Original Article

The Importance of the Autopsy in Ascertaining the Cause of Death and as an Audit Tool at the University College Hospital, Ibadan

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Abstract

Background: Different reasons for autopsies include medico-legal causes, medical education and deducing the cause of death. An additional benefit is auditing with regards to patient care in the diagnosis and treatment of diseases. The main objective of this study was to determine the concordance between ante-mortem clinical diagnoses and post-mortem causes of death. **Materials and Methods:** From January 2009 to December 2015, Autopsy records at the Department of Pathology, University College Hospital, Ibadan were reviewed. Discrepancies between the clinical diagnoses and postmortem findings were categorised using Goldman criteria into major and minor classes. Goldman's criteria can be sub-categorised into five classes: Class I, Class II, Class III, Class IV and Class V. Classification of the cause of death categories was by the International Classification of Diseases, Version 10. The study was carried out with respect to the world medical association's Declaration of Helsinki (2013). Data analysis was carried out with the use of the Statistical Package for the Social Sciences (SPSS version 22). **Results:** Five hundred and thirty-three cases were involved with a male-female ratio of 1.6. The most common postmortem causes of death were traumatic Injuries (20.6%), Circulatory system-related deaths (19.7%), infections (16.9%) and malignant neoplasms (9.4%). Only 298 (55.9%) of the cases showed a concordance between the post-mortem causes of death and the clinical diagnosis. **Conclusion:** The post-mortem autopsy is useful in the audit of current medical practice in our environment.

Keywords: Analysis, autopsy, cause of death, concordance, international classification of diseases, missed diagnosis, post-mortem

Introduction

Autopsy literally is defined as "to see for oneself".[1] Most times, the words 'post-mortem', 'necropsy' are used in its place to explain the same process. Autopsy examination involves an elaborate study of the deceased body including the skin surface with resection and separation of intra-abdominal/pelvic and intra-cranial viscera with subsequent macroscopic and histopathologic diagnosis.[1] Autopsies may be inclusive of whole-body examination or restricted to specific regions.[1] The term 'autopsy' should not be confused with 'dissection' which is often used erroneously when referring to autopsies. Dissection strictly refers to the separation of tissues and organs from one another with a view to further examination.[1]

There are two principal categories of autopsies: (1) Hospital autopsies performed at the bidding of the clinician with the consent of the next of kin and (2) the medico-legal autopsies. The medico-legal autopsies are divided into those with a civil or criminal interest (forensic autopsies) and those where death is assumed to be from natural causes (non-forensic medico-legal autopsies).[1]

Worldwide, the rates of hospital autopsies have witnessed continuous decline necessitating concerns on the impact on medical education, research and clinical audit. In the

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United Kingdom, Start *et al*. reported a rate of less than 10 per-cent of all deaths in the United Kingdom,[2] while in the United States, figures from the National Centre for Health Statistics show over 50% declining autopsy rates from 1972 to 2007.[3]

Locally in Nigeria, there have been a number of studies across tertiary hospitals which similarly show a decline in the autopsy rate.[4-6] However, A few authors disagree with this studies.[7] Reasons adduced to the declining rates include religion, level of education, poor knowledge of autopsy, poor experience with previous autopsies, difficulties with obtaining consent and administrative bottlenecks in obtaining an autopsy report.[4] The availability of advanced imaging and increasing availability of virtopsy procedures in advanced medical climes have also been attributed to this decline in hospital autopsies. Our study aims to investigate the use of autopsy as an audit tool in medical practice in our environment.

Materials and Methods

This study was a 7-year retrospective study of all hospital autopsies performed between January 2009 and December 2015. All cases were retrieved and reviewed from the records of the Department of Pathology, University College Hospital, Ibadan. Analytic variables including the age, gender, referral pattern to our hospital and time spent in the hospital before demise, clinical diagnosis, post-mortem causes of death and the organ system involved were collated. Classification of the cause of death categories was by the International Classification of Diseases, Version 10 (ICD-10). The study was carried out following the protocol for research in human subjects according to the World Medical Association's Declaration of Helsinki (2013).

