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## CAUSES OF SUDDEN NATURAL DEATH: A MEDICO-LEGAL AUTOPSY STUDY OF MEDICAL CASES IN AN AFRICAN REFERRAL CENTRE

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### ABSTRACT

**Objective:** To evaluate and characterise the causes of sudden natural deaths (SNDs) that occurred in medical cases in an African referral centre.

**Design:** A descriptive retrospective study.

**Setting:** University of Benin Teaching Hospital, between January 2005 and December 2011.

**Subjects:** Autopsy reports of 626 cases that were referred to the coroner.

**Results:** A total of 626 cases of SNDs were identified representing 30.3% of all autopsies performed within the period. There were 390 (62.3%) males and 236 (37.7%) females with a M:F ratio of 1.7:1. The age range of the cases was 19-105 years with a mean age of 51±17 years. The modal age group was 40-49 years which accounted for 19.8% of the cases, and most of the cases (56.8%) were seen in the 30-59 year age groups. In majority of cases (39.3%), the cause of death was related to the cardio-vascular system-principally death due to complications of hypertension which was seen in 88.2% of the cardio-vascular system diseases. Immune/infectious diseases (mainly AIDS), gastro-intestinal/hepatic lesions and respiratory diseases were seen in 15.2, 14.1 and 12.5% of cases respectively. SNDs due to malignant neoplasms were not a common finding as they occurred in 5.1% of cases.

**Conclusion:** This study shows that with the increasing modernisation of our lifestyle and dietary habits, cardio-vascular system diseases-particularly complications of hypertension have become the leading cause of sudden natural death in our environment.

### INTRODUCTION

Medico-legal (coroner's) autopsies are post-mortem examinations performed at the instance of the law, when a coroner or another authority is instructed to determine the cause, time and the circumstances of death (1,2). Coroner's autopsies in Nigeria date back to 1917 when only sudden deaths that involved European colonial masters were reported to the Coroner. However, in 1945 it was extended to include indigenous Nigerian population as reported in the coroner's law of Northern Nigeria (3). Medico-legal deaths can be classified based on the acceptable options of manner of death, which include; natural, accidental, suicidal, homicidal and undetermined

death (4,5). For the purpose of this study we limited ourselves to sudden natural deaths.

According to the World Health Organisation (WHO), sudden deaths are deaths which occur within 1 to 24 hours after the onset of symptom (6,7,8). In most cases the elapsed time is unknown. From the point of view of Forensic Medicine, sudden natural death (SND) is mainly defined as a rapid, unexpected and natural death. Causes of sudden natural deaths are mainly represented by cardio-vascular diseases and in turn followed by respiratory, neurological, digestive, infectious and genito-urinary conditions (6,9). Ischaemic heart disease is the leading cause of sudden natural death in developed countries of Europe and America, (10,11) but the incidence is low in developing countries (12,13). Autopsy studies in

Nigeria have shown that the most common cause of sudden natural death was cardio-vascular disease and that the complications of hypertension accounted for most cases (14,15). The aim of this study was to determine the causes of sudden natural death by a retrospective analysis of 626 autopsies carried out on patients who died of medical diseases within a seven-year period.

#### MATERIALS AND METHODS

The autopsy reports of medical cases in the records of the department of pathology, University of Benin Teaching Hospital, between January 2005 and December 2011 form the basis of this study. All medico-legal cases that occurred in the paediatric age group (0-18 years), had no identifiable cause of death and that were not natural and/or unexpected were excluded from the study. Also excluded were cases of victims who died from natural causes but were admitted for more than 24 hours with a clinical diagnosis.

Autopsy is an integral part of medico-legal investigations in Nigeria, as such much information as possible was obtained about each victim before beginning the autopsy to ensure correct interpretation

of the autopsy finding. Full post-mortem examination was done by consultant pathologists in the department using laid down standard format. Reports were analysed with respect to age, sex and cause of death (according to organ systems and diseases based on histopathological findings) using the SPSS version 15 statistical package.

#### RESULTS

During the seven-year period (January 2005-December 2011), 2065 medico-legal autopsies were performed. Six hundred and twenty six cases of sudden natural death were found in patients who died of medical conditions, and this constituted 30.3% of the total. There were 390 (62.3%) male and 236 (37.7%) female with a M:F ratio of 1.7:1. The age range of the cases was 19-105 years with a mean age of 51±17 years.

Table 1 shows the age and sex distribution of the cases. The modal age group was 40-49 years which accounted for 124 (19.8%) cases. This was closely followed by the 50-59 and 30-39 year age groups which accounted for 120 (19.2%) and 105 (16.8%) respectively. Thus the 30-59 year age groups (56.8%) constituted the majority of cases.

