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CARDIAC TROPONIN T LEVELS IN END-STAGE RENAL DISEASE PATIENTS UNDERGOING HEMODIALYSIS AT JARAMOGI OGINGA ODINGA TEACHING HOSPITAL, WESTERN KENYA: CROSS-SECIONAL STUDY DESIGN
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ABSTRACT

Background: **End-Stage Kidney Disease (ESKD) is a critical global health issue, particularly in low-resource settings like Kenya, where limited access to specialized care and dialysis exacerbates its rising prevalence and underreporting.**
Methods: **This study aimed at determining the cardiac** troponin T levels in ESKD patients undergoing hemodialysis at Jaramogi Oginga Odinga Teaching Hospital (JOOTRH), Kisumu County, Kenya**. This study employed a cross-sectional descriptive research design, examining 71 patients with ESKD. Besides cardiac troponin T, the whole blood (3-5 mL) was analyzed for kidney biochemical parameters. Descriptive statistics and Chi-square test was used to examine associations between dependent and independent variables using SPSS software version 25.**
Results: **The study included 71 (n=100) participants, 50.7% (n=36) were female and 49.3% (n=35) were male. The study observed that 98.6% (n=70) had elevated levels of cardiac Troponin T. Gender was significantly associated with phosphorus levels, with an odds ratio of 0.33 (95% CI: 0.11–0.98) and a p-value of 0.042. While no kidney biochemical parameters, except chloride, were significantly linked to cardiac Troponin T levels.**
Conclusion: **This study highlights the interplay between dialysis practices, biochemical disturbance, and cardiovascular risk in ESKD.**

Recommendation: Management of ESKD to adopt a personalized approach that incorporates, the demographic factors, biochemical profiles to optimize renal and cardiovascular outcomes.

INTRODUCTION

End-stage kidney disease (ESKD) is a growing global public health problem, particularly in low- and middle-income countries where access to specialized treatment such as hemodialysis remains limited [1]. Patients with ESKD are at increased risk of cardiovascular complications, which are among the leading causes of morbidity and mortality in this population [2]. Cardiac troponin T (cTnT) is a highly sensitive and specific biomarker of myocardial injury and plays an important role in the diagnosis of acute myocardial infarction (AMI) [3]. However, patients with ESKD often present with persistently elevated cTnT levels even in the absence of acute cardiac ischemia, making interpretation difficult [4]. Several mechanisms have been proposed to explain this phenomenon, including impaired renal clearance, chronic myocardial injury, systemic inflammation, and dialysis-related factors such as heparin use, fluid shifts, and dialysis membrane characteristics [5,6,8]. Consequently, distinguishing between chronic elevation and acute cardiac events in ESKD patients remains a major clinical challenge [7].

Despite the established clinical significance of cTnT among patients with ESKD, interpretation of elevated levels in hemodialysis patients remains complex because chronic kidney dysfunction and dialysis-related factors may influence circulating troponin concentrations [8]. Although studies from other settings have documented elevated cTnT levels among ESKD patients, there is limited information on troponin T levels and associated risk factors among patients undergoing hemodialysis in Kenya. This knowledge gap limits evidence-based clinical decision-making and may contribute to delayed or missed diagnosis of cardiovascular complications in this high-risk population.

Therefore, this study aimed to assess troponin T levels and associated factors among ESKD patients receiving hemodialysis at Jaramogi Oginga Odinga Teaching and Referral Hospital in order to inform targeted interventions and improve cardiovascular outcomes among these patients.

MATERIALS AND METHODS

Study design and setting: This was a cross-sectional descriptive study that was conducted at JOOTRH in Kisumu County. Jaramogi Oginga Odinga Teaching Hospital is a major referral and teaching hospital serving the western part of Kenya. The study was conducted between January and March, 2024, at the hospital Renal Unit, which offers routine hemodialysis services for patients diagnosed with end-stage kidney disease.

Study population: The study consisted of adults patients aged 18 years and above diagnosed with ESKD and undergoing hemodialysis at the renal unit with JOOTRH with the study period.

Inclusion and exclusion criteria: The study included patients aged 18 years and above diagnosed with ESKD and on hemodialysis for at least three months and must provide written informed consent. This study excluded patients with a documented history of acute myocardial infarction within the

previous three months, those with active infections or acute illness that could confound troponin T levels.

Sampling technique and sample size: A purposive sampling method was used to recruit eligible participants. The sample size of 71 was determined using Taro Yamane formula of 1967 for a finite population [9]. All eligible and consenting patients attending hemodialysis during the study period were enrolled.

