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The outcome of Patients on Hemodialysis at University Teaching Hospital of Kigali (CHUK) in a Period of September 2014 to March 2017 - A Retrospective Study on Patients with Acute and Chronic Renal Failure

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ABSTRACT

Background: Kidney dysfunction is both a national and international problem. Its incidence is increasing in the general population, mostly due to the high prevalence of diabetes, hypertension and the long-term consequences of acute kidney injury. The incidence and prevalence of kidney dysfunction necessitating dialysis are unknown in Rwanda as studies are lacking.

Methodology: This study describes the outcomes of the patients who received hemodialysis at CHUK. Data was retrospectively collected and statistically analyzed for 152 patients treated in the hemodialysis unit at CHUK between September 2014 and March 2017.

Results: The results have shown that 51.3% and 48.7% of the population being studied were identified to have acute kidney injury and chronic kidney failure respectively. The main risk factors for hemodialysis treatment were hypertension (48%), diabetes mellitus (46.7%), eclampsia (13.2%), and volume deficit (15.8%). Hyperkalemia, pulmonary edema, encephalopathy, and other uremic symptoms were present in 39-43% of patients and were the most common indications for hemodialysis. Encephalopathy and poor oxygen saturation were independent risk factors for death. 20.6% could not afford the usual provision of three sessions of hemodialysis per week and therefore didn't receive dialysis as frequently as recommended. Forty-five patients (20.6%) could not afford the usual provision of three sessions of hemodialysis per week and received less frequent dialysis.

Conclusion: There is high mortality in patients referred for hemodialysis in CHUK. Almost half of the patients have chronic renal failure and require permanent renal replacement therapy. Many patients limit therapy due to financial reasons.

Keywords (MeSH): Hemodialysis; Kidney dysfunction; Acute kidney injury; Chronic Kidney Injury

INTRODUCTION

The definition and epidemiology of acute kidney injury (AKI) have recently discussed and reported in the literature [1]. AKI previously termed acute renal failure (ARF) is a rapidly and potentially reversible deterioration of kidney function, leading to the retention of fluid and biochemical waste, and the potential disturbance of acid-base balance [1]. AKI is a potential public health challenge since it may extend from less severe forms of injury characterized by a minimal rise in serum creatinine (SCr) to more advanced injury where a patient may necessitate renal replacement therapy (RRT) [1, 2]. In contrast chronic kidney disease (CKD) is defined as the presence of abnormalities in kidney structure or function (e.g. albuminuria or glomerular filtration rate (GFR) < 60 mL/min/1.73 m2), present for longer than three months, with implications for health, and it is considered a significant risk factor for AKI [1-4]. Left unmanaged, AKI and CKD may lead to end-stage renal disease (ESRD) and ultimately to death.

Patients with ESRD have irreversible kidney damage and require renal replacement therapy (RRT) such as hemodialysis (HD) or peritoneal dialysis (PD) [5]. Another alternative for patients with ESRD is kidney transplantation; this is considered as the treatment of choice because it reduces the risk of mortality and improves quality of life more than RRT for appropriate candidates [1-5]. Unfortunately, most patients with ESRD are either not suitable for transplantation due to medical reasons, or a suitable organ cannot be identified, or the procedure or related medications may be unaffordable, particularly in

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resource-limited settings. Consequently, the majority of patients with ESRD will require RRT for the remainder of their lives [4, 5].

The life expectancy of patients with ESRD has gradually improved since the introduction of hemodialysis [6]. It is for this reason that hemodialysis has established itself as the treatment of choice worldwide for chronic and acute kidney failure [3, 7]. The incidence of chronic kidney disease is increasing around the globe because of an aging population, and higher prevalence of diabetes mellitus, hypertension and cardiovascular system diseases which result in acute and chronic kidney failure as potential complications. In 2013, around 3.2 million patients were being treated for ESRD worldwide. This number increases by approximately 6% each year. Of those 3.2 million patients, around 2.5 million were undergoing hemodialysis treatment [7, 8].

