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PREVALENCE OF HYPERTENSION AND ASSOCIATED RISK FACTORS AMONG HEMODIALYSIS PATIENTS AT AYDER COMPREHENSIVE SPECIALIZED HOSPITAL, TIGRAY, NORTH ETHIOPIA

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ABSTRACT: Hypertension is highly prevalent in hemodialysis patients. It was associated with the principal determinant factors of co-morbid and mortality in hemodialysis patients. However, its prevalence and determinants have not been studied well in Ethiopia. Therefore, the present study intended to assess the prevalence of hypertension and associated determinants among hemodialysis patients at Ayder Comprehensive Specialized Hospital, Tigray, North Ethiopia, in 2016. A retrospective cohort study was conducted by reviewing records of patients followed the hospital care from 2013 to 2016.Finally Logistic regression model was used to assess the presence of the association between response and predictor variables. The overall prevalence of hypertension in hemodialysis patient was 38.5% in the entire follow-up period. In clinical laboratory characteristics of the patients, a paired t-test showed that hypertension was significantly dropped from pre-dialysis to post-dialysis of hemodialysis patient. The significant predictors of hypertension in hemodialysis patient were; Age, uremic encephalopathy, uremic pericarditis, diabetes mellitus, obstructive nephropathy. This study, therefore, proposes that a nationwide survey should be conducted encompassing the entire hypertensive population to find out the prevalence of hypertension and its associated risk factors, so that a preventive strategy could be adopted to reduce the disease and complications related to it in the community.

Keywords: Hypertension; dialysis; Hemodialysis; Prevalence; Ethiopia

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INTRODUCTION

Chronic kidney disease (CKD) is increasingly recognized as a major public health problem worldwide.[1] Due to the asymptomatic nature of this disease, CKD is not frequently detected until its late stages, resulting in lost opportunities for prevention. Progression to end-stage renal disease or other adverse outcomes could be prevented or delayed through early detection and treatment of CKD.[2],[3]Epidemiology of patients with CKD and subsequent end-stage kidney disease in Sub-Saharan Africa (SSA) countries differs from developed countries.In SSA, CKD mainly affects young, reproductive adults in the age range of 20 to50 years old who are economically productive. With the poverty and debt burden increasing in most of the SSA countries coupled with late presentation, absent or poor distribution of Renal Replacement Therapy (RRT) and its associated high cost, identifying risk factors for CKD and ultimately determining screening and prevention strategies may help reduce the cost burden and improve morbidity and mortality.[4] Hypertension (HTN) is an important public health problem and affects 24% of the general population.[5]The prevalence of HTN in patients with CKD significantly exceeds that seen in the general population; it is estimated to be more than 70% in patients with End-Stage Renal Disease (ESRD) and undergoing hemodialysis (HD).[6], [7]Patients with CKD are in the highest risk group for cardio-vascular events.[8]Although HTN is an important predictor of cardiovascular mortality, several studies have questioned the link between HTN and mortality in HD patients. [9], [10]In SSA countries, hypertension and diabetes mellitus are among the leading cause of ESDR. By 2020, the burden of diabetes and cardiovascular disease will be increased by 130% in Africa alone, with concomitant increases in the prevalence of CKD and ESRD.[11]Accordingto WHO, in low income setting countries such as, Ethiopia chronic disease is a growing problem. Like many other chronic diseases, the incidence of CKD in Ethiopia is rising because of increased risk factors such as hypertension and diabetes mellitus.[12]Hypertension is common in HD patient. However, its prevalence and determinants have not been studied in Ethiopia. Therefore, the present study intended to assess theprevalence of hypertension and associated determinants among hemodialysis patients at Ayder Comprehensive Specialized Hospital (ACSH), Tigray, North Ethiopia, 2016.

2. MATERIALS AND METHODS

2.1. Study design and Period

A retrospective cohort study was conducted at AyderComprehensive Specialized Hospital,Mekelle fromApril2013 to August 2016.

