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ORIGINAL ARTICLE

Control of Hypertension among Diabetic Patients in a Referral Hospital in Tanzania: A Cross-Sectional Study

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ABSTRACT

BACKGROUND: Hypertension is common among diabetic patients. The co-existence of two conditions carries an excessive risk of severe complications and mortalities. Limited information exists on the determinants of poor hypertension control among these patients. We aimed at determining the prevalence and factors associated with poor hypertension control in these patients.
METHODS: Data of diabetic patients who were also hypertensive attending an outpatient clinic from 1 August 2015 to 31 December 2015 at Bugando Medical Centre were retrospectively analyzed. Uncontrolled hypertension was defined as a blood pressure of ≥130mmHg and/or ≥80mmHg systolic and diastolic respectively. A designed questionnaire was used to collect data of patients. Continuous variables were summarized by median and interquartile ranges (IQR) and categorical variables were summarized by frequency and percentage. Logistic regression was used to find the predictors of uncontrolled hypertension.
RESULTS: The majority of our study population were females, 161/295 (54.6%), and the median age was 57 years (IQR 50-64). The prevalence of hypertension was 206/295 (69.8%). A total of 174/206 (84.5%) patients had uncontrolled hypertension. This poor control was significantly associated with poor adherence to anti-hypertensives (OR 1.73[1.26-2.38] p=0.002), presence of any long-term complication (OR 3.19 [1.65-6.18] p=0.03) and overweight (BMI>24.9 Vs <24.9) (OR 1.68 [0.98-2.88], p=0.04). Under-prescription and ambiguous drugs combination was also observed.
CONCLUSION: The prevalence of poor hypertension control among diabetic patients in Tanzania is alarming. Most of the factors associated with this situation can be modified. The clinicians should advocate individualized management, continuous health education and adherence to the available guidelines.
KEYWORDS: Uncontrolled hypertension diabetes Tanzania

INTRODUCTION

There is a growing evidence that the burden of non-communicable diseases (NCDs) is rapidly increasing in sub-Saharan Africa (SSA) (1–3). Estimates of age-standardized mortality suggest that patients in SSA may have up to three-fold higher mortality rates than similar European cohorts for non-communicable diseases. Diabetes mellitus (DM) and hypertension are common diseases in Africa with high mortalities (4). Hypertension, a common comorbid in diabetes, affects more than 50% of diabetic patients (5–7). It is clear that the co-existence of these two conditions in a patient carries an excessive risk for both micro- and macro-vascular complications, and mortalities (8). A Framingham study, one of the largest meta-analysis surveys, showed a strong association between the two diseases. Co-existence of hypertension in diabetics is attributed to the risk of death and cardiovascular events by 44% and 41% respectively as compared to 7% and 9% risk by diabetes alone (9).

Blood pressure lowering in diabetic patients has a remarkable cardiovascular (CV) protective effect. Guidelines from the Joint National Committee (JNC-7) and American Diabetes Association (ADA) recommend maintaining blood pressure at <130mmHg systolic and <80mmHg diastolic in patients with diabetes. Usually, multiple anti-hypertensive agents are needed to achieve this goal (8,10). In most cases, adequate control of blood pressure (BP) in these patients is not attained (5,7,11). Information on the prevalence, control and risk factors of poor control of hypertension among diabetic patients in Tanzania is scarce. The objectives of this study were to determine the prevalence of hypertension among diabetics, to evaluate the degree of BP control, to describe the factors associated with poor BP control, and to evaluate the patterns of antihypertensive treatment prescription.

MATERIALS AND METHODS

This cross-sectional study was conducted in a diabetic clinic at Bugando Medical Centre (BMC). BMC is the zonal hospital for the Lake Victoria region in Northwest Tanzania, and it serves a population of approximately 13 million people. The clinic follows around 1000 diabetic patients from Mwanza region and referrals from around the Lake Zone. This study was conducted over a period of four months starting from August 2015.

