

Do we still need the autopsy? Clinical diagnosis versus autopsy diagnosis

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Abstract: The autopsy is one of the main tools for the evolution of medicine. Nevertheless, the autopsy rate declined worldwide in the last decades due to several reasons: progress in diagnosis of diseases, fear of legal consequences if a wrong diagnosis is proved, refusal of the deceased's family, reluctance of forensic pathologists and pathologists because of infectious risk and time consumption. However, despite the huge progress of medical science, discrepancies between the death diagnosis established by the clinician and the diagnosis established by the pathologist after performing the autopsy still exist and have remained relatively constant over the last 50 years. Our study aimed to identify the concordance rate between the cause of death established in the hospital and the cause of death established after performing the forensic autopsy and to determine the factors that could influence the concordance rate. The study group included 100 patients who died in hospital and underwent autopsy. We found a concordance rate of 45% which could be influenced by certain factors, such as: duration of hospitalization, inter-clinic consultation, mechanism of death, postmortem microscopic examination and the biochemical analysis performed during hospitalization. Our results support the fact that autopsy remains an essential tool for assessing the quality of care, for improving medical education process and for highlighting those diseases that represent "diagnostic challenges".

Key Words: autopsy, cause of death, diagnosis, concordance.

The evolution of medical science was heavily influenced by examination of corpses, a key method for the description, characterization and understanding of the functioning of the human body and of the effects of the diseases on the target organs; from 1950 until now, such studies have contributed to the understanding of more than 80 pathologies [1], and for a long time they have been considered to be a prerequisite for medical education and professional development [2].

However, in recent years, the rate of autopsy decreased dramatically worldwide, from approximately 60% in 1960 to 10% or less in 2005, both in the U.S. and Europe [2], with a minimum of 3.7% in France in 1997 [3]. This decrease is due to several factors,

including: progress in diagnosis of diseases, particularly the development of advanced medical imaging methods such as computer tomography and nuclear magnetic resonance [4]; the attitude of the deceased's family, which often opposes to autopsy [5]. Some authors [6-9] suggest the reluctance of the forensic experts and pathologists to perform the autopsy, possibly due to infectious risk and time consumption. More, several articles published in the last 5 years question the value of the autopsy [2, 10, 11], contributing in its turn to the declining of the autopsy rate.

Despite the progress in the diagnosis of various pathological or traumatic conditions, studies still find discrepancies between the cause of death recorded in

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the hospital and the cause of death established after performing the autopsy. Furthermore, the frequency of these discrepancies appears to have remained relatively constant over the last 50 years [12-18]. In addition, the discrepancies persist irrespective of the type of hospital or of patients (pediatric, neonatal, psychiatric or elderly) [6].

According to Romanian law, forensic autopsy is mandatory in cases of violent or suspect death, being requested by the police or prosecutor without asking consent from the deceased's family [19]. The clinicians can also ask for an autopsy in their dead patients to better understand the pathology and the cause of death; in such cases the autopsy is performed in the hospital's morgue and the deceased family's consent is compulsory.

MATERIAL AND METHOD

The overall objective of our study was to identify the concordance rate between the clinical cause of death and the cause of death established after performing the forensic autopsy. We also aimed at identifying the factors that could influence the rate of concordance between the two.

We conducted a retrospective study analyzing the medical files and the autopsy reports of 100 patients who died in hospital and underwent autopsy at the Institute of Forensic Medicine in Iasi, Romania. We included consecutive autopsies which met the study inclusion criteria, namely that the death had occurred in the hospital and the clinical diagnosis of death was established and written in the medical file. In all cases autopsy was requested by investigating authorities, as the death was violent, sudden or suspect.

The data collected was divided into: demographic (gender, age, residence); clinical (hospital and department in which the death occurred, number of days of hospitalization, whether the patient was transferred or not, whether he/she underwent surgery during hospitalization or if he/she received an inter-clinic consultation, biochemical and imagistic investigations); information about death and autopsy (type of death, mechanism of death occurrence, microscopic and toxicologic examination of the samples collected during the autopsy).

The concordance between the clinical diagnosis of death and the death diagnosis established by the forensic pathologist after finalization of the autopsy was assessed by applying the classification previously used in similar studies [4, 17, 20], as follows: class 1 - 100% concordance between the cause of death established in the hospital and the cause of death established after performing the autopsy; class 2 - discordance about preexisting illnesses; class 3 - partial discordance about the direct causes of death; class 4 - total discordance between the cause of death in hospital and the cause of

death at autopsy and class 5 - discordance concerning the underlying pathology and partial discordance regarding the direct causes of death. Each of the cases was classified in one category. If a case presented two types of discrepancies, it was classified in the category which corresponds to the worst error. Subsequently, the most frequently misdiagnosed, underdiagnosed or missed pathologies were identified.

