

# Causes Of Death At Autopsy In Hospitalized Adult Patients With Diabetes Mellitus: A Study From A Developing Country

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## Abstract

In order to determine the causes of death at autopsy in hospitalized adult diabetic patients at the University Hospital of the West Indies (UHWI), we reviewed the autopsy reports of consecutive autopsies performed over a 14-year period (1991 – 2004) in the Department of Pathology at the UHWI. Of the two thousand five hundred and forty-one adult autopsy reports retrieved, 400 (15.7%) represented patients with diabetes mellitus. The commonest cause of death was infection, followed by cardiovascular disease, which showed increasing frequency with time. Hyperglycaemic coma showed a significant decrease in frequency from the first seven-year period to the second. A reduction in mortality may possibly be accomplished through: patient education protocols that re-emphasise the importance of preventing injury and infection and the need for prompt solicitation of medical attention if infections occur; aggressive management of infections; and careful monitoring of cardiovascular function. Factors influencing the presence and severity of vascular disease require further investigation.

## INTRODUCTION

It has been widely reported that diabetes mellitus causes excess mortality in affected individuals [1,2,3,4], and that vascular disease, particularly coronary artery disease, is the major cause of death in these patients [1,2,3,5,6,7,8]. This information has largely been derived from studies that have utilized death certificate data [1,2,3,7] to determine cause of death. It has been suggested that cause of death may be inaccurately attributed to coronary artery disease in a significant proportion of death certificates [9] in the population in general, and that, although diabetes is frequently under-recorded on death certificates as an underlying or contributory cause of death [10,11,12], it is more likely to be recorded on the death certificates of those diabetic patients in whom death was deemed to be the result of cardiovascular disease [10].

These factors may have resulted in inaccurate estimates of the contributions of various diseases to death in diabetic patients, and may be different from those that would be obtained if autopsy data were used. A pilot investigation of the causes of death at autopsy, in adult diabetic patients dying at the University Hospital of the West Indies (UHWI) over the period January 1991 – July 1997, found that infection, rather than vascular disease was the commonest

cause of death [13]. We decided, therefore, to undertake a definitive investigation into the causes of death in hospitalized adult diabetic patients, in the form of a fourteen-year retrospective autopsy study. To the best of our knowledge, this is the first such study from the English-speaking Caribbean.

## PATIENTS AND METHODS

We retrospectively analysed autopsy reports from consecutive autopsies performed in the Department of Pathology, University of the West Indies (UWI), over the fourteen-year period January 1991 to December 2004. The department performs autopsies for deaths occurring at the UHWI – the 500-bed multidisciplinary teaching hospital attached to the Faculty of Medical Sciences at the UWI. The hospital exhibits an autopsy rate of 29.2% [14]. All autopsies were complete, and were performed according to standard methodology. In this study, patients are not identified by name or other unique identifiers, such as a hospital registration number, in keeping with the maintenance of patient privacy, dignity and confidentiality, in accordance with the Declaration of Helsinki.

The autopsy reports of all patients with diabetes mellitus were selected for analysis. As there were difficulties

encountered in retrieving the clinical patient records, the clinical details of the studied patients were obtained solely from the clinical summaries that accompanied the archived post-mortem reports. Consequently, histories of glycaemic control were not available for correlation with autopsy findings. Additionally, the majority of clinical summaries did not indicate the type of diabetes (I or II) present and so all diabetic patients were analysed together as one group. Based on the causes of death identified in previous similar studies [1,2,3,5,6,7,8,15], we categorized our causes of death according to disease-type using the following categories: infection, metabolic, malignant neoplasm, traumatic injury, and then grouped all remaining causes according to organ-system. A miscellaneous category was created for those causes of death that could not be included in any of the previous groups. The term “sepsis” was used for cases of multiple (two or more) foci of infection, diagnosed on the basis of gross morphological and/or histopathological criteria of infection in the involved organs, or cases of septicaemia confirmed by positive blood culture.

The data were used to calculate the percentage contribution of the different diseases to death in adult (> 18 yr) diabetic patients. We also compared the frequencies of the various causes of death in the first seven-year period of the study with those in the second.

