

## A retrospective study of the accuracy between clinical and autopsy cause of death in the University of Malaya Medical Centre

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### Abstract

It is well known that diagnostic accuracy of the clinical cause of death has not improved despite advances in diagnostic techniques. We aimed to investigate the accuracy of the clinical cause of death compared with the autopsy cause of death and to see if the Coroner's autopsy can play a role in clinical audit. Our study population consisted of all autopsies where the deceased was hospitalised or resuscitated at the Accident and Emergency Unit of the University of Malaya Medical Centre before death, performed during the period July 1998 to June 2000. The cases were subdivided according to natural and unnatural causes of deaths. Natural deaths were further subdivided in relation to the main organ systems involved while unnatural deaths were subcategorised into trauma, poisoning and burns. The rate of agreement between clinical and autopsy cause of death was further compared with duration of survival in the hospital.

Of 132 autopsies included in this study, 115 were Coroner's autopsies. 78% of cases showed agreement between clinical and autopsy cause of death. The agreement rate in Coroner's cases was 80.0%. For natural and unnatural causes, the agreement rate was 56.7% and 84.3% respectively. There were 6 cases (4.5%) where an initial accurate diagnosis might have altered the prognosis of the deceased. In general, the rate of agreement increased with duration of survival of patients. However, this was no longer observed after a survival of more than 28 days. Our findings agree with other similar studies. The diagnostic accuracy of cause of death has not improved despite the modernisation in medical technology. The autopsy still plays an important role in clinical audit and medical education.

**Keywords:** agreement, diagnostic accuracy, autopsy, cause of death

### INTRODUCTION

It is a well known fact that the clinical cause of death lacks in accuracy when compared to the autopsy cause of death<sup>1-6</sup>. This trend has continued to occur despite modernisation in medicine. The advances in the capability of the diagnostic tools have not improved the rate of accuracy in the clinical cause of death<sup>7</sup>.

An accurate cause of death is an important determinant in the running of clinical audit. In addition, the autopsy also plays an important role in medical education<sup>8,9</sup>. An accurate cause of death is also a useful epidemiological tool both for statistical purposes and health promotion.

Generally, post-mortem examinations are divided into hospital or coroner's autopsies. Hospital autopsies are usually performed on request of the clinicians and require the consent of the next of kin of the deceased. On the other hand, Coroner's autopsies are performed for

medicolegal purposes as required by the investigation authorities, which in Malaysia is under the Criminal Procedure Code.

In Malaysia, the hospital autopsy always has played a minimal role in clinical audit. This may be due to religious and cultural perceptions where the local communities generally are reluctant for any further manipulation of the body after death. As such, most of the autopsies are derived from the Coroner's system. However, it does not mean that information derived from the Coroner's autopsy cannot play an important role in determining the accurate cause of death in the hospitalised cases. It is well known that useful clinical information can be obtained from Coroner's autopsies<sup>10</sup>.

In this paper, we aim to study the accuracy of the clinical cause of death when compared to the autopsy cause of death in University of Malaya Medical Center (UMMC). Since in Malaysia,

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there are traditionally very few hospital autopsies, we hope to see if information derived from the Coroner's autopsies can also play a major role in determining the accurate cause of death in hospitalised patients. Any discrepancies in diagnosis, where an initial accurate diagnosis might significantly alter the treatment or prognosis of the patient were also studied.

## MATERIALS AND METHODS

Autopsy records of patient who were hospitalised before death, based on autopsies performed during the 2 year period from July 1998 to June 2000 were selected manually from the Autopsy Log Book in the forensic pathology unit of UMMC. These autopsies include those who were resuscitated unsuccessfully in the Accident & Emergency (A & E) Unit. Cases of 'brought-in-dead' where the patients were declared dead by the time they arrived to the A & E Unit, stillbirths and cases from other medical centres were excluded from the study. The latter cases were excluded because the clinical notes were not traceable or incomplete.

The duration of the patient's stay in hospital from admission until death was extracted from the Autopsy Report Form MR 546/1, which stated the date of admission and date of death. The clinical cause of death (COD) was either derived from the Mortuary Registration Form or from the clinical case notes if the COD was not completed in that form. Alternatively, the clinical history in the autopsy report was taken into consideration. The autopsy cause of death was obtained from the corresponding autopsy reports. Cases where the clinical notes could not be located and cases with unascertained cause of death both clinically and after an autopsy were excluded from the study.