Although hemodialysis saves and prolongs lives, patients starting hemodialysis have more than eight times the mortality rate compared to the general population [4]. Many patients who reach end-stage kidney disease die because RRT is either unavailable or unaffordable. Hemodialysis was initiated at CHUK in September 2014 in order to offer a therapeutic option to patients with severe acute and/or chronic kidney dysfunction and renal failure. In CHUK's dialysis service, the patients are managed by a team of highly trained nurses and medical professionals. Before the launch of the new dialysis center, many Rwandan patients seeking medical treatment for their renal failure were referred to hospitals in neighboring countries, including Kenya [9]. Knowledge of the most frequent causes of renal failure and the outcomes of patients treated with hemodialysis will facilitate future planning and development of RRT resources [10]. To our knowledge, this is the first study describing the diagnoses and outcomes of dialysis patients since the introduction of this service at CHUK in September 2014.

METHODS

Ethical consideration

Before conducting this study, ethical clearance was obtained from the CHUK in the division of Education, Research, and Training. The information gathered during this study was confidential, and neither the names of patients nor health providers are published. Only researchers have access to the study data.

Data collection

A retrospective analytical study was conducted on all patients who underwent hemodialysis treatment at CHUK in the hemodialysis service unit. Based on clinical and paraclinical criteria of the definition of AKI and CKD we retrospectively analyzed the files of all patients who underwent hemodialysis between September 2014 to March 2017(Table 2). The definition of AKI and CKD was based on physician's decision documented in the files after assessment of patient from the emergency room or any of the hosting departments of CHUK, and this follows the standard of care at CHUK to define AKI & CKD. To avoid the inconsistent, we redefine the AKI and CKD based on the clinical and paraclinical data found in the files and like other retrospective studies and therefore might suffer from bias.

Patients had to be stratified for risk of AKI according to the susceptibilities and exposures of AKI. An AKI patient was defined as any patient who was recently diagnosed with AKI from any acute disease such as malaria, drug-induced or muscle injury, septicemia, diabetes ketoacidosis, abrupt decompensation of heart failure, etc; with renal ultrasound confirming that the renal status is acute by radiologist or bedside renal ultrasound. All cases of eclampsia and bleeding with pre-renal failure were also considered as AKI. CKD was clinically defined based on history, clinical presentation, and renal ultrasound that is relevant to the poor cortex and medullar differentiation as well as the size of the kidneys which is small in certain conditions. Also, we considered laboratory parameters favoring CKD including positive proteinuria, low hemoglobin, hypocalcemia, and hyperphosphatemia. Patients defined as acute on chronic were also considered as having CKD. Between this period, data collection was attempted for a total of 162 patients, of which ten were excluded due to the incomplete files. The review consisted of three steps. Step one was initially identified by reviewing a register maintained at the hemodialysis unit at CHUK. The identified patients were then cross-checked on a computerized system to obtain their archive codes. The archive codes were then used to locate the complete medical records. If complete records could not be obtained, patients were excluded from further analysis.

The data manager was trained and evaluated by the Principal Investigator (PI) for two consecutive days to ensure that the data collected were accurate. A data extraction form was developed and utilized to ensure consistent collection from each patient's records. This data collection was carried out on 152 medical records that were available in the CHUK file library. We identified the indications of hemodialysis initiation based on documentation from the file. In each case-file, we checked at least one or more reason for hemodialysis and was put in a model for analysis.

Data management and analysis

After data collection, data were entered into Microsoft Excel and then exported to SPSS (Software Version 16.0; SPSS Inc, Chicago, IL, USA). A descriptive analysis was done to outline the characteristics of data, and univariate analysis was used to assess data which were statistically significant. The univariate analysis was carried out using Fisher's exact test or the $\chi 2$ (chi-square) test to test differences in patient characteristics between two groups (those who died and those who survived). $P < 0.05$ was taken to indicate a significant difference, and the odds ratio (OR) was noted at every significant value. Thereafter, multivariate analysis was carried out for data found to be significant for better assessment of independent causes of death. This was undertaken using the regression model. Survival curve analysis, using Kaplan-Meier curves was carried out to assess the length of survival from hemodialysis initiation. Chi-square testing or Fisher's exact test was used for categorical variables and one-way *ANOVA* for continuous variables.