Study population: We retrospectively reviewed clinical records of all patients who were attending our diabetic clinic from 01 August to 31 December 2015. Patients were excluded if they were younger than 18 years or pregnant. Patients' age, gender, occupation, smoking history, duration of diabetes, history of hypertension, use of antihypertensive and/or hypoglycemic drugs were recorded on structured questionnaires. Smoking history in this study was defined as being either previous or current smoker. Poor adherence to medications was defined as a patient's self-reported use of <80% of the prescribed drugs. This cut-off is widely acceptable and has been used in other studies for chronic drugs adherence (12). Other related clinical information was also documented. This included height, weight, blood pressures, Fasting Blood Glucose (FBG), cholesterol levels, presence of any documented chronic complication(s) and use of other long term medications. Body Mass Index (BMI) was calculated as kg/m^2 using the most recent records. The mean blood pressure from three recent visits was used to assess the degree of blood pressure control. Controlled hypertension was defined as the mean BP of <130/80mmHg. FBG measurements were also recorded. The mean FBG from three recent visits was used to define the Glycemic control. Patients were labeled to have poor glycemic control when average FBG was >7.0mmol/L. Glycosylated hemoglobin (HbA1C) was not done in these patients. The mean FBG of 7.0Mmol/L, which has been used as a cut-off point in this study, is justified by its correlation to around 6% HbA1C (13). The mean total cholesterol level from two recent consecutive visits was used to define the total cholesterol in this study.

Ethical statement: The study was approved by Bugando Medical Centre/ Catholic University of Health and Allied Sciences (BMC/CUHAS) joint Committee of Research and Publications.

Data analysis: Data was entered, verified and cleaned using Microsoft excel and analysis was done using STATA version 14 (*College Station, Texas*). Continuous variables were summarized by medians and interquartile ranges (IQRs), and categorical variables were summarized by frequency and percentage. Logistic regression was used to find the predictors of poor blood pressure control. Comparisons between the two groups were computed using chi-squared test for categorical variables, nonparametric Wilcoxon rank-sum test for continuous variables and student t-test to compare means between the groups.

RESULTS

Baseline characteristics of 295 enrolled patients attending diabetic clinic at BMC: A total of 295 patients attending diabetic clinic at the BMC from August to December 2015 fulfilled the inclusion criteria. Among these patients, 161/295 (54.6%) were females. The median age was 57 years (IQR 50-64). The mean Body Mass Index (BMI) of our patients was high 27 kg/m^2 (IQR 24-30). The mean duration of diabetes was 48-months (IQR 22-120), and hypoglycemic (anti-diabetic) drugs were prescribed to all patients. An average FBG in three consecutive visits was 9.6 (6.9-13.6) Mmol/dL (Table 1).

Table 1: Baseline characteristics of 295 enrolled diabetic patients attending diabetic clinic at BMC

Characteristic		Number (%) or median (IQR)
Sex	Male	134 (45.4)
	Female	161 (54.6)
Age in years		57 (50-64)
BMI (kg/m^2)		27 (24-30)
Marital status	Single	5 (1.78)
	Married	79 (27.9)
	Divorced	145 (51.2)
	Widowed	54 (19.0)
Address	Mwanza city	103 (34.9)
	Outside of Mwanza city	192 (65.1)
Work status	Informal employment	196(66.7)
	Formal employment	76 (25.9)
	Retired	22 (7.5)
Smoking history	Yes	32 (10.9)
	No	262 (89.1)
Duration of DM (months)		48 (22-120)
Duration on Anti-diabetics (Months)		36 (14-84)
Average FBG (Mmol/dl) (3 consequent visits)		9.6 (6.9-13.6)
Hypertensive	Yes	206 (69.8)
	No	89 (43.2)
Possession of any health insurance	Yes	91 (31.2)
	No	201 (68.8)

Prevalence of blood pressure control among diabetic patients attending diabetic clinic at BMC: Out of 295 diabetic patients attending diabetic clinic, 206(69.8%) were hypertensive. The median systolic and diastolic blood pressures were 140 (120-150) mmHg and 84 (78-89) mmHg

respectively. A total of 174/206 (84.5%) patients had uncontrolled BP (≥130/80mmHg).

Characteristics of 206 diabetic patients with hypertension attending diabetic clinic at BMC: Table 2 displays the baseline and clinical characteristics of hypertensive-diabetic patients. Fifty-six percent of these patients were females.