Classification was based on the autopsy COD. The causes of death were divided into 2 main categories - natural and unnatural. Natural deaths were further subclassified according to whether death related largely to the cardiovascular system, gastrointestinal system, respiratory system, genitourinary system, hepatobiliary system, neoplastic diseases, infective diseases and congenital conditions. Unnatural causes were further divided into trauma, poisoning and burns.

When comparing clinical and autopsy CODs, they were divided into Agreement and Discrepancy categories. If the autopsy and clinical CODs matched, they were considered to be in agreement. A case was also considered to be under the Agreement category if the diagnosis

was classified in the same general group e.g. coronary atherosclerosis by the pathologists and ischaemic heart disease by the clinicians. If there were discrepancies between the clinical and autopsy CODs within the same organ system, it was classified as 'minor discrepancy'. A major discrepancy was considered when the organ system where the pathology responsible for death was completely different from the clinical diagnosis. However, it did not mean that only major discrepancies in diagnosis were considered significant. A mistaken diagnosis within the same system e.g. aortic dissection for myocardial infarction (both under cardiovascular system) would still have catastrophic consequences.

Cases with discrepancies between the clinical and autopsy cause of death were further analyzed individually (by OBB) to see if an initial accurate diagnosis would have altered the initial management and prolonged the survival period of the deceased significantly.

## RESULTS

From July 1998 to June 2000, a total of 890 autopsies were performed at the UMMC. There were 168 autopsies where the patients died after being admitted to the hospital or after resuscitation in the Accident and Emergency Unit. However, only 132 autopsies were analyzed because in the rest, either the clinical notes or autopsy reports could not be located. One case was rejected because both the clinical diagnosis and autopsy failed to reveal the cause of death.

103 cases of the 132 showed agreement between the clinical and autopsy cause of death (78.0%). The other 29 cases showed discrepancies in their diagnosis with 15 cases classified under the minor discrepancy group and 14 cases under the major discrepancy group. Coroner's cases numbered 115 while the remaining 17 cases were hospital autopsies. Eighty percent of the Coroner's cases showed agreement between the autopsy and clinical diagnosis while 9.6% and 10.4% showing major and minor discrepancies respectively. For hospital autopsies, 64.8% showed agreement between both their clinical and autopsy cause of death while minor and major discrepancies each made up 17.6%, making a total discrepancy rate of 35.2% (Figure 1).

Of the 132 cases in this study, 30 deaths were considered natural while the rest were unnatural (e.g. trauma or poisoning). Within the former

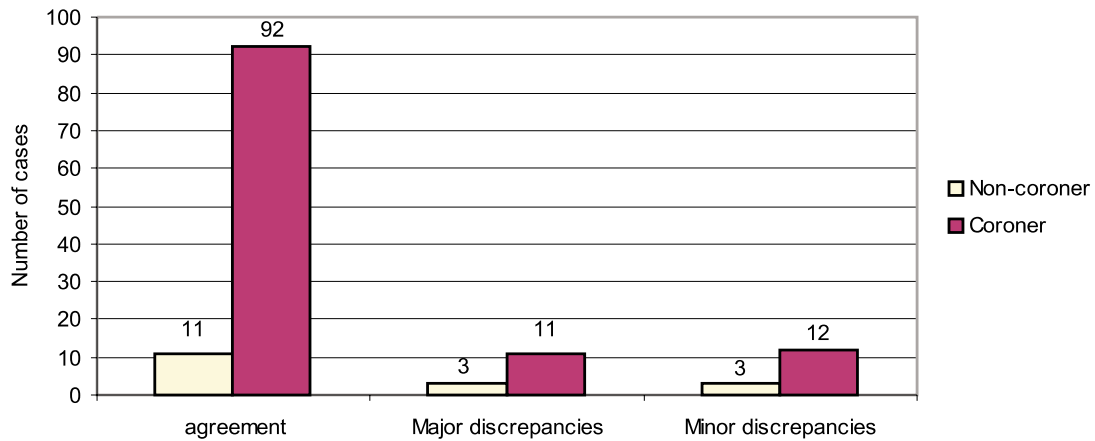


Figure 1: Distribution of agreement and discrepancies between clinical and autopsy cause of death according to Coroner's and Hospital autopsies (n = 132)