RESULTS

Characteristics of patients who underwent hemodialysis treatment (see tables below)

162 patients underwent hemodialysis at CHUK between September 2014 to March 2017. Ten patients were excluded due to incomplete medical files, and 152 patients were retained for analysis. 85 (55.9%) were male, and 67 (44.1%) were female. The mean age was 40.8 years with a minimum age of 13 years and a maximum age of 84 years (Standard Deviation of 16.7). Patients from all provinces were represented in this study, but more patients came from Kigali city (72; 47.4%) than any other province (Table 1). AKI accounted for 78 (51.3%) patients, and CKD accounted for 74 (48.7%) patients. In 81.6% of cases, the diagnosis of kidney failure (for both CKD and ERSD) was established at CHUK. The most commonly identified risk factors associated with the need for RRT included hypertension in 73 patients (48.0%) and diabetes in 71 patients (46.7%). It is important to note that some of the patients had more than one risk factors (Table 1). One hundred fifteen patients (75.7%) were initially assessed by medical officers or residents. The diagnosis of either AKI or ESRD of 146 patients (96.1%) was based on both clinical and paraclinical medical information. AKI was defined according to the Kidney Disease Improving Global Outcomes (KDIGO) criteria, and CKD was defined based on preceding clinical history and laboratory data (if available) or findings of renal atrophy on ultrasound examination. AKI can also be defined basing on diuresis data, however these data are missing and not analyzed in this study since they were not systematically quantified. The most common indications for hemodialysis for both AKI and CKD were encephalopathy (42.8%), pulmonary edema (39.5%), and hyperkalemia 43.4%. The jugular line was the most commonly utilized means of vascular access (80.9%). An arteriovenous fistula was used in only 5.7% of cases, who had benefit it from Indian or French vascular surgery team that yearly visit Rwanda. 70.4% of the patients had more than three hemodialysis sessions, but 20.6% were irregular due to financial reasons. At follow up, 46.1% of patients had died, and 53.9% survived (Table 2). Most of the patients died within four months of admission to the hemodialysis unit.

Univariate and multivariate analysis of variables concerning mortality

Univariate analysis shows that poor oxygen saturation, encephalopathy, and the jugular line were the only factors associated with mortality (Table 3). Independent predictors of mortality, Cox regression method revealed that poor oxygen saturation, encephalopathy, and the jugular line are major causes of death (Table 4).

Table 1. Description of demographic & clinical characteristics

Variable (N = 152 Mean = 41.81	SD = 16.68)	Frequency	%
Sex	Male	85	55.9
	Female	67	44.1
Province	Kigali City	72	47.4
	Out of Kigali	80	52.6
Type of Renal Failure	AKI	78	51.3
	CKD	74	48.7
Classification of AKI	Pre-renal	29	37.2
	Renal	46	59.0
	Post-renal	3	3.8
Stage of CKD	Stage 4	8	9.6
	Stage 5	66	90.4
Underlying disease	Diabetes	71	46.7
	Hypertension	73	48.0
	Eclampsia/preclampsia	20	13.2
	Volume depletion	24	15.8
	Post malaria	18	11.8
	Glomerulonephritis	3	2.0
	Nephrotoxicity	2	1.3
	Sepsis	2	1.3
	Benign prostate Hypertrophy	2	1.4
	Malignancy	3	2.1

Table 2. Characteristic of Hemodialysed patients

Variable N=152		Frequency	%
Indication of HD	Hyperkalemia	66	43.4
	Pulmonary Edema	60	39.5
	Encephalopathy	65	42.8
	Uremic syndrome	58	38.2
	Metabolic acidosis(documented)	1	0.7
	Toxic removal	1	0.7
Initial Evaluator	Medical Officers/Residents	115	75.7
	Specialist Internist	37	24.3
Vascular line	Jugular	123	80.9
	Femoral	19	12.5
	Fistula	9	5.7
	Subclavian	1	0.7
Number of HD sessions/ week	< 3 sessions	45	20.6
	≥3 sessions	107	70.4
Reasons of HD interruption	Hemodynamically unstable	1	8.3
	Hemorrhage on catheter site	1	8.3
	Financial reasons	7	58.3
	Medical decision	4	33.3
Abnormal vital signs	Low Blood Pressure	13	8.6
	Bradycardia/tachycardia	4	2.6
	Poor oxygen saturation	16	10.5
Outcome of HD	Death	70	46.1
	Survival	82	53.9
Admitting Department	Emergency	16	10.5
	Gynecology	16	10.5
	Intensive care	15	9.9
	Internal Medicine	99	65.1
	Pediatry	2	1.3
Stay before HD initiation (days Mean and SD)	Surgery	4	2.6
	Mean (M) and SD	6.9 (M)	13.28 (SD)
Duration of hospitalization(days)	Mean(M) and SD	28.18 (M)	27.40 (SD)

