Forensic Science International: Reports 4 (2021) 100229

Contents lists available at ScienceDirect

Forensic Science International: Reports

journal homepage: www.sciencedirect.com/journal/forensic-science-international-reports

Forensic exhumations and autopsies in Zambia, Africa

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ARTICLE INFO

Keywords:
Forensic
Exhumation
Autopsy
Zambia
Causes of Death

ABSTRACT

To our knowledge, this is the largest case series of forensic exhumation and autopsy cases in Africa to date. This paper fills a critical knowledge gap in Africa by profiling the cases, describing the challenges of accessing burial sites, conducting forensic autopsies at burial sites, and the approach to forensic exhumations and autopsies. An analysis of forensic exhumations and autopsies we had performed (January 2016 to December 2020) throughout Zambia was conducted using Microsoft Excel 2010. Of the 168 cases, 128 (76.2%) were male. The age ranged from 1 to 86, with a median age of 35.0 and a standard deviation of 21.4. The commonest age range was 31–45. The top five (5) circumstances of death were assault (17.9%), family violence (17.9%), body recovered in a water body (11.3%), body found in the bush (11.3%), alleged witchcraft (7.7%), alcohol abuse (6.5%) and mob violence (6.0%). The duration of burial ranged from < 1–30 months. The commonest duration was 1–5 months (56%). The total distance that the pathologists traveled was 261,250 km. The cause of death was determined in 112 (66.7%). The top 5 causes of death were blunt impact trauma to the head (29.8%), homicidal violence (10.1%), hanging (4.8%), fire (4.2%), and gunshot to the head (3.6%). This paper shows that forensic exhumations and autopsies address forensic questions critical to law enforcement and justice.

Introduction

Zambia uses a hybrid Medicolegal Death Investigation (MLDI) system involving a Coroner and Medical Examiner system. Upon notice of a medicolegal death, the Coroner orders an autopsy from the Office of the State Forensic Pathologist (OSFP) to determine the cause and manner of death [1,2]. The OSFP conducts all Forensic Autopsies (FA) through Forensic Pathologists (FP), Anatomical Pathologists (AP), and General Medical Officers (GMO) [2].

Currently, Zambia has a critical shortage of FPs, despite progress in training APs [3]. At the time of writing this paper, there was one (1) formally trained FP and three (3) APs based in the capital Lusaka who conduct FAs. Other parts of the country are served by GMOs [4], resulting in suspicious and homicidal cases being undertaken by GMOs with no training in MLDI procedures. The situation has prompted the police to advise the temporal burial of cases pending exhumation and autopsy by the FP and APs based in Lusaka [5].

Despite the critical shortage, the number of cases that require FAs is extensive and continues to increase and is widely scattered to permit FAs by the few FPs and APs in the country. From the year 2016 through to 2020, there were 900, 1200, 1600, 1850, and 2000 FAs conducted in Lusaka, respectively, according to unpublished annual reports at the OSFP.

Given this background, it is essential to explore how forensic exhumations and autopsies are performed using forensic pathology principles to yield reliable results utilized by law enforcement and justice.

Forensic exhumations and autopsies have helped investigate suspicious deaths and homicides by using investigative data provided by the police [5,6].

This paper provides our practice of forensic exhumations and autopsies in Zambia. It profiles the cases, the challenges of accessing burial sites, the approach and performance of forensic exhumations and autopsies conducted at the burial site.

Methods and methods

Ethics and permission

The Coroner gave authority to conduct the exhumations and autopsies through an Order for Exhumation and Postmortem Examination as per Inquests Act [1]. Forensic exhumations and autopsies are mandated by law; thus, no consent or ethical permission was required to

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https://doi.org/10.1016/j.fsir.2021.100229
Received 25 April 2021; Received in revised form 17 August 2021; Accepted 19 August 2021
Available online 21 August 2021

Table 1
A: Demographic characteristics.

