DOI: https://doi.org/10.53350/pjmhs20221611238

ORIGINAL ARTICLE

Effect of Hemodialysis Duration on Left Ventricular Hypertrophy in Patients of Chronic Kidney Disease

SHABAHAT ALI[1], RANA MUHAMMAD UMAR[2], BILAL AHMED[3], FARYAD ALI[4], QAZI ABDUL SABOOR[5], FURQAN YAQUB PANNU[6]
[1]*Assistant Professor of Cardiology Department Sahara Medical College, Narowal*
[2]*Consultant Nephrologist Department of Nephrology National Institute of Kidney Diseases Shaikh Zayed Hospital Lahore*
[3]*Senior Registrar Cardiology Department Mayo Hospital Lahore*
[4]*Assistant Professor of Cardiology, Department of cardiology Sahara Medical college, Narowal*
[5]*Professor of Cardiology Head of Cardiology Department Shaikh Zayed Hospital Lahore*
[6]*Senior Registrar Cardiology Department Mayo Hospital Lahore,*
Corresponding author: Shabahat Ali, Email: shabahatali11111@yahoo.com, Cell: 03004472651

ABSTRACT

Objective: To ascertain the effect of duration of hemodialysis on left ventricular hypertrophy in patients with chronic kidney disease.

Design: It was a cross sectional observational study.

Study Settings: Department of Cardiology, Shaikh Zayed Hospital Lahore over a period of 6 months from January 2021 to June 2021.

Material and Methods: This study was conducted, between February and September 2021, by recruiting 200 patients undergoing hemodialysis. Demographic and clinical data were recorded. Blood samples were taken for investigation. Body surface area was calculated using Du Bois Formula. To calculate LVM, Echocardiography (Echo) was done by using 2D M-mode in the standard manner. At the end of data collection, data was entered and analyzed using SPSS v.21. Single and multiple linear regression analysis were used to calculate impact of duration and other confounding variable on LVM.

Results: The mean age of the participants was 46.77±13.263. About 58.5% (117) were males and 41.5% (83) were females. Prevalence of LVH was 171(85.5%). The mean LVM for males and females was 248.44±26.67g and 182.88±22.43g respectively. Most of the participants (47.0%) were receiving HD for 25-36 months followed by 26.0%, 15.0%, 12.0% for 13-24 months, 3-12 months,37-48 months respectively. LVH was found to be strongly positively correlated with duration of dialysis. Increasing duration of HD was associated with an increased likelihood of exhibiting LVH.

Conclusion: The study concluded that there exist significantly strong relationship between increased duration of hemodialysis in CKD patients with frequency of left ventricular hypertrophy. So, in future practice it is recommended to focus on CKD patients undergoing hemodialysis with regard to duration of hemodialysis and expected frequency of left ventricular hypertrophy and its timely management.

Keywords: Chronic kidney disease, Left ventricular hypertrophy, Left ventricular mass index, Haemodialysis.

INTRODUCTION

Heart failure (HF) is the leading cause of cardiovascular disease in patients with chronic kidney disease (CKD).[1] As a result, in CKD patients, HF prediction and prevention are critical. Left ventricular hypertrophy (LVH) is the most common cause of HF.[2] Thus, in CKD, HF early identification and mitigation are highly important.[3] Due to increased preload, afterload, or both in patients of CKD, LV starts to develop hypertrophy by the adaptive mechanism. It has been noted that when both are present in one patient this process increases several times.[4] LVH is explained as an abnormal increase in LV mass (LVM) determined by echocardiography (Echo) in patients with CKD. There is now steady evidence that LVH has significant prognostic importance in CKD patients.[5]

LVH starts during the initial phases of CKD and impacts up to 20% of people in the first three stages of the disease. Left ventricular mass grows as CKD progresses, and LVH may effect up to 80% of ESRD patients during the onset of haemodialysis therapy.[6] In patients with CKD, cardiovascular disorders including coronary artery disease, congestive heart failure, arrhythmias, and sudden cardiac death are prominent causes of illness and mortality.[7]