Table 3. Univariate analysis of risk of death by characteristics

Characteristic	N	Death n(%)	Survival n(%)	OR(95% CI)	P-Value
Sex					
Male	85	37 (52.9)	48 (58.5)	1.259 (0.662-2.395)	0.482
Female	67	33 (47.1)	34 (41.5)		
Diagnosis					
AKI	78	41 (58.6)	37 (45.1)	0.582 (0.305-1.108)	0.098
CKD	74	29 (41.4)	45 (54.9)		
Risk Factors of Kidney failure					
Diabetes	71	28 (40.0)	43 (52.4)	1.654 (0.867-3.153)	0.125
Hypertension	73	29 (41.4)	44 (53.7)	1.637 (0.860-3.117)	0.133
Volume depletion	24	14 (20.0)	10 (12.2)	0.556 (0.230-1.344)	0.188
Eclampsia	20	9 (12.9)	11 (13.4)	1.050 (0.408-2.702)	0.919
Post-malaria	18	11 (15.7)	7 (8.5)	0.501 (0.183-1.371)	0.172
Others	12	7 (7.9)	5 (6)		0.231
Indications of hemodialysis					
Encephalopathy	65	36 (51.4)	29 (35.4)	0.517 (0.269-0.992)	0.046
Hyperkalemia	66	28 (40.0)	38 (46.3)	1.295 (0.679-2.471)	0.432
Pulmonary Edema	60	27 (38.6)	33 (40.2)	1.073 (0.558-2.061)	0.833
Uremia	58	27 (38.6)	31 (37.8)	0.968 (0.502-1.866)	0.923
Other indicators	2	2 (2.6)	00 (00)		0.305
Vascular access					
Jugular line	123	51 (72.9)	72 (87.8)	2.682 (1.52-6.248)	0.019
Femoral line	19	12 (17.1)	7 (8.5)	0.451 (0.167-1.218)	0.110
Other lines	10	1 (1.4)	9 (10.92)		0.237
Abnormal vital signs during HD					
Blood Pressure(hypotension)	13	7 (10.0)	6 (7.3)	1.407 (0.450-4.402)	0.556
Bradycardia/tachycardia	4	2 (2.9)	2 (2.2)	1.76 (0.161-8.576)	0.872
Oxygen Saturation	16	13 (18.6)	3 (3.7)	6.006 (1.636-22.054)	0.003

Table 4: Independent predictors of mortality, Cox regression method analysis (n=152)

Variable	Wald coefficient	p-value	(95.0% C.I)
Abnormal Oxygen Saturation during HD	7.297	0.007	(0.045-0.611)
Encephalopathy	5.241	0.022	(0.131-0.734)
Jugular line access	7.088	0.008	(0.037-0.510)

DISCUSSION:

Information regarding the epidemiology and outcomes of the management of renal failure in many parts of Africa is limited [9]. This report is the first detailed description of Rwandan patients referred for hemodialysis at a large teaching hospital. Several observations can be made. First, the mean age of the patients treated is 42 years, the sex ratio (male to female) is 1.26 and 48.7% of the patients treated had CKD (Table 2) mostly with underlying diabetes and hypertension, rather than AKI. The number of patients with CKD exceeded those with preeclampsia and malaria-related renal failure, long considered to be among the major contributors to renal failure in Sub-Saharan Africa [9, 10]. The most substantial portion of the patients came from Kigali City (47.4%), likely related to the geographical localization of CHUK. The 51.3% of the patients referred for dialysis had AKI. This may reflect a referral bias.

Due to the limited insurance coverage for dialysis and the unaffordability of chronic dialysis for much of the population, many patients with clear evidence of irreversible renal failure (such as renal atrophy on ultrasound examination) are not referred for dialysis. The diagnosis of renal failure necessitating dialysis for most patients (81%) was established at CHUK, possibly related to the greater availability of diagnostic information and greater awareness and desire to establish the diagnosis given the possibility of dialysis on-site. Most of the diagnoses were made based on both clinical and paraclinical investigations (91.6%) including urea and creatinine, hemoglobin level, proteinuria and kidneys ultrasound, but a precise; etiologic diagnosis was elusive due to the lack of availability of more advanced diagnostic modalities such as urine chemistry, microscopy, and biopsy.

