustration purposes, in the 1940s the autopsy rate was about 50%, whereas at the end of the century, it was <10%.[5] Autopsy is a medical procedure of profound importance for determining the cause of death, assessing the accuracy of clinical diagnosis and treatment efficacy, medical education, research and disease detection.[6,7] Some of the reasons for the reducing autopsy rate include new diagnostic procedures that increase the accuracy of clinical diagnosis, the attending physician's lack of interest in post-mortem diagnosis and the increasingly frequent use of modern visualisation techniques in forensic practice.[8]

On the other hand, research data suggest that despite the constant improvement in medicine and the availability of very precise diagnostic procedures, the discrepancy between clinical and post-mortem diagnoses has not been significantly reduced.[8] The available data on autopsies in the Republic of Serbia show that in the first half of the 20th century, the autopsy rate was about 20%. In the mid-1980s, it fell to about 10%, while an increase in the number of incorrect clinical diagnoses or conclusions about the cause of death was observed along with this trend.[9] In Serbia, examination and autopsy of the corpse is mandatory when death occurs in a health-care institution and the cause of death has not been determined, or <24 hours have elapsed since the beginning of the treatment at the stationary health-care institution. Autopsy is also

[1]Institute of Forensic Medicine 'Milovan Milovanovic', University of Belgrade – School of Medicine, Serbia
[2]Institute of Public Health of Serbia 'Dr Milan Jovanovic Batut', Serbia
[3]Institute for Cardiovascular Diseases 'Dedinje', Serbia

Corresponding author:
Milenko Bogdanović, Institute of Forensic Medicine 'Milovan Milovanovic', University of Belgrade – School of Medicine, 31a Deligradska str., 11000 Belgrade, Serbia.
Email: drbogdanovicm@gmail.com

mandatory at the request of the doctor who treated the deceased person, at the request of a close family member of the deceased and if death occurred during a diagnostic or therapeutic procedure.[10]

Taking all of this into account, we wanted to examine the clinical autopsy rate, as well as the degree of agreement between clinical and post-mortem diagnoses at the tertiary medical institution Clinical Hospital Center Zemun (CHC Zemun) during a five-year period.

Methods

This retrospective study was designed as a cross-sectional study, in which the level of agreement between clinical and post-mortem diagnoses was examined for the patients treated at CHC Zemun whose death occurred during hospitalisation. The research is based on data about 931 autopsies performed at the Institute of Forensic Medicine ;Milovan Milovanović' in Belgrade in the period from January 2011 to December 2015. In all analysed cases, clinical autopsies were performed at the request of the hospital. In addition to data collected from the autopsy records, case-history data were also analysed. The hospital visualisation procedures used in our cases were ultrasound diagnostic, X-ray, computerised tomography, endoscopy procedures and chat lab. One internal medicine resident and a forensic pathologist analysed the clinical history and autopsy reports for all autopsied patient. Clinical causes of death are established by specialist doctors. In order to prevent disagreement (between the forensic pathologist and the internal medicine resident) in understanding terms such as cause of death and mechanism of death, we defined them at the very beginning.

In this study, the influence of the following variables on the degree of agreement between clinical and post-mortem diagnoses was examined: age, sex, length of hospitalisation prior to death and cause of death. For further analysis, the sample was divided into two age groups based on the age at the time of death: <60 years of age and >60 years of age. According to the length of hospitalisation, three categories were established: <24 hours, between 24 hours and seven days and longer than seven days. In this study, we examined the degree of agreement between clinical and post-mortem diagnoses of the underlying cause of death. Diagnoses of the cause of death were encrypted and categorised in accordance with the 10th revision of the International Classification of Diseases (ICD-10). The deaths for which there were no available data from case histories were excluded from the study. The deaths of foetuses, neonates and children younger than one year were excluded from the analysis. Additionally, we excluded all cases (n=35) in which the cause of death was marked with unknown causes of mortality. These codes include R96 (sudden unexplained death in adult), R98 (unattended deaths) and R99 (other ill-defined and unspecified causes of mortality). In all other cases, a well-defined cause of death was established.

The established degree of agreement between clinical and post-mortem diagnoses was categorised as: complete agreement, incomplete agreement and disagreement. Cases in which the clinical and post-mortem diagnoses of the cause of death were identical were categorised as complete agreement. The incomplete agreement category included cases in which the clinical and post-mortem diagnoses of the cause of death were not the same but belonged to the same group of diseases according to the ICD-10 and whose treatment probably would not affect the outcome. Finally, if the clinical and post-mortem causes of death did not belong to the same group according to the ICD-10 and the treatment probably would affect the outcome, the case was classified as disagreement (in malignant neoplasm vs. myocardial infarction).