Variable	Overall Deaths (N = 168)	Accidents n (%)	Homicide n (%)	Suicide n (%)	Undetermined n (%)		
Sex							
Male	128 (76.2)	7 (6.2)	76 (59.4)	6 (4.7)	39 (29.7)		
Female	40 (23.8)	0 (0)	22 (55.0)	1 (2.5)	17 (42.5)		
Median Age ± SD (Range)years	35.0 ± 21.4 (1–86)	34 ± 16.8 (3–51)	39.5 ± 24.8 (1–86)	33.0 ± 11.8 (17–55)	35.0 ± 13.2 (2–67)		
1–15	29 (17.3)	3 (10.3)	19 (65.5)	0	7 (24.1)		
16–30	31 (18.5)	1 (3.2)	20 (64.5)	1 (3.2)	9 (29.0)		
31–45	53 (31.6)	1 (1.9)	30 (56.6)	1 (1.9)	21 (39.3)		
46–60	32 (19.1)	0	17 (53.1)	3 (9.4)	12 (37.5)		
61–75	16 (9.5)	0	11 (68.8)	2 (12.5)	3 (18.8)		
76–90	7 (3.6)	1 (14.3)	1 (14.3)	0	4 (57.1)		
Total	**168 (100)**	**7 (4.2)**	**98 (58.3)**	**7 (4.2)**	**56 (33.3)**		
N (%): number of cases (percentage)							
B: Circumstances of death							
Circumstances	**Overall Deaths (N = 168)**	**Age ranges**					
		1–15	**16–30**	**31–45**	**46–60**	**61–75**	**76–90**
Alcohol abuse	11 (6.5)	0	1 (9)	4 (36.4)	4 (36.4)	1 (9)	1 (9)
Alleged thief	3 (1.9)	0	2 (66.7)	1 (33.3)	0	0	0
Alleged witchcraft	13 (7.7)	0	0	0	5 (38.5)	6 (46.2)	2 (15.4)
Arson	3 (1.9)	0	2 (66.7)	0	0	1 (33.3)	0
Assaulted	30 (17.9)	2 (6.7)	6 (20.0)	15 (50.0)	7 (23.3)	0	0
Financial stress	4 (2.4)	0	1 (25.0)	1 (25.0)	1 (25.0)	1 (25.0)	0
Fire in the house	3 (1.9)	1 (33.3)	1 (33.3)	1 (33.3)	0	0	0
Dead in house	5 (3.0)	0	0	4 (80.0)	0	0	1 (20.0)
Body recovered in a water body	19 (11.3)	2 (10.5)	5 (26.3)	7 (36.8)	4 (21.1)	0	1 (5.3)
Found in sack	1 (0.6)	0	1 (100.0)	0	0	0	0
Found in pit latrine	1 (0.6)	1 (100.0)	0	0	0	0	0
Found the bush	19 (11.3)	2 (10.5)	5 (26.3)	7 (36.8)	4 (21.1)	0	1 (5.3)
Hanging	3 (1.9)	0	0	2 (66.7)	1 (33.3)	0	0
Ill health	5 (3.0)	4 (80.0)	0	0	0	0	1 (20)
Family violence	30 (17.9)	13 (43.3)	3 (10.0)	7 (23.3)	4 (13.3)	3 (10.0)	0
Mob violence	10 (6.0)	0	2 (20.0)	3 (30.0)	2 (20.0)	3 (30.0)	0
Relationship stress	3 (1.9)	2 (66.7)	0	0	0	1 (33.3)	0
Ritual killing	2 (1.2)	0	1 (50.0)	1 (50.0)	0	0	0
Road traffic accident	1 (0.6)	0	1 (100.0)	0	0	0	0
Witnessed Drowning	2 (1.2)	2 (100.0)	0	0	0	0	0
N (%): number of cases (percentage)							
C: Time-interval between burial and exhumation, and distance from central pathology facility							
Variable	**Overall Deaths (N = 168)**	**Accidents n (%)**	**Homicide n (%)**	**Suicide n (%)**	**Undetermined n (%)**		
Duration of burial (months)	Range 0.3–30	1–8	0.3–30	1–21	0.5–24		
< 1	7 (4.2)	0	3 (42.9)	0	4 (57.1)		
1–5	94 (56.0)	6 (6.4)	49 (52.1)	4 (4.3)	35 (37.2)		
6–10	45 (26.8)	1 (2.2)	30 (66.7)	2 (4.4)	12 (26.7)		
11–15	14 (8.3)	0	10 (71.4)	0	4 (28.6)		
16–20	2 (1.2)	0	2 (100)	0	0		
21–25	3 (1.8)	0	1 (33.3)	1 (33.3)	1 (33.3)		
26–30	3 (1.8)	0	3 (100)	0	0		
Distance from Central Forensic Pathology Facility in Lusaka	261,250 km	3870 (1.5)	160,040 (61.3)	10,400 (4.0)	83,440 (31.9)		
N (%): number of cases (percentage)							

conduct the autopsy. Data from these forensic exhumations and autopsies are stored at the OSFP. There are no case identifiers. Approval was obtained from the OSFP to access this anonymized data. The OSFP granted permission to access autopsy reports and publish the data.

