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Echocardiographic Screening for Cardiovascular Diseases in Asymptomatic Regular Hemodialysis Patients

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Abstract:

Background: End-stage renal disease (ESRD) patients on maintenance hemodialysis (HD) are more prone to sudden cardiac-related death.

Objective: This work was conducted to screen ESRD patients on maintenance HD with no history of cardiac diseases for cardiovascular abnormalities using Motion-Mode (M-Mode) Transthoracic Echocardiography.

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Patients and Methods: A total of 99 ESRD patients on maintenance HD with no history of cardiac diseases were divided according to HD duration into; Group 1: (22 patients <6 months). Group 2: (55 patients 6 months-3 years). Group 3: (22 patients > 3 years). After history taking, examination, and laboratory investigations, M-Mode Transthoracic Echocardiography was done on the non-dialysis day.

Results: The main findings included diastolic dysfunction (90.9%), valvular diseases (85.7%); [mitral insufficiency (43.3%), mitral calcification (10.1%), aortic insufficiency (18.2%), aortic calcification (14.1%)], abnormal interventricular septal diameter (IVSD) (40.4%), abnormal left atrial diameter (LAD) (31.3%), abnormal left ventricular ejection fraction (LVEF%) (17.2%), pulmonary hypertension (16.1%), ischemic heart disease (14.1%), and degenerative heart disease (5.1%). Significant differences were found among groups as regards LVEF%, IVSD, LAD, diastolic dysfunction, aortic calcification, and pulmonary hypertension (P<0.05) (S). Logistic regression analysis showed that the only significant predictor for diastolic dysfunction in HD patients with no history of cardiac diseases was the duration of dialysis (P<0.05) (S).

Conclusion: M-Mode Transthoracic Echocardiography is useful for screening HD patients even with no history of cardiac diseases. Diastolic dysfunction is the commonest finding and is independently related to HD duration.

KEYWORDS: M-Mode Transthoracic Echocardiography, End-stage renal disease (ESRD), Hemodialysis (HD), Diastolic dysfunction.

INTRODUCTION:

Cardiovascular disease (CVD) is the major cause of morbidity and mortality in patients with end-stage renal disease (ESRD) on regular hemodialysis (HD) [(1)]. Coronary heart disease in ESRD/HD patients is usually atypical or asymptomatic [(2)], and (42%) of asymptomatic HD patients have significant coronary artery stenosis [(3)]. Left ventricular hypertrophy (LVH) commonly affects HD patients and is usually related to arterio-venous fistulae (AVF), fluid overload, neuro-hormonal changes, and uremic toxins [(4)]. Excessive ultrafiltration can reduce systolic blood pressure and cause right wall motion abnormalities [(5)]. After HD initiation, cardiovascular events increase in the first weeks and are related to systemic inflammation and endothelial dysfunction [(6)]. Other factors leading to CVD in HD patients include uremic cardiomyopathy, secondary hyperparathyroidism, anemia, dyslipidemia, and uremic toxins [(7)]. Transthoracic echocardiography in HD patients showed a diastolic dysfunction in (34%) prior to HD session versus (16%) after the HD session [(8)]. The Kidney Disease Outcomes Quality Initiatives (KDOQI) guidelines recommend echocardiography assessment for all patients on dialysis and every three years or before renal transplantation [(9)]. HD patients develop hemodynamic changes that may affect echocardiographic testing, and there are new emerging echocardiographic techniques that can provide better information [(10)].

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This work was conducted to screen ESRD patients on maintenance HD with no history of cardiac diseases for cardiovascular abnormalities using Motion-Mode (M-Mode) Transthoracic Echocardiography.

PATIENTS AND METHODS:

This cross-sectional study had been carried out at the Nephrology and Dialysis Unit, Internal Medicine Department, and Cardiology Department, Faculty of Medicine, Zagazig University, Egypt, in the period from March 2018 to October 2018.

Inclusion Criteria:

It included a total of 99 patients with end-stage renal disease (ESRD), on regular hemodialysis (HD), (3 sessions/week, 4 hours/ session). The patients had no history of cardiac disease. They were grouped into 3 groups according to the duration of regular HD; Group 1: 22 patients (17 males & 5 females), mean age±SD (38.58±11.88) years, on regular HD for <6 months. Group 2: 55 patients (26 males & 29 females), mean age±SD (53.11±9.58) years, on regular HD for 6 months - 3 years. Group 3: 22 patients (17 males & 5 females), mean age±SD (48.27±11.55) years, on regular HD for >3 years.

