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Study of Left Ventricular Myocardial Function in Hemodialysis Patients using Transthoracic Echocardiography

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Abstract:

The aim of this study was to investigate the value of echocardiography for evaluation of the left ventricular functions of long-standing hemodialysis patients .

This study was done in the renal center in Sinnar Teaching Hospital in echocardiography department using sector probe of 3.5 MHz.

The study included 200 cases under regular hemodialysis, using questioner included patient personal data, and echocardiography findings, data was analyzed using computer programs for analysis (SPSS).

The results of this study revealed that according to echocardiography findings 37% impaired ejection fraction, 21% reduced stroke volume, 19% impaired cardiac output, 13% tachycardia, and 20% reduced wall motion.

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The study showed that the Age had negative correlations with Septum, COP, and a positive correlation with, EF, FS, and heart rate. In related Weight, levels show negative correlations with heart rate, EF, and fractioning shorting, stroke volume and a positive correlation with COP, stroke volume, but the Duration showed negative correlation with COP, stroke volume, and FS, and positive correlation Ejection fraction, and HR.

These studies concluded that echocardiography could be used for follow up hearts of these patients and adjust the suitable time for an intervention and echocardiography is a widely used evaluation tool in cardiovascular research.

Key words: Echocardiography, Left ventricular mass, Hemodialysis, cardiac function

INTRODUCTION

Uremia is associated with an increased risk of cardiovascular diseases, including coronary artery disease, myocardial infarction, and heart failure. Mortality is increased by 10- to 20-fold in dialysis patients compared with healthy individuals [1]. Most studies have used the conventional echocardiographic parameters of cardiac function, such as ejection fraction and fraction shortening, which are frequently normal in uremic patients [2,3]. A previous study showed that the ejection fraction and fraction shortening do not adequately describe the regional systolic function and the loading conditions affecting these parameters [4].

Attention has recently been focused on using Doppler tissue imaging to assess LV regional systolic function through the measurement of tissue velocities, displacement, strain, and strain rate. However, tissue Doppler imaging is limited by Doppler angle dependence, which can identify only the myocardial motion and deformation occurring in the direction of the ultrasound beam [5].

Therefore, it has been used primarily to assess longitudinal strain. However, the longitudinal strain is only 1 of the three principle components of the regional systolic function [6]. Two-dimensional speckle-tracking echocardiography was also recently adopted to detect the subtle impairment of the LV systolic function in uremic patients who have normal LVEF [7,8]. However, a major limitation of two-dimensional speckle-tracking echocardiography (2D STE) is that it is unable to quantify one of the three components of the local displacement vector because of the threedimensional (3D) anatomy of the LV and the complex 3D patterns of the wall motion [9].

The aim of this study was to investigate the value of echocardiography for evaluation of the left ventricular functions of long-standing hemodialysis patients .

MATERIALS AND METHODS

Study design and population:

A prospective, cohort study was carried out in Sinnar renal Center, between July 2014 to June 2017. The study population included 200 patients under regular hemodialysis with ESRD and regular HD, but very ill patients or who are known cardiac disease patients are excluded.

Equipment used

All patients subjected to echocardiography by two dimensions machine estate, using lab gold 30 cardiovascular machine(Italy), with phased array probe2.5MHz

Heart ultrasound scanning technique:

Tran's thoracic echocardiography was performed on all patients. The examination was performed in a supine, or 30 degrees left lateral decubitus position, with the left arm raised up above the head. This position brings the heart out toward

the chest wall, displaces the lingula of the left lung out of the way, and opens the inter costal space by spreading the ribs. The transducer is pressed firmly against the chest and moved back and forth slowly. The transducer is moved to different areas of the chest to provide a detailed view of the heart and its structures. At least four separate standard transducer positions which allow for different portions of the heart to be visualized in detail.

Statistics

Data were statistically analyzed using SPSS Statistics version 21 (USA). Categorical variables were expressed as number and percentage and analyzed using chi-square test. Continuous variables were expressed as mean± SD. A probability value $p< 0.05$ was considered statistically significant and a p-value <0.0001 was considered highly significant.