**STATISTICAL ANALYSIS**

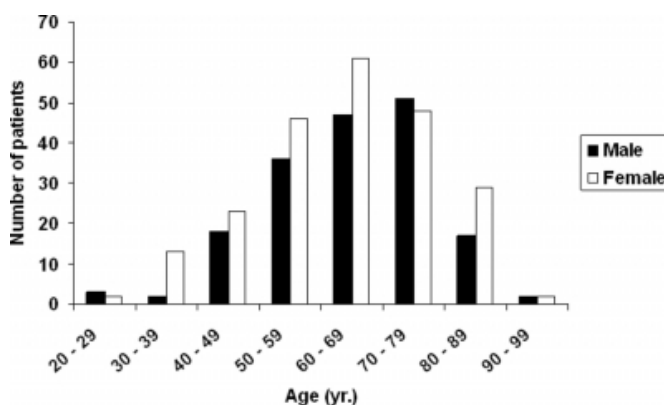
Data are expressed as frequencies, percentages, medians and means with standard deviation as appropriate. Chi square calculations were performed using Georgetown Linguistics Web Chi Square Calculator, Georgetown University, USA, 1996-2003. Statistical significance was defined by a p value of <0.05.

**RESULTS**

During the fourteen-year period reviewed, there were 3541 autopsies, 80 of which were excluded from analysis because of incomplete data in 76 and advanced body decomposition in four. Of the remaining 3461 autopsies, 2541 were performed on adult patients, and of this number 400 (15.7%) had been diagnosed with diabetes mellitus (176 males and 224 females; M: F ratio, 1:1.3). The diabetic patients ranged in age from 25 to 93 years, (median 65.00) and the greatest proportion (27%) was seen in the 60 – 69 year age group (Fig. 1).

**Figure 1**

Figure 1: Age and sex distribution of 400 diabetic patients



Further analysis of the 400 diabetic patients showed that the greatest proportion of patients (46.2%) was found on the Medicine service (Table 1), followed by the Accident & Emergency and Surgery services (21.8% and 18.2%, respectively).

**Figure 2**

Table 1: Distribution of 400 diabetic patients, by hospital service

Service	No. of patients (%)
Medicine	185 (46.2)
Accident & Emergency Unit	87 (21.8)
Surgery	73 (18.2)
Intensive Care Unit	32 (8.0)
Casualty	19 (4.8)
Obstetrics/Gynaecology	4 (1.0)
<b>TOTAL</b>	<b>400 (100)</b>

Table 2 shows the causes of death in all 400 diabetic patients. Infection was the commonest cause of death, with sepsis (multi-organ infection and/or septicaemia) accounting for the majority of these cases. Microbiological identification of the causative organism(s) was documented in all patients diagnosed with septicaemia. Overall, of all 94 patients dying as a result of infection, the causative organism was documented in 38 (40.4%). *Klebsiella pneumoniae* was the commonest isolated organism (26.3%), followed by *Eschericia coli* (23.7%) and *Staphylococcus aureus* (21.1%).

