

ORIGINAL ARTICLE

Trends of accuracy of clinical diagnoses of the basic cause of death in a university hospital

M H C Grade, S Zucoloto, J K Kajiwara, M T P Fernandes, L G F Couto, S B Garcia

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See end of article for authors' affiliations

Correspondence to:
Dr M H C Grade,
Department of Pathology,
Ribeirão Preto Medical
School, University of São
Paulo, Av. Bandeirantes,
3900 - Campus FMRP,
USP, 14.049-000,
Ribeirão Preto, Brazil;
marcio@rpa.fmrp.usp.br

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Aims: To determine the agreement between clinical and necropsy diagnoses of the basic cause of death, and to compare the results with those obtained in a previous study carried out at the same university hospital.

Methods: In total, 4828 necropsies, performed between 1990 and 1995 in the University Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo, Brazil, were reviewed. Examinations were concluded at the macroscopic part of the necropsy in nearly 35% of the cases. Statistical analysis was carried out using the κ coefficient comparing the clinical diagnosis and the diagnosis obtained after necropsy. The jackknife method was used to identify comparable κ values for the comparison of the two periods.

Results: Compared with the 1978–80 period, a significant increase in diagnostic agreement was seen for the group submitted to complete necropsy, whereas no similar increase was detected when only the macroscopic step was analysed.

Conclusions: There was a discrete tendency to an improved correlation between clinical and postmortem data stated by full necropsy analysis. The findings show that microscopic analysis remains important to confirm the cause of death in many cases. Diagnostic discrepancies remained high, and therefore complete necropsy continues to be an essential instrument for the assessment of clinical diagnosis.

Since the publication of a study that related deaths to alterations in normal anatomy,¹ necropsy has been established as an effective method to identify new nosological entities and to improve the investigation of known pathological diseases.^{2–3} In addition to diagnostic and therapeutic errors, various diseases and their mechanisms have been established since then, and therapeutic methods have been developed based on postmortem data.⁴

Although necropsies are thought to be of crucial importance for medical teaching and for insuring the quality of medical care,⁵ a decline in the number of necropsies has been reported in several hospitals.^{6–10}

The diagnostic process is a complex interaction between knowledge, abilities, and technical procedures under conditions of uncertainty.¹¹ The technology available for diagnostic procedures has made great advances during the past few decades, particularly in terms of resources for diagnostic imaging techniques, such as computed tomography, ultrasonography, and nuclear magnetic resonance. However, these new technologies have also contributed to false positive and false negative diagnoses.¹² Considering necropsy as the gold standard for diagnostic confirmation, studies carried out during the past 20 years have shown important disagreement and have failed to show a significant increase in diagnostic agreement in the assessment of pathologies, groups of pathologies, groups of patients (neonatal, paediatric, elderly, and psychiatric patients), or even different locations, such as intensive care units and hospitals affiliated or not with a university.^{13–23}

“The technology available for diagnostic procedures has made great advances during the past few decades, particularly in terms of resources for diagnostic imaging techniques”

Another relevant aspect concerns the mortality statistics obtained from death certificate data. The accuracy of this

information should be assessed and some studies have already demonstrated severe inaccuracies in death certificates.^{24–26}

The aim of our present study was to determine the diagnostic agreement between clinical and necropsy diagnoses, and the role of macroscopic analysis in postmortem examination. On the basis of the results obtained, we also intended to assess the trends of accuracy of the clinical diagnoses made at our institution by comparing the results with those obtained in a similar study carried out during the period from 1978 to 1980.²⁷

MATERIALS AND METHODS

Providing medical care at the primary, secondary, tertiary, and emergency level, the University Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo (HCFMRP-USP), Brazil, is a public teaching hospital and considered to be a reference centre, where a high proportion of those patients who die are submitted to necropsy.

Necropsies carried out at HCFMRP-USP during the period from 1990 to 1995 were analysed. Our study was approved by the research ethics committee of the institution. Necropsies were performed by trainee pathologists, under direct supervision of the teaching staff of the department of pathology. Necropsies are not carried out until the medical chart of the deceased and the necropsy request are available. This request contains a clinical/laboratory resume and the International Model of Death Certificate, which has been filled out by the clinician.

The basic cause of death was identified within the sequence of morbid events based on three sources: necropsy

Abbreviations: HCFMRP-USP, University Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo; ICD, International Classification of Diseases

request (clinical diagnosis), death certificate filled out after macroscopic examination (macroscopic diagnosis), and the necropsy report, including histological, biochemical, and serological tests, which were necessary for the identification of the main disease responsible for the process that resulted in death (final diagnosis).