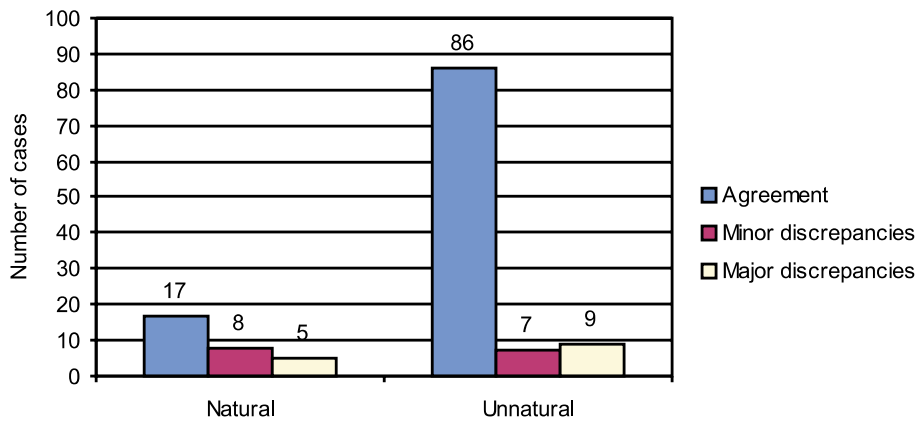


Figure 2: Agreement and discrepancy between clinical and autopsy cause of death among patients dying from natural and unnatural causes (n = 132)

group, there were 17 cases where both the clinical and autopsy cause of death were in agreement, while 8 and 5 cases showing minor and major discrepancies respectively, giving an agreement rate of 56.7% (Figure 2).

The natural causes of death were further subclassified to various organ systems. There were discrepancies (both minor and major) in the cardiovascular system, respiratory system, genitourinary system, hepatobiliary system, neoplastic diseases and infective diseases (Table 1). However, the numbers were too few for meaningful statistical analysis.

Of the 102 cases classified under the unnatural cause of death category, 80 deaths were due to trauma, 17 due to poisoning and 5 due to burns. Eighty-six cases (84.3%) showed agreement

between clinical and autopsy cause of death. Seven cases showed minor discrepancies while the other 9 cases showed major discrepancies (Table 2). All cases with minor discrepancies were in the trauma category and most of them showed only minor mistakes in tabulation of injuries e.g. the clinical cause of death given as head and abdominal injuries while the autopsy revealed only head injury. An example of a major discrepancy in the trauma category was when the significant injury was completely missed by the clinician, e.g. transection of the aorta.

Of the total of 29 cases with discrepancies between the clinical and autopsy cause of death, there were at least 6 cases where the management of the patient might have been altered

**Table 1: Agreement and discrepancy between clinical and autopsy cause of death in patients dying from natural causes (n=30)**

Natural	Agreement	Minor discrepancies	Major discrepancies	Total
Cardiovascular	4 (66.6%)	1 (16.7%)	1 (16.7%)	6
Respiratory	2 (50.0%)	1 (25.0%)	1 (25.0%)	4
Gastrointestinal	1 (100.0%)	0 (0%)	0 (0%)	1
Genitourinary	0 (0%)	1 (100.0%)	0 (0%)	1
Hepatobiliary	1 (33.3%)	0 (0%)	2 (66.7%)	3
Neoplastic	2 (66.7%)	1 (33.3%)	0 (0%)	3
Infective	4 (44.4%)	4 (44.4%)	1 (11.2%)	9
Congenital condition	3 (100.0%)	0 (0%)	0 (0%)	3

**Table 2: Agreement and discrepancy between clinical and autopsy cause of death in patients dying from unnatural causes (n=102)**