The data was analyzed with the SPSS version 14, using descriptive and inferential tests with prior testing of data for co-linearity. Correlations between the explanatory variables of diagnostic concordance were calculated by several methods (Pearson coefficient, Spearman coefficient, Kendall coefficient, Fisher exact test, and cross-tabulation). For continuous variables (age and days of hospitalization) we calculated the indicators of the central tendency (mean and median).

Research of bibliography (Medline indexed journals) and search conducted in the PUBMED database using the keywords "autopsy", "diagnosis based on the autopsy", "diagnostic errors" "autopsy + death certificate", "autopsy results + clinical diagnosis", "cause of death, autopsy, clinical diagnosis" showed that up to this moment, no studies such as this have been performed in Romania.

RESULTS

The descriptive analysis of the study group showed that 69% of the patients were male and 31% female; the average age was 56.38 years (with a median of 57 years); 59% of the cases were from rural and 41% from urban areas. 80% of the patients died in surgery clinics, 13% in Emergency Rooms and 7% in internal medicine clinics. The average number of days of hospitalization was 4.98 (with a median of 3.5 days). The therapeutic approach during hospitalization included surgery in 55% of the cases and at least one inter-clinic consultation in 53% of the patients. 70% of the patients were admitted in an Intensive Care Units during their hospitalization.

Basic biochemical analysis was performed in 75% of patients (25% of them underwent the analysis specific to their disease), and 37% underwent basic imaging analysis while 63% underwent advanced imaging investigations (CT and MRI).

Analysis of the autopsy reports revealed that 77% of the deaths were of violent causes, 18% of pathological causes and 5% were caused by both by violent and pathological factors. In 69% of the cases organ samples were collected for microscopic examination. Most commonly the death was determined by respiratory failure (39% of cases), followed by coma induced by brain damage (24%), shock and multi-organ failure (20%), cardio-vascular failure (16%) and renal failure (1%). Toxicologic examination for determining the blood alcohol concentration was performed in 28 cases and in 5

cases a general toxicological analysis was carried out.

The overall concordance between the cause of death established by the clinician and the cause of death established by the forensic pathologist was of 45% and at least one mismatch was identified in 55% of the cases. In 40% of the cases partial discordances concerned the direct cause of death. Total discordance between the two diagnoses was recorded in 4% of cases, in these cases the clinician considering that another organ / system is responsible for death compared with the findings of the forensic pathologist. In 9% of the cases, errors regarding the underlying pathology occurred; among them, liver cirrhosis was the most common omission in patients who died during the first 24 hours after admission in the hospital.

Analysis of the factors that could influence the diagnostic concordance rate revealed a statistically significant correlation with the duration of hospitalization, inter-clinic consultation, mechanism of death, postmortem microscopic examination and biochemical analysis performed during hospitalization. „Duration of hospitalization”, „postmortem microscopic examination” and the „biochemical analysis performed during hospitalization” are continuous variables also selected by other authors in similar studies [4, 21-23]. „Inter-clinic consultation” and „mechanism of death” are variables created by the authors of this study; we did not find the analysis of these variables in the literature reviewed.

Statistically significant correlation was observed between the variable "duration of hospitalization" and diagnostic concordance ($p < 0,05$). The cross-tabulation for the number of hospitalization days and the diagnostic concordance showed a better concordance rate for a shorter duration of hospitalization. The average of the perfect diagnostic concordance for the first 3 days of hospitalization was 51.56% (compared to the general rate of 45%), and the average concordance for 3-10 days of hospitalization decreased to 36.56%.

The patients who underwent an inter-clinic consultation (53%) had an overall error rate of 62.3%, while patients who did not need an inter-clinic consultation (47%) had an overall error rate of 45.67%, this difference being statistically significant ($p < 0,05$).

The postmortem microscopic examination has a statistically significant influence on the concordance rate both in terms of Pearson coefficient and non-parametric coefficients (Kendall and Spearman) ($p < 0,05$). The cross-tabulation between the microscopic examination and the diagnostic concordance for death of pathological causes showed that the diagnostic concordance was perfect in cases in which post-mortem microscopic examination was performed. It may be noted that out of all deaths due to pathological causes, in 87.5% cases microscopic examination was performed (compared with the overall rate of 69%).