Data collection procedure: Clinical and demographic data were obtained through face-to-face interviews and review of patient's medical records to record their age, gender, and dialysis frequency, comorbidity status. Whole blood sample of 3-5 mL was drawn from the participants during their routine dialysis session by a qualified phlebotomist. The kidney biochemical parameters analyzed included, serum creatinine, urea, potassium, sodium, chloride, calcium, phosphorus. These were analyzed using the Mindray BS-240 analyzer equipped with an ISE module (Mindray Bio-Medical Electronics Co., Ltd). The cardiac troponin T levels were measured using the Cobas e411 immunoassay analyzer (Roche Diagnostics), which utilizes the electrochemiluminescence immunoassay (ECLIA) technology. Internal and external quality control procedure were performed in accordance with the manufacturer's protocols.

Data analysis: Data were entered and analyzed using SPSS version 25. Descriptive statistics (mean, frequencies and percentage) were used to summarize demographic and clinical characteristics. The Chi0square test was used to assess association between cardiac troponin T levels and the independent variables such as age, gender, dialysis frequency and electrolyte levels.

p value for demarcation criteria that was considered statistically significant was set at <0.05.

Ethical considerations: Ethical approval for this study was obtained from the Institutional Scientific and Ethics Review Committee (ISERC) of JOOTRH, under reference number ISERC/JOOTRH/746/23. License permit was sought from the National Commission for Science, Technology, and Innovation (NACOSTI) with license number NACOSTI/P/24/34424.

RESULTS

Of these 71 (n=100) participants, 50.7% (n=36) were female and 49.3% (n=35) were male, resulting in a balanced male-to-female ratio of 1:1. The distribution of comorbidities associated with kidney diseases among the study participants revealed: 12.68% (n=9) had arthritis, 42.25% (n=30) had hypertension, 11.27% (n=8) had cancer, and 11.27% (n=8) were living with HIV. Additionally, 7.04% (n=5) had diabetes, 2.28% (n=2) had both hypertension and HIV, and 1.40% (n=1) had both hypertension and arthritis. Furthermore, 11.27% (n=8) reported having none of the comorbidities listed in the study.

In investigating the associations between demographic characteristics—specifically age and gender—and kidney biochemical parameters, the study found that age did not demonstrate a statistical association with the kidney biochemical parameters. as shown in table 1.

Table 1

Demographic characteristics and kidney biochemical parameters in End-Stage Kidney Disease Patients Undergoing Hemodialysis (n = 71)

Characteristics (Age, years)	Kidney Biochemical parameters	Normal (n, %)	Elevated (n, %)	χ^2 value	df	p value
20- 89-year	Creatinine	1 (1.4%)	70 (98.6%)	5.53	6	0.48
20- 89-year	Urea	2 (2.8%)	69 (97.2%)	4.58	6	0.59
20- 89-year	Sodium	29 (40.8%)	42 (59.2%)	9.13	6	0.16
20- 89-year	Potassium	47 (66.2%)	24 (33.8%)	3.8	6	0.69
20- 89-year	Calcium	15 (21.1%)	56 (78.9%)	6.5	6	0.36
20- 89-year	Phosphorus	20 (28.2%)	51(71.8%)	3.5	6	0.73
20- 89-year	Chloride	52 (73.2%)	19 (26.8%)	12.3	12	0.42

Gender exhibited a statistically significant association with phosphorus levels, with an odds ratio of 0.33 (95% CI: 0.11–0.98) and a p-value of 0.042 as shown in table 2.

Table 2

Association between gender and kidney biochemical parameters among ESKD patients receiving hemodialysis (n = 71)

Kidney biochemical parameter	Gender	normal level n (%)	abnormal level n (%)	Test statistic	OR (95% CI)	p-value
Creatinine level	Male	0 (0.0)	35 (49.3)	Fisher's exact test	-	1.000[a]
	Female	1 (1.4)	35 (49.3)			
Urea level	Male	1 (1.4)	35 (49.3)	Fisher's exact test	-	1.000[a]
	Female	1 (1.4)	34 (47.9)			
Sodium level	Male	15 (21.1)	20 (28.2)	$\chi^2 = 0.12$	1.2 (0.45–3.04)	0.730[b]
	Female	14 (19.7)	22 (31.0)			
Potassium level	Male	22 (31.0)	13 (18.3)	$\chi^2 = 0.11$	0.85 (0.32–2.24)	0.740[b]
	Female	24 (33.8)	12 (16.9)			

Calcium level	Male	7 (9.9)	28 (39.4)	$\chi^2 = 0.05$	0.88 (0.28–2.74)	0.820[b]
	Female	8 (11.3)	28 (39.4)			
Phosphorus level	Male	6 (8.5)	29 (40.8)	$\chi^2 = 4.15$	0.33 (0.11–0.98)	0.042[b]*
	Female	14 (19.7)	22 (31.0)			
Chloride level	Male	29 (40.8)	6 (8.5)†	Ordinal regression	0.38 (0.13–1.13)	0.083[c]
	Female	23 (32.4)	13 (18.3)†			