2.2. Study Area

Mekelle is the capital city of Tigray regional state. It is located 730 km north of Addis Ababa with a total estimated population of 337,676, of whom 164,096 are men and 173,580 women. The two largest ethnic groups are Tigre (96.2%), and Amhara (2.26%)[13] Ayder Comprehensive Specialized Hospital (ACSH) is a referral and teaching governmental hospital functions and supervised by the state Ministry of Health (MoH) of the government of Ethiopia. It serves up to 8 million populations in its catchment areas of the Tigray, Afar and South-eastern parts of the Amhara regional states. It provides a broad range of medical services to both in and out patients of all age groups. As such, the hospital can be designated as the most advanced medical facility, by all accounts, in the Northern part of the country and that it stands as the second largest hospital in the nation. It has 500 inpatient beds in four major departments and other specialty units. It is also used as a teaching hospital for the College of Health Sciences (CHS), Mekelle University. Dialysis Center is established in a private public partner agreement between Mekelle University, ACSH and Mahal Medical private limited company.[14]

2.3. Population

2.3.1. Source population

The source populations were all clients attending dialysis center at ACSH.

2.3.2. Study population

The study populations wereindividuals selected by consecutive sampling technique in dialysis center at ACSHduring the period of April 2013 and August 2016.

All adult patients (18 years and older) who were on maintenance hemodialysis for ESRD during the specified period were included in the study. However, patients on transient hemodialysis (patients from abroad who took HD at the Centre for short period of time) and incomplete medical record were excluded from the study. Consecutively, all eligible patients were considered as the smallest unitof the population.

2.4. Variables and source of data

The main outcome variable was hypertension among hemodialysis patients.Predictor variables considered were socio-demographic factors, laboratory tests, types of vascular access, co-morbidity factors, cause of death and dialysis modality. We extracted data on these predictor variables from register, follow-up forms, and other clinical records.These registers and forms are regularly filled as part of a routine paper-based patient record system.The data were extracted by a trained nurse.

2.5. Data processing and analysis

Data was first checked manually for completeness andthen entered into Epi-Info softwarever. 3.1. After data entry and cleaning, the data was transferred to SPSS ver. 20 for statistical analysis. Descriptive statistics were employed to describe the characteristics of the cohort and to estimate the prevalence of hypertension among HD patient.A paired t-test was used to compare baseline and end level of clinical laboratory tests of the patients. Bivariate analysis was performed using binary logistic regression. Variables which showed significant association in the bivariate analyses (P-value< 0.25) were candidates for the multivariate logistic regression model. To control for the effect of confounding variables, multivariate logistic regressions adjustments were used. Explanatory variables significantly associated with the outcome variable with p-value <0.05 in multivariate logistic regression were determined as independent predictors of hypertension(HD) patient. Finally, conclusion and recommendation were made based on the findings. Adjusted OR and 95% CI were used to interpret the findings.

2.6 Ethical considerations

Ethical approval was obtained from the Institutional Review Board of the CHS of Mekelle University. Accordingly, permission letter was secured from medical directors at ACSH. All the collected patient information was stored anonymous and data was kept confidential.

3. RESULTS AND DISCUSSION

A total of 130 HD patients were followed and eligible for the study with the response rate of 91%. Table-1 summarizes the demographic characteristics and clinical factors of the study population. Of these participants, 77(59.2%)were male. At the time of enrollment to HD, there were 65 (50%) patients at the age of 35-64 years. Majority of the patient residence were from East Tigray and Mekelle. RT-IJV was the predominant vascular accesses used for HD. Most of the patients (63.9%) had at least two sessions of dialysis a week.Table-2 summarizes the cause of death among patients on HD. Uremic encephalopathy and metabolic acidosis were the predominant cause of deaths in HD patients. A paired t-test showed that blood urea nitrogen significantly dropped from pre-dialysis level of 249.6 ± 122.1mg/dl to 185 ± 106.3mg/dl at the last session ($p < 0.001$). The hemoglobin level significantly dropped from pre-dialysis level of 9.2 ± 3.7g/dl to 7.6 ± 2.7g/dl at the last session ($p < 0.001$). Serum creatinine significantly dropped from pre-dialysis level of 11.6 ± 5.8mg/dl to 9.3 ± 5.4mg/dl at the last session ($p < 0.001$). Serum potassium also significantly dropped from pre-dialysis level of 5.2 ± 1.4meq/Lto 4.6 ± 1.26meq/L at the last session ($p < 0.001$).

