Original Paper

The clinical diagnostic accuracy rate regarding the immediate cause of death in a hospitalized geriatric population; an autopsy study of 1594 patients

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Die klinisch-diagnostische Treffsicherheit hinsichtlich der unmittelbaren Todesursache bei hospitalisierten geriatrischen Patienten; eine Autopsie-Studie bei 1594 Patienten

Zusammenfassung. Die Obduktionsfrequenz in der Gruppe der geriatrischen Patienten ist generell niedrig. Dieser Umstand führt zu einer Todesursachenstatistik, die großteils auf klinisch erhobenen Todesursachen beruht.

Ziel unserer Studie war die klinisch – diagnostische Treffsicherheit hinsichtlich der unmittelbaren Todesursache bei hospitalisierten geriatrischen Patienten zu erheben.

Klinisch angegebene und autoptisch gesicherte Todesursachen wurden bei 1594 Patienten, aus der Gruppe der über 69-Jährigen, verglichen. Die unmittelbare Todesursache wurde einer von sechs Todesursachengruppen zugeordnet: Kardiovaskuläre Erkrankungen (CV), maligne Neoplasmen (MN), bronchopulmonale Erkrankungen (BPE), Pulmonalembolie (PE), verschiedene (V) und Marasmus (M).

Insgesamt betrug die klinisch-diagnostische Treffsicherheit hinsichtlich der unmittelbaren Todesursache 52,5 %, sie war am höchsten in Fällen von MN (65,0 %), gefolgt von CV (56,0 %), M (50 %), BPE (48,3 %), V (44,3 %) und PE (26,6 %). Die häufigste Todesursachengruppe war CV (35,8 %), gefolgt von MN (24,3 %), BPE (19,8 %), PE (10,6 %), V (7,7 %) und M (1,9 %).

Die niedrige klinisch-diagnostische Treffsicherheit hinsichtlich der unmittelbaren Todesursache in unserer Studie weist auf die Notwendigkeit einer hohen Obduktionsfrequenz hin, um valide Todesursachenstatistiken zu erhalten.

Schlüsselwörter: Obduktion, Geriatrie, Mortalität, Todesursachenstatistik.

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Summary. *Background:* In the geriatric population the autopsy rate is low, leading to mortality statistics often based on clinical diagnoses alone.

Objectives: To determine the clinical diagnostic accuracy rate regarding the immediate cause of death (CDARCD), the number of major underlying diseases and sole diagnoses, and general data about the immediate cause of death in geriatric hospitalized patients.

Methods: The autopsy proven immediate cause of death was compared with the clinical diagnosis in 1594 patients over 69 years of age. Based on the autopsy protocols, the mean number of major underlying diseases and sole diagnoses were calculated. The immediate cause of death was classified into six groups: cardiovascular disease (CVD), malignant neoplasms (MN), bronchopulmonary disease (BPD), fatal pulmonary embolism (PE), miscellaneous (M), and marantic atrophy (MA).

Results: The overall CDARCD was 52.5 %, being highest in MN (65.0 %), followed by CVD (56.0 %), MA (50 %), BPD (48.3 %), M (44.3 %), and PE (26.7 %). The most common cause of death was CVD (35.8 %), followed by MN (24.3 %), BPD (19.8 %), PE (10.6 %), M (7.7 %) and MA (1.9 %). The mean number of major underlying diseases and sole diagnoses was 2.0 and 14.4 respectively.

Conclusions: The low CDARCD in our study strongly indicates the need for autopsy when reliable mortality statistics are desired.

Key words: Autopsy, geriatrics, vital statistics, mortality, cause of death.

Introduction

Worldwide, the population continues to get older [1–4]. The average life expectancy in Austria has risen within ten years from 72.4 years for males and 79.1 years for females (1991), to 76.0 and 81.7 respectively (2001) [5].

These figures show that an increasing population of the elderly requires additional medical care and this has led to the specialty of geriatrics [2, 6]. In the geriatric age group the cause of death often is determined by clinical

diagnosis alone, thus leading to data for mortality statistics that are often unconfirmed by autopsy studies [3].

A major characteristic of the geriatric patient is the presence of multimorbidity and polypathy, partly reflected by the number of major underlying diseases and sole diagnoses [4, 7–11].

As proved by autopsies, which remain one of the most reliable methods to validate clinical diagnoses, clinical diagnostic inaccuracies in hospitalized patients range from 6 % to 60 % [12–18].

The aim of this autopsy study was to obtain autopsy proven data about the causes of death in a geriatric hospitalized population over a seven-year period and to determine the clinical diagnostic accuracy rate regarding the immediate cause of death (CDARCD), the number of major underlying diseases, and the number of sole diagnoses.

