

Renal dysfunction among adult patients in Mwanza, Tanzania: prevalence, outcomes and associated factors

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Abstract

Background: The prevalence and mortalities due to renal diseases is estimated to be high in sub-Saharan Africa. However, little is known about these conditions among the hospitalized adult-patients in Tanzania. The objective of this study was to determine the magnitude, associated factors and outcomes of renal dysfunction among the inpatients at Bugando Medical Centre in Mwanza, Tanzania.

Methods: An analytical cross-sectional study was used to determine the prevalence and predictors while prospective cohort design was employed to determine the outcomes. Demographic, clinical and laboratory data were collected from all adult inpatients. For those patients with initial estimated Glomerular Filtration Rate (eGFR) of $<60\text{ml}/\text{min}/1.73\text{m}^2$, a repeat creatinine test was done after 3-months to diagnose the chronic kidney disease.

Results: Out of 637 patients, 48.2% were females and the median age was 45 years. Twenty-eight percent of the study population had renal dysfunction. The prevalence of Chronic Kidney Disease was 69.5% (41/59). The odds of having renal dysfunction was strongly predicted by older age ($p=0.009$), female sex ($p=0.004$), heart failure ($p<0.001$), diabetes ($p=0.04$), decreased urine output ($p<0.001$) and proteinuria ($p=0.004$). Mortality, both in-hospital (3.23 [2.19–4.74], $p<0.001$) and at 1-month post-discharge (3.07[2.13-4.41], $p<0.001$) was found to be significantly higher in patients with renal dysfunction.

Conclusion: This study has demonstrated a high prevalence of renal dysfunction and associated mortalities. This strongly emphasizes the need to increase awareness among clinicians in Tanzania on renal diseases so as to pro-actively screen, prevent, diagnose and provide early treatment of renal dysfunction among hospitalized patients.

Keywords: renal dysfunction, kidney, injury, disease, prevalence, outcomes, Tanzania

Introduction

Acute kidney injury (AKI) and chronic kidney diseases (CKD) are common in Africa and they cause high mortalities. AKI reportedly affects about 13 million people annually, of whom 85% are from low income countries. About 1.7 million deaths are thought to be caused by AKI annually (Mehta *et al.*, 2015). According to recent meta-analyses, the prevalence of CKD in Africa is estimated to be 13.9% (Li *et al.*, 2013; Stanifer *et al.*, 2014). The increase in incidence of these diseases is reflected by increase in prevalence of precipitators like diabetes mellitus, cardiovascular diseases and human immunodeficiency virus (HIV) infection (Arogundade & Barsoum, 2008; Okunol *et al.*, 2012). High mortality in the resource-limited countries in sub-Saharan Africa (SSA) is mostly attributed to lack of awareness of kidney diseases, unavailability of prevention programmes and poor access to renal replacement therapy (RRT) which is either due to high costs or unavailability of such interventions (Callegari *et al.*, 2012; Pozo *et al.*, 2012).

Reports from the USA and Europe have demonstrated that AKI and CKD are important co-morbidities among hospitalized adults (Susantitaphong *et al.*, 2013), and majority of patients with CKD are unaware of their renal disease status (Saunders *et al.*, 2015). Little is known about renal dysfunction (RD) among hospitalized adult-patients in most SSA countries including

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Tanzania. A need to establish the status of these diseases is therefore desirable. This study was therefore carried out to determine the prevalence, associated factors and outcomes of renal dysfunction among the inpatients at Bugando Medical Centre (BMC) in north-western Tanzania.

Materials and Methods

Study site and design

The study was conducted in the adult medical wards of BMC, a consultant and teaching hospital in Mwanza, Tanzania from October 2013 to March 2014. BMC is the zonal referral hospital for the Lake Victoria zone which serves about one-third of the country's population. The hospital has approximately 1,000 beds with an average of 10 medical admissions daily. An analytical cross-sectional study design was used to determine the prevalence and predictors while a prospective cohort study was used to determine the outcomes.