Study setting and population

The University College Hospital, Ibadan is a tertiary referral hospital in Ibadan, Western Nigeria with a 1000-bed capacity. It remains a major point of referrals in the region. Hospital autopsies are carried out on clinical cases after request from the managing clinician and due consent obtained from the relatives. Autopsies involving medico-legal cases are duly carried out according to the dictate of the state coroner law while also being respectful to the consideration of relatives of the deceased.

Study protocol

All autopsy records were retrieved from departmental post-mortem registers, departmental hospital post-mortem reports along with clinical case files retrieved from the medical records department. Records from the post-mortem registers, autopsy reports were cross-referenced with data from the clinical case files. The clinical diagnosis reached by the specialist consultant were obtained from the clinical case files. These clinical diagnoses inputted may have been possible with the benefit of a collateral history or with the help of full-spectrum radiologic and other investigative procedures available to the clinical team. Concordance between the autopsy findings and clinical diagnosis was noted, while discrepancies were categorised using Goldman criteria into major and minor classes.[8] In addition, the cause of death was categorized using the International Classification of diseases, version 10 (ICD-10).[9] The Goldman's criteria[8] can be divided into 5 classes namely:

Class I, missed major diagnosis (this includes the main disease (s) accounting for the clinical presentation of the patient and accounting for the primary cause of death). Erstwhile identification of this diagnosis before the death of this patient would have resulted in a change of treatment which may or may not have resulted in a complete cure or change in medical management. The reasons for this missed diagnosis border on clinical ignorance, misdiagnosis or misleading error-prone laboratory tests.

Class II, this category also involves missed major diagnoses similar to Class I. However, the difference is that perchance the diagnosis was available before the death of the patient, it would not lead to any change in the medical management of the patient. This class category thus differs from class I based on the prevailing medical knowledge or technology at the time the disease was made. Thus, class II errors are not permanent classes but depend on temporal trends regarding current knowledge of a disease and its management.

Class III, missed minor diagnoses (i.e. antecedent, non-contributory or unrelated disease conditions) that are not directly attributable to the main disease and primary cause of death, and do not contribute to the course of the illness or disease that eventually results in death.

Class IV, missed minor diagnosis similar to Class III, the difference being the antecedent disease or condition is related or contributory to the course of the main disease and eventually leads to death.

Class V, this class involves no discrepancies between the autopsy findings and clinical diagnosis, i.e., complete concordance.

Results

Five hundred and thirty-three autopsy cases were reviewed over the course of this 7-year period. Using the ICD-10, Injuries, Infections and Circulatory disorders accounted for the predominant causes of death in the hospital [Figure 1]. There was a predominance of males (312) when compared to females (221) with a Male: Female ratio of 1.4:1 [Figure 2]. Majority of the cases (55.9%), showed concordance with clinical and autopsy findings, whereas 44.1% of the cases were discordant with clinical and autopsy findings [Figure 2]. Males had a higher concordance rate than females, conversely, discordance rates were higher in females [Figure 2]. This is probably accounted for by the larger number of males in the study.

Primary cases managed at the hospital expectedly had the highest number of concordant cases. Surprisingly, the

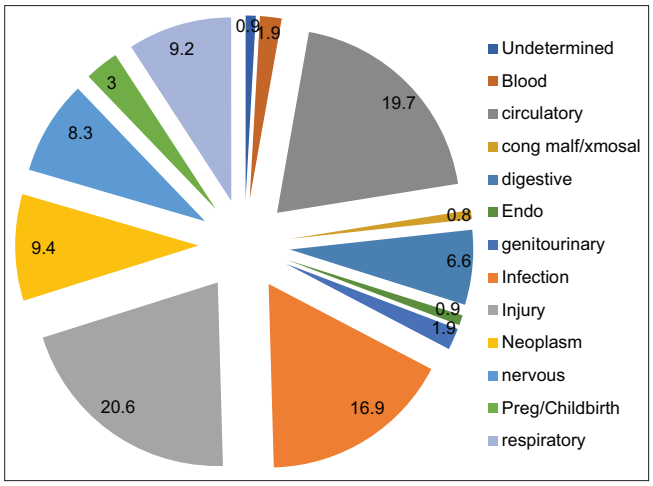

Figure 1: Pie chart showing break down of all the causes of death according to the International Classification of Diseases group