Exclusion Criteria:

Patients <18 years, with known valvular heart disease, cardiomyopathy, coronary disease, previous coronary intervention, pericardial effusion, arrhythmias, or any abnormalities detected by previous echocardiography were excluded.

Ethical Approvals:

Informed consent was taken from all participants, and the protocol was approved by the Ethical Committee and the Institutional Review Board (IRB), ZU-IRB#:10243, at the Faculty of Medicine, Zagazig University, Egypt, according to the Declaration of Helsinki for human studies.

All patients were subjected to the following:

Following history taking and clinical examination including systolic blood pressure (SBP), diastolic blood pressure (DBP), and absolute interdialytic weight gain (IDWG) (pre-dialysis weight from one session minus post-dialysis weight from the prior session) [(11)], the following investigations were done: Complete blood count (CBC), serum creatinine, blood urea nitrogen (BUN), serum total protein, albumin, calcium, phosphorous, intact parathyroid hormone (iPTH), and lipid profile.

Motion-Mode (M-Mode) Transthoracic Echocardiography:

On the non-dialysis day, M-Mode Transthoracic Echocardiography was performed on all participants [(12)]. The left atrial dimension (LAD) was examined at the end-ventricular

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systole at the aortic valve level, using the (leading-edge-to-leading-edge) convention. The left ventricular mass (LVM) was estimated by the left ventricular (LV) cavity dimension and wall thickness at the end-diastole. The LV mass index (LVMI) =LVM/body surface area. The LV systolic function was assessed by the LV ejection fraction (LVEF) [13].

Statistical Analysis:

Data were analyzed using SPSS 22 (Statistical Package of Social Science 22). Continuous data were presented as mean±SD and categorial data by the count and percentage. The Chi-Square test of association was used to detect the relationship between 2 categorical variables. ANOVA (One Way Analysis of Variance) test to detect differences between the means of two or more independent groups on a continuous dependent variable. Post-Hoc least significant difference (LSD) test for multiple comparisons between groups following ANOVA test. Binary logistic regression analysis to determine the independent risk factors that affect diastolic dysfunction. Levels of significance: p-value <0.05 was significant, and p-value >0.05 non-significant.

RESULTS:

There was a statistically significant difference among groups as regards the age being younger in group 1 than in group 2 or 3 (P<0.05) (S), and sex with more males in group 1 and group 3, while a nearly equal number of males and females in group 2 (P<0.05) (S). No statistically significant difference was found as regards SBP, DBP, absolute interdialytic weight gain (IDWG), or other cardiovascular diseases (CVD) risk factors (P>0.05) (NS) (Table 1).

There was a statistically significant difference among groups as regards the urea reduction ratio (URR%), with a normal URR% in group 1, and near normal URR% in group 3, and low URR% in group 2 (P<0.05) (S). No statistically significant difference was found as regards Hb%, serum creatinine, calcium, phosphorous, total cholesterol, triglycerides, total protein, albumin, or intact parathyroid hormone (iPTH) (P>0.05 (NS) (Table 1).

The commonest findings in maintenance HD patients detected by the M-Mode Transthoracic Echocardiography on the non-dialysis day included diastolic dysfunction (90.9%); [grade 1 (61.6%), grade 2 (26.3%), grade 3 (3%)], valvular diseases (85.7%); [mitral insufficiency (43.3%), mitral calcification (10.1%), aortic insufficiency (18.2%), aortic calcification (14.1%)], abnormal intraventricular septal diameter (IVSD) (40.4%), abnormal left atrial diameter (LAD) (31.3%), abnormal left ventricular ejection fraction (LVEF%) (17.2%), pulmonary hypertension (PH) (16.1%); [mild (10.1%), moderate (5%), severe (1%)], ischemic heart disease (IHD) (14.1%), and degenerative heart disease (DHD) (5.1%) (Table 2 & Figure 1).

Significant differences were found among groups as regards abnormal LVEF%, IVSD, LAD, diastolic dysfunction, aortic calcification, and pulmonary hypertension (P<0.05), but no significant difference as regards mitral insufficiency, mitral calcification, aortic

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insufficiency, ischemic heart disease or degenerative heart disease (P>0.05) (Table 3 & Figure 2).

