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Diagnostic errors; the need to have autopsies

C.M. Aalten, M.M. Samson*, P.A.F. Jansen

Department of Geriatric Medicine, University Medical Centre, PO Box 85500, 3508 GA Utrecht, the Netherlands, *corresponding author: tel.: +31 (0)30-250 82 80, fax: +31 (0)30-254 49 63, e-mail: m.samson@azu.nl

ABSTRACT

Introduction: In geriatric patients, atypical presentation and limitations in diagnostic scope may lead to underdiagnosis. The aim of this study was to establish the frequency, nature and causes of clinical diagnostic errors in a geriatric population.
Design: A retrospective study.
Methods: We assessed the accuracy of clinical diagnosis using autopsy results as our gold standard. Factors likely to influence accuracy of clinical diagnosis were identified. We used the (modified) classification of Goldman *et al.* to define discrepancy.
Results: We analysed 93 autopsies of a total of 331 deaths (28%). Discrepancies in major diagnoses were seen in 36 cases (39%). In 17 of these, clinical management might have been different if the diagnosis had been made premortem. These were: pulmonary embolism (4); unrecognised infection (4); intestinal ischaemia (3); ruptured aortic aneurysm (2); malignancy (1); tracheal obstruction (1); intestinal obstruction (1) and acute pancreatitis (1). Discrepancies in minor diagnoses were seen in 46 cases (50%). About one third of these were clinically relevant. Discrepancies occurred more frequently if there was a degree of uncertainty about clinical diagnosis (p<0.001).
Conclusion: Major discrepancies between clinical diagnosis and autopsy findings were seen in 39% of our study population. They occur more often in the case of uncertain clinical diagnosis. Our findings stress the continuing and important role of autopsy in improving clinical practice in geriatric medicine.

KEYWORDS

Autopsies, diagnostic errors, geriatric medicine

INTRODUCTION

When it comes to diagnostic accuracy, autopsy is – and probably will remain for some time to come – the gold standard. Autopsy has been in use as a diagnostic tool for more than 3000 years. The Sumerians used animal entrails for divination of the future. The ancient Greeks used autopsy for the study of human anatomy. Galen made the link between visible pathology and disease. But it was not until the Renaissance in Europe that autopsy became standard practice. The famous Dutch physician Herman Boerhaave established the link between clinical syndromes and postmortem findings.[1] After the heyday of autopsy in the 19th and early 20th centuries, the technique has seen a steady decline in popularity. Nowadays, autopsy rates of 5% are no exception.[2]
Yet autopsy remains a valuable tool to evaluate the diagnostic and therapeutic process. Especially in the geriatric population because both the atypical presentation of disease and limitations in diagnostic scope may lead to underdiagnosis of potentially treatable disorders. The aim of this study was to establish the prevalence of diagnostic error in a geriatric population, using autopsy findings as our gold standard. Furthermore, we identified factors, both general and specifically geriatric, which were likely to negatively influence clinical diagnostic accuracy.

MATERIALS AND METHODS

Setting

The study was conducted in the Department of Geriatric Medicine of the University Medical Centre Utrecht, a large university-affiliated teaching hospital. The ward admits patients for both acute geriatric medicine and geriatric rehabilitation.

Selection of cases

From the hospital records, we identified all patients who had died while admitted to the geriatric ward of the

University Medical Centre Utrecht and on whom autopsy was performed between 1 July 1992 and 31 December 2002. Only those who died of natural causes were included.

Method

The clinical notes and autopsy reports were reviewed independently by the same reviewer (CMA). From the clinical notes, data were identified on age, gender, length of admission, extent of diagnostic or therapeutic intervention, major and minor diagnoses, level of certainty of diagnosis and whether or not death was expected. From the final autopsy reports, we identified major and minor diagnoses, extent of autopsy and clinical questions asked by the attending physician

Both clinical and autopsy diagnoses were classified according to ICD 10 (International Classification of Disease, tenth edition). Diagnoses were grouped into seven categories: cardiovascular disease, pulmonary disease, neoplastic disease, gastrointestinal disease, systemic infection, renal disease and miscellaneous (remaining diagnoses).

Discrepancies were classified according to the method of Goldman *et al.*,[3] modified by Battle *et al.*[4] (*table 1*). Class 1 errors were defined as discrepant major diagnoses, the knowledge of which antemortem might have led to changes in clinical management and to prolonged survival. Class 2 errors were discrepant major diagnoses, the knowledge and treatment of which would not have prolonged survival. Class 3 errors were discrepant minor diagnoses that would have been treated if known and class 4 errors were discrepant minor diagnoses of possible epidemiological or statistical importance. The remainder were classified as nondiscrepant (class 5) or nonconclusive (class 6). If more than one error occurred in the same case, it was classified according to the worst one.

Assessment

The chief investigator (CMA) identified all discrepancies between clinical and autopsy findings. Those discrepancies were reviewed by all three investigators, who classified them individually and independently. Consensus was sought between the three investigators.

