Journal of Renal and Hepatic Disorders

ORIGINAL ARTICLE

Echocardiographic Changes in Patients with End-Stage Renal Disease at Initiation of Dialysis

Shabana Nazneen, Muzamil Latief, Manjusha Yadla

Department of Nephrology, Gandhi Medical College, Secunderabad, Hyderabad, India

Abstract

Introduction: Echocardiography is a simple and established method of evaluating cardiac functions, assessing left ventricle geometry, and systolic and diastolic functions. Patients with chronic kidney disease have a tremendous burden of cardiovascular disease (CVD), and patients with end-stage renal disease (ESRD) are at a greater risk of CVD and deaths.
Materials and Methods: In this study, 245 incident dialysis patients were included, and none of the patient was on erythropoietin. All the patients were aged >18 years. Patients with ESRD, already on maintenance dialysis, were not included in this study. Patient's data such as demographic details, comorbidities, laboratory values, echocardiographic changes, management, and outcome were recorded.
Results: Out of 245 patients, 165 (67.3%) were males and 80 (32.6%) females. The mean age of the patients was 49.7 years. Left ventricular hypertrophy (LVH) was observed in 188 (76.7%), mild left ventricular dysfunction (LVD) in 25.7%, moderate LVD in 23.67%, severe LVD in 8.5%, global hypokinesia in 33.8%, valvular heart disease in 26.5%, regional wall motion abnormality in 4.4%, and pericardial effusion in 1.6% patients. Echocardiographic changes, such as LVD, LVH, and global hypokinesia, were observed in greater number in hypertensive group compared to normotensive group ($P < 0.05$). On regression analysis adjusted for age and gender, we found that hypertension and anemia (<10 g/dL) were associated with LVH. Further, hypertension and anemia (Hb < 10 g/dL) were associated with LVD. Similarly, anemia (Hb < 10 g/dL) was associated with global hypokinesia and valvular heart disease. LVD was associated with death in our study.
Conclusion: Echocardiography is a noninvasive diagnostic test which detects early changes in cardiac parameters. All ESRD patients with hypertension and anemia at the time of initiation of renal replacement therapy must undergo echocardiography screening.

Keywords: echocardiography; hypertension; CKD

Received: 28 April 2021; *Accepted after Revision*: 29 May 2021; *Published*: 8 June 2021

Author for correspondence: Latief M, Department of Nephrology, Gandhi Medical College, Secunderabad, Hyderabad, India, Email: muzamillatief.b@gmail.com

How to cite: Nazneen S, et al. Echocardiographic Changes in Patients with End-Stage Renal Disease at Initiation of Dialysis. J Ren Hepat Disord. 2021;5(1): 44–48.

Doi: https://doi.org/10.15586/jrenhep.v5i1.98

Copyright: Nazneen S, et al.

License: This open access article is licensed under Creative Commons Attribution 4.0 International (CC BY 4.0). http://creativecommons.org/

Introduction

Patients with chronic kidney disease (CKD) have a tremendous burden of cardiovascular disease (CVD), and patients with end-stage renal disease (ESRD) are at a greater risk of CVD and death (1,2,3). CKD is a risk factor for cardiovascular events, and the risk of events increases as CKD progresses to ESRD. Association of CKD with CVD is commonly explained by a typical clustering of several cardiovascular risk factors, including traditional and nontraditional CKD-related factors (2,3,4). Anemia and hypertension

are most consistently associated with cardiac failure, a pre-lethal occurrence that leads to two-thirds of deaths in all patients on dialysis (5). The risk of cardiovascular mortality is 10- to 20-fold higher than in age- and gender-matched control subjects (2,5). One of the major structural cardiac abnormalities in patients with CKD is left ventricular hypertrophy (LVH), which is associated with increased risk for cardiac ischemia, congestive heart failure as well as a very strong independent predictor of cardiovascular mortality (1,6,7). LVH is the most common geometric abnormality in CKD and independent prognostic predictor, especially in patients on dialysis (8). Left ventricular dysfunction (LVD) on start of hemodialysis is a stratifying risk of CVD and an all-cause mortality in ESRD (6,9). It is strongly associated with cardiac failure and as one of the independent predictors of cardiovascular death. Echocardiography is a simple and established method of evaluating cardiac functions, assessing left ventricle geometry, and systolic and diastolic functions.