In response to pathophysiological stressors, the left ventricular mass (LVM) arises causing LVH. Concentric LVH is caused by pressure overload as well as hypertension (HTN), while eccentric LVH is caused by volume overload as well as valvular disease.[8] The presence of LVH is linked with an elevated risk of cardiac events and mortality, while the absence of LVH is linked to a decrease in cardiovascular (CVS) disease and mortality.[9,10] Patients with CKD are more likely to suffer from an acute cardiac event. In these patients, LVH is a prevalent condition that results in considerable morbidity and mortality.[8]

The term "cardiorenal syndrome" was introduced at a consensus conference of the Acute Dialysis Quality Initiative Group to describe a clinical overlap between cardiac and renal problems.[11] The primary hallmark of uremic cardiopathy is LVH, which is linked to CRS type 4 (chronic cardiorenal syndrome). Regardless of glomerular filtration rate (GFR) levels, CVS problems can occur at any time in CKD patients.[7] More frequent HD has been proposed as a novel therapeutic paradigm, and observational studies have linked longer and more frequent HD sessions to a reduced prevalence of LVH.[7] Foley et al. reported that the probability of developing LVH increased with increased duration of HD and there was a strong correlation between LVMI and duration of dialysis.[12] But the evidence was limited to a fewer international studies and there was no locally published material that's why this study was conducted in local settings which are different from foreign settings and associated health care facilities to establish this relationship.

MATERIAL AND METHODS

A total of 200 patients with CKD having age above 18 years undergoing hemodialysis were selected from the Nephrology department, SKZ Hospital Lahore. Patients with acute or chronic infection, autoimmune disease, valvular pathology and other congenital heart diseases, diagnosed cardiovascular disease before starting haemodialysis treatment or with poor echogenic window or receiving active treatment with steroids or immunosuppresses and malignancy were excluded from the study. A detailed explanation of the purpose of the study, potential risks, and benefits were given. After that patients were asked to sign a consent form. Demographic and previous clinical data were collected from the patients' medical records which included: age, gender, BMI, blood sugar levels, and aetiology of CKD. SBP and DBP were taken on the spot. Blood samples were collected from all patients for blood tests after 12-hour overnight fasting. The eGFR was calculated by using the Cockroft and Gault formula.

All patients underwent baseline laboratory investigations including Hb levels, serum creatinine, serum urea, and baseline ECG. All lab investigations were done by the pathology department of SKZ hospital. 2D M-mode Echo and Doppler examinations were

performed in the standard manner. The M-mode examination was carried out in accordance with the recommendations of the American Society of echocardiography. Echo was used to measure the left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diameter (LVESD), inter-ventricular septum thickness (IVST), left ventricular posterior wall thickness (LVPWT), left atrial diameter (LAD), RWMA and EF. Data was entered and analysed by using SPSS v.21. Data were analyzed by a statistician blinded to the patients and groups. Data for age, duration of dialysis, LVMI, creatinine, haemoglobin, BMI, urea, SBP, DBP was as mean±SD (standard deviation). Data for gender, LVH, Diabetes mellitus, HTN, No. of dialysis per week was described as frequency and percentage. LVH's correlation was done with the duration of dialysis using Logistic regression.

RESULTS

A total of 200 participants were involved in the study. The mean age of the participants was 46.77±13.263. The mean BMI was 26.32±2.18kg/m2. Out of 200 hundred HD patients, 58.5% (117) were males and 41.5% (83) were females. The mean haemoglobin level was 8.81g/dl. The prevalence of LVH was 171(85.5%). A total of 33.5% (67) patients were suffering from DM along with CKD. About 126 patients were suffering from HTN. Out of all the patients, 29 males and 16 females were concurrently suffering from both DM and HTN. Most patients (88%) were receiving dialysis 3 times per week followed by 9% two times per week and only 3% once a week. The mean duration of dialysis onset was 25.31±9.85 months. Most of the participants (47.0%) were receiving HD for 25-36 months followed by 26.0%, 15.0%, 12.0% for 13-24 months, 3-12 months ,37-48 months respectively as given in Table 1.