Study design

An analysis of forensic exhumations and autopsies we had performed throughout Zambia was conducted. These cases were referred to the OSFP for forensic exhumation and autopsy, where the proximate cause of death was not found by the first GMO or cases where the police advised temporal burial awaiting a FA by the OSFP. The cases analysed were exhumed and autopsied in the period January 2016 to December 2020. Information on circumstances surrounding the death and medical history was obtained from the next of kin and the investigating police officer by the FP or AP prior to the exhumation and autopsy.

Pre-exhumation and autopsy examination procedures

The pathologists and their assistants had defined protocols on coordination during the exhumation and autopsy procedures as per Practice Manual for Medicolegal Death Investigations at the OSFP in Zambia.

Table 2
Causes of death vs. manner of death.

Variables	Overall (N = 168)	Manner of death (n)			
Cause (s) of death		**Accident**	**Homicide**	**Suicide**	**Undetermined**
Fire	7 (4.2)	2	5	0	0
Drowning	2 (1.2)	2	0	0	0
Electrocution	1 (0.6)	1	0	0	0
Positional asphyxia	1 (0.6)	1	0	0	0
Blunt impact trauma to head	50 (29.8)	1	49	0	0
Blunt impact trauma to chest	5 (3.0)	0	5	0	0
Chop wounds to head	5 (3.0)	0	5	0	0
Chop wounds to neck	2 (1.2)	0	2	0	0
Chop wounds to chest	1 (0.6)	0	1	0	0
Gunshot to head	6 (3.6)	0	6	0	0
Gunshot to torso	3 (1.8)	0	3	0	0
Hanging	8 (4.8)	0	1	7	0
Homicidal violence	17 (10.1)	0	17	0	0
Ligature strangulation	1 (0.6)	0	1	0	0
Manual strangulation	2 (1.2)	0	2	0	0
Mechanical asphyxia	1 (0.6)	0	1	0	0
Unascertained	56 (33.3)	0	0	0	56
Total	**168 (100)**	**5**	**98**	**7**	**56 (33.3)**

Fig. 1. A: Difficulties in accessing burial sites. B: Villagers, pathologists and police officers walking to the burial site.