All statistical tests were performed using IBM SPSS Statistics for Windows v23.0 (IBM Corp., Armonk, NY). A chi-square (r x k) test was conducted to compare the degree of agreement between clinical and post-mortem diagnoses in the distribution of selected variables (length of hospitalisation, sex, age group and cause of death). Bivariate logistic regression (with 95% confidence intervals) was used to calculate the odds ratio (OR) between degree of agreement between clinical and post-mortem diagnoses and sex and age group: the independent variable in the bivariate analysis was the degree of agreement between clinical and post-mortem diagnoses (complete agreement/disagreement), while sex and age groups (<60/≥60 years) were used as dependent variables. The level of statistical significance was set at $p < 0.05$, while p-values of <0.01 were considered statistically highly significant, and the selected confidence interval was 95%.

Results

During the observed five-year period, 931 autopsies of patients previously treated in CHC Zemun were performed. Based on previously established criteria, 54 cases were excluded from further analysis. The ages of the deceased ranged from 29 to 98 years ($M = 74$ years). In terms of sex, the average age of males was 70 years, and females 74 years. With reference to the defined age groups, 13.2% of the deceased were aged <60 years, while 86.8% were aged >60 years. In 314 (34%) cases of death, a complete agreement between the clinical and post-mortem diagnoses of the cause of death was determined, a disagreement was found in the

same percentage and incomplete agreement between diagnoses was observed in 303 (32%) cases. Distribution of deaths according to sex, age, causes of death and length of hospitalisation is shown in Table 1.

A significant difference was noticed regarding underlying causes of death ($p < 0.001$). Namely, circulatory causes of death were the most frequent (in all three degrees of agreement between clinical and post-mortem diagnoses) compared to other causes of death. On the other hand, sex and the length of hospitalisation had no statistically significant effect on the difference between clinical and post-mortem diagnoses of the cause of death ($p = 0.94$ and $p = 0.45$, respectively).

By analysing the influence of age and sex of the deceased on the risk of clinical misdiagnosis of the cause of death, it was observed that in those >60 years, the risk of disagreement between clinical and post-mortem diagnoses is 2.5-fold higher compared to those <60 years, who have 2.5-fold higher chance for a correct clinical diagnosis (OR = 2.52; $p < 0.001$; Table 2).

When it comes to the influence of sex on the accuracy of diagnosis, it was concluded that in both sexes, the chances for clinical misdiagnosis are almost the same (OR = 0.98; $p > 0.05$; Table 2).

Discussion

In accordance with the health-care law, in the case of an inpatient's death, a clinical autopsy must be performed if the patient dies within 24 hours following hospital admission.[10] In our sample, 81.1% of the deceased had previously spent <24 hours in hospital after admission. Also, a clinical autopsy must be performed if the cause of death cannot be determined solely from hospital files, or if death occurs in the course of a diagnostic or therapeutic procedure.[10] Additionally, a hospital doctor may request an autopsy if he/she wants to check the clinical diagnosis. Therefore, in residual 18.9% of cases, the length of hospitalisation was >24 hours, and the autopsy was performed because doctors wanted to check the clinical diagnosis and, in those cases, multiple diagnoses were present. If there had been more cases of this type, it might be possible that the level of agreement between the clinical and autopsy diagnoses would have been different from what we found, but the direction of such potential changes can only be assumed. According to the medical records, there were no cases of death that occurred during therapeutic or diagnostic procedures. Unfortunately, in our country, the autopsy request does not state precisely why the autopsy is required in each specific case.

The discrepancy between clinical and post-mortem diagnoses in our study was found in 34% of cases,

Table 2. Influence of sex and age on the risk of misdiagnosis.

	OR	95% CI	*p*-Value
Complete agreement/disagreement			
Male/female	0.981	0.744–1.293	0.891
<60/≥60 years	**2.522**	1.715–3.708	**<0.001**

Statistically significant values are shown in bold.
OR: odds ratio; CI: confidence interval.

Table 1. Agreement between diagnoses with reference to demographic and clinical parameters of the deceased.