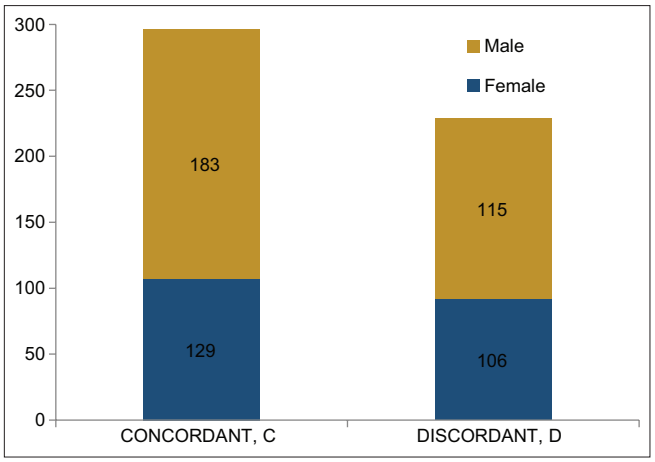

Figure 2: Bar chart showing the breakdown of concordant and discordant cases among males and females

highest number of discordant cases were also seen in primary cases [Table 1].

Over the years, the number of autopsy cases drastically reduced [Table 2]. This was also accompanied by a reduction in the number of concordant cases among the autopsies done [Table 1]. The exception to this trend was in 2012 [Table 2]. The number of discordant cases also mirrored the declining trends seen in the aforementioned concomitant category. It is pertinent to point out that with the exception of the years 2009 and 2011, the differences between the rates of concordant and discordant cases over the years have been quite minimal [Table 1]. The discordant rate in 2014 was more than the concordance rate in 2014 notably. Goldman Class V errors have been the most common errors followed by Class I and Class II [Table 3]. There was no case of Class IV documented, hence its absence from the table [Table 3]. Ironically, the disease systems commonly implicated in both Class I and Class V errors were included both the Central Nervous System and Cardiovascular systems, suggesting that the bulk of cases seen at autopsies involved these two specialities [Table 4].

The mortalities showed a multi-nodal pattern across the age groups with the highest number of deaths occurring in the 30–39, 40–49-and 50–59-year age groups, respectively [Table 5]. Class I errors were the most common among three age groups spanning the 3rd to the 6th decades. Class V errors were also more common in the 3rd to 5th decade [Table 5]. At the other end of the paediatric age spectrum, most mortalities occurred in the neonatal period, with Class V errors being the most common Goldman errors in this group [Table 5].

Table 1: Percentage concordance and discordance between the clinical diagnosis and postmortem diagnosis

Clinical diagnosis versus postmortem diagnoses	Primary	Referred
Concordant	237 (79.5)	61 (20.5)
Discordant	194 (82.6)	41 (17.4)
Total	431 (80.9)	102 (19.1)

Table 2: Breakdown of concordant versus discordant cases in each of the various years involved in the study

Year	Concordant, C	Discordant, D	N/A	Total
2009	66	48	3	117
2010	56	51	0	107
2011	74	43	0	117
2012	20	14	0	34
2013	40	31	0	71
2014	33	36	0	69
2015	11	7	0	18
Total	300	230	3	533

N/A: Not available

Table 3: Analysis showing Goldman error class distribution over the years

Year	Class I	Class II	Class III	Class V	Total
2009	42	7	0	68	117
2010	52	4	0	51	107
2011	47	5	2	63	117
2012	14	1	0	19	34
2013	24	7	0	40	71
2014	32	5	0	32	69
2015	5	3	0	10	18
Total	216	32	2	283	533