Each diagnosis was coded according to the categories of three characters of the 10th manual of the International Classification of Diseases (ICD-10).²⁸ The data obtained were grouped according to the 21 categories of diseases of the ICD (table 1). Still births, fetal deaths, and deaths of children aged less than 1 year were excluded from the analysis.

The population analysed was divided into three groups: group 1, comparison of the basic cause of death based on the necropsy request and that obtained after macroscopic examination; group 2, comparison of the clinical diagnosis and the final one, which includes complementary investigations, such as microscopy; and group 3, comparison of the macroscopic step with the final diagnosis.

The κ coefficient of agreement was calculated to compare the degree of diagnostic agreement between the groups. We regrouped the diagnoses according to the ninth revision of the ICD.²⁹ The data were then compared statistically with those from 1978–80,²⁷ using the jackknife method for the comparison of two independent κ values, except for group 3, because this comparison was not performed in the previous study.

RESULTS

In total, 8443 deaths occurred at HCFMRP-USP between 1990 and 1995, with 77.75% of those who died being submitted to necropsy. Among them, in addition to the categories excluded from our study as mentioned earlier, there were several cases for which public organisations other than the HCFMRP-USP were responsible as a result of legal requirements, such as the Legal Medicine Institute, even though the death had occurred at our hospital.

For the remaining 4828 necropsies, the three diagnoses were not available for all cases. Examinations were concluded

at the macroscopic part of the necropsy in almost 35% of the cases. Another factor for the lack of diagnostic data was failure to fill out the documents or inability to read the diagnosis because it was written in an illegible manner.

For group 1 (4491 cases), the κ coefficient of agreement was 0.679, with a variance of 3.62×10^{-5} ; for group 2 (2901 cases), κ was 0.645, with a variance of 5.67×10^{-5} ; and for group 3 (3096 cases), κ was 0.915, with a variance of 5.69×10^{-5} .

The results obtained for each group are presented according to the distribution of the diagnoses within the different ICD-10 categories, and are shown in tables 2–4.

Regrouping of the present data according to the disease categories of the ninth revision of the ICD (table 5) permitted statistical comparison between these independent variables using the jackknife method to identify comparable κ values for the comparison of the two periods (table 6). Table 7 shows a comparison of the sensitivity and specificity for group 2.

DISCUSSION

In our present study, diseases of the circulatory system were found to be the main cause of death (1573), followed by neoplasms (790), and infectious and parasitic diseases (414), as stated in the death certificate. This finding characterises HCFMRP-USP as a reference centre in the region with a large number of deaths caused by cancer; however, it should be emphasised that no data were computed regarding the many deaths caused by AIDS, which would belong in the category of infectious and parasitic diseases as basic cause of death, because the pathology service of the hospital did not carry out a necropsy on most of these patients during our study period.

Analysis of the levels of agreement between the groups showed a lower κ value for group 2 than for group 1, which might be explained by the easier detection of discordant findings when a more rigorous method of analysis is used.

The level of agreement between macroscopic diagnosis and the final diagnosis after microscopic examination was highly significant (0.915). The pathology service of HCFMRP-USP frequently uses this type of examination, which is only disregarded when the macroscopic findings make the diagnosis obvious. This is because we are a teaching hospital, and microscopic examination is carried out routinely in many cases. Nevertheless, despite an apparent high rate of agreement between macroscopic and microscopic findings, only microscopic examination revealed the tendency towards improvement in the level of diagnostic agreement seen in our study.

Zaitoun and Fernandez³⁰ also showed that histological examination significantly contributed to the final diagnosis in 5% of their series, whereas other minor pathological findings contributed in 6% of their cases.

By regrouping the diseases according to the ninth revision of the ICD, we also compared, as suggested by Saracci,³¹ the diagnostic sensitivity of complete necropsy. The results showed that most comparable groups maintained almost the same level of diagnostic sensitivity. The following sensitivity rates were observed for the categories with the largest numbers of deaths: diseases of the circulatory system (74.1% in the previous study *v* 75.3% in our present study), neoplasms (81.6% *v* 81.6%), and infectious and parasitic diseases (59.4% *v* 61.4%). It is worth mentioning that the sensitivity for the last category might increase if necropsies of patients with a diagnosis of AIDS were carried out and computed—this diagnosis as a basic cause of death shows a higher chance of agreement because our hospital is a reference centre in the region for the follow up of these patients.