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**Figure 3**

Table 2: Causes of death in 400 adult diabetic patients

Cause of death		No. of patients (%)
<b>Infection</b>		<b>94 (23.5)</b>
Sepsis	48	
Pneumonia	27	
Meningitis	6	
Acute pyelonephritis	3	
Spontaneous bacterial peritonitis	2	
Leptospirosis	2	
Other*	6	
<b>Cardiovascular</b>		<b>75 (18.8)</b>
Coronary artery disease	48	
Congestive cardiac failure	18	
Aortic dissection	5	
Acute left ventricular failure	2	
Fatal arrhythmia	1	
Right heart failure	1	
<b>Respiratory</b>		<b>46 (11.5)</b>
Pulmonary thromboembolism	40	
Other†	6	
<b>Metabolic</b>		<b>45 (11.2)</b>
Hyperglycaemic coma	26	
Renal failure	15	
Hypoglycaemia	4	
<b>Malignant neoplasms</b>		<b>22 (5.5)</b>
Carcinomas	20	
Non-Hodgkin's lymphoma	2	
<b>Gastrointestinal</b>		<b>21 (5.3)</b>
Haemorrhage	10	
Perforated viscus	5	
Intestinal obstruction	4	
Other‡	2	
<b>Central nervous</b>		<b>17 (4.2)</b>
Cerebrovascular disease	14	
Haemorrhage §	8	
Infarction ¶	6	
Subarachnoid haemorrhage	2	
Subdural haemorrhage	1	
<b>Liver, gall bladder and pancreas</b>		<b>10 (2.5)</b>
Acute pancreatitis	3	
Hepatic failure	5	
Other§	2	
<b>Traumatic injury</b>		<b>12 (3.0)</b>
Head injury	5	
Multiple trauma	2	
Spinal cord injury	2	
Other	3	
<b>Miscellaneous¶¶</b>		<b>12 (3.0)</b>
<b>No cause of death identified</b>		<b>46 (11.5)</b>
<b>TOTAL</b>		<b>400 (100)</b>

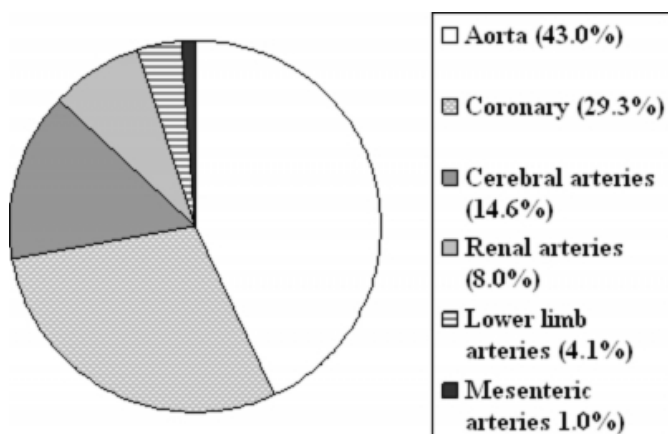
\* infective endocarditis, thoracic empyema, mediastinitis, cerebral abscess, necrotizing fasciitis, subdural empyema †acute respiratory distress syndrome (2), interstitial lung disease, pulmonary hypertension, aspiration pneumonitis, chronic obstructive pulmonary disease ‡gastric outlet obstruction, anastomotic dehiscence §portal hypertension, cholestatic liver disease || lower limb trauma, poisoning, burns ¶ multi-organ system failure (4), reactionary haemorrhage (3), bleeding diathesis (2), iatrogenic haemorrhage, toxic epidermal necrolysis, systemic amyloidosis

Atherosclerotic disease accounted for 52 of 400 (13%) deaths; 48 of these (92.3%) were due to coronary artery disease and 4 (7.7%) were the result of carotid or vertebrobasilar atherosclerosis causing cerebral or cerebellar infarction. The remaining two cases of central nervous system infarction were both cerebellar in location and were consequent on thrombosis attributed to underlying antiphospholipid antibody syndrome.

Analysis of all 400 patients showed that atherosclerosis was present in 235 (58.8%), and 166 of these (70.6%) had atherosclerosis identified in multiple (two or more) sites, giving a total of 488 atherosclerotic sites among the 235 patients (Fig. 2). The commonest sites involved were the aorta, in 210 patients (43.0%), the coronary arteries in 143 (29.3%) and the cerebral arteries in 71 (14.6%). Ten cases of aortic atherosclerosis were complicated by unruptured aortic aneurysms, which were infrarenal in location in eight (80%). Forty-eight (33.6%) of the 143 patients with coronary artery atherosclerosis died as a result of this disease. The incidence of atherosclerosis increased from 51.4% (90 of 175 patients) in the first seven-year period of the study to 64.4% (145 of 225 patients) in the second.