Unnatural	Agreement	Minor discrepancies	Major discrepancies	Total
Trauma	66 (82.4%)	7 (8.8%)	7 (8.8%)	80
Poisoning	15 (88.2%)	0 (0%)	2 (11.8%)	17
Burns	5 (100%)	0 (0%)	0 (0%)	5

significantly to change the prognosis if the initial diagnosis was correct (Table 3). Two cases were in the natural cause of death category while the rest were classified under unnatural cause of death. All these cases were classified under the major discrepancy group except for one. Three brief case reports showing cases in different categories (natural, trauma, poisoning) are illustrated below:

**Case 1**

A 2<sup>1/2</sup>-year-old girl was admitted for low-grade fever with cough and vomiting. Later she became dyspnoeic. Chest X-ray showed hilar infiltrates. The clinical diagnosis was Reye's Syndrome grade IV and the differential diagnosis was encephalitis. She deteriorated and subsequently died. The autopsy showed that she had extensive bilateral bronchopneumonia. The upper lobes of both lungs appeared firm and consolidated with petechial haemorrhage on the lung surfaces. Her liver was enlarged and congested but did not show any histological features consistent with Reye's syndrome.

**Case 2**

A 77-year-old woman pedestrian was involved in a road traffic accident. She was suspected to suffer from intra-abdominal injuries. An emergency laparotomy was performed but the abdomen was found to be normal. She died in the operating theatre. The autopsy showed that she had suffered from fractured ribs and clavicle with surrounding haematoma, fracture of the humerus, fracture of the skull and fracture of the C4 vertebra. Her gastrointestinal, hepatobiliary and genitourinary system were all normal.

**Case 3**

A 66-year-old woman was admitted with suspicion of chlorox poisoning (a corrosive agent). She was diagnosed to have aspiration pneumonia and treated accordingly. She died after 3 days of hospitalisation. The autopsy revealed that she had advanced coronary artery disease with no evidence of any pneumonia. There were no signs of corrosion (burns around the mouth, sloughing of oesophageal and stomach mucosa).

**Table 3: Summary of cases where an initial accurate diagnosis may have altered prognosis or prolonged survival**

Classification	Clinical COD	Autopsy COD	Discrepancy
Natural	Reye's Syndrome	Aspiration collapse of lung	Major
Natural	Reye's Syndrome	Bronchopneumonia	Major
Unnatural	Bilateral severe lung contusion	Multiple injuries and liver laceration	Major
Unnatural	Intraabdominal injuries	Multiple injuries	Major
Unnatural	Aspiration pneumonia due to poisoning	Coronary artery disease	Major
Unnatural	Atrial fibrillation and compression fracture of lumbar sacral spine	Fracture of pelvis	Minor

**Table 4: Agreement and discrepancy in clinical and autopsy cause of death according to duration of hospital stay (n=132)**

Duration	Agreement	Minor discrepancies	Major discrepancies	Total discrepancies	Total studied
< 1 day	40 (66.6%)	10 (16.7%)	10 (16.7%)	20	60
1 - 3 days	24 (88.9%)	1 (3.7%)	2 (7.4%)	3	27
4 - 7 days	19 (86.4%)	1 (4.5%)	2 (9.1%)	3	22
8 - 28 days	17 (94.4%)	1 (5.6%)	0 (0%)	1	18
> 28 days	3 (60.0%)	2 (40.0%)	0 (0%)	2	5

There were 60 (45.5%) cases who survived less than 1 day, 27 (20.4%) between 1-3 days, 22 (16.7%) between 4-7 days, 18 (13.6%) between 8-28 days and 5 (3.8%) more than 28 days (Table 4). The highest percentage (94.4%) of agreement was in the category of survival between 8-28 days. The category with survival more than 28 days, showed the lowest percentage of agreement and therefore the highest percentage of discrepancies. The next highest percentage of discrepancy was in the group with less than 1 day survival (33.4%). 2 (40%) out of 5 patients in the group surviving more than 28 days category showed minor discrepancies. In the major discrepancy group, the largest group was those with less than 24 hours survival. There was no major discrepancy between the autopsy and clinical diagnoses after a survival period of 8 days or more.