Table 1 Disease groups of the manual of the 10th revision of the International Classification of Diseases (ICD) distributed according to the 21 categories

ICD category	Disease group
1	Some infectious and parasitic diseases
2	Neoplasms
3	Blood disorders, disorders of the haemopoietic organs, some immune disorders
4	Endocrine, nutritional, and metabolic diseases
5	Mental and behavioural disorders
6	Nervous system diseases
7	Diseases of the eyes and adnexa
8	Diseases of the ear and mastoid apophysis
9	Diseases of the circulatory system
10	Diseases of the respiratory tract
11	Diseases of the digestive tract
12	Diseases of the skin and of the subcutaneous layer
13	Diseases of the osteomuscular system and connective tissue
14	Diseases of the genitourinary tract
15	Pregnancy, delivery, and puerperium
16	Some disorders originating during the perinatal period
17	Congenital malformations, deformities, and chromosome aberrations
18	Symptoms, signs, and abnormal findings upon clinical and laboratory examination not classified elsewhere
19	Lesions, poisoning, and some consequences of external causes
20	External causes of morbidity and mortality
21	Factors influencing the health status and contact with health services

Table 2 Distribution of patients who died at HCFMRP-USP from 1990 to 1995 according to the 21 diagnostic categories of the ICD-10 based on the basic cause of death on the CD and that obtained after MD

CD	MD																					Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	272	7	0	7	2	13	0	0	40	14	21	2	0	4	1	0	0	1	4	0	0	388
2	7	669	0	0	4	1	0	0	10	3	16	0	0	3	0	0	0	0	0	0	0	713
3	1	3	50	0	0	1	0	0	8	1	6	0	1	1	1	0	0	0	0	0	0	73
4	4	2	1	97	10	1	0	0	32	1	9	0	0	2	0	0	0	0	1	0	0	160
5	3	5	0	1	200	1	0	0	12	3	10	0	0	2	0	0	0	0	0	0	0	237
6	7	5	1	2	4	105	0	4	13	7	1	1	0	1	0	0	0	0	0	0	0	151
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
9	60	23	4	9	16	18	0	0	1206	32	31	2	1	13	1	0	5	4	4	0	0	1429
10	38	38	3	12	22	9	0	0	174	223	29	1	10	16	1	0	1	8	6	0	0	591
11	14	23	0	3	57	2	0	0	25	7	249	0	0	9	0	0	0	0	0	0	0	389
12	1	0	0	0	0	0	0	0	1	1	0	11	1	0	0	0	0	0	0	0	0	15
13	0	1	1	0	0	0	0	0	2	1	0	0	23	0	0	0	0	0	0	0	0	28
14	3	8	2	8	2	1	0	0	23	6	3	0	2	89	1	0	1	1	1	0	0	151
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	21
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
17	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	23	0	0	0	0	24
18	2	4	0	1	4	0	0	0	8	1	10	0	0	1	0	0	0	11	1	0	0	43
19	2	2	0	0	2	1	0	0	18	1	3	0	0	0	0	0	0	3	41	0	0	73
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	414	790	62	140	323	153	0	7	1573	301	388	17	38	141	26	1	30	28	58	1	0	4491

CD, necropsy request; HCFMRP-USP, University Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo; ICD, International Classification of Diseases; MD, macroscopic examination.

Some categories of the ICD showed a lower diagnostic sensitivity than others, especially category 18 (symptoms, signs, and abnormal findings upon clinical and laboratory examination not classified elsewhere). On the basis of the description of this category, it is assumed that an exact diagnosis was not made, but that only alterations produced by the disease were considered, represented by clear examinations, signs, and symptoms.

With respect to improvement in diagnostic sensitivity, a significant increase from 38.6% to 61.3% was observed for the category of mental and behavioral disorders, a finding mainly demonstrating the concern of clinicians to include chronic alcoholism as a basic cause of death. In the category of

respiratory diseases, diagnostic sensitivity increased significantly from 35.7% to 76.6%. This is because of the greater care in excluding non-specific pneumonia as a basic cause of death, in addition to the significant improvement in diagnostic procedures during the past few years. A significant increase in sensitivity from 37% to 60% was also seen for the category of congenital malformations, deformities, and chromosome aberrations, indicating improvement in the assessment of these cases, in addition to the diagnostic procedures used in this area.