Table-1: Socio-demographic characteristics and the Prevalence of hypertension among HD patientsand the clinical factors of hemodialysis in ACSH, North Ethiopia.

Characteristics Hypertension (HD)	Yes	No	Count(%)
Sex			
Male	34	43	77(59.2%)
Female	16	37	53(40.8%)
Religion			
Christian	44	70	114(87.6%)
Muslim	01	06	07(5.4%)
Other	05	04	09(7%)
Age			
19-34	13	26	39 (40%)
35-64	31	34	65 (50%)
>=65	02	18	20(15.4%)
Place of residence			
West Tigray	10	10	20 (15.4%)
East Tigray	21	34	55 (42.3%)
Mekelle	11	27	38 (29.2%)
South &Central Tigray	08	09	17 (13.1%)
Types of vascular access*			
RT-IJV	39	55	94 (72.3%)
LTIJV	03	02	5 (3.8%)
AVF	06	13	19 (14.6%)
AVG	01	06	7 (5.4%)
Other	01	04	5 (3.8%)
Frequency of dialysis per sessions/week			
Once	09	16	25(19.2%)
Twice	34	49	83(63.9%)
Tripled	07	15	22(16.9%)
Co-morbidity factors			
Diabetes mellitus			
Yes	19	09	28 (21.5%)
No	31	71	102 (78.5%)
Obstructive Nephropathy			
Yes	17	07	24 (18.5%)
No	33	73	106 (81.5%)
Polycystic kidney disease			
Yes	05	06	11 (8.5%)
No	45	74	119 (91.5%)
HIVAN			
Yes	09	07	16(13.1%)
No	41	73	114 (86.9%)

* AVG - ArterioVenous Graft; AVF -ArterioVenous Fistula; LT-IJV-Left Internal Jugular Vein; RT-IJV- Right Internal Jugular Vein; HIVAN-Human Immune Deficiency Virus Associated Nephropathy

3.1 Ascertaining the clinical laboratory characteristics of hypertension in HD patient

In clinical laboratory characteristics, a paired t-test showed that hypertension was significantlydropped from pre-dialysis to post-dialysis of HD patient. Furthermore, having pre-dialysis hypertension had significantly higher values than post-dialysis. Hence, in bloodurea nitrogen,hypertension wassignificantly dropped from pre-dialysis(255.2 ± 122.2mg/dl)to post – dialysis(176.5 ± 110.7mg/dl) ($p < 0.001$); in hemoglobin level,hypertension wassignificantly dropped from pre-dialysis (9.4 ± 3.6g/dl)topost-dialysis(7.9 ± 3.0g/dl)($p < 0.001$); in serum creatinine, hypertension wassignificantly dropped from pre-dialysis(12.6 ± 6.1mg/dl)to post-dialysis(9.1 ± 6.2mg/dl)($p < 0.001$); and in serum potassium,hypertension wassignificantlydropped from pre-dialysis (5.3 ± 1.35meq/L) to post-dialysis(4.6 ± 1.37meq/L)($p < 0.001$).

Table-2: Prevalence of hypertension amongcause of death factors on HDpatients in ACSH, North Ethiopia.

Cause of death Hypertension	**Yes**	**No**	Count (%)
Uremic features			
Yes	37	40	77 (59.2%)
No	43	40	53 (40.8%)
Uremic encephalopathy			
Yes	43	38	81 (62.3%)
No	07	42	49 (37.7%)
Pulmonary Edema			
Yes	32	16	48 (36.9%)
No	18	64	82 (63.1%)
Metabolic Acidosis			
Yes	40	41	81 (62.3%)
No	10	39	49 (37.7%)
Fluid overload & hyperkalemia			
Yes	33	23	56 (43.1%)
No	17	57	74 (56.9%)
Uremic pericarditis			
Yes	25	08	33 (25.4%)
No	25	72	97 (92.3%)

3.2 Prevalence of hypertension in HD patient

The overall prevalence of hypertension in HD patientwas38.5%(34 males and 16 females)in the entire follow-up period.By frequency of dialysis persessions, prevalence of hypertensionwas higher among patients that undergo twice hemodialysis than once and tripled: 41% vs. 36% and 32%.By age groups, prevalence of hypertension was higher among patients in the age of 35-64 years old than 19-34 years old and >=65 years old: 47.7% vs. 33.3% and 10% respectively.Uremic pericarditisispresent in 75.8% of patients was associated with a higher prevalence of hypertension than its absence.Diabetic

mellitus present in 67.8% of patients, was associated with a higher prevalence of hypertension than its absence. Furthermore, Obstructive nephropathy present in 70.8% of HD patients was associated with a higher prevalence of hypertension than its absence(Table-3).