Nominal by Interval variable correlation, also known as Eta correlation, between LVH and duration showed that LVH was strongly positively correlated with the duration with Eta=0.966 and R^2= 0.025. Logistic regression was performed to ascertain the effects of HD duration onset on the likelihood that participants have LVH. The logistic regression model was statistically significant, $\chi^2(1) = 4.864$, p= .027. The model explained 4.3% (Nagelkerke R^2) of the variance in heart disease and correctly classified 85.5% of cases. The increasing duration was associated with an increased likelihood of exhibiting LVH.

A chi-square analysis was done to associate HTN with LVH which revealed that X(1)=2.79, p=0.049 which showed a significant relationship between LVH and HTN. Phi and Cramer's V also showed significant association.

Table 1: Demographic Characteristics of the Study Population

Characteristics	Participants (n=128)
Age (Years)	47.77±3.263
Gender	
• Male	117 (58.5%)
• Female	83 (41.5%)
BMI (kg/m2)	26.32±2.18
Prevalence of LVH	
• Yes	171 (85.5%)
• No	29 (14.5%)
Frequency of Dialysis per Week	
• 1	6 (3.0%)
• 2	18 (9.0%)
• 3	176 (88.0%)
Mean Duration of Dialysis	25.31±9.85
• 3-12 months	30 (15.0%)
• 13-24 months	52 (26.0%)
• 25-36 months	94 (47.0%)
• 37-48 months	24 (12.0%)
Hb level (g/dl)	8.81
eGFR	12.23±1.08
Serum creatinine levels of the patient(mg/dl)	9.79±1.35
Serum Urea levels of the patients(mg/dl)	120.23±21.39
Mean duration of onset dialysis (months)	25.31±9.85

Table 2: LVM Stratified for Gender

Gender of the participant		Min.	Max.	Mean	SD
Male	LVM	168.90	285.92	248.44	26.67
Female	LVM	138.07	244.05	182.88	22.43

Table 3: Relationship between LVH and duration of HD

Directional Measures			
			Value
Nominal by Interval	Eta	Presence of Left Ventricular Hypertrophy Dependent	.966
		Duration since in dialysis(months) Dependent	.158
Correlations			
		Presence of LVH	Duration of dialysis (months)
Presence of LVH	Pearson Correlation	1	.158
	Sig. (2-tailed)		.025
Duration since in dialysis(months)	Pearson Correlation	.158	1
	Sig. (2-tailed)	.025	

Table 4: Relation between LVH and HTN

			Presence of LVH	
			Yes	No
Presence of HTN	Yes	Count	109	17
		% within Presence of HTN	86.5%	13.5%
		% within Presence of LVH	63.7%	58.6%
		% of Total	54.5%	8.5%
	No	Count	62	12
		% within Presence of HTN	83.8%	16.2%
		% within Presence of LVH	36.3%	41.4%
		% of Total	31.0%	6.0%
Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	
Pearson Chi-Square	2.79	1	.0497	
Likelihood Ratio	.276	1	.600	

DISCUSSION

LVH is a common cause of morbidity in people with CKD, and it puts them at risk for heart failure. Multiple risk variables play role including volume overload, inflammation, anaemia, hypo-albuminaemia, hyperphosphataemia and arterial HTN, etc.[13] This study was conducted to determine effect of hemodialysis duration on left ventricle hypertrophy in patients with CKD.

Most of the participants in the study were middle-aged with a mean age of 46.77±13.263 years. The mean age of patients in this study was lower than USA and Kingdome of Saudi Arabia which was discovered to be 60 years old and 55 years old, respectively by Han et al. and Rizvi and Manzoor as 47.4 years in the range of 17-85 years.[14,15]

A noteworthy gender difference was noted in this study in relation with distribution of disease as 58.5% (117) were males and 41.5% (83) were female with male predominance as 1.3:1. This finding is similar to other studies from Iraq (69% males and 31%females) by Latif et al., KSA (60.1% males and 39.9% females) by Shaheen and Al-Khader et al., and India (67.8% males and 32.2% females) by Kartheek and Reddy, who had previously reported similar male predominance in patients with CKD undergoing hemodialysis.[16,17,4]

Mean BMI in this study was 26.32±2.18 years. A little lower BMI in patients with CKD was reported by Han et al. as 25.05±4.12 years.[14] For CKD patients, anaemia is a serious issue as well as a predictor of CVS risk. The average haemoglobin concentration in this study was 8.81 g/dl. In a meta-analysis of 15 studies, Parfrey et al. (2009)[20] found that anaemia correction lowered LVM only in those participants who had severe anaemia at onset (10 g/dl) and were addressed to a lower goal haemoglobin level (12 g/dl).