LVEF% mean±SD was normal in the 3 studied groups; group 1 (65.41±3.66%), group 2 (58.84±8.44%), and group 3 (56.73±9.87%), the IVSD diameter mean±SD was increased in group 3 (12.18±1.56 mm) than in group 2 (10.78±2.08 mm), and normal in group 1 (9.05±2.3 mm), and LAD was increased in the 3 studied groups; being higher in group 2 (40.53±6.12 mm), than group 3 (38.27±6.07 mm), than group 1 (33.45±5.28 mm) (Table 3 & Figure 2).

Diastolic dysfunction was present in all patients in group 2; [grade 1 (70.9%), grade 2 (27.3%), grade 3 (1%)], and group 3; [grade 1 (40.9%); grade 2 (50%), grade 3 (9.1%)], and in 59.1% of group 1 (grade 1). As regards valvular diseases, mitral insufficiency was found in (50%, 36.4%, and 54.5% in groups 1, 2, and 3), and aortic insufficiency (4.5%, 20%, and 27.3% in groups 1, 2, and 3), mitral calcification (13.6%, 5.5%, and 18.2% in groups 1, 2, and 3), then aortic calcification (25.5%) in group 2 only (Table 3 & Figure 2).

Pulmonary hypertension was present in group 2 (18.2%); [mild (9.1%), moderate (7.3%), and severe (1.8%)], and group 3 (27.3%); [mild (22.7%), and moderate (4.6%)]. Ischemic heart disease was found in (9%, 10.9%, and 27.3% in groups 1, 2, and 3). Degenerative heart disease was found in (7.3%, and 4.6% in groups 2, and 3) (Table 3 & Figure 2).

Logistic regression analysis for potential predictors of diastolic dysfunction in ESRD patients on HD showed that the only significant predictor was the duration of dialysis (P<0.05) (S). Other variables including age, sex, SBP, DBP, other risk factors for CVD, Hb%, BUN (pre- and post-dialysis), serum creatinine, calcium, phosphorous, albumin, total cholesterol, triglycerides, or intact parathormone (iPTH) were not significant predictors for diastolic dysfunction in patients on HD (P>0.05) (NS) (Table 4).

Table 1: Demographic, clinical and laboratory data of the studied groups.

Variables	**Group 1 (n=22) (<6 Ms)**		**Group 2 (n=55) (6 Ms- 3 Ys)**		**Group 3 (n=22) (>3 Ys)**		**test**	**P**
Age (years) mean±SD	38.68±11.88		53.11±9.58 [α]		48.27±11.55 [α]		**(F)** 14.68	**<0.05 S***
Sex	**No.**	**%**	**No.**	**%**	**No.**	**%**	**x2** 9.2	**<0.05 S***
Males	17	72.2%	26	47.3%	17	72.2%		
Females	5	22.8%	29	52.7%	5	22.8%		
	mean±SD		**mean±SD**		**mean±SD**		**(F)**	**P**
SBP (mmHg)	141.4±23.56		142±23.21		143.24.01		0.057	0.94 NS
DBP (mmHg)	84.09±7.96		83.64±8.02		84.09±8.54		0.038	0.96 NS
Absolute IDWG (Kg)	1.24±0.56		1.09±023		1.46±0.82		0.004	0.97 NS

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CVD risk factors	No.	%	No.	%	No.	%	x2 0.009	0.99 NS
Yes	7	31.8%	18	32.7%	7	31.8%		
No	15	68.2%	37	67.3%	15	68.2%		
	mean±SD		**mean±SD**		**mean±SD**		**(F)**	**P**
Hb (gm/dl)	10.97±1.67		10.62±2.5		11.41±3.02		0.49	0.6 NS
URR%	70.78±16.7		56.21±22.19 $^{\alpha}$		64.27±19.63 $^{\beta}$		4.4	**<0.05 S***
S. Creat (mg/dl)	11.89±2.8		12.56±2.46		11.17±2.57		2.564	0.08 NS
S. Ca (mg/dl)	8.96±0.68		8.95±0.67		9.07±0.67		0.28	0.76 NS
S. PO4 (mg/dl)	4.95±1.85		4.84±1.84		4.3±1.51		0.3	0.74 NS
S.T. Prot. (gm/dl)	6.24±0.54		6.29±0.52		6.73±0.56		0.11	0.91 NS
S. Alb. (gm/dl)	3.79±0.37		3.78±0.39		3.79±0.38		0.005	0.99 NS
S.T. Cholest. (mg/dl)	195.5±21.54		196±21.31		186.7±29.89		1.292	0.28 NS
S. Trigl. (mg/dl)	134.96±15.43		134.4±15.32		135.1±17.39		0.028	0.97 NS
Serum iPTH (pg/ml)	285.96±249.95		267.29±236.06		285.96±249.95		0.73	0.93 NS