Many hypertensive patients, 117 (56.8%), were in the age group of 51-65 years. Severe hypertension was seen in 57/206(27.7%) and 40/206(19.4%) patients for systolic BP ≥ 160mmHg and diastolic ≥ 100mmHg respectively. Nearly 40% of 206 had at least one chronic complication related to either Diabetes and/or hypertension. The most common complications reported were peripheral neuropathy, 23(11.2%), stroke, 21(10.2%), and chronic kidney disease, 16(7.8%).

Table 2: Characteristics of 206 diabetic patients with hypertension attending diabetic clinic at BMC (n=206).

Characteristic		Number % or Median (IQR)
Sex	Female	116 (56.3)
	Male	90 (43.7)
Age (years)		58 (IQR 53-65)
Age group (years)	<35	8 (3.9)
	35-50	33 (16.0)
	51-65	17 (56.8)
	>65	48 (23.3)
Smoking history		23 (11.2)
Systolic blood pressure(mmHg)	<120	39 (18.9)
	120-139	56 (27.2)
	140-159	54 (26.2)
	≥160	57 (27.7)
Diastolic blood pressure (mmHg)	<80	43 (20.8)
	80-89	78 (37.9)
	90-99	45 (21.8)
	≥100	40 (19.4)
Duration of using anti-hypertensives (Months)		48 (24-108)
Duration of DM (Months)		65 (26-120)
Average Fasting Blood Glucose (Mmol/dL)	FBG <7	57 (27.7)
	FBG ≥7≤11	69 (33.5)
	FBG >11	80 (38.3)
Average total Cholesterol (Mmol/L)		4.8 (3.8-6.1)
Patients with documented complications		81 (39.3)
Types of complications documented	Peripheral neuropathy	23 (11.2)
	Stroke	21 (10.2)
	Chronic Kidney Disease	16 (7.8)
	Retinopathy	13 (6.3)
	Ischemic Heart Disease	4 (1.9)
	Peripheral Vascular Disease	2 (1.0)
	Diabetic Foot Ulcer	1 (0.5)
Using other long term drugs		114 (59.1)
Types of drugs used	Statins	66 (57.9)
	Aspirin	35 (30.7)
	Tricyclic anti-depressants	12 (10.52)

Predictors of hypertension control among diabetic patients with hypertension attending diabetic clinic at BMC: In this study, we found that poor control of hypertension in diabetic patients was significantly associated with poor adherence to anti-hypertensives (OR 1.73[1.26-2.38] p=0.002), the presence of any long-term complication (OR 3.19 [1.65-6.18] p=0.03) and overweight (BMI>24.9 Vs <24.9) (OR 1.68 [0.98-2.88], p=0.04). Furthermore, we have also

demonstrated that poor BP control had a positive trend in the patients with the age group of 56-65years, and those who were residing within the city with the odds ratio of 2.7 [95% CI, 1.1-06.9] (p= 0.04) and 3.1[1.1-8.3], p=0.04) respectively in univariate analysis. These features were not significant in multivariate analysis (Table 4).

Prescription pattern of anti-hypertensives among diabetic patients: All, except one patient, were prescribed on at least one antihypertensive drug and among them 105 (51.2%), 80 (39.0%) and 9(4.4%) were on monotherapy, two drugs combination and three/more drugs combination respectively. Median duration on anti-hypertensives was 48 months (IQR 24-108). Types of anti-hypertensives used were Angiotensin II converting enzyme Inhibitors (ACEI) 112 (54.6%) and angiotensin II receptor blocker (ARB) 62 (30.2%), Calcium channel blockers (CCB) 92 (44.9%), Beta-Blockers (BB) 8 (3.9%), Diuretics 7 (3.4%) and Hydralazine 6 (2.9%). Details of anti-hypertensives prescription pattern have been shown in Table 3.