Materials and methods

The study is based on 1594 consecutive autopsies (autopsy rate: 45 %) carried out between the years 1995 and 2002, and performed on patients over 69 years of age. The autopsies were performed in our institution, which is the pathologic department of a 1300 bed-hospital in Vienna, Austria, with psychiatric, surgical, internal, neurological, orthopaedic, and geriatric departments. The study group consisted of 901 females (56.5 %) and 693 males (43.5 %); the patients age ranged from 70 to 106 years (mean: 82.3 years).

A computerized database (©microsoft excel) was created including data of postmortem diagnosis of the immediate cause of death, the number of major underlying diseases, and the number of sole diagnoses in each single case.

The clinical diagnosis of the immediate cause of death was compared with the autopsy proven, graded correct when equal, and incorrect when unequal. Cases with no clinical diagnoses stated on the autopsy assignment were graded as unclear, but classified as incorrect when calculating the CDARCD.

The autopsy-proven immediate causes of death were further classified into six groups: cardiovascular disease, malignant neoplasms, bronchopulmonary disease, fatal pulmonary embolism, miscellaneous, and marantic atrophy, the latter reflecting the inability to find an unequivocal morphology of the immediate cause of death at autopsy.

Results

The most common cause of death was cardiovascular disease (570, 35.8 %), followed by malignant neoplasms (388, 24.3 %), mainly bronchial carcinoma (242, 62.4 %), bronchopulmonary disease (315, 19.8 %), including pneumonia and severe emphysema, fatal pulmonary embolism (169, 10.6 %), miscellaneous (122, 7.7 %), and marantic atrophy (30, 1.9 %) (Table 1, 2).

The number of major underlying diseases and sole diagnoses ranged from 1 to 5 (mean 2.1) and 1 to 33 (mean 14.4) respectively (Fig. 1).

Clinical diagnoses were correct in 837 cases (52.6 %), incorrect in 425 (26.7 %), and unclear in 332 (20.8 %, Table 3).

The overall CDARCD was 52.5 %, being highest in malignant neoplasms (65.0 %), followed by cardiovascular disease (56.0 %), marantic atrophy (50 %), broncho-

Table 1. Immediate cause of death and clinical diagnostic accuracy rate regarding the immediate cause of death (CDARCD)

Cause of death	No./%	CDARCD %
Cardiovascular disease	570/35.6	56.0
Malignant neoplasms	388/24.3	65.0
Bronchopulmonary disease	315/19.8	48.3
Fatal pulmonary embolism	169/10.6	26.6
Miscellaneous	122/7.7	44.3
Marantic atrophy	30/1.9	50.0
Total	1594/100	–
Mean	–	52.5

pulmonary disease (48.3 %), miscellaneous (44.3 %), and fatal pulmonary embolism (26.6 %, Table 1, 3).

Discussion

Over the past decades, a worldwide fall in the number of autopsies is evident in many countries [19–22].

According to Middleton et al., autopsy rates in the United States have declined from an average of 53 % in the 1940s to 18 % four decades later, and in the same period from 47 % to 11 % in patients over the age of 65 years [1]. Recently, Bombi et al. reported a fall of the autopsy rate in their institution (Barcelona, Spain) from 20 % in 1993 to 9.1 % in 2000 [19].

In highly specialized units, such as Intensive Care Units (ICU) or neonatal ICU, the fall is not so marked, in 1998, Dhar et al. reported an autopsy rate of 62 % in

Table 2. Miscellaneous causes of death

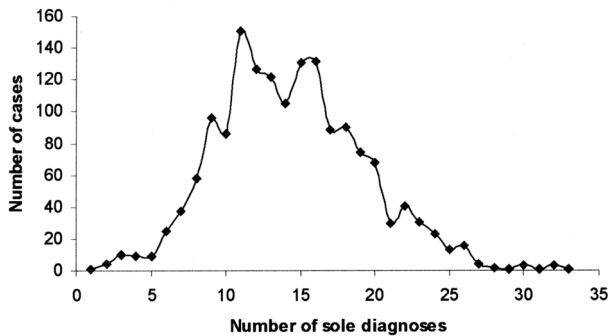| Cause of death	No./%
Pulmonary tuberculosis	37/30.3
Peritonitis	17/13.9
Gastrointestinal ulcer	11/9.0
Hepatocirrhosis	9/7.4
Cerebral bleedings	7/5.7
Acute pyelonephritis	6/4.9
Pulmonary fibrosis	6/4.9
Septicemia	4/3.3
Brain edema	3/2.5
Esophageal variceal bleeding	3/2.5
Ileus	3/2.5
Meningoencephalitis	3/2.5
Bolus death	2/1.6
Interstitial nephritis	2/1.6
Subarachnoidal bleeding	2/1.6
Thoracic empyema	2/1.6
Amyloidosis	1/0.8
Diverticulitis	1/0.8
Gastrointestinal bleeding	1/0.8
Hematothorax	1/0.8
Wegener's granulomatosis	1/0.8
Total	122/100

Fig. 1. Number of every single diagnose determined by autopsy including major and minor diseases / affections

a neonatal ICU in Canada, and in 2002 Tai et al. reported an autopsy rate of 22.3 % in an ICU in Cleveland, USA [12, 23–25].