	Complete agreement, *n* (%)	Incomplete agreement, *n* (%)	Disagreement, *n* (%)	Total, %	*p*-Value
Length of hospitalisation					
≤24 hours	263 (83.8)	242 (79.9)	250 (79.6)	81.1	0.669
2–7 days	30 (9.6)	35 (11.6)	36 (11.5)	10.9	
≥7 days	21 (6.7)	26 (8.6)	27 (8.6)	8.0	
Age					
≤60 years	65 (20.7)	22 (7.3)	36 (11.5)	13.2	**<0.001**
≥60 years	249 (79.3)	281 (93.7)	278 (88.5)	86.8	
Sex					
Male	164 (52.2)	157 (51.8)	160 (51)	52	0.948
Female	150 (48.8)	146 (48.2)	154 (49)	48	
Cause of death					
Circulatory diseases	148 (47.3)	260 (85.8)	209 (66.8)	66.4	**<0.001**
Neoplasm	115 (36.7)	13 (4.3)	16 (5.1)	15.5	
Digestive system diseases	16 (5.1)	13 (4.3)	43 (13.7)	7.8	
Respiratory system diseases	10 (3.2)	10 (3.3)	31 (9.9)	5.5	
Other diseases	24 (7.7)	7 (2.3)	14 (4.5)	4.8	

Statistically significant values are shown in bold.

while incomplete agreement was observed in 32%. Kotovic et al., who conducted research on a similar topic, found complete agreement in 16.3% and incomplete agreement in 28.1% between clinical and post-mortem diagnoses of the underlying cause of death.[11] The research carried out by Shojania et al., which included 45 studies conducted between 1966 and 2003, showed that the median (i.e. major error) was 23.5%, and their frequency ranged between 4.1% and 49.8%.[12] Our results are in line with the results of previous studies carried out in Serbia where the difference between ante- and post-mortem diagnosis ranged from 18% to 45%.[9]

In our study, the most common causes of death were circulatory diseases (66.5%), followed by neoplasms (15.5%), digestive system diseases (7.7%) and respiratory diseases (5.5%). These data are in accordance with data from countries in the region where circulatory diseases are the underlying cause of death.[13,14] In addition, the results of a study conducted in Barcelona between 1991 and 2000 indicated that the most common cause of death was some of the circulatory diseases.[15] Our data are most similar to the study conducted in Greece, where circulatory diseases were the most common (67.9%), while respiratory and gastrointestinal diseases were the second most common (9.4%).[14]

According to the Institute of Public Health of Serbia, the underlying cause of death in 2011 was circulatory diseases, with an incidence of 53.9%, which remained constant in the following years as well, reaching 52.4% in 2015. In our study, the incidence of circulatory disease is slightly higher compared to the general population. The observed difference could be explained by the fact that the most of the deceased ub this study had been receiving inpatient treatment for <24 hours at the time of their death, and the development of the clinical presentation of particular conditions such as acute myocardial infarction and thromboembolism occurs suddenly.

No statistically significant difference was observed by examining the influence of hospitalisation length on the agreement between clinical and post-mortem diagnoses. The obtained results are in accordance with most similar studies investigating this relationship.[7,11] Some authors have found that inpatient treatment for 2 and 10 days prior to the occurrence of death contributes to a greater degree of disagreement between clinical and post-mortem diagnoses.[16,17] On the other hand, certain studies have shown that the risk of discrepancy between diagnoses is two- to threefold higher in females.[11,18,19]

In people aged >60 years, the chances for disagreement between diagnoses are statistically increased, that is, the risk of disagreement between the clinical and post-mortem diagnoses of the cause of death is 2.52-fold higher in people aged >60 years. This piece of information is inconsistent with reports from other researchers.[7,20,21] Kotovich et al. have shown that elderly people have a 2.35-fold higher chance of disagreement between clinical and post-mortem diagnoses, which is similar to our results. This is due to numerous co-morbidities in older patients and vague clinical presentations,[11] while other authors state poorer prognosis of the disease in older patients in general, which can influence doctors and families of patients not to complete the diagnostic procedure.[22]

Our results show that there is a statistically significant difference in the agreement between diagnoses relative to the causes of death, that is, circulatory diseases are the most common cause of death, in particular coronary and hypertensive heart disease with consequent stroke, heart failure, thromboembolism and cerebrovascular disease. Also, keeping in mind that in our sample, 86.8% of the deceased were aged >60 years, it is to be expected that circulatory disease would be their primary cause of death.

Comparison between clinical and post-mortem diagnoses can be a very challenging and complicated process. There are several methods and criteria for classifying errors when comparing the diagnoses. The methods in which the degrees of agreement between the diagnoses are classified in our study are not exactly the same as in other studies, which primarily refers to cases labelled as incomplete agreement. Some researchers also took accompanying diseases into consideration, classified the incomplete agreement in several subcategories and also examined the effect of error on the outcome.

We recognise some limitations to this study, such as the small number of cases with a length of hospitalisation of >24 hours (possible selection bias). On the other hand, in cases where hospitalisation lasted <24 hours (81% of the deceased in our study), the autopsy rate was 100%, and there was no selection bias. Therefore, it is obvious that the sample is imbalanced with regard to the length of hospitalisation. Our study was designed as a retrospective study, and thus could have been imprecise in terms of data collection. Prospective studies that include all deaths in a particular hospital would be more appropriate for estimation of differences between clinical and autopsy diagnosis.