**Figure 4**

Figure 2: Distribution of atherosclerosis in 234 diabetic patients



Hypertension was present in 266 (66.5%) of the 400 diabetic patients, and increased in incidence from 61.1% (107 of 175 patients) in the first seven year period to 70.7% (159 of 225 patients) in the second. The disease contributed to death via spontaneous intracerebral haemorrhage and congestive cardiac failure. All eight patients with spontaneous intracerebral haemorrhage had concomitant hypertension, and in seven, the location of the haemorrhage was deemed to be consistent with spontaneous hypertensive intracerebral

haemorrhage. In the remaining patient, haemorrhage resulted from a ruptured arteriovenous malformation. Congestive cardiac failure was the second commonest cardiovascular cause of death, accounting for 4.5% of all deaths (Table 2). The majority (66.7%) of cases of congestive cardiac failure were the result of underlying hypertensive heart disease. In an additional three patients (16.7%), both hypertensive and ischaemic heart disease were documented, and it was uncertain which was directly responsible for causing cardiac failure. The remaining three cases of congestive cardiac failure were attributed to dilated cardiomyopathy in two, and ischaemic heart disease in one. The two cases of left ventricular failure were accounted for by coronary artery disease in one, and thyrotoxic cardiomyopathy in the other.

Pulmonary thromboembolism (PTE) accounted for 40 deaths (10%) (Table 2). In thirteen of these patients (32.5%) prolonged immobilization (primarily the result of metabolic comas or cerebrovascular accidents) was thought to be a contributing factor to PTE. Post-surgical status was presumed to be the major contributing factor in seven (17.5%), and widely metastatic carcinoma in four (10%). In fifteen patients (37.5%), the underlying cause of PTE was uncertain; two of these patients were obese. The remaining patient had two prior documented episodes of PTE and was presumed to have either a congenital or acquired cause of hypercoagulability, but this was not further elucidated.

Hyperglycaemic coma was the leading metabolic cause of death, accounting for 6.5% of the 400 deaths in diabetic patients.

Malignant neoplasms were documented in 40 patients, and directly caused death, as a result of tumour burden, in 22, the latter representing 5.5% of all deaths (Table 2). Of these 22 cases, 20 were carcinomas and two were non-Hodgkin's lymphomas. The primary sites of the twenty carcinomas that directly caused death were pancreas (4), endometrium (3), prostate (2), lung (2), colorectal (2), larynx (1), liver (1), periampullary region (1), thyroid (1) and jejunum [neuroendocrine] (1). Two patients had disseminated carcinomatosis with uncertain primary sites.

In six of the remaining 18 patients, the malignant neoplasms contributed to death. Four carcinomas (one breast, one pancreas and two unknown primaries) caused PTE, one endometrial carcinoma caused rectal perforation and sepsis, and one non-Hodgkin's lymphoma caused immunosuppression, thus enabling the development of fatal

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pneumonia. Twelve patients died from causes unrelated to their malignant neoplasms (three breast carcinomas, three lung carcinomas, three prostate carcinomas, one thyroid carcinoma, one oesophageal carcinoma and one gastric carcinoma).

Table 3 shows the breakdown, by age and gender, of the various causes of death in the 400 diabetic patients. In patients under the age of 40 years, metabolic diseases were the commonest cause of death, while in those over age 40 years, the commonest cause of death was infection. Vascular disease was uncommon in the 40 – 49 year age group, as well as in the 25 – 39 year age group, where two of the three documented cases of cerebral/cerebellar infarction were the result of arterial thrombosis caused by the antiphospholipid antibody syndrome. Vascular disease, particularly coronary artery disease, was the second commonest cause of death in those patients aged 50 years and older, and these patients accounted for 97.9% of all deaths due to coronary artery disease.