*Statistically significant difference. P<0.05 significant. F (ANOVA test), x2 (Chi-Squared). Ms (months). Ys (years). SBP (systolic blood pressure). DBP (diastolic blood pressure). IDWG (interdialytic weight gain). CVD (cardiovascular disease). Hb (hemoglobin). URR% (Urea reduction ratio). S. (serum). Creat (creatinine). Ca (calcium). PO4 (phosphorous). T (total). Prot (protein). Alb (albumin). Cholest (cholesterol). Trigl (triglycerides). iPTH (intact parathormone hormone). Values with superscript $^{\alpha}$ are different from group 1. Values with superscript $^{\beta}$ are different from group 2.

Table 2: Echocardiographic findings in studied patients on regular HD.

Echocardiographic findings in patients on regular HD	Number of patients (No.)	Percentage (%)
Diastolic dysfunction	90	**90.9%**
Grade 1	61	61.6%
Grade 2	26	26.3%
Grade 3	3	3%
Valvular diseases	85	**85.7%**
Mitral insufficiency	43	43.3%
Mitral calcification	10	10.1%
Aortic insufficiency	18	18.2%
Aortic calcification	14	14.1%
Abnormal intraventricular septum diameter (IVSD)	40	**40.4%**
Abnormal left atrial diameter (LAD)	31	**31.3%**

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Anormal left ventricular ejection fraction (LVEF)%	17	**17.2%**
Pulmonary hypertension (PH)	16	**16.1%**
Mild	10	10.1%
Moderate	5	5%
Severe	1	1%
Ischemic heart disease (IHD)	14	**14.1%**
Degenerative heart disease (DHD)	5	**5.1%**

Table 3: Comparison of the Echocardiographic findings in the 3 studied groups.

Variables	**Group 1 (n=22) (<6 Ms)**		**Group 2 (n=55) (6 Ms- 3 Ys)**		**Group 3 (n=22) (>3 Ys)**		**test**	**P**
	mean±SD		**mean±SD**		**mean±SD**		**F**	
LVEF%	65.41±3.66		58.84±8.44 $^{\alpha}$		56.73±9.87 $^{\alpha}$		7.4	**<0.05 S***
IVSD mm	9.05±2.3		10.78±2.08 $^{\alpha}$		12.18±1.56 $^{\alpha \beta}$		13.21	**<0.05 S***
LAD mm	33.45±5.28		40.53±6.12 $^{\alpha}$		38.27±6.07 $^{\alpha}$		11.18	**<0.05 S***
	No.	%	No.	%	No.	%	**x2**	**P**
Diastolic dysfunction (n=90) (90.9%)								
Total	13	59.1%	55	100%	22	100%	47.9	**<0.05 S***
Grade 1	13	59.1%	39	70.9%	9	40.9 %		
Grade 2	-	-	15	27.3%	11	50%		
Grade 3	-	-	1	1.8%	2	9.1%		
Mitral insufficiency (n=43) (43.4%)								
Yes	11	50%	20	36.4%	12	54.5 %	2.61	0.27 NS
No	11	50%	35	63.6%	10	45.5 %		
Mitral calcification (n=10) (10.1%)								
Yes	3	13.6%	3	5.5%	4	18.2 %	3.19	0.2 NS
No	19	86.4%	52	94.5%	18	81.8 %		
Aortic insufficiency (n=18) (18.1%)								
Yes	1	4.5%	11	20%	6	27.3 %	4.09	0.13 NS
No	21	95.5%	44	80%	16	72.7 %		