Statistics

To establish correlations and statistical significance, we used Pearson's χ^2 test and Student's T test. All calculations were made using SPSS 10.0.5 statistical software.

RESULTS

In the period under study, 331 people died and 94 autopsies were performed (autopsy rate 28.4%). One of these was a coroner's autopsy and this was excluded from analysis. Therefore, 93 autopsies were used in our analysis. In this population, there were 45 males and 48 females. The average age at death was 81.6 (60 to 102) years. There were 12 full autopsies (both body and skull), 80 body only and one skull only. In 74 cases, there was a completed clinical request for autopsy, including clinical questions to be answered by the pathologist. In 72 cases, all clinical questions could be answered by the pathologist.

According to the classification presented in *table 1*, there were 17 (18.3%) class 1 errors; 19 (20.4%) class 2 errors; 7 (7.5%) class 3 errors and 15 (16.1%) class 4 errors. Thirty-one cases (33.3%) were nondiscrepant and in four cases (4.3%), neither the clinician, nor the pathologist could identify the probable cause of death. In 24 cases, major and minor errors occurred together, making a total of 46 cases (50.5%) in which minor errors were identified.

Major diagnostic errors occurred significantly more often if there was a degree of uncertainty about diagnosis antemortem ($p<0.001$). Age, gender or length of final admission did not correlate with the occurrence of major diagnostic errors. Neither did the occurrence of sudden death or conscious decisions to limit the scope of diagnostic interventions (*table 2*).

Table 1. *Classification of clinical diagnostic error*[2,3]

Class	Definition	Examples
1	Discrepancy in major diagnosis. Knowledge before death would have led to a different management that could have prolonged survival or cured the patient	Pulmonary embolism treated as pneumonia Tuberculosis diagnosed and treated as malignancy
2	Discrepancy in major diagnosis. Knowledge before death would not have led to longer survival, even with correct treatment	Osteomyelitis as the source of a systemic sepsis in patient dying of multiorgan failure
3	Discrepancy in minor diagnosis not directly related to cause of death, but with symptoms that should have been treated or would have eventually affected prognosis	Carcinoma of the lung in patient dying of a ruptured aneurysm, Peptic ulceration in patient dying of pulmonary embolism
4	Discrepancy in minor diagnosis with possible epidemiological or genetic importance	Goitre Asymptomatic gallstones
5	Nondiscrepant diagnosis	
6	No satisfactory diagnosis was found clinically or on autopsy to explain death	Patient died suddenly without clear indication of underlying disease. Autopsy did not elucidate cause of death

Each case is classified only once according to the worst occurring diagnostic error.

The autopsy diagnoses of the class 1 errors were as follows: pulmonary embolism (4); unrecognised infection (4); intestinal ischaemia (3); ruptured aortic aneurysm (2); malignancy (1); tracheal obstruction (1); intestinal obstruction (1) and acute pancreatitis (1).
Clinical diagnostic accuracy was highest for pneumonia (77.8%) and neoplastic disease (63.6%) and lowest for pulmonary embolism (16.7%) (*table 3*).

DISCUSSION

Our main finding was that major diagnostic errors occur in 39% of our population. Of these 17 were class 1 errors, the knowledge of which antemortem would or could have led to a different management and possibly improved survival. The other 19 are class 2 errors, the knowledge and correct treatment of which antemortem would not have improved survival. This illustrates the ongoing importance of autopsy as an instrument of feedback on the clinical diagnostic and therapeutic process in geriatric medicine. Our percentage of diagnostic errors compares quite unfavourably with several other studies.[3,5] In a major review on this subject, Shojania *et al.*[6] found a median major error rate of 23.5% (range 4.1 to 49.8%) and a median class 1 error rate of 9% (range 0 to 20.7%).
There are several possible causes for our relatively high error rate. First, the average age at death in our study was 81.9 years, which is considerably higher than the average in other large studies. Very little is known in the literature about the prevalence of diagnostic errors in the geriatric population as compared with the general population.[7-9]
Increasing age was found to negatively influence diagnostic accuracy in the study by Battle *et al.*,[4] but not in ours. It is likely that this can be explained by the relative homogeneity of our population. With one exception, all our cases would fall within the highest age bracket of their study (65 years and older).
In our opinion, an atypical disease presentation and conscious decisions not to pursue possible lines of diagnostic investigation both contribute to the high percentage of major diagnostic errors. Atypical presentation is common in the geriatric age group. Diseases and disorders may manifest by a paucity or total absence of classical symptoms and only present with general and atypical signs such as fatigue and anaemia. It is important to realise that conscious restrictions in the scope of investigations in the geriatric population does not stem from ageism or nihilism. Frequently, geriatric clinicians refrain from further investigation at the express request of the patients or their relatives. This is motivated by concerns about the impact of the proposed tests on the patient's immediate well-being and the consequences of the possible findings. If there is no suitable therapy for this particular patient, it may be wise not to investigate the possible presence of the disease. These decisions are made on an individual basis, taking into account factors such as comorbidity and physical performance.
These factors lead to a situation in which we are not treating our geriatric patients by the bright neon light of 21st century medical science, but by the flickering candle of the 19th century. This uncertainty may lead to the adoption of the 19th century's post hoc approach to diagnosis by increasing the number of autopsies in the higher age groups.