Data collection

All patients over 18 years of age who were admitted to the medical wards of BMC during the study period were eligible for the study and those who consented were enrolled in the study. Demographic and clinical data were collected within 24 hours from the time of admission. A modified structured version of the World Health Organization (WHO) Stepwise approach to surveillance (STEPS) questionnaire was used (WHO, 2011). Additional questions regarding the clinical features of renal dysfunction were added to the questionnaire.

A standardized physical examination was performed for each subject. This included measurements of blood pressure (BP), height, and weight. BP was measured with a mercury sphygmomanometer using standard technique (James *et al.*, 2014). BP was considered to be elevated if it was equal to or greater than 140/90mmHg. The body mass index (BMI) was calculated for all subjects and classified using the WHO classification of obesity (Nishida *et al.*, 2010). Venipuncture was performed on all subjects to obtain blood samples for serum creatinine, HIV and random blood glucose (RBG). Analysis of creatinine was done using an automated machine (Cobas Integra 400 Plus analyzer; Roche, Germany) and the obtained value was used to calculate estimated Glomerular Filtration Rate (eGFR) by using CKD-EPI equation (Levey *et al.*, 2009). Serum creatinine was repeated during a follow-up visit at a 3-month interval for patients with initial eGFR of $<60\text{ml}/\text{min}/1.73\text{m}^2$. RBG was done using a glucometer (GlucoPlus; Glucoplus Inc. Canada), and HIV tests were performed according to the Tanzanian National Guidelines for Provider-Initiated Testing and Counseling (PITC) (MoHSW, 2007). Urine samples were collected by the patient themselves in sterile containers. Within five minutes of urine collection, urinalysis was performed by using urine dipstick (Multistix; Siemen Medical Solutions Diagnostics, USA).

Renal dysfunction in this study was defined as low eGFR ($<60\text{ml}/\text{min}/1.73\text{m}^2$) on admission while CKD was defined according to the Kidney Disease Improving Global Outcomes (KDIGO) diagnosis criteria that is persistently low eGFR ($<60\text{ml}/\text{min}/1.73\text{m}^2$) on a follow-up visit at 3 months (Zarbock *et al.*, 2014). Primary outcome was the prevalence of renal dysfunction while secondary outcomes were the factors associated with renal dysfunction and mortality rates of such patients which occurred both in the hospital and at their homes 1 and 3 months' post-discharge.

Data analysis

Data were analyzed using STATA programme version 13 (College Station, Texas, USA). Descriptive statistics were computed by determining means and standard deviations for normally distributed continuous variables. Medians and inter-quartile ranges were used for abnormally distributed continuous variables as well as for proportions for categorical variables. Means, medians and proportions were compared using the student's t-test, Wilcoxon rank sum test and Pearson chi-

square test or Fisher's exact test, respectively. P-value of less than 0.05 was considered significant. Predictors were evaluated by univariate analysis. Predictors with a p-value of <0.10 by univariate analysis were included in the multivariate logistic regression analysis. The odds ratios with 95% confidence intervals were determined.

Ethical considerations

Ethical approval was sought and obtained from the Catholic University of Health and Allied Science/Bugando Medical Centre joint Committee of Research and Publications (Ref. No. CREC /054/2013). Participants were recruited only after giving an informed written consent or after receiving consent given by a close relative in case of participants who were mentally unstable. All results were provided to the clinicians involved in patient's care and the patients were managed as per BMC's protocol.

Results

Baseline characteristics

A total of 637 patients were included in the analysis. Out of these, 307 (48.2%) were females and the median age was 45 years (IQR 32-61 years). A history of hypertension was present in 160 (25.1%) patients. Twenty-six (4.1%) of the 637 patients had history of kidney disease. Both, the systolic and diastolic mean blood pressures were normal [118 (102-140) and 76 (70-70) mmHg, respectively] (Table 1).