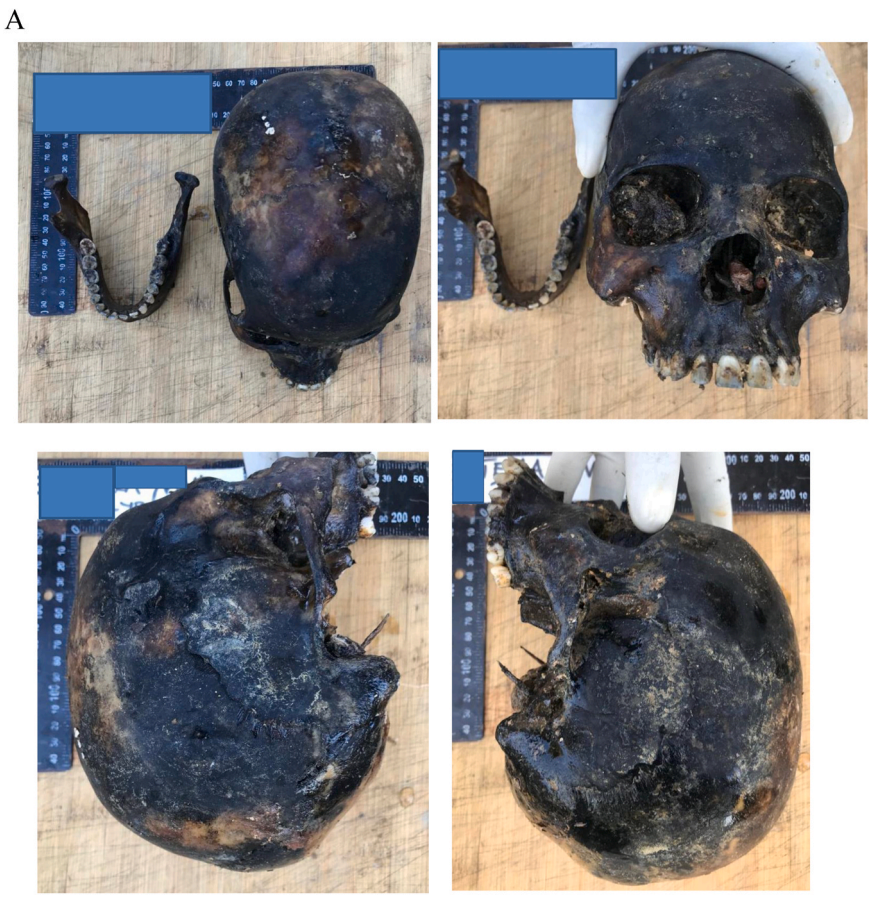

Fig. 2. A 1 and A 2: Examination of the skeletal remains (skull). B: Examination of the ribs and upper limbs. C: Examination of pelvis and vertebrae. D: Examination of lower limbs.

Exhumation and autopsy procedures

The exhumation process was supervised by the pathologist and the autopsy was performed at the gravesite. In all cases, we followed universal precautions using Personal Protective Equipment (PPE). Autopsies were performed in line with guidelines in the Practice Manual for Medicolegal Death Investigations at the OSFP in Zambia.

Data collection and analyses

Data on the decedent demographics, circumstances of death, duration of burial, distance from the central pathology facility, opinion of the cause of death, and manner of death were entered in excel and analyzed using Microsoft Excel 2010. The variables were grouped and presented as frequencies and percentages.

Results

Demographic characteristics of forensic exhumation and autopsy cases are shown in Table 1A. Of the 168 forensic exhumation and autopsy cases 128 (76.2%) were male. The age ranged from 1 to 86 years, with a median age of 35.0 and a standard deviation of 21.4. The commonest age range was 31–45.

The circumstances of death are presented in Table 1B. The top five (5) circumstances of death were assault (17.9%), family violence (17.9%), body recovered in a water body (11.3%), body found in the bush (11.3%), alleged witchcraft (7.7%), alcohol abuse (6.5%) and mob violence (6.0%).

The time intervals between burial and exhumations and the distance from the central pathology facility are presented in Table 1C. The durations of burial ranged from < 1–30 months. The commonest duration was 1–5 months (56%), followed by 6–10 months (26.8%). The total distance that the pathologists covered was 261,250 km. 61% was covered for homicides, while 31.9% was covered for undetermined manner of deaths.

The causes of death are given in Table 2. The cause of death was determined in 112 (66.7%). The top 5 causes of death were blunt impact trauma to the head (29.8%), followed by homicidal violence (10.1%), hanging (4.8%), fire (4.2%), and gunshot to head (3.6%).

Discussion

To our knowledge, this is the most extensive report of forensic exhumation and autopsy cases in Africa to date. We are aware of only one other such study in Africa [7]. This paper fills a critical knowledge gap in Africa by profiling the cases, describing the challenges of accessing burial sites, conduction of forensic autopsies at the burial site, and the approach to forensic autopsies.

One hundred and sixty-eight (168) forensic exhumations and autopsies were performed from 2016 to 2020, at a rate of 42 per year. A similar study conducted in Nigeria revealed a rate of 3 cases per year [9], while another German paper showed a rate of 4.1 cases per year [8]. This high rate is attributed to the practice of the police, which limits the number of suspicious and homicidal deaths autopsied by GMOs [5]. The police advise the next-of-kin to bury the decedent awaiting exhumation and autopsy by the FP or APs from the OSFP.

More males (76.2%) were present in this study in conformity with Cordilia et al., who found that males were predominant in a medicolegal

Fig. 2. (*continued*).

population in Lusaka, Zambia [10]. Other similar studies had similar findings [7,8,10,11]. The age range 31–45 was most predominant, with homicides (56%) most common, followed by undetermined (39.3%). Cordelia et al. suggested that the age range 21–45 in a medicolegal population was most at risk of engaging in behavior predisposing them to premature death [12].

The circumstances of the death help the FP or AP formulate a hypothesis of the cause of death and focuses the FA towards addressing medicolegal questions [7,13]. Assault and family violence (intimate partner, filicide, son killing father or mother) were the most common circumstances (17.9%) surrounding death. This may be attributed to the cultural setup in Zambian villages where people of the same family live in close proximity. The second most common circumstances surrounding a death included a body being recovered from a water body and the bush (11.3%). The reason for this finding is unknown, but we hypothesize that it may be related to the concealment of the body in homicidal deaths.