The study used echocardiography which is an excellent non-invasive diagnostic modality and found that prevalence of LVH was 171(85.5%). This prevalence is relatively high as compared to other studies such as 65% in Iraq and 46% in Denmark but was similar to HEMO studies which have clearly demonstrated that the prevalence of LVH is more than 80% in HD patients.[16,12] CKD is a complicated metabolic disorder. Long-term exposure to uremic toxins has been shown to have deleterious consequences for cardiac function. Fibrosis and myocyte death result from this continuous exposure. Although the exact composition of these

toxins is unknown, some components in uremic plasma have been identified as having potential inotropic and chronotropic effects. Dialysis for a prolonged period of time exposes myocytes to uremic toxins for a prolonged period of time. This could help to explain why LVH is so common.[8] Individuals with large body sizes may have larger LVM. As a result, indexing LVM has been recommended as a way to improve LVM calculation by reducing the effect of body size.[19] Mean LVM for males and females was 248.44±26.67 and 182.88 respectively. When prevalence was compared among both genders; males had a significantly higher prevalence with a ratio of 1.65:1 for male to female; which is similar to previous studies.[15,16]

Most patients (88%) were receiving dialysis 3 times per week followed by 9% two times per week and only 3% once a week. The mean duration of dialysis onset was 25.31±9.85 months. Nominal by Interval Eta correlation between LVH and duration showed that LVH in this study is strongly positively correlated with the duration with Eta=0.966 and R2= 0.025. Better control of hemodialysis sessions and peritoneal dialysis exchanges is a significant element in the care of LVH patients. More frequent HD has been proposed as a novel therapeutic paradigm, and observational studies have linked longer and more frequent HD sessions to a reduced prevalence of LVH.[7] As there was no follow-up and intervention in this study this recommendation was not studied.

To determine impact of HD duration onset on likelihood of patients having LVH, logistic regression was used. The logistic regression model successfully identified 85.5% of patients and explained 4.3% of the variance in heart disease and our findings are in line with earlier reported relationship by Foley et al.[12]

Finally, there are certain limitations to this research. First and foremost, this is a cross-sectional study, with all the limitations that entail. It is necessary to be speculative while discussing potential causal pathways. One of the study's shortcomings is that it was designed to exclude participants with obvious pre-existing heart illnesses. To rule out asymptomatic coronary ischemia, no stress tests were conducted. It was impossible to track changes in heart morphology over time as a result of the removal of excess fluid by renal replacement therapy. As a result, in this observational investigation, the association between fluid overload and LVH does not allow us to assess causality. Furthermore, while urine volume and proteinuria were variables that may influence our findings, we were unable to analyze them since they were not accurately measured in all individuals. Another drawback was being a single centered this study has a high probability of patient selection bias. This study, on the other hand, offers some advantages. The study's key strength was that the patients were very similar health condition and the majority of them had three sessions each week.

CONCLUSION

This study concludes that as the duration of dialysis increases frequency of LVH. Therefore, in future practice, it is recommended to consider the same to coupe its shortcomings and associated side effects.