Materials and Methods

In this prospective observational study conducted in a tertiary care teaching hospital over a period of 1 year, the included patients were incident dialysis patients, and none of the patient was on erythropoietin. All the patients were aged >18 years. Patients with ESRD already on maintenance dialysis were not included in this study. Patient data such as demographic details, comorbidities, laboratory values, echocardiographic changes, management, and outcome were recorded. Echocardiography (two-dimensional and M-mode) was done in all patients. A total of 245 patients were included in the study. Data analysis was performed using statistical software SPSS (Version 20.0). Descriptive statistics were used for the analysis. Statistical tests were two-tailed, and $P < 0.05$ was considered to show a statistical difference. Chi-square test for association was performed between different treatment modalities used and the patient outcomes.

Results

Out of the included 245 patients, 165 (67.3%) were males and 80 (32.6%) females. The mean age of the patients was 49.7 years, and the mean serum creatinine was 7.7 mg/dL. The majority of patients were in the age group of 41–50 years, as shown in Table 1. Hypertension was found in 199 (81%), diabetes in 70 (28.5%), coronary heart disease (CHD) in 18 (7.3%), and anemia in 193 (78.7%) patients. Etiology of the CKD was presumed. Chronic interstitial nephritis (CIN) was established in 189 (77.1%), chronic glomerulonephritis (CGN) in 26 (10.6%), diabetic kidney disease in 23 (9.38%), and polycystic kidney disease in 7 (2.8%) patients. LVH was observed in 188 (76.7%), mild LVD in 25.7%, moderate LVD in 23.67%, severe LVD in 8.5%, global hypokinesia in 33.8%, valvular heart disease in 26.5%, regional wall motion abnormality (RWMA) in 4.4%, and pericardial effusion in 1.6% patients (Table 2). Echocardiographic changes, such as LVD, left ventricular hypertrophy (LVH), and global hypokinesia, were found in greater number in hypertensive group compared to normotensive group ($P < 0.05$) (Table 3). Patients with hemoglobin (Hb) < 10 gm/dL had echocardiographic changes such as LVH in 82%, LVD in 66%, global hypokinesia in 49%, and valvular heart disease in 30% patients, with statistically significant $P < 0.05$, compared with anemic patients with Hb >10 gm/dL (Table 4). Patients were further analyzed on the basis of ejection fraction (EF), and demographic details, comorbidities, and echocardiographic changes and outcomes were also studied. In reduced EF group, 68.7% were females, 64% had hypertension, 75.8% had LVH, and RWMA was found in 81.8% patients. Among patients who died, 92.3% had reduced EF (Table 5). Patients with LVD and global hypokinesia had higher mortality compared with those who had normal left ventricular function with a statistically significant $P < 0.05$ (Table 6). On regression analysis adjusted for age and gender, we found that hypertension and anemia (Hb < 10 g/dL) was associated with

Table 1: Demographic details of patients

Mean age	49.7
Mean serum creatinine	7.7
Males	165 (67%)
Females	80

Table 2: Echocardiographic changes.

Echocardiographic Changes	Number of Patients N (%)
LVH	188 (76.7%)
Mild LVD	63 (25.7%)
Moderate LVD	58 (23.67%)
Severe LVD	21 (8.5%)
Global hypokinesia	83 (33.8%)
RWMA	11 (4.4%)
Valvular heart disease	65 (26.5%)
Pericardial effusion	4 (1.6%)

RWMA: regional wall motion abnormalities; LVD: left ventricular dysfunction; LVH: left ventricular hypertrophy.

Table 3: Echocardiographic changes compared in normotensive and hypertensive patients.

	Hypertensive (N = 199)	Normotensive (N = 46)	P-value
LVD	128	14	0.00032
LVH	174	14	<0.001
Global hypokinesia	74	9	0.02
RWMA	10	1	0.47
Valvular heart disease	59	6	0.025
Pericardial effusion	2	2	0.16

RWMA: regional wall motion abnormalities; LVD: left ventricular dysfunction; LVH: left ventricular hypertrophy.

Table 4: Echo changes compared with hemoglobin values.