Discussion

In recent times, there has been an emphasis on the need for quality assurance in healthcare.[9] This involves a committed systematic and continuous approach to maximise available standard of care in the middle of dwindling resources. This scenario is pretty much the case in resource-poor environments such as ours. This quality assurance involves various parameters such as clinical standards, performance

Table 4: Analysis of Goldman error classes across the various international classification of disease systems

Organ	Class I	Class II	Class III	Class V	Total
Breast	0	0	0	2	2
Breast, hepatobiliary	0	0	0	1	1
CNS	38	6	0	108	152
CNS, CVS	1	0	0	0	1
CNS, ENDOCRINE	0	1	0	0	1
CNS, GUS	0	1	0	0	1
CNS, musculoskeletal	0	0	0	1	1
CNS, RESP SYS	1	0	0	0	1
CVS	64	7	1	36	108
CVS, GIT	0	0	0	1	1
CVS, GIT, RESP SYS	0	0	0	1	1
CVS, GUS	1	0	0	2	3
CVS, haematolymphoid	1	0	0	0	1
CVS, RESP SYS	1	0	0	3	4
Endocrine	1	0	0	2	3
Endocrine (thyroid)	2	1	0	0	3
Endocrine, musculoskeletal	0	0	0	1	1
GIT	17	4	0	26	47
GIT, CVS	0	0	0	1	1
GIT, GUS	2	0	0	0	2
GIT, haematolymphoid	0	0	0	1	1
GIT, haematolymphoid, GUS	0	0	0	1	1
GIT, musculoskeletal	0	0	0	1	1
GIT, RESP SYS	0	0	0	2	2
GUS	21	2	0	32	55
GUS, CVS	2	1	0	0	3
GUS, GIT	0	0	0	1	1
GUS, haematolymphoid	1	0	0	0	1
GUS, RESP SYS	0	0	0	1	1
Haematolymphoid	4	3	0	7	14
Haematolymphoid, RESP SYS	0	0	0	1	1
Head and neck	0	0	0	1	1
Hepatobiliary	14	1	0	6	21
Hepatobiliary, CVS	1	0	0	0	1
Hepatobiliary, GIT, haematolymphoid	0	0	0	1	1
Hepatobiliary, haematolymphoid	1	0	0	1	2
Multisystemic	0	0	0	1	1
Musculoskeletal	1	0	0	4	5
Musculoskeletal, haematolymphoid	0	0	0	1	1
Musculoskeletal, RESP SYS	0	0	0	1	1
Musculoskeletal, skin	0	0	0	1	1
N/A	4	0	0	1	5
Peritoneal pleura	1	0	0	0	1
RESP SYS	31	5	1	29	66
RESP SYS, CVS	0	0	0	1	1
RESP SYS, GIT	2	0	0	0	2
RESP SYS, GUS	1	0	0	0	1
Skin	2	0	0	1	3
Soft tissue	1	0	0	2	3
Total	216	32	2	283	533

CNS: Central nervous system, CVS: Cardiovascular system, GIT: Gastrointestinal tract, GUS: Genito-urinary system, RESP SYS: Respiratory system, N/A: Not available

management and client satisfaction.[10] Research committed to the utility of the autopsy as a quality assurance tool is sparse. Publications advocating for improvement in the quality of patient care via the autopsy practice have not been identified.[10]

Table 5: Analysis of goldman error classes among the different age groups

Age stratification	Class I	Class II	Class III	Class V	Total
<24 h	2	0	0	0	2
<1 year	9	0	0	14	23
1-4 years	4	0	0	3	7
5-9 years	3	1	0	4	8
10-14 years	0	0	0	6	6
15-19 years	4	1	0	5	10
20-29 years	16	5	0	38	59
30-39 years	39	5	1	54	99
40-49 years	36	4	0	54	94
50-59 years	36	8	1	53	98
60-69 years	38	7	0	29	74
> or =70 years	29	1	0	23	53
Total	216	32	2	283	533

Most post-mortem reports from the available hospitals in our environment are redundant constituting 'orphan data'.[11] This is regrettable as the effectiveness of therapy, accuracy of patient prognosis, satisfaction and outcome can be easily gotten from the autopsy (The interpretative value of the autopsy practice in scrutinising healthcare remains unquestionable).