Results

Table (1): Frequency percentage according to gender of the patients :

	Frequency	Percent
Male	86	43
Female	114	57
Total	200	100.0

Table (2): Frequency percentage according to age of the patients

	Frequency	Percent
20-30	54	27.0
30-40	44	22.0
40-50	24	12.0
50-60	36	18.0
More than 60	42	21.0
Total	200	100.0

Table (3): Frequency percentage according to weight

	Frequency	Percent
20-40	28	14.0
40-60	110	55.0
More than 60	62	31.0
Total	200	100.0

Table (4): Frequency percentage according Hemodialysis Duration

	Frequency	Percent
1-24	66	33.0
25-48	76	38.0
49-72	36	18.0
More than 72	22	11.0
Total	200	100.0

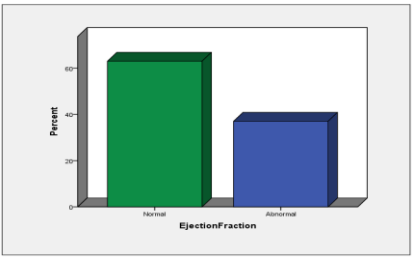

Figure 1: Frequency percentage according Ejection Fraction

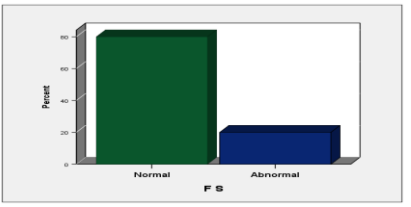

Figure 2: Frequency percentage according to Fraction Shorting

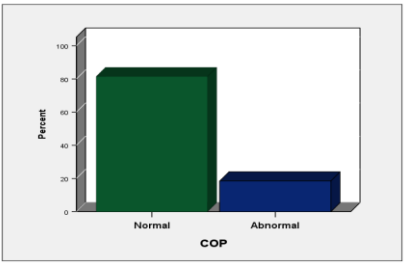

Figure 3: Frequency percentage according Cardiac Out Put

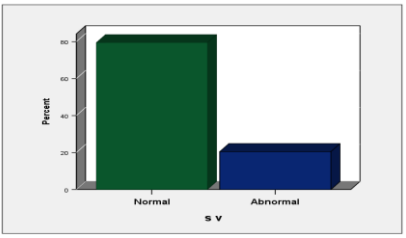

Figure 4: Frequency percentage according Stroke Volume

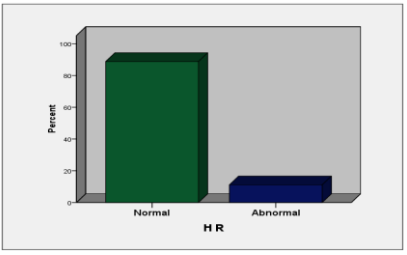

Figure 5: Frequency percentage according to Heart Rate

Table 6: Chi-Square Tests Hemodialysis Duration * EF

Duration		EF		Total	Pearson Chi-Square	Sig (p_value)
		Normal	Abnormal			
1-24	Count	46	20	66	9.618[a]	.022
	Expected Count	41.6	24.4	66.0		
25-48	Count	47	30	77		
	Expected Count	48.5	28.5	77.0		
49-72	Count	16	20	36		
	Expected Count	22.7	13.3	36.0		
more than 72	Count	17	4	21		
	Expected Count	13.2	7.8	21.0		
Total	Count	126	74	200		
	Expected Count	126.0	74.0	200.0		

Table 7: Chi-Square Tests Hemodialysis Duration * COP

Duration		COP		Total	Pearson Chi-Square	Sig (p_value)
		Normal	Abnormal			
1-24	Count	52	14	66	3.287[a]	.35
	Expected Count	53.8	12.2	66.0		
25-48	Count	63	14	77		
	Expected Count	62.8	14.2	77.0		
49-72	Count	28	8	36		
	Expected Count	29.3	6.7	36.0		
more than 72	Count	20	1	21		
	Expected Count	17.1	3.9	21.0		
Total	Count	163	37	200		
	Expected Count	163.0	37.0	200.0		

Table 8: Chi-Square Tests Hemodialysis Duration * SV

Duration		SV		Total	Pearson Chi-Square	Sig (p_value)
		Normal	Abnormal			
1-24	Count	50	16	66	5.548[a]	.136
	Expected Count	52.5	13.5	66.0		
25-48	Count	58	19	77		
	Expected Count	61.2	15.8	77.0		
49-72	Count	31	5	36		
	Expected Count	28.6	7.4	36.0		
more than 72	Count	20	1	21		
	Expected Count	16.7	4.3	21.0		
Total	Count	159	41	200		
	Expected Count	159.0	41.0	200.0		