Table 1: Baseline characteristics of the study subjects

Characteristic	Number (%) or Median [IQR]
BMI	22.6 [20.3-25.3]
Underweight BMI <18.5	83 (12.9)
Normal BMI ≥18.5 & <25	390 (60.6)
Overweight BMI ≥25 & <30	102 (15.8)
Smoking	Smoker
	134 (21.0)
	Never
	503(78.7)
Alcohol	Never
	404 (62.4)
	Prior to last month
	190 (29.4)
	In last month or current
	53 (8.2)
Prior use of herbal medicines	130 (20.5)
History of hypertension	160 (25.1)
SBP* in mmHg	Hypotension (<90)
	25 (3.9)
	Normal BP (90 – 139)
	439 (68.2)
	Hypertension (>140)
	178 (28.0)
DBP† in mmHg	Hypotension (<60)
	42 (6.5)
	Normal BP (60 -89)
	421 (65.4)
	Hypertension (>90)
	181 (28.1)
CCF by Framingham criteria	145 (22.4)
History of kidney disease	26 (4.1)
Renal dysfunction	eGFR <60 mL/min/1.73 m ²
	175 (27.5)
Urine output	Normal
	560 (87.9)
	Decreased
	77 (12.1)
History of diabetes	46 (7.2)
HIV rapid test	Known HIV+
	117 (18.4)
	Newly tested HIV+
	32 (5.0)
	Newly tested HIV -
	473 (74.3)

Key: *Systolic blood pressure; †Diastolic blood pressure

Of the study participants, majority (47,7%) had primary school education. Other were had either completed post-secondary education (11.1%) or had incomplete primary school education (36.7%). Peasants accounted for majority of the study subjects (47.1%), followed by self-employed (28.8%) and civil servant or business men/women (24.2%).

Prevalence and factors associated with renal dysfunction

Among 637 patients admitted, 175 (27.5%) were found to have renal dysfunction. Of these, 56.6% patients died and 9.7% lost follow-up leaving only 59 for analysis at 3-month interval. The prevalence of chronic kidney disease was 69.5% (41/59). Using univariate analysis, old age (≥ 45 years) (OR 1.17 [0.97-1.41] $p < 0.001$), female sex (OR 1.45 [1.02-2.05], $p = 0.04$) and overweight (OR 1.63 [1.03-2.57] $p = 0.04$) were found to predict renal dysfunction. Other clinical predictors of renal dysfunction were hypertension; both by history (OR 3.06 [2.09-4.49] $p < 0.001$) and measurement on admission (2.13 [1.47-3.09] $p < 0.001$), congestive heart disease as determined by Framingham criteria (OR 2.92 CI [1.99-4.29] $p < 0.001$), diabetes mellitus (OR 3.51 [1.91-6.45] $p = 0.001$) and history of decreased urine output (OR 3.01 [1.85-4.89] $p < 0.001$) (Table 2).

Table 2: Factors associated with renal dysfunction among 637 patients admitted in Medical wards at BMC by univariate analysis