†Combined high and low chloride levels, [a] Fisher's exact test, [b] Chi-square test, [c] Ordinal regression analysis, *Statistically significant at $p < 0.05$

The study observed that 98.6% (70/71) of the patients had elevated cardiac Troponin T levels. Analysis of the association between gender and kidney biochemical parameters showed that phosphorus levels were significantly associated with gender ($\chi^2 = 4.15$, OR = 0.33, 95% CI: 0.11–0.98, $p = 0.042$). However, creatinine, urea, sodium, potassium, calcium, and chloride levels were not significantly associated with gender among patients with ESKD receiving hemodialysis, as shown in Table 2.

Table 3

Association between renal biochemical parameters and cardiac Troponin T levels among ESKD patients receiving hemodialysis (n = 71)

Kidney biochemical parameter	Troponin T level	normal level n (%)	abnormal level n (%)	Test statistic	OR (95% CI)	p-value
Creatinine level	Normal cTnT	0 (0.0)	1 (1.4)	Fisher's exact test	-	1.000[a]
	High cTnT	1 (1.4)	69 (97.2)			
Urea level	Normal cTnT	0 (0.0)	1 (1.4)	Fisher's exact test	-	1.000[a]
	High cTnT	2 (2.8)	68 (95.8)			
Sodium level	Normal cTnT	1 (1.4)	0 (0.0)	Fisher's exact test	-	0.410[a]
	High cTnT	28 (39.4)	42 (59.2)			
Potassium level	Normal cTnT	1 (1.4)	0 (0.0)	Fisher's exact test	-	1.000[a]
	High cTnT	45 (63.4)	25 (35.2)			
Calcium level	Normal cTnT	0 (0.0)	1 (1.4)	Fisher's exact test	-	1.000[a]
	High cTnT	15 (21.1)	55 (77.5)			
Phosphorus level	Normal cTnT	0 (0.0)	1 (1.4)	Fisher's exact test	-	1.000[a]
	High cTnT	20 (28.3)	50 (70.4)			
Chloride level	Normal cTnT	0 (0.0)	1 (1.4)†	Ordinal regression	L1: 1.06 (0.53–1.60)	<0.001[c]*
	High cTnT	52 (73.2)	18 (25.4)†		L2: 2.05 (1.31–2.78)	<0.001[c]*

†Combined high and low chloride levels, [a] Fisher's exact test, [c] Ordinal regression analysis, *statistically significant at $p < 0.05$

The study observed that 98.6% (70/71) of the participants had elevated cardiac Troponin T levels. Analysis of the association between renal biochemical parameters and cardiac Troponin T levels showed no statistically significant association for creatinine, urea, sodium, potassium, calcium, and phosphorus levels ($p > 0.05$). However, chloride levels demonstrated a statistically significant association with cardiac Troponin T levels based on ordinal regression analysis ($p < 0.001$), as shown in Table 3.

Table 4

Risk factors associated with cardiac Troponin T levels among ESKD patients undergoing hemodialysis (n = 71)

Risk factor	Troponin T level	Category n (%)	Test statistic	p-value
Presence of comorbidity	Normal cTnT	Present: 1 (1.4)	Fisher's exact test	1.000[a]
		Absent: 0 (0.0)		
	High cTnT	Present: 62 (87.3)		
		Absent: 8 (11.3)		
Type of comorbidity	Normal cTnT	Hypertension: 1 (1.4)	Monte Carlo Fisher's Exact test	1.000[da]
		Cancer: 0 (0.0)		
		HIV: 0 (0.0)		
		Arthritis: 0 (0.0)		
		Diabetes mellitus: 0 (0.0)		
		None: 0 (0)		
	High cTnT	Hypertension: 32 (45.1)		
		Cancer: 8 (11.3)		
		HIV: 8 (11.3)		
		Arthritis: 9 (12.7)		
		Diabetes mellitus: 5 (7.0)		
		None: 8 (11.3)		
Number of dialysis sessions per week	Normal cTnT	One session/week: 1 (1.4)	Fisher's exact test	0.169[a]
		Two sessions/week: 0 (0.0)		
	High cTnT	One session/week: 11 (15.5)		
		Two sessions/week: 59 (83.1)		

[a] Fisher's exact test, [d] Monte Carlo Fisher's Exact test.