**Table 1**  
*Age and Sex Distribution of Sudden Natural Death Cases*

Age group	Male	Female	Total	Percent
10-19	3	1	4	0.6
20-29	31	33	64	10.2
30-39	59	46	105	16.8
40-49	87	37	124	19.8
50-59	78	42	120	19.2
60-69	65	32	97	15.5
70-79	44	34	78	12.5
80-89	21	8	29	4.6
90-99	2	2	4	0.6
100-109	0	1	1	0.1
Total	390	236	626	100

**Table 2**  
*Causes of Sudden Natural Deaths According to Systems*

System	Male	Female	Total	Percent
Cardio-vascular system	155	91	246	39.3
Immune system/Infections	46	49	95	15.2
Gastro-intestinal/Hepatic system	61	27	88	14.1
Respiratory system	50	28	78	12.5
Endocrine/Metabolic system	39	21	60	9.6
Genito-urinary system	20	17	37	5.9
Central nervous system	19	3	22	3.5
Total	390	236	626	100

**Table 3**  
*Detailed distribution of sudden natural death cases*

<b>Cardio-vascular diseases (n:246)</b>	<b>Male (n:155)</b>	<b>Female (n:91)</b>
Hypertensive heart disease	133	84
Valvular heart disease	6	2
Ischaemic heart disease	5	2
Hypertrophic cardio-myopathy	4	1
Dilated cardio-myopathy	3	1
Congenital heart disease	1	0
Pulmonary embolism	1	0
Others	2	1
<b>Immune diseases/Infections (n:95)</b>	<b>Male (n:46)</b>	<b>Female (n:49)</b>
Retroviral disease	44	49
Viral haemorrhagic fever	2	0
<b>Gastro-intestinal/Hepatic diseases (n:88)</b>	<b>Male (n:61)</b>	<b>Female (n:27)</b>
Liver cirrhosis	23	4
Peptic ulcer disease	11	7
Primary liver cell carcinoma	6	4
Carcinoma of the head of pancreas	7	3
Hepatitis	2	4
Colorectal carcinoma	3	1
Gastric carcinoma	1	0
Others	8	4
<b>Respiratory diseases (n:78)</b>	<b>Male (n:50)</b>	<b>Female (n:28)</b>
Pneumonia	26	17
Pulmonary tuberculosis	8	6
Asthma	7	1
Chronic obstructive airway disease	5	1
Bronchogenic carcinoma	3	1
Lung abscess	1	1
Lung fibrosis	0	1
<b>Endocrine/Metabolic diseases (n:60)</b>	<b>Male (n:39)</b>	<b>Female (n:21)</b>
Diabetes Mellitus	39	21
<b>Genito-urinary diseases (n:37)</b>	<b>Male (n:20)</b>	<b>Female (n:17)</b>
Pyelonephritis	10	9
Chronic glomerulonephritis	8	7
Renal cell carcinoma	2	1
<b>Central nervous system diseases (n:22)</b>	<b>Male (n:19)</b>	<b>Female (n:3)</b>
Meningoencephalitis	8	2
Tetanus	5	0
Epilepsy	2	1
Cerebral malaria	2	0
Others	2	0

**Table 4**  
*Malignant Cases of Sudden Natural Deaths*

Neoplasms	Male	Female	Total	Percent
Primary liver cell carcinoma	6	4	10	31.3
Carcinoma of the head of pancreas	7	3	10	31.3
Colorectal carcinoma	3	1	4	12.5
Bronchogenic carcinoma	3	1	4	12.5
Renal cell carcinoma	2	1	3	9.4
Gastric carcinoma	1	0	1	3.1
Total	22	10	32	100

Table 2 shows the causes of sudden natural deaths (SND) according to organ systems. The most common cause of SND was cardio-vascular system related diseases, which was seen in 246 (39.3%) cases and 63% (155/246) of these cases were seen in males, with a mean age of 57.4±15years. In the majority of cases, death was due to complications of hypertension which accounted for 88.2% (217/246) of cases. Others were valvular heart disease, 3.2% (8/246); ischaemic heart disease, 2.8% (7/246); Hypertrophic cardiomyopathy, 2% (7/246), and dilated cardio-myopathy, 1.6% (4/246) (Table 3).

The second most common cause of SND was related to immune/infectious diseases which were seen in 95 (15.2%) cases. Females were slightly more in number accounting for 51.5% (49/95) of the cases and the mean age was 38.4±11years. AIDS related deaths was the main cause of death in this group as it occurred in 93 cases with only two cases of viral haemorrhagic fever (Table 3).

Gastro-intestinal/hepatic lesions were the third leading cause of SND as they were seen in 88 (14.1%) cases. It occurred more in males, constituting 69.3% (61/88) of the cases with a mean age of 49.9±15 years. Liver cirrhosis accounted for majority of deaths in this group as it occurred in 30.7% (27/88). Peptic ulcer disease, primary liver cell carcinoma and carcinoma of the head of pancreas were seen in 20.1% (18/88), 11.4% (10/88) and 11.4% (10/88) of the cases respectively (Table 3).