Table 2. *Factors influencing major error rate*

	Number of autopsies	Major errors		
		n	%	
Total	*93*	*36*	*(39.8)*	
Sex				
- Male	45	18	(40)	NS
- Female	48	18	(37.5)	NS
Clinical diagnosis				
- Certain	30	1	(2.8)	P<0.001
- Uncertain	63	35	(53.8)	
Sudden death	30	14	(46.7)	NS
Expected death	63	22	(34.9)	NS
Age				
- <80 years	35	15	(41.7)	NS
- >80 years	43	18	(41.9)	NS
Full diagnostic scope	50	18	(36)	NS
Final admission				
- <1 week	18	7	(38.9)	NS
- 1 week-1 month	61	20	(32.8)	NS
- >1 month	24	9	(37.5)	NS

P<0.05 was considered statistically significant. NS = nonsignificant.

Table 3. *Predictive value of clinical diagnosis and accuracy of clinical diagnosis as compared by autopsy diagnosis*

	Total	Confirming clinical major diagnosis	%
Autopsy major diagnosis			
Cardiovascular			
- Myocardial infarction	7	4	57.1
- Congestive heart failure	3	1	33.3
- Other	6	4	66.7
Pulmonary			
- Pneumonia	18	14	77.8
- Pulmonary embolism	6	1	16.7
- Other	2	1	50
Neoplastic disease	22	14	63.6
Gastrointestinal disease	11	5	45.5
Systemic infection	7	3	42.9
Renal disease	1	1	100
Miscellaneous	7	6	85.7
Unknown	3	3	100
Clinical major diagnosis			
Cardiovascular			
- Myocardial infarction	5	4	80
- Congestive heart failure	2	2	100
- Other	4	4	100
Pulmonary			
- Pneumonia	21	15	71.4
- Pulmonary embolism	1	1	100
- Other	4	2	50
Neoplastic disease	23	14	60.9
Gastrointestinal disease	8	5	62.5
Systemic infection	10	4	40
Renal	3	0	0
Miscellaneous	8	6	75
Unknown	4	0	0

The range of class 1 diagnostic errors was found to be quite similar to other studies: pulmonary emboli, infections, intestinal ischaemia, ruptured aortic aneurysm, malignancy, intestinal obstruction and acute pancreatitis were seen in our study. In his study, Goldman[3] also found a high number of unrecognised myocardial infarctions. We found none. This may be due to improved diagnostic options in the past 20 years. Pulmonary embolism is still frequently missed despite improved diagnostic tools. This may be due to a low index of suspicion. Two cases of ruptured aortic aneurysm were missed in our study. It is debatable whether these should be called class 1 errors. We decided to do so, because both diagnosis and treatment (acute surgery) are feasible even at a high age. Contrary to the younger age group, ischaemic intestinal disease has relatively few symptoms (diarrhoea and moderate leucocytosis) and may be easily missed or mistaken for other disease. The absence of typical or classical signs and symptoms in general may lead to uncertainty in diagnosis. Fever is often absent in infectious disease in the elderly. Older people frequently have an altered awareness of pain. Major metabolic disturbances such as hyperglycaemia and renal failure present with amazingly mild symptoms. Furthermore, patients with delirium or dementia are less capable of indicating their complaints.

Diagnostic errors go both ways. As *table 3* illustrates, major disease groups are both overdiagnosed and underdiagnosed. When interpreting the results of this table, it is important to keep in mind that for the purposes of this study, only one major diagnosis, both clinical and on autopsy, was allowed. It is very possible that a patient who was clinically classified as having died of cancer was found on autopsy to have died of an acute myocardial infarction, although the cancer was also confirmed. Findings that were felt not to have immediately led to the decease of the patient were classified as minor findings. It happened only very rarely that a major clinical diagnosis was not confirmed either as a major or as a minor autopsy diagnosis.

Minor diagnostic errors were seen in approximately half of all our cases (49.5%). Sonderegger[5] found a rate of 46%.

However, this cannot be compared because we found that minor errors frequently occurred together with major errors and both were counted. The sum total of class 3 and class 4 errors in our study was 23.6%.

Frequent unsuspected minor autopsy findings were scars from old myocardial infarctions, diverticular disease of the colon, generalised arteriosclerosis evidence of previous tuberculosis, renal cysts and thyroid nodules.

There are several limitations to our study. First, its retrospective design. Second, the low percentage of autopsy and finally, the fact that it is limited to patients admitted to one geriatric ward. It would be interesting to compare our findings to those of a similarly aged population of a general medical ward.

Further research in this interesting topic is necessary. A prospectively designed multicentre study with involvement of both geriatric and general medical wards may show whether our findings are typical for either the age group or for the geriatric population.

In conclusion, our findings stress the continuing and important role of autopsy in improving clinical practise in geriatric medicine.

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