The autopsies done can serve as a validation in the issuance of death certificates, most of which are hastily and erroneously filled with poor representation of the circumstances or cause of death. Interestingly, no study in our locale presently cites disparities between the death certificate and diagnosis at autopsy. Hill put this figure between 30% and 50%[12] in the United States. Figures though vary in different studies.[13] These statements emphasize the importance of death certificates in obtaining mortality statistics, as well as the incidence and prevalence of diseases.[10] Unfortunately, autopsies are not 'error-free'.[10]

Over the 7-year period studied, the hospital recorded 5623 mortalities from which 533 autopsies were performed in our institution. This amounts to an autopsy rate 9% (76 per year), a precipitously low value when compared to a previous study carried out by Dada-Adegbola and Thomas in 1996 with an autopsy completion of 39.6% (342 cases) a year.[14] Coroner cases accounted for 72% of these autopsies with hospital post-mortems accounting for the remaining 28%. Our study also noted increasing coroner requests compared to routine medical autopsy requests which was in keeping with other studies.[6,15]

This study showed a concordance rate of 55.9% (298 cases)–Table 1. This is at variance with that recorded by Dada-Adegbola and Thomas with a higher concordance rate of 81.87%.[14] This suggests that the quality of clinical healthcare given over the years is steadily decreasing. This cannot be unattributed to increasing technical and human resource flight of health-care personnel within the country, poorly maintained health-care facilities and poor funding within the health sector. In addition, some clinicians have shown a fallible over-reliance on modern diagnostic imaging techniques in offering ante-mortem diagnosis due to advancing medical technology.

Furthermore, pertinent to note, are the Class I Goldman cases[8] included in the discordant cases for which the patient would have benefitted immensely from if the diagnoses were gotten ab-initio. This degree of discordance recorded in this study is unacceptably high with a class 1 error rate of 40.5% [Table 3]. Class 1 error rates vary in most countries; Shojania *et al*. postulated that most institutions in the U. S had a major error rate of 8.4%–24.4%, with a class 1 error rate of 4.1%–6.7%.[16] In Berlin, Wittschieber *et al*. reported a class 1 major discrepancy value of 10.7% in 2008, which was much reduced from 15.1% in 1988.[17] Likewise, in India, the disparity between ante-mortem and post-mortem diagnoses between 1947 and 2010 was reported to have declined overall at a value of 9.35% which at face value is still elevated. It is widely believed that low- and middle-income countries account for most cases of clinicopathologic diagnostic disparities due to limitations in diagnostic techniques. It is possible that the high value of the class 1 errors in our environment (40.5%) could generally reflect the difference in the quality of healthcare offered in different climes compared to ours. This is negated statistically with the declining figures of the class 1 error rates over the years indicating an improved diagnostic accuracy in current medical practice [Table 3]. Another consideration is that the tertiary and referral designation of our centre could signify an "apparent selection bias for special cases requiring specialist care thus explaining the high discordant figures. Special cases as used in this context refer to mortalities with late clinical presentation, unexplored clinical evaluation with absent or inadequate ancillary diagnostic modalities for follow-up and management. Similarly, other designated tertiary centers, in our country have also reported a high discordance rate.[18]

Literature suggests that 10%–13% of all deaths are said to be potentially preventable with the correct diagnosis.[13] However, this figure could be reduced.[13] According to Goldman *et al*., the percentage of major discrepancies has not changed.[8] This is because rising disease rates are followed by an upgrade in the diagnosis of diseases.[8] In addition, over the course of medical practice, there has been a rather sustained period of error vulnerable practice as a result of inadequacies in medical knowledge at that period in time.[8]