REFERENCES

1. Furusawa K, Takeshita K, Suzuki S, Tatami Y, Morimoto R, Okumura T, et al. Assessment of abdominal aortic calcification by computed tomography for prediction of latent left ventricular stiffness and future cardiovascular risk in pre-dialysis patients with chronic kidney disease: a single center cross-sectional study. Int J Med Sci 2019;16(7):939-48. doi: 10.7150/ijms.32629
2. Rahman M, Xie D, Feldman HI, Go AS, He J, Kusek JW, et al. Association between chronic kidney disease progression and cardiovascular disease: results from the CRIC study. Am J Nephrol 2014;40(5):399-407. doi.org/10.1159/000368915
3. Tuegel C, Bansal N. Heart failure in patients with kidney disease. Heart 2017;103(23):1848-53. doi: 10.1136/heartjnl-2016-310794
4. Segall L, Nistor I, Covic A. Heart failure in patients with chronic kidney disease: a systematic integrative review. BioMed Res Int 2014;2014(1):1-21. doi.org/10.1155/2014/937398
5. Kartheek AV, Reddy VS. Assessment of cardiac dysfunction in patients with end stage renal disease in a tertiary care hospital. J Evid Based Med Health 2019;6(24):1668-72. doi: 10.18410/jebmh/2019/337
6. Park M, Hsu CY, Li Y, Mishra RK, Keane M, Rosas SE, et al. Associations between kidney function and subclinical cardiac abnormalities in CKD. J Am Soc Nephrol 2012;23(10):1725-34. doi: https://doi.org/10.1681/ASN.2012020145
7. Di Lullo L, Gorini A, Russo D, Santoboni A, Ronco C. Left ventricular hypertrophy in chronic kidney disease patients: from pathophysiology to treatment. Cardiorenal Med 2015;5(4):254-66. doi.org/10.1159/000435838
8. Yildirim U, Gulel O, Eksi A, Dilek M, Demircan S, Sahin M. The effect of different treatment strategies on left ventricular myocardial deformation parameters in patients with chronic renal failure. Int J Cardiovasc Imag 2018;34(11):1731-9.
9. Mor-Avi V, Lang RM, Badano LP, Belohlavek M, Cardim NM, Derumeaux G, et al. Current and evolving echocardiographic techniques for the quantitative evaluation of cardiac mechanics: ASE/EAE consensus statement on methodology and indications endorsed by the Japanese society of echocardiography. Eur J Echocardiogr 2011;12(3):167-205. doi.org/10.1093/ejechocard/jer021
10. Mancuso FJ. Real-time three-dimensional echocardiography and myocardial strain: ready for use in clinical practice. Arq Bras Cardiol 2019;113:946-7. doi.org/10.5935/abc.20190179
11. Ronco C, Di Lullo L. Cardiorenal syndrome in western countries: Epidemiology, diagnosis and management approaches. Kidney Dis 2016;2(4):151-63. doi.org/10.1159/000448749
12. Foley RN, Curtis BM, Randell EW, Parfrey PS. Left ventricular hypertrophy in new hemodialysis patients without symptomatic cardiac disease. Clin J Am Soc Nephrol 2010 1;5(5):805-13. doi: 10.2215/CJN.07761109
13. Nitta K, Iimuro S, Imai E, Matsuo S, Makino H, Akizawa T, et al. Risk factors for increased left ventricular hypertrophy in patients with chronic kidney disease: findings from the CKD-JAC study. Clin Exp Nephrol 2019;23(1):85-98.
14. Han BG, Lee JY, Choi SO, Yang JW, Kim JS. Relative overhydration is independently associated with left ventricular hypertrophy in dialysis naïve patients with stage 5 chronic kidney disease. Sci Rep 2020;10(1):1-1. doi.org/10.1038/s41598-020-73038-8
15. Rizvi SA, Manzoor K. Causes of chronic renal failure in Pakistan: a single large center experience. Saudi J Kidney Dis Transplant 2002;13(3):376-9.
16. Latif II, Jaffar AM, Abdulla AT, Ali NK. Echocardiographic assessment of left ventricular systolic function among patients with chronic kidney disease managed in Ebn Sena dialysis center in Diyala. Diyala J Med 2017;13(2):63-71.
17. Shaheen FA, Al-Khader AA. Epidemiology and causes of end stage renal disease (ESRD). Saudi J Kidney Dis Transplant 2005;16(3):277-81.
18. Parfrey PS, Lauve M, Latremouille-Viau D, Lefebvre P. Erythropoietin therapy and left ventricular mass index in CKD and ESRD patients: a meta-analysis. Clin J Am Soc Nephrol 2009;4(4):755-62. doi: https://doi.org/10.2215/CJN.02730608
19. Lee SW, Min HK, Chae DW, Oh KH, Ahn C, Chung W, et al. Indexation of left ventricular mass to predict adverse clinical outcomes in pre-dialysis patients with chronic kidney disease: Korean cohort study of the outcome in patients with chronic kidney disease. PloS One 2020; 15(5): e0233310. doi.org/10.1371/journal.pone.0233310