The Fischer test with the dichotomously transformed data revealed a direct proportionality relationship between the biochemical analysis performed during hospitalization and the concordance between the cause of death established by the clinician and the one established by the forensic pathologist ($p < 0,05$), meaning that the increase in the complexity of biochemical investigations determines an increased concordance rate.

We found an overall number of 71 discordant diagnosis, of which 65 were missed by clinicians and 6 were considered valid in the hospital but were not confirmed at autopsy. In certain cases, we observed multiple discordant diagnosis, recorded by us as separate entities (because we are interested in the share of the pathological entities in the total discrepancies and not in the discordance rate).

The strongest correlation was recorded between the mechanism of death and the diagnostic concordance ($p < 0,01$). Compared with the overall concordance rate of 45%, some mechanisms are very likely to generate discordances. The most common causes of error were in the field of the respiratory pathology (44.61% of the total discordance), most commonly: hypostatic bronchopneumonia (65.51%), pulmonary oedema (17.24%) and pleural effusion (6.89%). Three out of the six diagnoses recorded in hospital as a cause of death, but not confirmed at autopsy, were also in the field of respiratory diseases (pulmonary edema, chronic respiratory failure and pneumonia).

Head trauma determined 43.07% of all the discordant diagnosis. For this type of injury, the most frequent errors were by omission - failing to diagnose in hospital subarachnoid hemorrhage (25%), subdural hematoma (10.71%) and intracerebral hematoma (7.14%).

A significant percentage of these errors concerned undiagnosed fractures (42.85%), most commonly located at the base of the skull (25%, compared with 10.71% for cranial vault fractures). Fractures of the C6 vertebra were missed in 7.14%, and in one case a diagnosis of C5-C6 fracture was recorded in the medical observation chart, but was not confirmed at the autopsy.

DISCUSSIONS

We found an overall concordance of 45% between the cause of death established by the clinician and the cause of death established by the forensic pathologist and at least one mismatch in 55% of the cases. These results are concordant with the results of other similar studies.

In a study on forensic autopsies, Ermenc found an overall concordance rate of 48.87%, while partial and total discordance were recorded at a rate of 36.24% (22.74% and 13.50% respectively) [17]. A second study, conducted by the same researcher, using the same classification, revealed a rate of 9.87% of total discordance and a

rate of 27,55% of partial discordance due to the partial disagreement on the cause of death or disagreement about the underlying pathology (20.68% and 6.87% respectively) [20]. Pakis conducted a study on the cases in which the clinicians had been accused of malpractice [18], and the result showed a concordance rate of 49.1%.

A retrospective study on 252 forensic autopsies found a complete concordance between the clinical diagnosis and the diagnosis established by the forensic pathologist in only 29% of the cases, the low value being explained by the high percentage (42%) of cases where the autopsy request did not include the clinician's diagnosis [4].

Studies on the concordance between the clinical diagnosis and autopsy diagnosis conducted in the Pathology Departments in hospitals showed that the commonly undiagnosed pathology and causes of death vary according to the profile of the hospital, but the error rate is comparable to that obtained in studies conducted in forensic medicine facilities. A study that compared the concordance rates recorded in the intensive care unit, surgery department and geriatrics-gerontology department and the corresponding Pathology Departments, found similar discrepancy rates (27.8%, 32.7% and 31.3% respectively), although a significant difference between the level of patients' investigation was recorded [24].

A study in the Pathology Departments of the Kharian Military Hospital, showed a rate of 20% for class I and II Goldman discrepancies. [25] Another study, conducted in departments of internal medicine and surgery revealed a discrepancy rate of 11.6% [26].

Roosen's study in ICUs revealed a rate of 26% of type I and II Goldman class errors (16% and 10% respectively) [27]. A five years study in ICUs in Helsinki, on 388 patients who died [28] found a 95% concordance rate between the diagnosis established by the ICU physician and the diagnosis established by the pathologist [29]. One reason for this high rate could be the fact that the department has a strong policy in favor of performing autopsies in all the deceased patients (346 out of the 388 dead patients were autopsied).

The lowest discrepancy rates have been reported in the burns medical units and trauma units, where some studies reported discordance rate of only 3% [31].

Our findings indicated that the duration of hospitalization influence the concordance rate in the sense that a better concordance rate corresponds to a shorter duration of hospitalization, this conclusion being similar to that obtained by other studies [22], probably due to the direct relationship between the incidence of nosocomial pathology, that is difficult to diagnose, and the duration of hospitalization.