**Figure 5**

Table 3: Causes of death in 400 diabetic patients, by age and gender

Cause of death	25 – 39 yr			40 – 49 yr			50 – 64 yr			65 + yr			Total
	M	F	T	M	F	T	M	F	T	M	F	T	
Infection	-	3	3	6	11	17	15	12	27	22	25	47	94
Coronary artery disease	-	-	-	-	1	1	10	11	21	7	19	26	48
Other cardiovascular diseases	-	1	1	2	-	2	4	2	6	9	9	18	27
Pulmonary thromboembolism	-	2	2	2	-	2	1	10	11	9	16	25	40
Other respiratory diseases	-	-	-	-	-	-	2	2	4	-	2	2	6
Metabolic	3	4	7	5	4	9	3	8	11	9	9	18	45
Malignant neoplasms	-	1	1	-	-	-	6	3	9	4	8	12	22
Gastrointestinal diseases	-	-	-	1	2	3	4	-	4	9	5	14	21
Intracerebral haemorrhage	-	-	-	1	-	1	3	2	5	2	-	2	8
Cerebral/cerebellar infarction	-	3	3	-	-	-	1	1	2	1	-	1	6
Other central nervous system diseases	-	-	-	-	-	-	-	-	-	1	2	3	3
Liver, gallbladder, pancreas	1	-	1	-	1	1	4	3	7	1	-	1	10
Traumatic injury	1	1	2	-	-	-	3	3	6	2	2	4	12
Miscellaneous	-	-	-	-	1	1	1	3	4	4	3	7	12
No anatomical cause of death	-	-	-	1	3	4	3	12	15	13	14	27	46
Total	5	15	20	18	23	41	60	72	132	93	114	207	400

Further analysis of those patients aged 50 years and over shows that, among males in the 50 – 64 year age group, infection accounted for the majority of deaths (25.0%), followed by coronary artery disease (16.7%) and malignant neoplasms (10.0%). Among females in the same age group, infections (16.7%) and coronary artery disease (15.3%) were

also the commonest causes of death, but PTE (13.9%) placed third, whereas it accounted for only 1.7% of deaths in males of this age. Among males in the 65 year and older age group, infections (23.7%), metabolic disease (9.7%), PTE (9.7%) and coronary artery disease (7.5%) were the commonest causes of death. In females of the same age, the same four diseases occupied the top four rankings, with infections (21.9%) in first place, but with coronary artery disease (16.7%) superseding PTE (14.0%) and metabolic disease (7.9%).

Table 4 shows a comparison of the frequencies of the various categories of cause of death with respect to the two seven year periods under study, and the frequencies of some single disease entities within each category.

**Figure 6**

Table 4: Causes\* of death in diabetic patients, by year of autopsy

Cause of death	No. of patients (%)		$\chi^2$	df	p value
	1991 - 1997	1998 - 2004			
Infections	45 (25.7)	51 (22.7)	0.5	1	NS
Cardiovascular disease	25 (14.3)	50 (22.2)	4.07	1	<0.05
Coronary artery disease	18 (10.3)	30 (13.3)			
Congestive cardiac failure	4 (2.3)	14 (6.2)			
Other	3 (1.7)	6 (2.7)			
Metabolic disease	23 (13.1)	22 (9.8)	1.12	1	NS
Hyperglycaemic coma	18 (10.2)	8 (3.6)	7.34	1	<0.01
Hypoglycaemia	0	4 (1.8)			
Renal failure	5 (2.9)	10 (4.4)			
Respiratory disease	18 (10.2)	28 (12.4)	0.45	1	NS
Pulmonary thromboembolism	16 (9.1)	24 (10.6)			
Other	2 (1.1)	4 (1.8)			
Neoplasms	9 (5.1)	13 (5.8)	0.08	1	NS
Gastrointestinal disease	9 (5.1)	11 (4.9)	0.01	1	NS
Central nervous system disease	9 (5.1)	8 (3.6)	0.61	1	NS
Cerebrovascular disease	8 (4.5)	6 (2.7)			
Haemorrhage	6 (3.4)	2 (0.9)			
Infarction	2 (1.1)	4 (1.8)			
Other	1 (0.6)	2 (0.9)			
Liver, gall bladder and Pancreas	8 (4.5)	2 (0.9)	5.48	1	<0.025
Acute pancreatitis	3 (1.7)	0			
Hepatic failure	3 (1.7)	2 (0.9)			
Other	2 (1.1)	0			
Traumatic injury	6 (3.4)	6 (2.7)	0.20	1	NS
Miscellaneous	2 (1.1)	9 (4.0)	3.01	1	NS

\* Excludes cases in which no cause of death was identified, df, degrees of freedom, NS, not significant