Table 9: Chi-Square Tests Hemodialysis Duration * HR

Duration		EF		Total	Pearson Chi-Square	Sig (p_value)
		Normal	Abnormal			
1-24	Count	61	5	66	3.445[a]	.328
	Expected Count	57.8	8.3	66.0		
25-48	Count	66	11	77		
	Expected Count	67.4	9.6	77.0		
49-72	Count	29	7	36		
	Expected Count	31.5	4.5	36.0		
more than 72	Count	19	2	21		
	Expected Count	18.4	2.6	21.0		
Total	Count	175	25	200		
	Expected Count	175.0	25.0	200.0		

Table 10: Chi-Square Tests Hemodialysis Duration * FS

Duration		EF		Total	Pearson Chi-Square	Sig (p_value)
		Normal	Abnormal			
1-24	Count	57	9	66	6.654[a]	.084
	Expected Count	52.8	13.2	66.0		
25-48	Count	55	22	77		
	Expected Count	61.6	15.4	77.0		
49-72	Count	29	7	36		
	Expected Count	28.8	7.2	36.0		
more than 72	Count	19	2	21		
	Expected Count	16.8	4.2	21.0		
Total	Count	160	40	200		
	Expected Count	160.0	40.0	200.0		

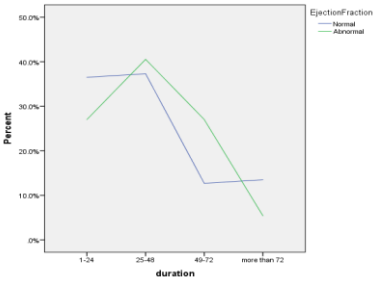

Figure 5: Hemodialysis Duration*E_F

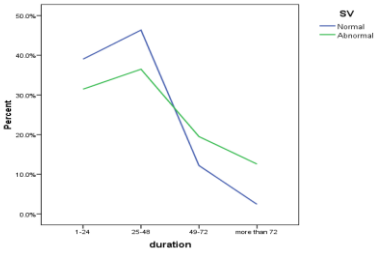

Figure 6: Hemodialysis Duration*SV

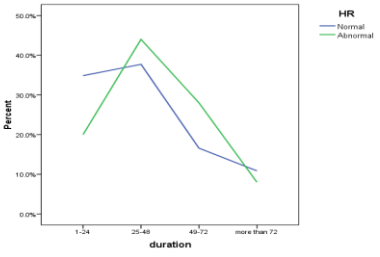

Figure 7 Hemodialysis Duration*HR

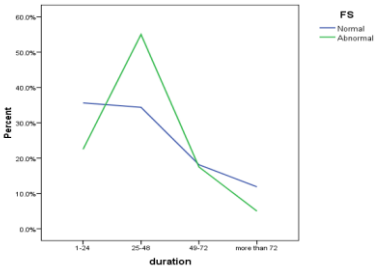

Figure 8: Hemodialysis Duration*FS

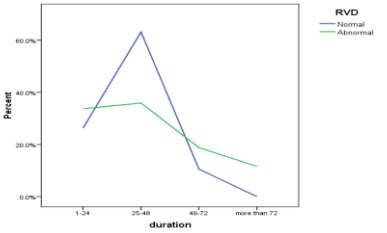

Figure 9: Hemodialysis Duration*RVD

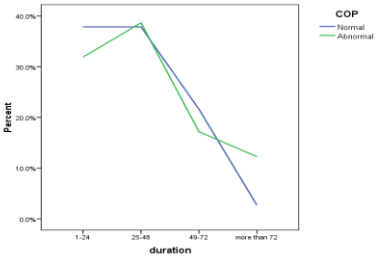

Figure 10: Hemodialysis Duration*COP

Figure (11) 55years old male on dialysis for three years with normal systolic function EF73%

Figure (12)50years old female on dialysis for three years with normal systolic function EF65%

Figure (13)30years old female on dialysis for five years with systolic dysfunction EF 41%

Figure (14)45years old male on dialysis for three years with systolic dysfunction EF 54%

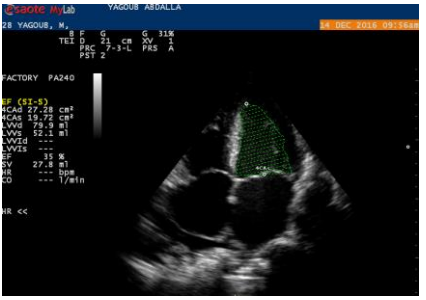

Figure (15)68years old male on dialysis for one year with impaired systolic function EF 35%; stroke volume is 27.8ml