Table 3: Prescription patterns of anti-hypertensives among 205 diabetic patients

Drug	Total (%) n=205	Monotherapy 105 (51.2%)	Two drugs 80 (39.0%)		Three or more drugs 9 (4.4%)	
ACEI	107 (52.2)	60 (57.1%)	ACEI & CCB	35 (43.8)	BB, CCB & Hydralazine	3 (33.3)
CCB	92 (44.9)	19 (18.1)	ARB & CCB	22 (27.5)	ARB, CCB& Diuretics	2 (22.2)
ARB	51 (24.9)	17 (16.2%)	ACEI & ARB	8 (10.0)	ACEI, CCB & Hydralazine	2 (22.2)
BB	10 (4.9)	0	BB & CCB	5 (6.3)	BB, Hydralazine & CCB	1 (11.1)
Diuretics	8 (3.9)	0	CCB & Diuretics	3 (3.8)	ACEI, ARB & BB	1(11.1)
Hydralazine	6 (2.9)	0	ARB & Diuretics	1 (1.3)		
			ACEI & Diuretics	1 (1.3)		

DISCUSSION

In this study, we found that nearly 70% of diabetic patients had hypertension and only few (15.5%) reached their target BP values. Poor adherence to anti-hypertensive medications, the presence of any long-term complication and overweight/obesity significantly predicted poor control of hypertension in these patients.

Trends of data collected by the World Health Organization (WHO) suggest that the number of people with uncontrolled hypertension has risen over the recent years, and the highest being in Africa (30%). The prevalence of diabetes has also been increasing globally, particularly in middle and lower income countries (14). These trends undoubtedly reflect the reported high magnitude of co-morbidity between the two diseases (11–13). In Tanzania, Mwita et al reported the prevalence of hypertension among diabetic patients to be 55% at Muhimbili National Hospital in 2012(7), where lower prevalence of 29.3% was reported at the same center two decades ago (18). In the index study, we have demonstrated this magnitude to be much higher (69.8%). This drift clearly suggests a radical increase of this burden in the country.

We have observed a low rate (15.5%) of control of hypertension in the index study. Comparably similar rates have been observed in Tanzania (34%), Cameroun (10.2%) and Malaysia (23.5%) (7,15,19). Several randomized trials have associated significant clinical benefits of tight BP control among diabetic patients (20–22). In the United Kingdom Prospective Diabetes Study (UKPDS), for instance, it was found that each 10mmHg reduction in systolic BP was associated with average reduction of 15% in diabetes-related mortalities due to myocardial infarction (11%) and micro vascular complications (retinopathy and nephropathy) (13%) (20). Nearly 40% of our patients already had at least one chronic complication due to Diabetes/ hypertension/both.

Table 4: Logistic regression analysis for predictors of poor control of blood pressure among diabetic patients with hypertension attending diabetic clinic at BMC