The fourth most common cause of SND in this study was related to the respiratory system which constituted 12.5% (78/626) of the cases. Sixty-four percent (50/78) cases occurred in males with a mean age of 47.5±19years. Pneumonia was the most common disease in this group as it accounted for 55% (43/78) of the cases. Pulmonary tuberculosis and acute severe asthma occurred in 18% (14/78) and 10% (8/78) of cases respectively (Table 3).

SND related to endocrine/metabolic disorders were the fifth most common in this study and incidentally only diabetes and its complications occurred in this group. It accounted for 9.6% of the

study population with a male preponderance of 65% (39/60) and a mean age of 54.2±15years.

Genito-urinary disorders were the sixth most common cause of death occurring in 37 (5.9%) cases. There was a slight male preponderance of 54% and a mean age of 48.4±19.5 years. Pyelonephritis was seen in 51.4 (19/37) cases while chronic glomerulonephritis was found in 40.5% (15/37) cases. Renal cell carcinoma was seen in three cases (Table 3).

The least common cause of death was related to the central nervous system (CNS) which accounted for 3.2% of the study population with 86.4% (18/22) occurring in males and a mean age of 36.9±17 years. The common CNS lesions encountered were meningoencephalitis and tetanus which occurred in 45% (10/22) and 22.7% (5/22) of cases respectively (Table 3).

Table 4 shows the cases of malignant neoplasms encountered in this study. It occurred in 5.1% of the cases. Primary liver cell carcinoma and carcinoma of the head of pancreas were found in 31.3% (10/32) cases each, while colorectal carcinoma and bronchogenic carcinoma occurred in 12.5% (4/32) cases each. Renal cell carcinoma and gastric carcinoma were less common findings.

## DISCUSSION

According to the Nigerian coroner's law, all cases of sudden deaths must be reported to the coroner who orders an autopsy as part of the investigations into the circumstances of death. The causes and circumstances of sudden deaths can broadly be classified into natural and unnatural deaths (15). Sudden natural deaths (SNDs) involve important matters in forensic pathology and have several characteristics, such as an unknown clinical history, very short course of death and a common interference with post-mortem changes.

SNDs constituted 30.3% of all deaths within the seven year period of this study, while the remaining 69.7% of deaths were due to sudden unnatural causes. Similar findings have been observed in Turkey,

Uganda and several parts of Nigeria (1,8,15,16). However, previous study by Amakiri showed SNDs as the most common indication for coroner's autopsies in Ibadan, Nigeria, where it constituted 55.6% of the cases studied (14).

Three hundred and ninety (390) cases were encountered in males which accounted for 62.3% of the study population with a male to female ratio of 1.7:1, which is similar to previous report by Azmak in Turkey, Morentin in Spain and Aligbe in Nigeria (8,9,15). Thus males present a higher risk of sudden natural death than females.

The age range of cases in this study was 19-105 years with a mean age of 51±17 years and a modal age of 40-49 years, which represented 19.8% of the study. Furthermore majority of cases occurred in the 30-59 year age groups which represented 56.8% of the study population. These observations are similar to studies by Odeanmi in Ibadan and Aligbe in Benin (15,17). However, a peak age group of 60-69 years has been reported by Escoffery in the West Indies (18). The high occurrences of SNDs among male adults in their prime of life means that many families are bereaved of their breadwinners with its' unpleasant economic downturn in the subsequent quality of life of the children and widows.

Cardio-vascular disease related deaths accounted for the highest number of SNDs as they occurred in 39.3% of cases. This finding is similar to previous studies in Nigeria where 31.1 and 45% respectively of cardio-vascular related deaths have been reported in Benin and Jos (1,15). Higher rates have been reported in Turkey and USA where it accounted for 55 and 53.4% respectively of SNDs (8,19). A lower rate of 23% was reported in Japan (20). Hypertension and its complications accounted for 88.2% of cardio-vascular diseases. Left ventricular failure, hypertensive heart disease and cerebro-vascular disease in that order were the most common causes of death in this category of cardio-vascular diseases. This shows that hypertension is still a major public health issue in our environment. Previous autopsy series in Nigeria have shown that hypertension is the most common cause of SND among Nigerian adults (14,15,21). Most of the patients were previously asymptomatic, apparently healthy individuals and the post-mortem examination revealed a concentric free left ventricular wall thickness of 1.5cm and above together with other organ changes. Valvular heart disease, ischaemic heart disease and cardio-myopathies were less common findings in this study. In contrast to studies in the developed worlds, ischaemic heart disease was seen in 2.8% of patients that died of cardio-vascular diseases. Ischaemic heart disease is the most common cause of cardio-vascular disease related deaths in developed countries (1,18).