Characteristics	No. (%) with RD (n=175)	No. (%) without RD (n=462)	Odds ratio [95% CI]	P-value		
H/O* KD†	14 (8.0)	12 (2.6)	3.25 [1.47-7.17]	0.004		
H/O HTN‡	73 (42.2)	87 (19.3)	3.06 [2.09-4.49]	<0.001		
H/O CCF	40 (23.1)	40 (8.8)	3.11 [1.92-5.02]	<0.001		
H/O diabetes	25 (14.4)	21 (4.6)	3.51 [1.91-6.45]	<0.001		
Urine output	Normal	137 (78.3)	3.01 [1.85-4.89]	<0.001		
	Decreased	38 (21.7)			39 (8.4)	
SBP in mmHg	Hypotension (< 90)	10 (5.7)	1.94 [0.84-4.45]	0.12		
	Hypertension (>139)	71 (40.6)	2.13 [1.47-3.09]	<0.001		
DBP in mmHg	Hypotension (<60)	14 (8.0)	1.40 [0.72-2.74]	0.32		
	Hypertension (>89)	101 (57.8)	0.54 [0.37-0.78]	0.001		
CCF by Framingham criteria	65 (37.1)	78 (16.9)	2.92 [1.99-4.29]	<0.001		
Albumin	0	98 (56.0)	1	1		
	+1	32 (18.3)	43 (9.3)	2.8 [1.71-4.62]	<0.001	
	+2	28 (16.0)	43 (9.3)	2.4 [1.44-4.04]	0.001	
	+3	17 (9.7)	4 (0.9)	15.0 [4.18-53.50]	<0.001	
	RBC	0	137 (78.3)	1	1	
		+1	17 (9.7)	13 (2.8)	3.53 [1.67-7.45]	0.001
		+2	10 (5.7)	11 (2.4)	2.46 [1.02-5.90]	0.045
+3		11 (6.3)	14 (3.0)	2.12 [0.94-4.77]	0.07	

Key: *History of; †Kidney disease; ‡Hypertension

When these factors were subjected to multivariate analysis, old age ($p = 0.009$), female sex ($p = 0.004$), heart failure by history ($p = 0.008$) and Framingham criteria ($p < 0.001$), history of diabetes ($p = 0.04$) history of decreased urine output ($p < 0.001$) and proteinuria of 3^+ ($p = 0.004$) remained as strong predictors of renal dysfunction (Table 3).

Table 3: Factors associated with renal dysfunction among patients admitted at BMC by multivariate analysis (N=637)

Characteristic	Odds ratio [Confidence Interval]	P value
Female sex	1.49 [1.03-2.19]	0.04
Age (≥ 45 versus < 45) years	1.02 [1.00-1.03]	0.009
History of heart failure	2.09 [1.24- 3.61]	0.008
History of diabetes	2.09 [1.05- 4.15]	0.04
Reduced urine output	1.83 [1.11-3.02]	< 0.001
Systolic hypertension (SBP > 139)	2.12 [1.10- 4.08]	0.024
Heart failure by Framingham criteria	3.08 [2.02-4.69]	< 0.001
Albuminuria (+3)	15.0 [4.18-53.50]	< 0.001

Patient's outcomes

One hundred and seventy-five (27.5%) out of 637 patients were found to have renal dysfunction. During the post admission follow-up, the re-admission rates were higher both at 1 and 3 months of patients with renal dysfunction than those without renal dysfunction. When mortalities between two groups were compared, they were significantly higher in patients with renal dysfunction than those without renal dysfunction both in the hospital and at one month follow up ($p < 0.001$). Mean duration of stay in hospital was the same (6 days) in both subjects. These differences also remained statistically significant even after adjusting for age, sex and HIV status (Table 4).

Table 4: In-hospital, 1- and 3-month outcome post-discharge among adults admitted with renal dysfunction and those with other conditions

Outcome Number/ Median	Renal dysfunction (N=175)	Other conditions (N=462)	Odds ratio [95%CI]	P-value
eGFR (ml/min/1.73m ²)	41 [25-49]	90 [90-90]	NA	NA
eGFR (< 15 ml/min/1.73m ²)	21 (11.0%)	NA	NA	NA
In-hospital mortality rate	62 (35.4%)	80 (17.3%)	3.23 [2.19-4.74]	< 0.001
Duration of hospital stay (days)	6 [3-8]	6 [4-10]	0.97 [0.93-1.00]	0.07
Mortality at 1 month	26/98 (26.5%)	62/346 (17.9%)	3.07 [2.13-4.41]	< 0.001
Readmission rate at 1 month	33/98 (33.7%)	68/345 (19.7%)	1.96 [1.20-3.18]	0.007
Mortality at 3 month	11/72 (15.3%)	29/284 (10.2%)	0.63 [0.29-1.33]	0.23
Readmission rate at 3 month	15/70 (21.4%)	43/282 (15.3%)	1.52 [0.78-2.92]	0.21
Chronic kidney disease	41/59 (69.5%)	NA	NA	NA