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Aortic calcification (n=14) (25.5%)								
Yes	-	-	14	25.5%	-	-	13.05	**<0.05 S***
No	22	100%	41	74.5%	22	100%		
Pulmonary hypertension (n=16) (16.1%)								
Total	-	-	10	18.2%	6	27.3 %	12.89	**<0.05 S***
Mild	-		5	9.1%	5	22.7 %		
Moderate	-		4	7.3%	1	4.6%		
Severe	-		1	1.8%	-	-		
Ischemic heart disease (n=14) (14.1%)								
Yes	2	9%	6	10.9%	6	27.3 %	4.06	0.13 NS
No	20	91%	49	89.1%	16	72.7 %		
Degenerative heart disease (n=5) (5%)								
Yes	-	-	4	7.3%	1	4.6%	1.75	0.42 NS
No	22	100%	51	92.7%	21	95.4 %		

*Statistically significant difference. P<0.05 significant. F (ANOVA test). x2 (Chi-Squared). LVEF (left ventricular ejection fraction) (normal range 52-72%). IVSD (intraventricular septum diameter) (normal range 6-11 mm). LAD (left atrial diameter) (normal range 20-40 mm). Pulmonary hypertension: Mild (35-45 mmHg). Moderate (46-60 mmHg). Severe (>60 mmHg). Values with superscript $^{\alpha}$ are different from group 1. Values with superscript $^{\beta}$ are different from group 2.

Table 4: Binary logistic regression analysis for potential predictors of diastolic dysfunction in ESRD patients on regular HD.

Variables	ß	OR (95% CI)	P
Duration of dialysis (months)	7.557	1914.5 (2.17 to 1687.18)	**<0.05 S***
Age (years)	-0.040	0.961 (0.827 to 1.115)	0.597 NS
Sex	-0.502	0.605 (9.024 to 15.428)	0.761 NS
Systolic blood pressure (SBP) (mmHg)	0.028	1.029 (0.934 to 1.133)	0.563 NS
Diastolic blood pressure (DBP) (mmHg)	0.001	1.001 (0.774 to 1.293)	0.996 NS
Absolute interdialytic weight gain (IDWG) (Kg)	-0.189	0.828 (0.681 to 1.007)	0.059 NS
CVD risk factors	-5.071	0.006 (0.001 to 5084)	0.465 NS

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Hb (gm/dl)	0.419	1.521 (0.751 to 3.079)	0.244 NS
BUN (predialysis) (mg/dl)	0.113	1.119 (0.953 to 1.315)	0.171 NS
BUN (postdialysis) (mg/dl)	0.079	1.082 (0.882 to 1.331)	0.454 NS
Serum creatinine (mg/dl)	-0.899	0.407 (0.161 to 1.028)	0.057 NS
Serum calcium (mg/dl)	0.080	1.084 (0.116 to 10.1)	0.944 NS
Serum phosphorous (mg/dl)	0.356	1.427 (0.642 to 3.174)	0.383 NS
Serum total protein (gm/dl)	-1.030	0.357 (0.032 to 4.025)	0.405 NS
Serum albumin (gm/dl)	-0.406	0.667 (0.009 to 1.473)	0.852 NS
Serum cholesterol (mg/dl)	0.126	1.134 (0.873 to 1.475)	0.346 NS
Serum triglycerides (mg/dl)	-0.309	0.734 (0.528 to 1.021)	0.006 NS
Serum intact parathormone (iPTH) (pg/ml)	0.001	1.000 (0.994 to 1.006)	0.992 NS
ß (regression coefficient), OR (odds ratio).			

*Statistically significant difference. P<0.05 significant. CVD (cardiovascular disease). Hb (hemoglobin). BUN (blood urea nitrogen).