Predictive factor		Number with controlled BP (%) n=32	Number with uncontrolled BP (%) n=174	Unadjusted OR (95% CI) value	P	Adjusted OR (95%CI) value	P
Sex	Female	14 (43.8)	102 (58.6)	0.55(0.26-1.17)	0.12		
	Male	18 (56.3)	72 (41.4)				
Age (years)	>65	6 (18.8)	42 (24.1)	1.4 (0.5-3.7)	0.51		
	56-65	6(18.8)	67(38.5)	2.7(1.1-6.9)	0.04		
	46-55	14 (43.8)	46 (26.4)	0.5(0.2-1.0)	0.05		
	36-45	3(9.4)	11(6.3)	0.7(0.2-2.5)	0.53		
	<36	3(9.4)	8(4.6)	0.5(0.1-1.9)	0.28		
BMI	>24.9	28 (87.5)	162(93.1)	2.9(1.0-8.0)	0.02	1.7(1.0- 2.9)	**0.04**
	<24.9	4 (12.5)	12 (6.9)				
Occupation	Unemployed	18 (56.3)	115 (66.5)	1.0 (0.6-1.5)	0.86		
	Employed	12 (37.5)	41 (23.7)				
	Retired	2(6.3)	17 (9.8)				
Address	Mwanza city	5(15.6)	63 (36.2)	3.1(1.1-8.3)	0.04		
	Outside Mwanza city	27 (84.4)	111(63.8)				
Smoking		2(6.3)	21(12.1)	2.1(0.5-9.3)	0.35		
Possession of medical insurance		12 (37.5)	52 (30.1)	1.1(.0.6-2.2)	0.57		
Duration of DM (months)		84 (32-120)	62 (26-128.3)	1.0 (0.9-1.01)	0.52		
FBG(Mmol/dL)	<7	9 (28.13)	48(27.59)	0.9 (0.4-2.3)	0.95		
	>7	23 (71.8)	126 (72.41)				
Average total cholesterol (Mmol/dL)	<3.8	3 (9.4)	20 (11.5)	1.3(0.4-4.5)	0.73		
	3.8-6.1	7 (21.9)	37 (21.3)	0.9 (0.4-2.4)	0.93		
	>6.1	22 (68.8)	117 (67.3)	0.9 (0.4-2.1)	0.87		
Duration of antihypertensive (months)		48 (26-84)	48 (24-108)	1.1(1.0-1.2)	0.23		
Type of antihypertensive	ACEI/ARB	27 (84.4)	129 (74.1)	0.5 (0.2-1.5)	0.22		
	CCB	39 (22.4)	15 (46.9)	3.2 (1.3-7.9)	0.02		
	BB	1(3.2)	7 (4.0)	1.3 (0.2-10.6)	0.83		
	Diuretics	0	7 (4.0)	*	*		
	Hydralazine	0	6 (3.5)	*	*		
Good adherence		31 (96.6)	138 (79.3)	2.13(1.47-3.09)	<0.001	2.12(1.10- 4.08)	**0.002**
Documented complications		7 (21.9)	74 (42.5)	2.64(1.08-6.44)	0.03	3.19(1.65- 6.18)	**0.01**

Good adherence to anti-hypertensive medications among diabetic patients has been associated with better hypertension control (23) and decreased risk of CV disease, CV events and mortality (24). Similar to our findings, adherence to anti-hypertensives among diabetic patients is generally poor (25,26). This might be partly caused by failure of the patients to prevail with increased pile of drugs to be taken, or potentiated side effects from both anti-hypertensives and hypoglycemics.

In the case study, we have observed a direct association between overweight/obesity and poor control of BP. Similarly, a large Swedish survey of National Diabetes register which recruited more than1500 patients demonstrated the same findings. In this survey, both lower BMI at baseline and during follow-up had a favorable association for control of BP (27). Chew *et al* reported similar findings in Malaysia (19). A combination of Diabetes, hypertension and obesity has been

related with autonomic imbalance and circadian disruption of the autonomic tones during day and night periods. These effects may contribute to the observed findings (28).

Most patients with diabetes require multiple anti-hypertensive medications to achieve the target blood pressure. (20,29). A meticulous combination of anti-hypertensive is therefore desirable. Under-prescription of anti-hypertensives was observed in this study where less than one-half (43.4%) of our patients were prescribed on two or more anti-hypertensives. Despite that short-coming, the majority of our patients were prescribed on Renin-Angiotensin system blockers either in combination with other agents or as a monotherapy. This prescription pattern is in agreement with several international guidelines due to their role in significant reduction of CVD-related deaths, stroke and delaying deterioration of Glomerular Filtration Rate (GFR) in patients with Chronic Kidney Disease (CKD) (8,10,30,31). Unexpectedly, ACEI with ARB was prescribed in nine patients. This regime is not recommended as it does not have any added advantage (32). Human errors might be the reasons for these incorrect prescriptions.

In conclusion, the prevalence of poor control of hypertension among diabetic patients in a tertiary hospital is high and it is highly predicted by modifiable factors. Incongruous prescription of anti-hypertensives is also evident. We believe that our findings will encourage health care providers to deliver the health services according to guidelines and the patient's individualization. Importantly, clinicians should endlessly continue to provide health education on adherence, preventive measures and control of NCDs. Further follow-up studies are necessary to ascertain the long-term outcome of these patients.

This study has limitations. Being a cross sectional study, the fate of diabetes and hypertension co-morbidity could not be assessed. The time from diagnosis of diabetes and hypertension could also not be evaluated. Despite these shortcomings, we believe that these findings are important and relevant as they provide a broad picture of the situation locally and a baseline information for further studies on the subject.

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