In each of the two time periods, infection was the commonest cause of death, followed by cardiovascular disease. The reduction in frequency of infections from the first period to the second (25.7% to 22.7%) was not statistically significant. The increase in proportional representation of cardiovascular deaths in the second time period compared to the first (14.3% to 22.2%) was statistically significant ( $\chi^2 = 4.07$ ,  $df = 1$ ,  $p < 0.05$ ), and was accounted for primarily by increases in the proportion of deaths due to congestive cardiac failure (2.3% to 6.2%) and coronary artery disease (10.3% to 13.3%). The decrease in cerebrovascular disease frequency (4.5% to 2.7%) was primarily due to a decrease in intracerebral haemorrhage, from 3.4% in the first period, to 0.9% in the second. The

category diseases of the liver, gall bladder and pancreas exhibited a significant decrease in frequency ( $\chi^2 = 5.48$ ,  $df = 1$ ,  $p < 0.025$ ) from the first period to the second, and the constituent diseases all showed decreases in frequency from the first time period to the second. All other categories of disease showed non-significant changes in frequency.

Analysis of single disease entities showed a significant decline in the frequency of hyperglycaemic coma as a cause of death ( $\chi^2 = 7.34$ ,  $df = 1$ ,  $p < 0.01$ ). The changes observed in coronary artery disease, congestive cardiac failure, intracerebral haemorrhage and cerebral infarction were not statistically significant.

## **DISCUSSION**

The autopsy rate at our institution is higher than that reported in several others, worldwide [14], but it is, nonetheless, less than 100%. Consequently, all diabetic patients dying at our hospital during the study period did not receive autopsies. However, we feel that the total number of diabetic deaths analysed in this study is sufficient for meeting the stated objectives. It is also possible that the profile of fatal diseases in hospitalized diabetic patients may be different from those dying within the community, thus preventing true comparisons between our study and some others.

Infection was the commonest cause of death in our diabetic patients. This contrasts with findings in other studies, conducted in developed countries, in which vascular disease contributed to the majority of deaths [1,2,3,5,6,7,8]. However, Zargar et al. [15], investigated deaths in diabetic patients in a developing country, like ours, and found, like us, that infection was the chief contributor to death. They suggested that the high prevalence of infections among their diabetic patients may be indicative of the overall high prevalence of infection in the population at large, in developing nations. This may be one explanation for the significant contribution of infection to mortality in our diabetic patients. The decreasing (albeit slightly) contribution with time may be in keeping with the decreasing contribution of infection to mortality in the population at large, in Jamaica [16]. As complete clinical records were not available for this study, we could not evaluate any specific clinical factors that may have contributed significantly to the incidence and outcome of infections in diabetic patients. The results suggest, however, that those individuals involved in the education of diabetic patients should specifically emphasise the importance of preventing injury and infection, and the need

for prompt solicitation of medical attention if infections occur.

Cardiovascular disease was the main cause of death in previous studies [1,2,3,5,7,8], and was the second commonest cause of death in this study, where it was accounted for primarily by coronary artery disease. The increase in the proportion of deaths due to coronary artery disease, from the first period to the second, may be indicative of a continuing trend in which coronary artery disease will ultimately surpass infection as the commonest cause of death. A similar scenario appears to have occurred previously among diabetic patients in another country – Goto and Suzuki [6] reported that, in Japan, over the period 1958 – 1985, infection as the cause of death in diabetic patients decreased from 22.6% to 15.5%, while coronary artery disease increased its proportional contribution from 6.0% to 17.0%. The increase in the incidence of atherosclerotic disease among diabetic patients is consistent with the increase in chronic diseases such as atherosclerosis, observed in the Caribbean population in general over the past several years [16, 17]. The latter is thought to be primarily the result of changes in dietary (consumption of energy-dense foods) and lifestyle practices (particularly decreased physical activity) [17]. These factors may have also contributed to the increasing incidence of atherosclerosis observed among the diabetic patients in this study. The unavailability of clinical records made it impossible to determine any correlation between the levels of glycaemic control and/or compliance with dietary restrictions, exercise regimes and medication, with the presence of vascular disease.