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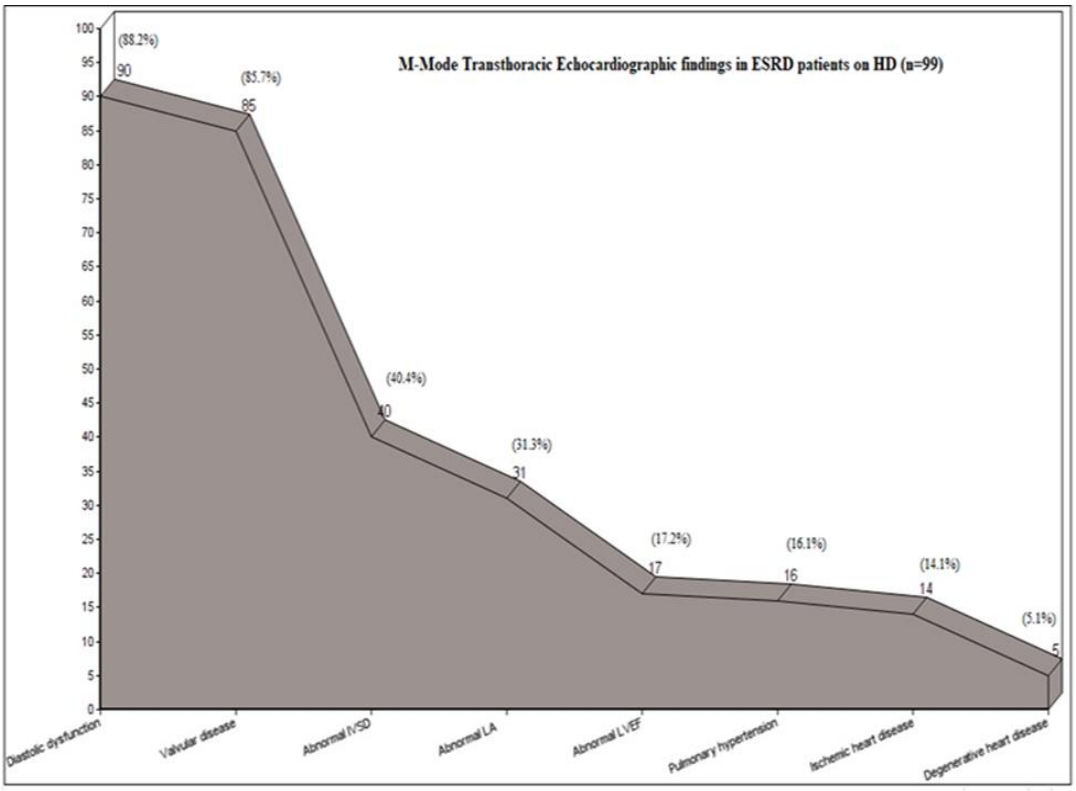

Figure 1: Echocardiographic abnormalities in studied patients on HD.

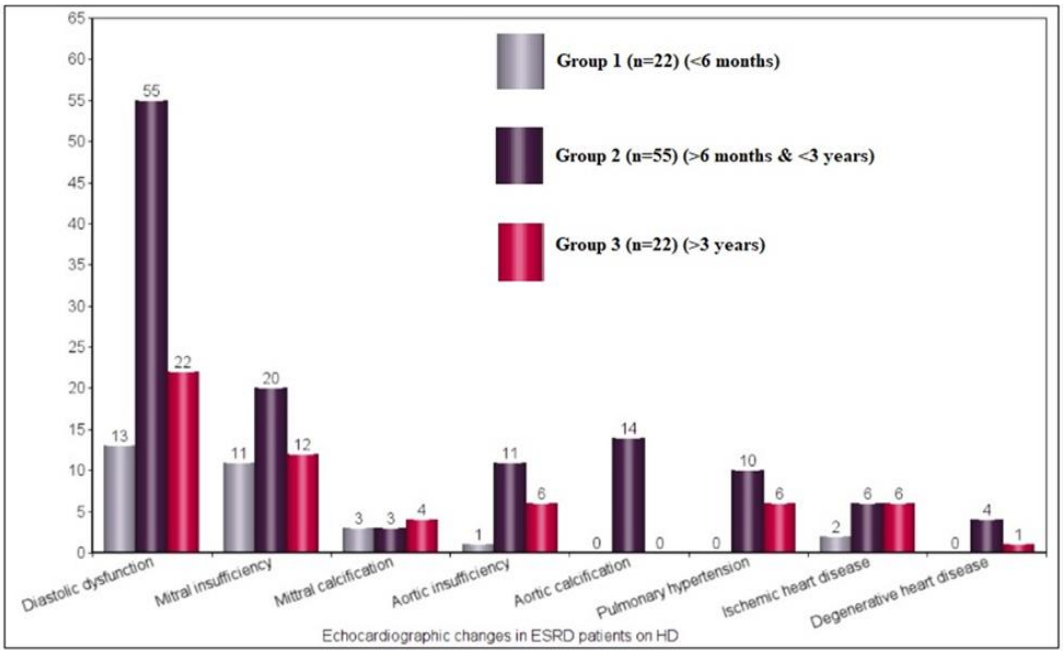

Figure 2: M-Mode Transthoracic Echocardiographic findings in each of 3 studied groups of patients on hemodialysis (HD).