Table-3. Crude and Adjusted Odds ratio for determinant factors associated with hypertension among HD patient in ACSH, North Ethiopia.

Variables	**Hypertension**		**COR(95%CI)**	**AOR (95%CI)**
	Yes	**No**		
Sex				
Male	34	43	0.55(0.261, 1.15)*****	0.53(0.17, 1.65) *****
Female	16	37	1	
Age				
19-34	13	26	0.056(0.006, 0.52)**	0.008(0.001, 0.2)***
35-64	31	34	0.22(0.05, 1.11)**	0.19(0.022, 1.58)*
>=65	02	18	1	1
Uremic encephalopathy				
Yes	43	38	0.15(0.059, 0.366)****	0.19(0.047, 0.8) **
No	7	42	1	1
Uremic pericarditis				
Yes	25	8	0.11(0.044, 0.278)****	0.18(0.041, 0.79) **
No	25	72	1	1
Diabetes mellitus				
Yes	19	9	0.21(0.084, 0.59) ****	0.12(0.026, 0.55)***
No	31	71	1	1
Obstructive Nephropathy				
Yes	17	7	0.19(0.07, 0.492)****	0.18(0.039, 0.836) **
No	33	73	1	1
Fluid overload				
&hyperkalemia	33	23	0.21(0.097, 0.044)****	1.12(0.315, 4.01)
Yes	17	56	1	1
No				
Metabolic Acidosis				
Yes	40	41	0.26(0.116, 0.597)****	0.33(0.089, 1.2) *
No	10	39	1	1
Pulmonary Edema				
Yes	32	16	0.14(0.063, 0.312)****	0.64(0.17, 2.36) *
No	18	64	1	1
Uremic features				
Yes	37	40	0.35(0.16, 0.76)***	1.05(0.29, 3.9)
No	13	40	1	1

Significant at: *P<0.25; ** P<0.05; *** P<0.01; **** P<0.001; COR: Crude OddRatio; AOR: Adjusted OddRatio; CI: Confidence Interval.

3.3 Determinant factors associated with hypertension among HD patient

Based on the results of bivariatelogistic regression analysis shown in Table-3, variables which showed significant association with hypertension among hemodialysis patients at 5% significant level were selected for multivariate analysis. In multivariate logistic regression result, odds ratiois the estimated multiplicative change in the odds for a unit change in the predictor variables, controlling for the effects of other predictors. The significant predictors of hypertension among hemodialysis patients inACSH at 5% significant level after controlling for theeffects of others predictors were; Age, uremic encephalopathy, uremic pericarditis, diabetes mellitus, obstructive nephropathy(Table-3). Hence, those who had uremic encephalopathywere about 81% (AOR=0.19; 95% CI= (0.047, 0.8)) less likely to develophypertension in hemodialysis patients. In addition those who had uremic pericarditis were about 82% (AOR=0.18; 95% CI= (0.041, 0.79)) less likely to develop hypertension in hemodialysis patients. Concerning the socio-demographic factors,those who had Age between19-34were about 99.2% (AOR=0.008; 95% CI= (0.001, 0.2)) less likely to develop hypertension in hemodialysis patients; as well as those who had Age between35-64were about 81% (AOR=0.19; 95% CI= (0.022, 1.58)) less likely to develop hypertension in hemodialysis patients.Regarding the co-morbidity factors,those who had diabetic mellitus were about 88%(AOR=0.12; 95% CI= (0.026, 0.55)) less likely to develop hypertension in hemodialysis patients.In addition those who had obstructive nephropathywere about 82% (AOR=0.18; 95% CI= (0.039, 0.836)) less likely to develop hypertension in hemodialysis patients (Table-3). The prevalence of hypertension in HD patients remains high and was associated with a high morbidity and mortality.[15]The overall prevalence of hypertension in HD patientwas38.5%in the entire follow-up period.This finding was consistent with a study done inIndia that shows 38%in the entire follow-up period.[16]However, this result was higher than study done in Cameroon and Ethiopia with hypertension prevalenceof 30.9% and 19.8%respectively.[17],[18]Regarding thedemographic characteristics on predictor variable,the result of the study revealed that, prevalence of hypertensionwas predominant in male thanfemale among HD patients.This finding was consistent with a cohort study done in Japan. [19] The result of this study confirmed that, having pre-dialysis hypertension had significantly higher values thanthose that were in post-dialysis.This finding was consistent with a cohort study done inItaly that shows, having pre-dialysis hypertension or pre-dialysis isolated systolic hypertension had significantly higher values for all variables considered than those that were in post-dialysis.[20]Moreover,in bloodurea nitrogen, havinghypertension was significantly dropped from pre-dialysis(255.2 ± 122.2mg/dl) to post-dialysis (176.5 ± 110.7mg/dl) (P< 0.001); in hemoglobin