	Hb < 10 gm/dL (N = 193)	Hb > 10 gm/dL (N = 52)	P-value
LVH	159 (82%)	29 (15%)	0.0003
LVD	128 (66%)	14 (7.2%)	<0.0001
Global hypokinesia	79 (49%)	4 (2%)	0.000004
RWMA	10 (5.1%)	1 (0.5%)	0.47
Valvular heart disease	58 (30%)	7 (3.6%)	0.02
Pericardial effusion	3 (1.5%)	1 (0.5%)	1

RWMA: regional wall motion abnormalities; LVD: left ventricular dysfunction; LVH: left ventricular hypertrophy.

Table 5: Comparison of groups with preserved and reduced ejection fraction

Column 1	Preserved EF (103)	Reduced EF (n = 142)	P value
Male	76 (46.6%)	87 (53.7%)	
Female	26 (32.5%)	55 (68.7%)	
HTN	71 (35.6%)	128 (64%)	0.00003
DM	29 (41.4%)	41 (56.9%)	1
CAD	3 (16.6%)	15 (83%)	0.02
LVH	43 (24%)	135 (75.8%)	2.6
RWMA	2 (18%)	9 (81.8%)	0.1
Valvular heart disease	14 (22.9%)	47 (77%)	0.00052
PE	2 (40%)	3 (60%)	1
Global hypokinesia	13 (13.5%)	83 (86.4%)	2.3
Hb < 10 gm/dL	65 (33.6%)	128 (66.3%)	3.7
Death	2 (7.6%)	24 (92.3%)	0.00021

HTN: Hypertension; DM : Diabetes Mellitus; CAD: Coronary artery disease; LVH: Left Ventricular Hypertrophy; PE: Pericardial Effusion; Hb: Haemoglobin

LVH with odds ratio (OR) = 0.06 and 0.29 (P < 0.001 and P = 0.003), respectively. Further, hypertension and anemia (Hb < 10 g/dL) were associated with LVD with OR = 3.36 and 5.04 (P = 0.001 and P < 0.001), respectively. Similarly, anemia (Hb < 10 g/dL) was associated with global hypokinesia, OR = 8.44 (P < 0.001) and valvular heart disease, OR = 4.02 (P = 0.006). LVD was associated with mortality with OR = 16.9 (P = 0.001).

Discussion

Cardiovascular disease is very common in patients with CKD, and is by far the leading cause of morbidity and mortality in end-stage renal disease. We observed that majority of the patients were aged 41–50 years, with the mean age of 49.7 years, similar to the findings of Singh et al. (5) (Table 7). In our study, male population (67%) was predominant, similar to Singh et al. (5) and Foley et al. (7). Hypertension was found in 81.2% patients, correlating with other studies (6,8). We observed significant echocardiographic changes in hypertensive group compared to normotensive group. LVH was examined in 76% patients, as observed by Laddha et al., who observed LVH in 74% patients in their study (10). In a study conducted by Zoccali et al., LVH was found in 77% patients (9). Similar observations were made by Singh et al. (5). In anemic patients (with Hb < 10 gm/dL), echocardiogarphic changes were observed correlating with other studies. In anemic patients, LVH was found in 82% and LVD in 66% cases. It was comparable with the observations made by Singh et al. (5), Parfrey et al. (8), and Datta et al. (11). Patients with reduced EF had higher risk of valvular heart disease and significant mortality, similar to the observations made by Yamada et al. (6). Mortality occurred in 26 (10.6%) patients; among these, Hb < 10 gm/dL was found in 23 (88.4%), LVH in 23 (88.4%), LVD in 24 (92%), and global hypokinesia in 19 (73%) patients, correlating with the studies carried out by Yamada et al. (6) and Zoccali et al. (9).

Table 6: Factors associated with mortality.

	Death N = 26	Alive	P-value
Hb < 10 gm/dL	23		0.3
LVH	23		0.2
LVD	24		0.002
Global hypokinesia	19		0.0001
RWMA	3		0.1
Valvular heart disease	9		0.3
Pericardial effusion	1		0.3

RWMA: regional wall motion abnormalities; LVD: left ventricular dysfunction; LVH: left ventricular hypertrophy.

Limitations

This was a 1-year study and no further follow-up took place.

Conclusion

Echocardiohraphy is a noninvasive diagnostic test to detect early changes in cardiac parameters. All ESRD patients with hypertension and anemia at the time of initiation of renal replacement therapy (RRT) should undergo echocardiography screening.