A decrease in diagnostic sensitivity was seen for the category of diseases of the osteomuscular system and connective tissue (81.8% to 50.0%). This finding probably

Table 3 Distribution of patients who died at HCFMRP-USP from 1990 to 1995 according to the 21 diagnostic categories of the ICD-10 based on diagnosis of the basic cause of death on the CD and the FD

CD	FD																					Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	172	9	0	5	2	1	0	0	31	5	19	1	1	2	0	0	0	1	5	0	0	254
2	4	390	0	2	3	1	0	0	9	1	8	0	0	2	0	0	0	1	0	0	0	421
3	0	5	21	0	0	1	0	0	3	1	4	0	2	0	1	0	0	0	0	0	0	38
4	4	0	1	48	9	5	0	0	19	2	3	0	0	1	0	0	0	0	1	0	0	93
5	6	2	0	0	147	0	0	0	7	2	5	0	0	2	0	0	0	0	0	0	0	171
6	6	3	0	2	3	62	0	2	9	3	1	1	0	1	0	1	0	0	0	0	0	94
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
9	36	15	3	7	9	10	0	0	807	20	21	1	1	10	1	0	4	3	4	0	0	952
10	22	29	1	7	20	3	0	0	130	128	19	1	7	9	1	0	1	5	9	0	0	392
11	22	18	0	1	43	1	0	0	19	2	148	0	0	10	0	0	0	0	0	0	0	264
12	1	0	0	1	0	0	0	0	1	0	0	9	1	0	0	0	0	0	0	0	0	13
13	1	0	0	0	0	1	0	0	2	0	0	0	13	0	0	0	0	0	0	0	0	17
14	3	3	2	6	0	0	0	0	17	3	4	0	1	53	2	0	1	0	1	0	0	96
15	1	0	0	0	0	0	0	0	1	0	0	0	0	0	13	0	0	0	0	0	0	15
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	9	0	0	0	0	10
18	1	3	1	1	1	0	0	0	7	0	4	0	0	0	0	0	6	1	0	0	0	25
19	1	1	0	0	3	0	0	0	10	0	2	0	0	0	0	0	0	1	24	0	0	42
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	280	478	29	80	240	85	0	5	1072	167	239	13	26	90	18	1	15	17	45	1	0	2901

Cases for which no microscopic investigation was carried out were excluded. CD, necropsy request; FD, final necropsy report; HCFMRP-USP, University Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo; ICD, International Classification of Diseases.

Table 4 Distribution of patients who died at HCFMRP-USP during the period from 1990 to 1995 according to the 21 diagnostic categories of the ICD-10 based on the necropsy diagnosis of the basic cause of death obtained after MD and FD

MD	FD																					Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	255	3	0	2	2	1	0	0	3	0	4	0	0	0	0	0	0	0	1	0	0	271
2	1	486	0	1	1	1	0	0	4	1	0	0	0	0	0	0	0	1	0	0	496	
3	0	1	29	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	32	
4	1	0	0	75	5	5	0	0	5	1	0	0	0	0	0	0	0	1	1	0	94	
5	7	1	0	0	235	1	0	0	4	1	3	0	0	0	0	0	0	0	0	0	252	
6	4	3	0	0	0	75	0	0	8	2	0	0	0	0	0	1	0	1	0	0	94	
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	6	
9	8	4	0	1	2	1	0	0	1105	8	2	0	1	4	0	0	1	0	2	0	1139	
10	6	7	0	1	3	0	0	0	9	159	1	0	1	0	0	0	0	0	4	0	191	
11	10	7	0	2	13	0	0	0	1	0	239	0	0	2	1	0	0	1	0	0	276	
12	0	0	0	1	0	1	0	0	0	0	0	13	0	0	0	0	0	0	0	0	15	
13	0	0	0	0	0	1	0	0	0	1	0	0	25	0	0	0	0	0	0	0	27	
14	0	0	1	1	1	0	0	0	2	1	2	0	0	91	1	0	0	0	1	0	101	
15	1	0	0	0	0	0	0	0	1	0	0	0	0	0	20	0	0	0	0	0	22	
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
17	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	14	0	0	0	15	
18	1	1	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	16	0	0	22	
19	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	40	0	42	
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	294	513	30	84	263	87	0	6	1147	175	252	13	27	97	22	1	15	20	49	1	3096	

FD, microscopic examination; HCFMRP-USP, University Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo; ICD, International Classification of Diseases; MD, macroscopic examination.

reflects the small number of deaths in this group (five each year) and is associated with inadequate reporting of the basic causes of death, because in various cases respiratory problems were classified as the direct cause of death. A decrease (71.4% to 58.9%) in diagnostic sensitivity, although not highly significant, was also seen for diseases of the genitourinary tract.

Improvement in the level of agreement with the final diagnosis was seen compared with that found in a study carried out in our hospital at the end of the 1970,²⁷ which was not the case when the diagnoses on the death certificates were compared.