The commonest time interval between burial and exhumation was 1–5 months (56.0%). This may be due to erratic funding, a lack of FPs or APs, and the long distances to access the burial sites. The delay in forensic exhumation and autopsy may lead to loss of evidence of soft tissue injuries [7]. Akhiwu et al. in Nigeria also found that funding contributed to delayed exhumations and autopsies. Asad et al. suggested that the delay in exhumations in Pakistan was due to the cultural beliefs that the procedure is a humiliation to the decedent and the lengthy legal process [11].

To access burial sites, the pathologists covered a total distance of 261,250 km cumulatively by road to conduct forensic exhumations and autopsies. Despite traveling such long distances, the pathologist had to walk on foot or use a bicycle to reach the gravesites, as most are inaccessible by road [see Fig. 1]. This is exhausting and stressful for the health of the FPs or APs and their assistants. FPs and APs and their assistants risk snakebites during their work as they access the burial sites in the bushes [see Fig. 1].

The forensic autopsies were conducted on-site, without the luxury of an autopsy table [See Fig. 2]. This situation is strenuous for the FPs or APs and poses a physical challenge after traveling long distances to the gravesite. In the German paper, forensic autopsies were conducted in the medicolegal facility [8]. Our performance of forensic autopsies at the gravesite is due to the logistical challenges of getting the bodies to the central pathology facility in Lusaka, which is costly to the OSFP due to the distances involved. Additionally, cultural beliefs in Zambia would not allow bodies of the deceased to be moved out of their original burial sites.

Causes of death were determined in 67.3% of the forensic exhumations and autopsies, results similar to findings by Akhiwu, W.O et al. in Nigeria, who found a cause of death in 63.8% of cases, and Karger B et al. in Germany, who found a cause of death in 66.5% of cases [7,8]. The similarity in findings may be attributed to a selection bias inherent in MLDIs where law enforcement agencies prioritize cases of homicides and suspicious deaths. However, Humayun et al. in Pakistan found a lower percentage of causes of death (42.9%). They concluded that the success rate depended on the state of decomposition of the body and soil of the cemetery [10]. We believe that the success rate depends on the competence and experience of the FP or AP and the investigating police officer, enabling an integration of the circumstances surrounding the death and the autopsy findings [7].

Blunt impact trauma to the head (29%) was the commonest cause of death, followed by homicidal violence (10.1%). Homicidal violence is a descriptive cause of death based on the history and totality of the circumstances of the death, which is invoked when the autopsy findings show marginal or no injuries and do not elucidate a specific mechanism of death. This descriptive cause of death, in our experience, is helpful in operational terms because it allows the police to continue with the criminal investigation given the violent circumstances of death [7].

In our experience, homicides (58.3%) and undetermined (32.7%) were the most common manners of death. Homicides are predominant because the police engage the OSFP to conduct forensic exhumation and autopsies. The undetermined manner is primarily due to unclear circumstances of death, such as bodies found in a water body or the bush and without trauma on autopsy. Opining a cause of death on bodies after exhumation is challenging as there may be loss of soft tissue and evidential material found on the clothing. Therefore the FP or AP must think as a physician and not as a morbid anatomist [13].

Our approach to forensic exhumation and autopsy involves close teamwork with the investigating police officers [14]. Our objectives include identifying the gravesite, determining the cause and manner of death by integrating circumstances of death and reviewing scene photographs, excluding factors that may have contributed to the death, and collecting evidentiary material and documentation of findings [13,15]. After background data is made available by the police and witnesses, a FA is then performed that focuses on a formulated hypothesis for the case in question. A cause of death opinion is formulated based on the background information, forensic autopsy findings, and ancillary studies [7].

Despite this being the most extensive study of forensic exhumation and autopsies in Africa, an anthropologist's input and having a moving autopsy suite would benefit this kind of work. The casework could also benefit from imaging studies, especially in deaths involving traditional homemade guns that we classify as shotguns. We also note that the many cases that were unascertained could have benefited from toxicologic studies. However, the traditional poisons are not well studied in Zambia, and our toxicology laboratory would not have detected them.

Our experience shows that performing forensic exhumations and autopsies addresses MLDI questions and informs law enforcement and justice.

Funding

The authors did not receive any funding for this case report.

CRediT authorship contribution statement

Luchenga Mucheleng'anga: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administrationa, **Viktor Telendiy**: Validation, Investigation, Data curation, Writing – review & editing, Visualizationa, **Suzyani Simumba**: Validation, Writing – review & editingb, **Cordilia Himwaze:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization.

Conflict of interest

The authors declare no conflict of interest.

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