However, the results of different studies on this aspects are contradictory. A study by Ong *et al.* [21] concluded that the concordance rate increases with

the duration of hospitalization up to 28 days, then this relationship is no longer observed. Tavora *et al.* observed this relationship, but without the time limitation of the aforementioned study; the average discordance rate was 27% for those hospitalized for less than 1 day, 18% for the duration of hospitalization between 1 day and 1 week and 11% for hospitalization longer than 1 week [32].

On the other hand, Mort *et colab.*, in a study conducted in a surgical ICU ward, concluded that for a duration of hospitalization of less than 48 hours the chances for a concordant diagnosis are three times higher; the longer the hospitalization the lower the chances for a concordant diagnosis. More, the patients with at least one major discordance between clinical diagnosis and post-mortem diagnosis had a median duration of hospitalization two times higher than those who had a perfect diagnostic concordance [22].

The variable inter-clinic consultation was not used in any of the studies described in the literature documenting this work. In our study the group that underwent inter-clinic consultation registered a rate of partial discordance of 47.2% vs. 32.6% in the group without an inter-clinic consultation, probably because the need for an inter-clinic consult suggests the existence of many symptoms showing the suffering of multiple organs and systems, and can be considered an indicator of the complexity of pathology and diagnosis. However, the inter-clinic consultation ensures a decrease of the discordance rate with respect to the underlying pathology (5.7% vs. 10.9%).

Our findings showed that the microscopic examination increases the chances for a concordant diagnosis.

Some reports and studies, however, consider that this examination has a weak contribution to establishing the post-mortem diagnosis [11] and draw attention of the forensic pathologists and pathologists to the high costs and the time required to perform it.

On the other hand, there are studies supporting the value of the microscopic examination. Zaitoun *et al* [33] collected 6-12 organ samples for each of 108 autopsied cases. The results indicated that 5% of the major diagnoses and 23% of the diagnostic errors were found only after this examination, concerning mainly the respiratory system (bronchopneumonia, pulmonary fibrosis and emphysema).

In 2004, Grade *et al.* compared the discordance rate obtained in their research with the results of a similar research performed during the period 1978-1980 at the same hospital [34]. The results showed a similar frequency of the diagnostic error of 35% for those autopsies in which no tissues were harvested for microscopic examination. The error rate was significantly lower in the autopsies that included microscopic analysis, the authors considering that the two variables (rate of concordance and microscopic examination) are correlated. This can

be explained by two mechanisms: first, some clinical diagnosis cannot be confirmed by gross examination, the characteristic changes in these pathologies being revealed only by microscopic examination; second, an autopsy that does not include this examination may be a source of discordances itself, influencing the results and feedback on the medical performance.

Our results suggest that there is a direct proportionality relationship between the variable biochemical analyzes performed during hospitalization and the concordance between the diagnosis of death established by the clinician and the one established by the forensic pathologist; furthermore, increasing the complexity of biochemical investigations determines an increased probability of concordance. An opposite conclusion is drawn by Scordi-Bello *et al.* who showed that there is no statistically significant difference between the groups concordant/ discordant according to the type and the complexity of the investigations. They dismissed the hypothesis that the amount of ante-mortem investigation correlates with a better diagnostic accuracy chipping [24].

Our study found that the pathology of the respiratory system is the main source of diagnostic discrepancies, as showed by the literature data. Thus, most of the articles published so far on this subject emphasize that there are some frequently overlooked or undiagnosed diseases in determining the cause of death

by the clinicians such as pneumonia [18, 26, 29]. Silfvast indicates in his study a discrepancy rate of 62% for this diagnosis [29] while Juric [26] pointed out the omission of this diagnosis in a proportion of 67.5% of the cases, mainly due to the coexistence of other diseases.

Another diagnosis of respiratory area, often overlooked, is pulmonary thromb-embolism [30], with a discordance rate of about 30%.

CONCLUSIONS

The cause of death diagnosed by the clinician in the hospital is not always consistent with the one established by the forensic pathologist after performing the autopsy. Depending on the hospital unit that conducted the study and the type of autopsy performed (anatomic-pathological vs. forensic), percentages of agreement / disagreement vary but remain high enough to justify performing the autopsy more often.

The results of our study, consistent with those in the literature, assert that the autopsy remains an indispensable tool in assessing the quality of care, improving medical education process and highlighting those diseases that raise "diagnostic challenges". In this context, the authors recommend performing the autopsy in all cases in which the physicians has doubts about the diagnosis of death, to ensure the progress and improvement of medical practice.

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