This study found that the autopsy rate at CHC Zemun is higher than the average, which can be explained by the consistent application of the health-care law, which requires that an autopsy be performed on any deceased person who was treated for <24 hours in a stationary health-care institution. The risk of misdiagnosis is higher for those who are aged >60 years at the time of their death. An increase in the number of autopsies would be one of the best methods to make

discrepancies between clinical and post-mortem diagnoses visible, and a good method for continuous evaluation of diagnostic tests, as well as for providing a wider perspective on presentations of different clinical conditions.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The Ministry of Science and Technological Development, Republic of Serbia (grant number OI 175093), supported this work.

References

1. Nakhleh RE, Baker PB and Zarbo RJ. Autopsy result utilization: a College of American Pathologists Q-probes study of 256 laboratories. *Arch Pathol Lab Med* 1999;123:290–295
2. Veress B and Alafuzoff I. A retrospective analysis of clinical diagnoses and autopsy findings in 3,042 cases during two different time periods. *Hum Pathol* 1994;25:140–145
3. Hill R. The current status of autopsies in medical care in the USA. *Qual Assur Health Care* 1993;5:309–313.
4. Nemetz P, Ludwig J and Kurland L. Assessing the autopsy. *Am J Pathol* 1987;128:362–379
5. Bonds LA, Gaido L, Woods JE, et al. Infectious diseases detected at autopsy at an urban public hospital, 1996–2001. *Am J Clin Pathol* 2003;119:866–872
6. Landefeld CS, Chren MM, Myers A, et al. Diagnostic yield of the autopsy in a university hospital and a community hospital. *N Engl J Med* 1988;318:1249–1254
7. Spiliopoulou C, Papadodima S, Kotakidis N, et al. Clinical diagnoses and autopsy findings: a retrospective analysis of 252 cases in Greece. *Arch Pathol Lab Med* 2005;129:210–214
8. Costache M, Lazaroiu AM, Contolenco A, et al. Clinical or postmortem? The importance of the autopsy; a retrospective study. *Maedica (Buchar)* 2014;9:261–265.
9. Kanjuh V and Tatić V. Opadanje broja autopsija i nepotvrđene kliničke dijagnoze – da ili ne? *Vojnosanit Pregl* 2004;4:117–123.
10. Atanasijević T, Popović V and Aleksandrić B. Sudskomedicinska obdukcija i ekshumacija. In: V Popović and T Atanasijević, urednici. *Sudska medicina*. Belgrade: CIBID Medicinskog fakulteta Univerziteta u Beogradu, 2013, p.42.
11. Kotovicz F, Mauad T and Saldiva PHN. Clinico-pathological discrepancies in a general university hospital in Sao Paulo, Brazil. *Clinics* 2008;63:581–588.
12. Shojania KG, Burton EC, McDonald KM, et al. Changes in rates of autopsy-detected diagnostic errors over time: a systematic review. *JAMA* 2003; 289:2849–2856.
13. Jurić G, Tentor D and Jakić-Razumović J. Autopsy findings and clinical diagnoses: retrospective study of 3,117 autopsies. *Croat Med J* 1999;40:71–76.
14. Vougiouklakis T, Fragkouli K, Mitselou A, et al. A comparison of the provisional clinical diagnosis of death with autopsy findings. *Rom J Leg Med* 2011;19:177–182.
15. Bombí JA, Ramírez J, Solé M, et al. Clinical and autopsy correlation evaluated in a university hospital in Spain (1991–2000). *Pathol Res Pract* 2003;199:9–14.
16. Mort TC and Yeston NS. The relationship of pre mortem diagnoses and post mortem findings in a surgical intensive care unit. *Crit Care Med* 1999;27:299–303.
17. Maris C, Martin B, Creteur J, et al. Comparison of clinical and post-mortem findings in intensive care unit patients. *Virchows Arch* 2007;450:329–333.
18. Battle RM, Pathak D, Humble CG, et al. Factors influencing discrepancies between premortem and postmortem diagnoses. *JAMA* 1987;258:339–344.
19. Avgerinos DV and Björnsson J. Malignant neoplasms: discordance between clinical diagnoses and autopsy findings in 3,118 cases. *APMIS* 2001;109:774–780.
20. Veress B and Alafuzoff I. A retrospective analysis of clinical diagnoses and autopsy findings in 3,042 cases during two different time periods. *Hum Pathol* 1994;25:140–145.
21. Cameron HM, McGoogan E and Watson H. Necropsy: a yardstick for clinical diagnoses. *BMJ* 1980;281:985–988.
22. Friederici HHR and Sebastian M. Autopsies in a modern teaching hospital. *Arch Pathol Lab Med* 1984;108:518–521.