The second most common cause of SND in this study was related to diseases of immunity/

infectious, which were encountered in 15.2% of cases. Acquired immunodeficiency syndrome (AIDS) related deaths were seen in 98% (93/95 cases) and viral haemorrhagic fever was seen in only two cases. AIDS is an emerging disease and deaths arising from the late complications of the disease are still very high in our environment. Septicaemia and severe anaemia in that order were among the most common causes of death in this category. Some studies in Nigeria have shown infections to be the second most common cause of SNDs in their autopsy series (14,15). However, in contrast to this study none found HIV / AIDS related deaths as the highest contributor to this group. Odesanmi and Amakiri have separately reported bacterial and parasitic infections as the major contributor to this category of SNDs (14,17). These findings are not surprising since infections are still the main leading non-traumatic causes of death in our environment which has been further compounded by the AIDS pandemic (a major health challenge in developing countries).

The third most common cause of SND was related to gastro-intestinal/hepatic diseases which accounted for 14.1% of cases. This figure is similar to findings by Azmak in Turkey, Amakiri in Nigeria and Fernando in Sri Lanka where it accounted for 10.4, 11.9 and 13.6% of cases respectively in their study population (8,14,22). Liver cirrhosis was the major lesion in this category and it occurred in 30.7% of gastro-intestinal/hepatic disease cases. Liver cirrhosis is the twelfth most common cause of death in the US. The common worldwide causes of this lesion are alcohol abuse, viral hepatitis especially in developing countries and non-alcoholic hepatitis (23). The most common cause of death in these patients as found in this study was ruptured oesophageal varices. Peptic ulcer disease was found in 20.1% of all gastro-intestinal/hepatic diseases seen in this study. Azmak in Turkey has previously reported an incidence of 27.5% among the gastro-intestinal disease cases. (8) Upper gastro-intestinal bleeding and peritonitis, similar to previous reports were the most commonly seen complications of peptic ulcer disease in this study (24).

The fourth most common cause of SND was related to respiratory system diseases which accounted for 12.5% of the study population. Bacterial pneumonia and pulmonary tuberculosis accounted for 55 and 18% each of respiratory diseases. This is similar to previous study by Aligbe, Amakiri and Odesanmi who found respiratory infections as the most common contributor to respiratory system related SNDs (14,15,17). Azmak in Turkey and Escoffery in Jamaica have independently reported 69.8% and 40.9% incidence of respiratory infections (8,180). This seemingly high rate of respiratory system related SNDs from infections can be attributed to poverty, lack of adequate health care facilities and poor sanitary conditions that is rife in most developing

countries. Though some studies in developed countries have reported many people dying from acute severe asthma (24), this was not a very common cause of death in this study as it occurred in only eight cases.

The fifth most common cause of SND was related to endocrine/metabolic disorders which occurred in 9.6% of the cases. Incidentally they were all due to diabetes and its complications. Electrolyte derangement from acute diabetic complications and septicaemia in that order were the leading causes of death in this category. This finding is in keeping with the westernisation of lifestyle and dietary habit in the sub-Saharan Africa (15).

SNDs related to genito-urinary and central nervous systems were not very common findings in this study as they accounted for 5.9 and 3.2% respectively of the study population. The most common lesions in these categories were pyelonephritis and meningoencephalitis which were seen in 19 and 10 cases respectively. This trend is not surprising since infections are still a major cause of death in our environment, similar to observations by Aligbe and Akang in their autopsy series (15,25).

SNDs related to malignant neoplasms occurred in 32 cases, thereby constituting 5.1% of the study population. Primary liver cell carcinoma and carcinoma of the head of pancreas were the most common malignancies encountered and they were found in ten cases each, both accounting for 62.5% of the malignant cases. This is in contrast to a previous study by Aligbe where lymphohemotogenous malignancies constituted 61% of the cancer cases and 11.1% of the cases were primary liver cell carcinoma (15). Bronchogenic carcinoma and colorectal carcinoma were found in four cases each, similar to studies by Azmak in Turkey and Hirvonen in Finland (8,26). These findings show that cancer related SNDs are still rare in our environment probably due to its low incidence or paucity of data on these lesions.

In conclusion, SNDs constitute an important part of medico-legal autopsies and cardio-vascular disease related deaths form a significant proportion of our study population. Emerging causes of natural deaths such as AIDS, metabolic disorders (diabetic mellitus) and infectious respiratory diseases must be borne in mind when performing autopsies on medical patients that die suddenly. It is hoped that our findings will strengthen medical practice in our environment as it emphasises the importance of medico-legal autopsies for clinical and epidemiological studies.

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