level,havinghypertension wassignificantly dropped from pre-dialysis (9.4 ± 3.6g/dl) topost-dialysis (7.9 ± 3.0g/dl)($p < 0.001$); in serum creatinine,having hypertension wassignificantly dropped from pre-dialysis (12.6 ± 6.1mg/dl) to post-dialysis (9.1 ± 6.2mg/dl)($p < 0.001$); and in serum potassium, havinghypertension wassignificantlydropped from pre-dialysis (5.3 ± 1.35meq/L) to post-dialysis (4.6 ± 1.37meq/L)($p < 0.001$).The result of the study was found to be closely similar with the study conducted in Italy and Iran. [21] Concerning the co-morbidity predictor variablediabetic mellitus revealed that, was significantly associated with a prevalence of hypertension; which were those people who had diabetic mellitus was about 88% of the time at risk of developing hypertension in HD patientthan those who had no diabetic mellitus (AOR=0.12; 95% CI= (0.026, 0.55)). Some previous studies were in line with this finding.[22], [23] Furthermore, Obstructive nephropathyis another co-morbidity risk factor and hadasignificantly associated with a prevalence of hypertension;which were those people who had obstructive nephropathy that was about 82% time at risk of developing hypertension in HD patient than those who had no obstructive nephropathy(AOR=0.18; 95% CI= (0.039, 0.836)). Some previous study was in line with this finding. [24], [25] This is one of the few studies in Ethiopia that explored prevalence of hypertension and associated determinants in HD patients. The strength of this study is the inclusion of all HD patients participated in our study makes our study has a large sample size. This study has some limitations that are shared with most studies. The retrospective nature of the study design limited to include other associated determinant factors that may influence the risk of co-morbidity and mortality in HD patients.

4. CONCLUSION

Hypertension is highly prevalent in HD patients. It is associated withthe principal determinant factors ofco-morbid andmortality in HD patients. Health-care workers in hypertension facilities need to pay more attention with regards to patient counseling on HDand regular assessment for renal function. There is an urgent need to establish follow-up programs in high-risk population such as hypertensive with an aim to identify determinants of hypertension in HDand put in place prevention mechanisms so as to help to reduce the burden in terms of cost, morbidity, and mortality.We found in our study that determinants of hypertension in HD patientswere: Age, uremic encephalopathy, uremic pericarditis, diabetes mellitus, and obstructive nephropathy.This study, therefore, proposes that a nation-wide survey to be conducted encompassing the entire hypertensive population to find out the prevalence of hypertension and its associated risk factors, so that a preventive strategy or an entire

defensive framework could be adopted or planned to reduce the disease and complications related to it in the community.

ABBREVIATIONS

CKD: Chronic Kidney Disease; RRT: Renal Replacement Therapy; SSA: Sub-Saharan Africa; ESRD: End Stage Renal Disease; ACSH: Ayder Comprehensive Specialized Hospital; CHS: Collage of Health Sciences: HD: Hemodialysis:: LT-IJV: Left Internal Jugular Vein; RT-IJV: Right Internal Jugular Vein.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

There is no any conflict of interest by author.

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