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DISCUSSION:

Cardiovascular disease (CVD) affects more than half of HD patients and increases their risk of death 20 times more than the general population [(1)], and cardiac arrest usually occurs without obvious coronary manifestations [(14)].

This cross-sectional study screened 99 ESRD patients on regular HD with no history of cardiac diseases using M-Mode Transthoracic Echocardiography performed on the non-dialysis day. The age was significantly younger in patients with a less than 6 months HD duration than in other groups, and the urea reduction ratio (URR) was less in patients with a longer duration of HD. Most patients who were excluded from this study were older patients and those with longer duration of HD, who were previously diagnosed with cardiac disease or with cardiac related symptoms. The risk for CVD in HD patients is higher in older patients and longer duration since the start of dialysis [(15)].

Diastolic dysfunction was the commonest finding being present in (90.9%) of all studied HD patients, affecting (56.1%) of ESRD patients who started HD within 6 months and all patients (100%) with a longer HD duration. This agrees with Antlanger et al., who performed a post-dialysis Echocardiography for HD patients and found that 95% of patients had diastolic dysfunction [(16)].

We found that the only significant predictor for diastolic dysfunction in ESRD patients on HD was the duration of HD, with more risk for diastolic dysfunction with longer duration of HD. This agrees with Abbasnezhad et al., who reported that the grade of diastolic dysfunction significantly increased with longer HD duration, and in grade IV diastolic dysfunction, the mean HD duration was more than 2 years [(17)].

Similarly, left ventricular hypertrophy (LVH) was present in (71.4%) of HD patients with a duration of more than 3 months with Hb<10 gm%, versus (14.2%) in patients with Hb ≥ 10 gm%. HD patients with hypertension had a higher prevalence of LVH (51.8%), and systolic dysfunction [(18)].

Also, ESRD patients usually have structural and functional cardiac abnormalities, especially those with hypertension and anemia. The commonest abnormalities are left ventricular hypertrophy (LVH) and diastolic dysfunction and have prognostic value for their sudden death [(19)].

Valvular diseases in HD patients were frequent (85.7%), with mitral insufficiency being the commonest (43.4%), followed by aortic calcification (25.5%), aortic insufficiency (18.1%), and mitral insufficiency (10.1%). Valvular heart disease is common in ESRD patients on HD and aortic and mitral valves are commonly affected by sclerosis and calcification [(20)].

This agrees with Kitamura et al., who found that (65%) of ESRD patients have cardiac valve calcification at the start of HD [(21)]. Also, Ureña-Torres et al. reported valvular heart disease in HD patients (26.5%), but they studied only patients with incident HD (less than 6 months) [(22)].

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Lin et al. studied the echocardiographic findings in HD patients for years and found that de-novo cardiac valve calcification occurred in (45.9%), aortic (33.3%), mitral (24.1%), and both aortic and mitral (11.4%) [(23)].

LVEF% abnormality was present in (17.2%) of all studied HD patients, with a significantly reduced mean, while abnormalities in IVSD (40.4%) and LAD (31.3%) were significantly increased in HD with longer duration. This agrees with Abbasnezhad et al., who demonstrated that with longer HD duration there was more reduction in LVEF, higher LVH, LA dilatation, and mitral insufficiency [(17)].

Laddha et al. revealed that in HD patients LVH was present in (74.3%), systolic dysfunction (<25%) in (8.6%) of HD patients, and LVEF (< 50%) in (24.3%) [(24)]. Also, Momeni et al., screened HD patients with a duration of more than 3 months using echocardiography and then repeated the examination after 12 months. Despite the adequacy of HD, the LVEF% decreased significantly after a year and valvular disorders and LVH were common even in the patients without obvious cardiac disease [(25)].

Han et al. followed ESRD patients on incident HD for 27.2 months with echocardiography. They found that (29.4%) of HD patients had cardiovascular events during this period and had higher LV mass index, left atrial velocity index, right ventricular systolic pressure, and a significantly lower LV ejection fraction than patients without cardiovascular events [(26)].