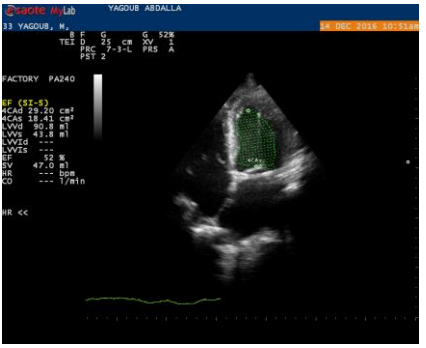

Figure (16)36years old male on dialysis for three years with EF 52%; stroke volume is 47ml

Discussion

This study was conducted in the renal center in Sennar Teaching Hospital on 200 patients on regular dialysis, 43% of them male, and 57% are female (Table 1)

These patients categorize age wise into 4 groups, the most frequent age group ranged from 20 to 30 years old composed of 54patients which are 27%, and the next group is 30 to 40 years old composed of 44patients which are 22.0%. The third group more than 60 years old composed of 42patients which are 21.0% and the fourth group from 50 to 60 years old composed of 36patients which are 18.0% and the last group is

40 to 50 years old composed of 24patients which are 12.0%small. (Table 2)

The body weight of 110patients was ranged from 40.0 - 60.0 kg and represented 55%, , 62patients (31%) more than 60.0 kg and the last index of 28patients (14%) were 20.0 -40.0 kg, respectively hemodialysis always associated with weight loss.(Because of the filtering of blood sugar).(Table 3)

This study showed that 38% of the patients stand on dialysis for 25-48 months followed by 33% on dialysis for 1-24 months (66 patients) then 18% (36 patients) stand for 49-72 months and finally 11%(22patients) stand for more than 72 months. (Table 4)

This research showed that regarding left ventricular Ejection fraction (EF) 63% of patients (126patients) had Normal EF Figures (11,12) and 37% (74 patients) suffering different grade of systolic dysfunction. Figures (1,13-16). And 80% (160 patients) of patients had normal fractioning shorting, and 20%of cases (40 patients) had reduced wall motion. Figure (2).And this proved by cardiac output where 81 %(162patients) of patients had normal cardiac output and 19 %(38 patients) had reduced cardiac output. Figure (3). This study cleared that 79 %(158patients) of patients had normal stroke volume and 21% (42patients) had small stroke volume. Figure (4).This is a little bit higher than *Foley et a*l. whose studied 432 dialysis patients prospectively in the 1980s focus on LV function They found that 31% had systolic dysfunction. [10,11] and relatively in line with Zoccali et al. they studied 254 patients in 2008 they concluded that 22% had systolic dysfunction. [12] and more near to Mallamaci et al. whose studied 246 patients in 2001 and found that 13% had systolic dysfunction[13]nd all most match with Greaves et al. whose studied 84 patients in 1994, and they found that 36% of patients have systolic dysfunction[14]

This study revealed that: 87.0% of patients had normal heart rate and 13.0% with tachycardia Figure (5), and there is

no statistically significant association between hemodialysis duration and septum change (P-value= 0.34), COP change p-value= 0.35. Figure (6), SV change (p-value= 0.13.), figure (7) , HR change(p-value= 0.13.) Figure (8) and FS change (P-value= 0.08.) Figure (9), but there is a statistically significant association between duration and EF change (P-value= 0.022) Figure (10).

Compare to patients with Echocardiography studies. Age levels show negative correlations with cardiac output, and a positive correlation with Ejection fraction, heart rate and fraction shortening. Weight levels show negative correlations with Ejection fraction, heart rate, fractioning shorting and a positive correlation with cardiac output, stroke volume

CONCLUSIONS:

This study has been done in sinnar teaching hospital for 200 ESKD patients on hemodialysis their age above20 years old (88male, 112 female), any patient with known history of heart disease is excluded.

The study concluded that 63% impaired systolic dysfunction, 79% reduced stroke volume, 13% tachycardia, and 80% reduced wall motion.

Tran's thoracic echocardiography scanning is very important to detect any change that may occur in the heart during long-term hemodialysis; further research needs in hearts of these patients.

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