In this study, the majority of breast cases referred were as a result of breast cancer, an increasingly prevalent disease diagnosed in its late stages in our environment. Thus, the low level of discrepancy between clinical and post-mortem diagnosis [Table 4]. The discrepancy rates noted occur in patients who die and have autopsy. Patients who are discharged as well as deceased patients in which no autopsy was done are not accounted for.[13]

In this study, higher concordance rates were generally seen in cases involving longer periods of hospitalisation usually after 72 h off hospitalization. Discordant rates were generally higher over shorter periods of hospital stay. Shorter hospital rates have been recorded as having greater tendency for discrepancies between clinical and post-mortem diagnosis.[19]

The high mortality seen among the younger age group (30–39-year age group) would not be surprising considering the high rate of injuries (road traffic accidents and violence) reported in this age group.[6,15] These mortalities also accounted for the bulk of our cases [Figure 1]. This can be explained with the rapidly expanding population and urban migration with decrepit unsafe transport, housing and security systems in both springing and established urban developments within the Ibadan study area. The high rate of mortality rate in these younger age groups is quite noticeable in contrast to the mortality rate in the older (geriatric age group, >70 years)–Table 5. This would suggest that the latter population has a low autopsy rate from this data analysis. Various reasons adduced for this low incidence of geriatric autopsies include ageism and therapeutic nihilism on the part of geriatric clinicians who deliberately restrict the scope of post-mortem investigations.[20] This may account for pseudo-confidence in clinical diagnosis in managing geriatric cases. Similar trends were documented in the United States from 1972 to 2007, where majority of autopsies carried out were in the younger age group.[3] Disease conditions were reported to be the common cause of death among older patients in contrast to external causes in younger people.[3] Deaths due to external causes were more likely to be determined by autopsy than deaths due to diseases or ill-defined conditions.[3]

In our environment, aside the minimal requests from geriatric clinicians, this age group are also likely to have relations who will refuse autopsies on their aged relatives for social reasons.[4]

Paradoxically, this geriatric group is the most likely to be afflicted with multiple systemic pathologies. This myriad of pathologies may interact, producing distortions in the course or aggressiveness in the clinical presentation of most diseases. This in turn predisposes this group of patients to a high error rate in 'clinical diagnosis'.[10]

As a correlate to the aforementioned point, the highest discordances between clinical and autopsy diagnosis occurred in the endocrine and cardiovascular systems, which are commonly affected by multiple pathologies in the elderly including hypertension, diabetes, hyperlipidemia, metabolic syndrome to name a few. This is similar to findings in Brazil which observed that majority of class 1 and class 2 discrepancies were in critically ill patients with cardiovascular complications.[21] The interaction of these conditions would be of significant interest in our environment given the unique aggressive course of these diseases in Africans particularly. These questions can be justifiably answered with the use of autopsies.

Documentation of the cause of death in our institution involves the WHO pattern–where a primary and secondary cause of death is ascribed in the first row sub-divided into the 1A, IB and 1C categories (representing the mechanism of death, primary cause of death and secondary cause of death). Any background disease is stated under the 2nd row. The recurrence with which clinical questions are answered by the autopsies can serve as indicators for the diagnostic utility of the autopsy to physician education and clinical performance. The autopsies may reveal unanticipated findings which could be diagnostic possibilities or clinically suspected diagnoses that were never ascertained.

Most autopsy requests from clinicians in our practice are mostly for the primary cause of death. This is at variance to more developed climes where the emphasis is placed on the immediate circumstances/mechanisms leading to death (most often, the primary cause already clinically/radiologically is already known). Background diseases identified during the autopsy may also help clarify the limited clinical presentation to the managing physician who oftentimes is confronted with a seriously ill patient with no significant medical history, poor and inappropriate drug use and a possible flight risk due to inadequate funds. This approach to autopsy reflects the limited modalities and constraints in achieving a workable clinical diagnosis in our resource-limited setting.