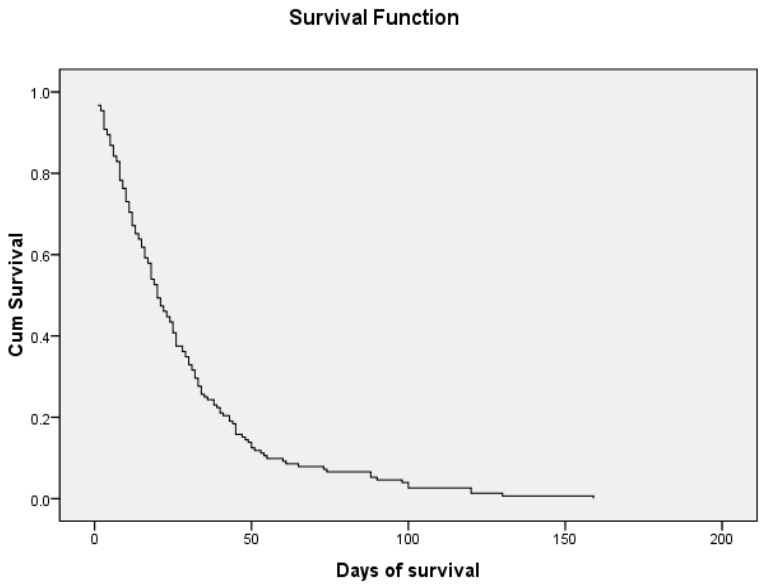

Figure 1. Kaplan Meir curve showing length of survival for patients on hemodialysis.

Overall, mortality was high at 46.1%, and higher in patients with AKI (59%) than CKD (41%), which is in keeping with the well-established high mortality for patients with AKI. Encephalopathy and impaired oxygenation were associated with a higher likelihood of death. Mortality in this Rwandan population appears to be similar to other African dialysis populations reported in literature [11-13]. Many patients in this study received dialysis less than three times per week, mainly due to the affordability. The issues around the cost of RRT reported in other developing nations [12, 13] have led the Kidney Disease Improving Global Outcomes (KDIGO) initiative to consider the publication of a guide on palliative care for patients with stage-5 CKD after it was found that in many parts of the world RRT was not available or accessible [13-16].

Cieza and co-authors discussed the survival rates of patients on three RRT methods (hemodialysis, peritoneal dialysis, and kidney transplant) seen at a private clinic in Peru between January 1st, 2008 and December 31st, 2011 [7]. The survival rate for patients on HD was 95.1% ± 0.21 (n = 90). High mortality rates in the three methods of RRT were observed for female patients and patients aged 60 years or older. The type of patients enrolled in their studies almost certainly explains the discrepancy in mortality when compared to our study. The studies cited enrolled patients on three modes of RRT, many of which began treatment non-emergently. Furthermore, patients who died on their initial hospitalization were excluded, whereas our report includes only patients who were referred urgently for hemodialysis (the only available modality) and includes all patients referred to the dialysis unit for whom records were available. Finally, it is possible that patients treated at private clinics may have more medical and financial resources on which to draw.

Studies showed that adequate renal monitoring has been associated with better outcomes in patients on hemodialysis [17-21]. Among other things, renal monitoring includes having patients on planned dialysis, having a follow-up with a nephrologist, and offering patients an arteriovenous fistula as a permanent area for vascular access [11, 19]. However, despite these recommendations, most of the patients in our study started HD with a temporary venous catheter (jugular or femoral). Also, for 10.5% of patients, the first dialysis was considered emergent, i.e., there's a high risk of imminent death. Only 24.3% of patients were initially evaluated by a specialist. The outcomes reported in this study were similar to those described in a Brazilian study, in which nearly half of the patients on hemodialysis died, and only (approximately) one in four had been seen by a nephrologist before being prescribed hemodialysis [12].

CONCLUSION

In conclusion, this report describes the demographic and clinical characteristics of 152 patients referred over approximately three years for treatment at a newly established dialysis unit in a large Rwandan teaching hospital. Half of these patients had a diagnosis of CKD. Overall mortality was 46% and highest in those patients with either abnormal oxygen saturation during hemodialysis or encephalopathy.

There is high mortality in patients referred for hemodialysis. Almost half of the patients have chronic renal failure and require permanent renal replacement therapy. Many patients limit the frequency of therapy due to financial reasons. We recommend more prospective studies to assess the etiology of renal failure based on biopsy and more definitive laboratory analysis. We also recommend the creation and maintenance of a national registry to compile data on diagnoses and outcomes of patients with both AKI and CKD to facilitate planning and resource allocation.

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