At least for the US, a possible explanation for the decrease in overall autopsy rates could be the fact that in 1970 the Joint Commission on the Accreditation of Hospitals abolished the minimum limits for the performance of autopsies over all at 25 % in university teaching hospitals, and at 20 % in non-teaching hospitals [19]. The fact that autopsy is costly and not reimbursable, fear of litigation, and the tendency to believe that advances in medical technology provide greater diagnostic accuracy could have decreased the autopsy rates [12, 26, 27].

In our institution, however, between the years 1995 and 2002, there was an overall autopsy rate of 49,2 % and an autopsy rate of 45 % in patients over 69 years of age.

Research has documented the increasing validity of autopsy findings with increasing autopsy rates, as a result of the elimination of selection biases [1, 28, 29]. Our high autopsy rate thus acts to support the validity of our findings.

In our study, the CDARCD was 52.5 %. This is very low compared to published data about CDARCD in general. In a study of 1933 autopsies over a ten-year period, Bombi et al. could find a CDARCD of 92.7 %, the authors distinguished between major error (i.e. different International Classification of Diseases or misdiagnosis affected patients outcome) and minor error (i.e. no medical consequences), the resulting CDARCD was 96.2 % when only major errors were considered [19].

Our data, however, are similar to published data on the elderly patient. Gross et al. report a CDARCD of 60 % in 234 autopsied patients between 64 and 103 years (mean

84.5 years), and Bordin et al. noticed a good CDARCD in 44 % and a sufficient one in 18 % in their study of 114 patients with a mean age of 99 years [29, 30].

Middleton et al report a CDARCD of 65 % in patients over 64 years and 70 % in patients below 65 years and could not find significant age-related discrepancies in diagnostic accuracy rates [1].

In our study, the highest CDARCD was observed in MN (65.0 %), which is similar to Gross et al. (58 %), but lower than rates in an ICU (79 %) [12, 29]. This could probably be due to the overall reduction of invasive and non-invasive high-tech medicine diagnostic procedures in the geriatric population.

PE was a common finding in our study group (10.6 %) and had the lowest CDARCD with 26.6 %. In a review of the antemortem accuracy in diagnosing PE according to increasing age, Goldhaber et al. found that the elderly group was the most difficult population in which to obtain a correct antemortem diagnosis and found that this was associated with the presence of congestive heart failure and pneumonia. This association was confirmed by other authors [29, 31].

Our findings regarding the mean number of major underlying diseases (2.0) and the mean number of sole diagnoses (14.3), support the concept of the geriatric patient as having complex, multisystem disease presentations [1]. As Battle et al. write, "these discrepancies are presumably due to the influence of age on the clinical expression of diagnostic signs and symptoms and multiple diseases" [32].

We thus assume that multimorbidity and polypathy may mask clinical signs and has a negative effect on CDARCD.

Previous studies and our data show an overall low CDARCD in the geriatric population [29–31]. Reasons for this could be the reduction of diagnostic procedures in combination with the multimorbidity and polypathy in this population.

When confronted with the overall low CDARCD in the geriatric population, many colleagues argue that this has little impact on daily clinical practice, since correct clinical premortem diagnosis often would not have changed the patient's outcome, and the difference between clinical premortem diagnoses and pathological postmortem diagnoses is sometimes merely "academic" [1]. Albeit this may be true in many cases, and will remain substance for debate, a low CDARCD in combination with a low autopsy rate in the geriatric population lead to mortality statistics of doubtful value. Additionally quantitative and qualitative data of major and minor diseases, which

Table 3. Correct, incorrect, and unclear clinical diagnoses regarding the immediate cause of death

Autopsy diagnosis	Clinical diagnosis			Total No.
	correct-No./ %	incorrect-No./ %	unclear-No./ %	
Malignant neoplasms	252/65.0	53/13.7	83/21.4	388
Cardiovascular disease	319/56.0	136/23.9	115/20.2	570
Marantic atrophy	15/50.00	8/26.7	7/23.3	30
Bronchopulmonary disease	152/48.3	115/36.5	48/15.2	315
Miscellaneous	54/44.3	31/25.4	37/30.3	122
Fatal pulmonary embolism	45/26.6	82/48.5	42/24.9	169
Total	837/52.5	425/26.7	332/20.8	1594

are assumed to have additive and permissive effects in the general pathological processes in geriatric patients, are largely lost [7, 33, 34]. The average life expectancy continues to rise and treatment of the geriatric patient has to be further improved [3, 6]. We therefore need reliable data about the causes of death in the geriatric population and, to further our understanding of the pathological processes in multimorbidity and polypathy, quantitative and qualitative data about major underlying diseases and minor diseases. We agree with others, that autopsy is an invaluable tool to provide this data and emphasize the need for high autopsy rates in the geriatric population.

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