Table 7: Comparison with other studies.

	N	LVH			LVD
		Overall	HTN	Hb (<10 gm/dL)	
Present study	245	76.7%	87%	82%	57%
Foley et al. (7)	433	75%			
Bansal et al. (1)	190	79%			48%
Laddha et al. (10)	70	74%	74%	82%	23%
Zoccali et al. (9)		71%			46%
Yamada et al. (6)	1254				13%, EF < 35 predicts poor outcome
Datta et al. (11)	230	96%		89%	51%

LVD: left ventricular dysfunction; LVH: left ventricular hypertrophy; EF: ejection fraction; HTN: Hypertension

Conflict of Interest

None. All the authors contributed equally to this study.

Funding

No funding was received for this study.

References

1. Bansal N, Keane M, Delafontaine P, Dries D, Foster E, Gadegbeku CA, et al. A longitudinal study of left ventricular function and structure from CKD to ESRD: the CRIC study. Clin J Am Soc Nephrol. 2013 Mar;8(3):355–62. https://doi.org/10.2215/CJN.06020612
2. Herzog CA, Ma JZ, Collins AJ. Poor long-term survival after acute myocardial infarction among patients on long-term dialysis. N Engl J Med. 1998 Sep 17;339(12):799–805. https://doi.org/10.1056/NEJM199809173391203
3. Go AS, Chertow GM, Fan D, McCulloch CE, Hsu CY. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. N Engl J Med. 2004 Sep 23;351(13):1296–305. https://doi.org/10.1056/NEJMoa041031. Erratum in: N Engl J Med. 2008;18(4):4. PMID: 15385656.
4. Baigent C, Burbury K, Wheeler D. Premature cardiovascular disease in chronic renal failure. Lancet. 2000 Jul 8;356(9224):147–152. https://doi.org/10.1016/S0140-6736(00)02456-9
5. Singh Shivendra, Doley PK, Pragya P, Sivasankar M, Singh VP, Singh Neelam. Echocardiographic changes in pts with ESRD on MHD-A single center study. J Cardiovasc Dis Diagn. 2014; 2:4. https://doi.org/10.4172/2329-9517.1000165
6. Yamada S, Ishii H, Takahashi H, Aoyama T, Morita Y, Kasuga H, et al. Prognostic value of reduced left ventricular ejection fraction at start of hemodialysis therapy on cardiovascular and all-cause mortality in end-stage renal disease patients. Clin J Am Soc Nephrol. 2010 Oct;5(10):1793–1798. https://doi.org/10.2215/CJN.00050110. Epub 2010 Jul 1.
7. Foley RN, Parfrey PS, Sarnak MJ. Clinical epidemiology of cardiovascular disease in chronic renal disease. Am J Kidney Dis. 1998 Nov;32(5 Suppl 3):S112–S119. https://doi.org/10.1053/ajkd.1998.v32.pm9820470
8. Parfrey PS, Foley RN, Harnett JD, Kent GM, Murray DC, Barre PE. Outcome and risk factors for left ventricular disorders in chronic uraemia. Nephrol Dial Transplant. 1996 Jul;11(7):1277–1285. https://doi.org/10.1093/ndt/11.7.1277
9. Zoccali C, Benedetto FA, Mallamaci F, Tripepi G, Giacone G, Cataliotti A, et al. Prognostic value of echocardiographic indicators of left ventricular systolic function in asymptomatic dialysis patients. J Am Soc Nephrol. 2004 Apr;15(4):1029–1037. https://doi.org/10.1097/01.asn.0000117977.14912.91
10. Laddha M, Sachdeva V, Diggikar PM, Satpathy PK, Kakrani AL. Echocardiographic assessment of cardiac dysfunction in patients of end stage renal disease on haemodialysis. J Assoc Physicians India. 2014 Jan;62(1):28–32. PMID: 25327089.
11. Datta S, Abraham G, Mathew M, Somasundaram H, Muralidharan TR, Moorthy A, et al. Correlation of anemia, secondary hyperparathyroidism with left ventricular hypertrophy in chronic kidney disease patients. J Assoc Phys India (JAPI). 2006 Sep;54:699–703. PMID: 17212016.