Pulmonary hypertension (PH) was present in (16.1%) of HD patients, only in those with longer duration. HD using arterio-venous fistula (AVF) is associated with an increased risk of PH, as it causes a left-to-right shunt, and chronic volume overload, independent of the increase in total body water, hence causing right ventricular failure [(27)].

Ischemic heart disease was found only in (14.1%) of HD patients, and it increased significantly in patients with HD duration of more than 3 years (27.3%). Ischemic heart disease (IHD) was detected by M-Mode Echocardiography in HD patients, although selected patients did not have any clinical manifestations. This may be related to the autonomic neuropathy commonly present in HD patients. The frequency of IHD in HD patients was higher in HD duration >3 years.

This agrees with Cozzolino et al., who found that patients on regular HD had coronary heart disease (40%) and ventricular hypertrophy (70%) [(28)]. Also, Kitamura et al. examined ESRD patients using transthoracic echocardiography and computed tomography at the initiation of HD and reported coronary artery calcification in (81.3%) [(21)]. The higher prevalence of ischemic heart disease in their studies may be explained by their inclusion of all HD patients including those with known cardiac diseases. In our study, all patients with known cardiovascular disease had been excluded.

On the other hand, Choi et al. used conventional echocardiography at the initiation of the HD session and found silent myocardial ischemia in (38.2%) of high-risk asymptomatic patients. Their LV end-systolic volume, LV mass index, and left atrial velocity index were significantly higher, and the LVEF was significantly lower than in patients without myocardial ischemia [(29)].

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Degenerative heart disease was found in (5.1%) of ESRD patients on HD, only in patients with longer HD duration. The absence of degenerative heart disease in patients with incident HD and its presence in longer duration may indicate myocardial fibrosis or the effect of inflammatory markers caused by HD.

Patients with chronic kidney disease (CKD) and hypertension are at risk to develop diastolic heart failure caused by myocardial fibrosis [(30)]. Also, histological studies have shown that diffuse myocardial fibrosis was found in HD patients [(31)].

ESRD patients usually suffer from other risk factors for diastolic dysfunction, such as diabetes mellitus, abnormal mineral metabolism, coronary artery disease, and oxidative stress [(32)]. LV dysfunction and hypertrophy in HD patients may be related to hypertension, anemia, volume overload, inflammation, and other risk factors [(33)].

M-mode echocardiography may have errors in calculations of left ventricular mass as many assumptions are required for its assessment [(34)]. Reduced LVEF on starting HD therapy may predict cardiovascular mortality in ESRD patients. Thus, screening of LVEF by echocardiography at the start of HD therapy might be recommended to predict prognosis [(35)].

Echocardiography is useful for screening ESRD patients on HD even asymptomatic patients with anemia and hypertension. It has the advantages of cost-effectiveness, non-invasive technique, ability to detect early abnormalities in cardiac parameters, and risk identification. Thus, echocardiography screening for ESRD patients on HD has diagnostic, therapeutic, and prognostic implications [(18)].

Although most studied HD patients had hypertension, hyperlipidemia, hyperphosphatemia, anemia, hyperparathyroidism, elevated serum creatinine and absolute IDWG, they showed no significant differences among groups of variable HD duration. Also, regression analysis showed that none of these parameters independently predicted diastolic dysfunction in studied HD patients, except for the duration of HD.

This agrees with Naito et al., who reported that age, sex, hypertension, hyperlipidemia, diabetes mellitus, smoking, and medications, none of them affected the improvement of LV diastolic or LV systolic dysfunction in HD patients [(36)].

Points of strength: This study shows the importance of performing M-Mode Transthoracic Echocardiography for all ESRD patients on HD, even asymptomatic patients, or those without known cardiovascular disease, especially those with longer duration of HD.

Limitations of the study: Repeated Echocardiographic examination after modifying risk factors would have been more informative.

CONCLUSION:

M-Mode Transthoracic Echocardiographic examination for ESRD patients on maintenance HD reveals numerous cardiovascular abnormalities, especially diastolic dysfunction, and valvular diseases. HD patients even with no history of cardiac diseases, with any HD duration, would benefit from early diagnosis of cardiovascular diseases by echocardiography and their treatment.

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