Paradoxically, limited or absent clinical history for the pathologist may lead to an over-estimated or underestimated categorization of Goldman classes. This is relevant in our environment given that a sizeable number of admitted patients have not been adequately followed up before clinical presentation as alluded to earlier. This results in difficulty with assigning the Goldman class. In some cases, inherent discrepancies by the pathologist may reflect improper categorisation of the case category. This may explain the absence of class IV cases in this study, as the interpretation of what constitutes a missed unrelated significant finding may reflect differing individual pathophysiologic interpretations among pathologists in the different autopsies as well as the perceived significance of the finding in view of the available health care modalities present.

In more advanced practices, the trend is for minimally invasive autopsies (i.e., laparoscopy, computed tomography (CT) angiography or image-guided tissue biopsies) or 'virtual autopsies' involving a variety of advanced imaging techniques (i.e., USS, CT, magnetic resonance imaging [MRI] autopsies) to determine the cause of death.[22-24] Studies have shown a relatively fair outcome with the use of MRI and CT scans in determining the cause of death and related or unrelated diagnoses.[25] More advantages may be gotten from using available imaging modalities with respect to the varied clinical presentations of patient mortalities.[25] Even minimally invasive autopsies have been recorded to be superior to conventional autopsies in unique cases where total body examination is required.[26] The results in the afore-mentioned scenarios were disease and organ-system specific.

It is recommended that a combination of contrast-enhanced imaging with minimally invasive biopsies be used for overall improved sensitivity and specificity.[26]

In their systematic analysis of diagnostic utilities among conventional autopsies, minimally invasive autopsies and non-invasive imaging studies, Wagensveld *et al*. found the

conventional autopsies to be superior to the latter two methods either individually or combined.[26]

This is not to discredit either of the approaches, as specific clinical presentations may dictate their usefulness, i.e., as ab-initio screening methods before conventional autopsies for highly infectious cases involving hepatitis C virus and HIV where full exposure may not be possible, or precise image-guided location of microscopic lesions which were over-looked macroscopically.[26] Generally, these attempts to reduce or prevent invasion increases the overall cost of the autopsy with regards to diagnostic equipment and facilities, technical expertise of trained personnel/specialists and additional work burden.[23,26]

Variations of the minimally invasive autopsy have been practiced with varied results in environments similar to ours.[27] In Mozambique, minimally invasive autopsies showed a concordance of 80% in infectious diseases, with similar figures in the diagnosis of a few endemic malignancies like Kaposi Sarcoma and Hepatocellular carcinoma.[27] The specificity was however much reduced compared to the traditional autopsy in various other non-infectious diseases.[27]

This might warrant a practicable compromise between diagnostic or clinical utility of minimally invasive autopsies/noninvasive autopsies, especially in resource-poor settings which lack modern imaging, technical expertise and a largely unrealistic healthcare specialist to population ratio.

This study did not consider verbal autopsies as these are not used in our immediate geographic locale. Although advocated by the WHO in scenarios where medical certification is lacking in arriving at the cause of death, they are highly inaccurate as no post-mortem physical examination is involved. These verbal autopsies are highly inaccurate and are prone to gross category mis-classification. In areas where the presence of skilled pathologists is available, the traditional autopsy still remains best equipped in arriving at a cause of death in our environment. The traditional autopsy also allows proficiency in the skill, interpretation and training of future pathologists as well as active engagement with clinicians.

Conclusion

Future studies on autopsies as quality indicators in the region are encouraged in view of the difficulties in obtaining mortality statistics and the poor record-keeping behaviour which were experienced in the course of this study. Traditional autopsies are still useful and recommended as practical, low cost and efficient clinical audit tools in our resource-limited and under-funded health-care system.

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Conflicts of interest

There are no conflicts of interest.

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