## DISCUSSION

The rate of agreement (the diagnostic accuracy) found in this study was 78% (Figure 1). The rate for both minor and major discrepancies was 11% each giving a total of 22%. The rate of agreement in Coroner's cases was also similar (80%), a result which was not surprising given that Coroner's cases comprised a high percentage (87.1%) in our study group. These results were consistent with the other studies particularly with a Singapore study which analysed only Coroner's autopsies<sup>1</sup>.

The rate of agreement was not surprisingly found to be different in both natural and unnatural causes of death (Figure 2). Agreement was much higher (84.3%) in unnatural than natural cases (56.7%). The higher rate of agreement in unnatural causes was expected, as the history and injuries in unnatural causes are usually

straightforward, making the clinical diagnosis more obvious. Our results on unnatural deaths were also in keeping with other studies elsewhere<sup>3,11</sup>.

On the other hand, the lower rate of agreement in natural causes was expected because of various reasons. Firstly, in natural causes, the history and clinical presentation might not be obvious and sometimes misleading. Therefore, it would be more likely for misdiagnoses to occur. Furthermore, in some cases the autopsy was requested in the first place because death was unexpected and the cause not known with certainty. Most of our cases were Coroner's cases. Some of the cases were reported to the Coroner because the causes of death were not known or clear in the first place whereas cases with clinically obvious cause of death would not have been subjected to the same procedure. As such, there would be a higher rate of autopsies amongst difficult cases, among whom the diagnostic accuracy of the clinicians would be lower than normal. Our case numbers were too small to find out if any organ systems were more significantly misdiagnosed. Other studies had noted that the cerebrovascular system and infectious disease were the main categories with high discrepancies between the clinical and autopsy cause of death<sup>1,6</sup>.

We also noted 6 cases (out of 132) where the diagnostic discrepancies were significant enough to change the prognosis of the patient. We admit that this was a very subjective judgment which was made by comparing both clinical and autopsy causes of death, clinical notes and the brief clinical notes in the autopsy report. Nevertheless, this brief exercise showed that autopsies were indispensable for an accurate mortality audit.

There was a relationship between the length of survival period with the rate of agreement between causes of death. The rate of agreement appeared to be higher with a longer duration of survival. This was expected as the clinical diagnosis would improve after the signs and symptoms of the patient became clearer with time together with the input of both laboratory and ancillary investigations including diagnostic imaging. However, the rate of discrepancy appeared to rise again after a survival period of more than 28 days. This was again expected, as complications would have arisen making the condition of the patient more complex. Unexpected potential life-threatening complications may present including pulmonary embolism and fat embolism. Very often, such

patients would be suffering from a multitude of problems instead of a single disease. A prolonged stay in the hospital may also lead to overdiagnosis i.e. a diagnosis of complications which may not have occurred at all<sup>5</sup>. However it must be pointed out that our study population in that category was small and may not be representative of the true situation. The highest rate of agreement was found in the those with a duration of hospital stay between 8-28 days. However, our findings did not concur with other studies which found that the length of stay in the hospital do not play an important role with the accuracy of diagnosis<sup>1,4,6</sup>.

The clinical cause of death is derived from clinical findings, laboratory findings, diagnostic imaging and other ancillary investigations such as electrocardiograms. The autopsy cause of death on the other hand, is inferred from the pathological findings. The pathologist performing the post-mortem examination would have the advantage of the medical history and circumstances to elevate a possible cause of death to be the cause of death<sup>12</sup>. As such, there are bound to be differences between causes of death derived by both means. However, in recent years especially with the advent of modern investigative techniques particularly in the area of diagnostic imaging, these differences would be expected to decrease.

Our findings concluded that there is still a significant rate of inaccuracies in the cause of death given by clinicians despite the diagnostic advances. In spite of the fact that nearly all of our autopsies were Coroner's autopsies, it has been shown that they can play an important role in hospital audit. A good hospital audit is dependent on an accurate cause of death. The autopsy should be seen as a continuation of the clinical investigations, even though the Coroner's autopsy was not requested by the clinicians in the first place. The Coroner's autopsy should be used for medical education and to improve the clinicians' diagnostic skill. In addition, an accurate mortality statistic is vital for the health planners to form strategies for primary prevention. Therefore, the autopsy still retains an important role in diagnostic medicine despite modernisation in medicine.

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