The study assessed selected risk factors associated with cardiac Troponin T levels among patients with ESKD undergoing hemodialysis. Presence of comorbidity, type of comorbidity, and number of dialysis sessions per week were not significantly associated with elevated cardiac Troponin T levels among the study participants ($p > 0.05$), as shown in Table 4. Hypertension was the most common comorbidity observed among patients with elevated cardiac Troponin T levels.

DISCUSSION

The present study identified a statistically significant relationship between gender and phosphorus levels in patients with End-Stage Kidney Disease undergoing hemodialysis. The odds ratio of 0.33 in the current study suggests that males may have a lower likelihood of elevated phosphorus levels, highlighting the importance of gender-specific interventions in managing phosphorus levels for better patient outcomes in hemodialysis. These results underscore the potential need for gender-specific approaches in managing phosphorus levels among hemodialysis patients. The observed gender disparity may be partially explained by differences in dietary phosphorus intake and phosphorus metabolism. Given these findings, it is important for clinicians to consider gender as a factor when developing individualized phosphorus management plans. This finding is consistent with prior research that underscores the influence of demographic factors, such as gender, on kidney function and various biochemical markers. Chronic kidney disease-mineral and bone disorders (CKD-MBD) have been linked to the cardiovascular complications of kidney failure, with elevated phosphate levels (hyperphosphatemia) playing a significant role in worsening heart-related issues in these patients [10]. Research has shown that gender differences in dietary habits, including phosphorus intake, can affect phosphorus metabolism, with factors like αKlotho and FGF23 playing a crucial role in regulating phosphorus levels and contributing to the development of CKD-MBD [11].

The current study found that only chloride was significantly associated with cTnT levels, while other kidney parameters (creatinine, urea, potassium, phosphorus, sodium, calcium) were not statistically significant. The significant association between chloride and cTnT observed in this study suggests a potential, though underexplored, relationship between electrolyte imbalances and myocardial stress or injury in the hemodialysis population. Chloride disturbance have been implicated in acid-base balance and volume status, which are known to influence cardiovascular outcomes; however, their direct link to cTnT requires further investigation. This observation contrasts with previous studies, which reported that there was a significant association between cTnT levels and markers of poor kidney function [12]. Suggested correlation between myocardial injury and worsening kidney function, reinforcing the well-documented relationship between kidney dysfunction and cardiovascular risk in patients with end-stage kidney disease. The discrepancy between the results of the two studies could be attributed to difference in the patient populations, variations in comorbidities, disease stages, or other demographic characteristics potentially influencing the results. Furthermore, differences in dialysis quality and regional healthcare access might contribute to variations in the findings.

The current study found that while common comorbidities such as hypertension, obesity, cancer, HIV, and arthritis were not statistically significant in relation to elevated cardiac troponin T (cTnT) levels, the frequency of dialysis sessions per week emerged as a significant risk factor. This suggests that increasing the frequency of dialysis could potentially reduce cardiovascular risk in patients with end-stage kidney disease (ESKD). These findings align with previous studies, including those by [11], which have highlighted the importance of optimizing

dialysis schedules to improve fluid and electrolyte balance, ultimately benefiting cardiovascular health. Specifically, these studies [10], have emphasized that increasing dialysis frequency beyond the typical three sessions per week may help mitigate cardiovascular risk and improve overall health outcomes in ESKD patients.

In the context of the Kenyan healthcare system, where most ESKD patients typically undergo dialysis twice a week, the current study's findings are particularly relevant. Given that twice-weekly dialysis falls below the standard recommendation, this study further underscores the need to adjust dialysis frequency as a modifiable factor to reduce cardiovascular events and enhance patient outcomes. The link between dialysis frequency and improved cardiovascular health aligns with the broader body of evidence suggesting that more frequent dialysis sessions can play a crucial role in stabilizing patients' fluid and electrolyte balance, which directly impacts heart health.

Limitation of the study

The study was constrained by a small sample size and a cross-sectional design, with troponin and renal biochemical parameters measured at a single time point, despite participants undergoing biweekly dialysis sessions.

CONCLUSION

This study emphasizes the importance of personalized care for ESKD patients, highlighting the role of gender in phosphorus levels, and the significance of chloride in cardiovascular risk. Based on the study finding's, it is recommended that the management of ESKD to adopt a personalized approach that incorporates, the demographic factors, biochemical profiles to optimize renal and cardiovascular outcomes.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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COMPETING INTERESTS

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

AUTHORS' CONTRIBUTIONS

R.K.I posed the research question. R.N.D. and R.K.I was in charge of the methodology (including ethics approval), formal analysis and investigation. The original draft and review of the article was compiled by R.K.I, and R.N.D.

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DATA AVAILABILITY

The data that support the findings of this study are openly available.

DISCLAIMER

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors and the publisher

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