Key: NA= not applicable; CI=Confidence Interval

Discussion

This study has demonstrated that nearly one-third of the patients had renal dysfunction. Of these, two thirds had CKD. This prevalence is unacceptably high as compared to overall prevalence of CKD in other SSA countries (Sumaili *et al.*, 2009; Stanifer *et al.*, 2014). Higher prevalence in our study can be explained by an in-hospital based environment which involved in-patients study participants. In addition, poor community awareness on renal diseases, inadequate health facilities and absence of proper renal prevention programmes are likely to have contributed to this higher prevalence. Similar findings have also been reported from other surveys (Carter & Callegari, 2007; Arogundade & Barsoum, 2008).

Similar to our findings, advanced age and low level of education have been demonstrated to be associated with renal dysfunction elsewhere (Bello *et al.*, Singh *et al.*, 2009; Sumaili *et al.*, 2010; Fraser *et al.*, 2013; Khajehdehi *et al.*, 2014). However, most of our patients were relatively

younger than those in the developed countries where patients are predominantly middle-aged and elderly (Castro & Coresh, 2009). This is possibly a reflection of the higher prevalence of the predisposing illnesses like hypertension and infections causing glomerulonephritis and interstitial nephritis in this age group in most developing countries (Naicker *et al.*, 2003; Fabian & Naicker, 2009; Hall *et al.*, 2011; Peck *et al.*, 2013).

In agreement with many other studies, hypertension, diabetes mellitus and congestive heart failure were found to be associated with renal dysfunction in our study. Renal dysfunction is usually a complication of these conditions if not timely treated. A concurrent increase in prevalence of these diseases in our population with inadequate control (Peck *et al.*, 2013; Kamuhabwa & Charles, 2014) explains their positive relation to renal dysfunction. In another study at the same center, Janmohamed *et al.* (2013) reported very high prevalence of CKD among diabetic patients attending outpatient clinic.

HIV/AIDS in our study was not found to be significantly associated with renal dysfunction. However, a recent study in Ghana has indicated positive association between the two conditions (Sarfo *et al.*, 2013). This association has also been implicated by low CD4 count (Msango *et al.* 2011). A study by Mpondo *et al.* (2014) has suggested the improvement of renal function in these patients following ART drugs. Majority of our HIV-infected patients were aware of their status and were already enrolled for care and treatment services including the use of ART drugs that might have induced an improvement of their renal functions. The high mortality among patients with renal dysfunction found in our study during hospitalization and post-discharge is consistent with other findings elsewhere (Ympa *et al.*, 2005). A high relative risk for all-cause death associated with CKD observed in this study has also been reported elsewhere by Tonelli *et al.* (2006).

This study had some limitations which include the inability to perform renal biopsy for establishing a progression of renal disease and loss of follow-up to some patients at 3-month post-discharge. Despite these shortcomings, the findings are important and relevant as they provide a broad picture on the situation locally and a baseline information for further studies on the subject.

The current study has conclusively demonstrated that prevalence and mortality rates are high among BMC in-patients with renal dysfunction and that majority of them are unaware of their status. It is justifiable belief that our findings emphasize the need for increasing awareness on the renal diseases among clinicians in Tanzania so as to screen, prevent, diagnose and treat renal dysfunction early. On the bases of these findings, we strongly urge and recommend provision of renal replacement therapy services at BMC in order to reduce high burden of morbidity and mortality from these conditions. We also recommend a follow-up study of these patients to determine long term outcome on their health conditions.

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors' Contribution

SBK, ATS, collected the clinical information and managed the patient; SBK, FAB, DWG wrote the manuscript. All authors critically revised the manuscript and approved the final draft.

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