This tendency towards improvement in the level of diagnostic agreement has rarely been reported in the literature, as shown by Sonderegger-Iseli *et al* and Tsujimura and colleagues¹¹⁻³² in a review of similar studies

in the literature. Recently, in Brazil Coradazzi *et al* presented a study comparing two periods (1975–82 *v* 1992–6), and showed an improvement in diagnostic agreement of 72.9% to 79.4% for the basic cause of death.³³

This trend was seen in our pathology service as a result of an improvement in the assessment of the basic cause of death by clinicians, which was especially evident with respect to chronic alcoholism as the basic cause. It should be mentioned, however, that advances in diagnostic techniques might also influence this tendency. However, this improvement seems to be small in view of the many advances that occurred during the 1980s and at the beginning of the 1990s. Therefore, it is important to emphasise that disagreements continue to occur, as shown in several studies.¹³⁻²³

In this respect, each procedure that helps in the analysis of diagnostic discrepancies should be emphasised. Our findings show that microscopic analysis remains important to establish or confirm the cause of death in many cases. Further studies are necessary to discern those situations in which microscopic analysis is most useful.

Quality control is a highly important objective in health care and one of the main reasons why necropsy continues to be essential for improving medical care.³⁴ Necropsy continues to be the gold standard for the determination of the cause of death and associated diseases, and is necessary for the assessment of quality of care in health services. It should be

Table 5 The 17 categories of diseases of the ninth revision of the International Classification of Diseases (ICD), 1975

ICD category	Group of diseases
1	Infectious and parasitic diseases
2	Neoplasms
3	Endocrine, nutritional, and metabolic diseases and immunity disorders
4	Diseases of the blood and bloodforming organs
5	Mental disorders
6	Diseases of the nervous system and sense organs
7	Diseases of the circulatory system
8	Diseases of the respiratory system
9	Diseases of the digestive system
10	Diseases of the genitourinary system
11	Complications of pregnancy, childbirth, and the puerperium
12	Diseases of the skin and subcutaneous tissue
13	Diseases of the musculoskeletal system and connective tissue
14	Congenital anomalies
15	Certain conditions originating in the perinatal period
16	Symptoms, signs, and ill defined conditions
17	Injury and poisoning

Table 6 Values of κ_j (κ for comparison) for study groups 1 and 2 for the periods 1978–80 and 1990–5

	Group 1	Group 2*
κ_j 1978–80	0.661	0.601
Variance	2.75×10^{-4}	3×10^{-4}
κ_j 1990–5	0.661	0.646
Variance	5.85×10^{-5}	1×10^{-4}

*Significant difference for values in a Z table score. Group 1, comparison of the basic cause of death based on the necropsy request and that obtained after macroscopic examination; group 2, comparison of the clinical diagnosis and the final one, which includes complementary investigations, such as microscopy.

Table 7 Sensitivity and specificity comparison for the 17 categories of ICD-9, 1978–80 v 1990–5, group 2

ICD category of disease	1978–80		1990–5	
	Sens (%)	Spec (%)	Sens (%)	Spec (%)
1	59.4	95.6	61.4	97.2
2	81.6	97.9	81.6	98.9
3	55.0	98.2	60.0	98.4
4	83.3	99.2	72.4	99.4
5	38.6	99.1	61.3	99.2
6	75.0	98.6	74.4	99.1
7	74.1	88.2	75.3	95.0
8	35.7	96.1	76.6	90.9
9	55.6	96.6	61.9	96.0
10	71.4	96.8	58.9	98.5
11	68.4	100.0	72.2	99.9
12	50.0	99.8	69.2	99.9
13	81.8	99.7	50.0	99.9
14	37.0	99.7	60.0	100.0
15	50.0	99.8	0.0	100.0
16	25.0	97.3	35.3	99.3
17	70.8	98.5	54.3	99.2

Group 2, comparison of the clinical diagnosis and the final one, which includes complementary investigations, such as microscopy.
ICD-9, ninth revision of the International Classification of Diseases; sens, sensitivity; spec, specificity.

Take home messages

- When the periods 1978–80 and 1990–5 were compared there was an improved correlation between clinical and postmortem data in the group submitted to complete necropsy, although this was not the case when only the macroscopic step was analysed
- Microscopic analysis remains important to confirm the cause of death in many cases
- Diagnostic discrepancies remained high, so that complete necropsy continues to be essential for the assessment of clinical diagnosis

remembered that necropsy is not free of errors, but provides the best diagnosis of the cause of death.

Authors' affiliations

M H C Grade, S Zucoloto, J K Kajiwara, M T P Fernandes, L G F Couto, S B Garcia, Department of Pathology, Ribeirão Preto Medical School, University of São Paulo, Av. Bandeirantes, 3900 - Campus FMRP, USP, 14.049-000, Ribeirão Preto, Brazil

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M H C Grade, S Zucoloto, J K Kajiwara, et al.

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