Hypertension increased with time, in keeping with the trend of its increasing incidence within the general Jamaican population [16, 17]. Its development is also influenced by the dietary and lifestyle factors described above. As with vascular disease, we were unable to correlate these factors with the presence of hypertension, as a result of the unavailability of patient records.

Pulmonary thromboembolism accounted for 10.0% of all deaths, and showed a fairly constant percentage contribution over the two time periods analyzed (9.1% in the first and 10.6% in the second). In other studies reviewed, this disease was not a major contributor to death. We were unable to locate any studies that show any causal association between diabetes mellitus and pulmonary thromboembolism. We believe that the fairly high contribution of this disease to death in our diabetic patients may be a function of

hospitalization, as 50% of cases were caused by either prolonged immobilization within hospital or the post-surgical state.

Metabolic disease varied in its contribution to death in various studies reviewed (0.1% to 16.0%). Our investigation revealed that metabolic disease was the fourth commonest contributor to death in adult diabetic patients dying at our hospital, accounting for 11.2% of these deaths. Additionally, there was a decrease in the proportional contribution of this category of disease to death in the second time period compared to the first (13.1% to 9.8%). This decrease was primarily accounted for by a significant decrease in the percentage of deaths caused by acute hyperglycaemia (10.2% in the first period compared to 3.6% in the second). The decreased incidence in hyperglycaemic coma may have resulted from various factors, including improved management of hyperglycaemic coma with time, improved overall management of glycaemic control, improved patient compliance with medication, diet and home glucometer monitoring of glucose levels and improved education and awareness of diabetic patients. A clinical study is required to properly investigate the influence of these factors.

While the percentage contribution of hyperglycaemia to death decreased in the second time period, renal failure increased, from 2.9% in the first period to 4.4% in the second. Goto and Suzuki [6] also showed an increase in renal failure deaths with time (14.9% to 19.9%), but an explanation for this trend was not postulated. The increase observed in our study cannot be adequately explained using the analysed autopsy data. It is unclear whether this increase may be indicative of an increase in the incidence of renal failure among our diabetic patients, or of an increase in autopsy requests among patients dying with renal failure.

The frequency of death secondary to neoplasms was lower in our study (5.5%) than in the studies reviewed, where the percentage contribution ranged from 9.0% to 26.0%. In addition, the proportion of deaths occurring secondary to malignant neoplasms remained fairly constant over the two time periods (5.1% in the first period; 5.8% in the second). The lower frequency observed in our study may be partially explained by the fact that our oncology service has a low autopsy request rate [14].

In our study, gastrointestinal disease accounted for 5.0% of all deaths, and this remained fairly constant over the two periods analyzed (5.1% in the first; 4.9% in the second).

These rates are higher than those reported in the studies reviewed, where they ranged from 1.86% to 2.3% [2,15]. The gastrointestinal diseases seen among our patients were predominantly surgical emergencies, and since our study population was hospital-based, this may explain the relatively high frequency of these diseases in our study.

Our rate of 2.5% for deaths due to diseases of the liver, gall bladder or pancreas is intermediate between those found in other studies, where similar diseases contributed to between 0.37% and 4.6% of deaths [2,15]. We believe that the percentage contribution to death, of each of the diseases in this category, is too small to allow for meaningful interpretative analysis.

The data from this study indicate that while infections are the predominant cause of death in hospitalized adult diabetic patients, coronary artery disease is becoming a progressively more significant contributor. It would appear that in order to decrease mortality among these patients, these two diseases must be aggressively tackled. Diabetic patient educators should re-emphasise the importance of preventing injuries and infections, and the need to seek prompt medical attention if these occur; infections must be aggressively managed; and cardiovascular function must be closely monitored. Specific factors (glycaemic control, compliance with medication, diet, exercise) that have been reported to influence the presence and severity of vascular disease should be investigated to determine the degree of their contributions. The results of such investigations will undoubtedly be instrumental in the development of strategies geared towards the prevention and control of vascular disease. The increasing contribution of renal failure to death warrants further investigation.

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