TO STUDY THE ROLE OF ECHOCARDIOGRAPHY IN DETECTING VARIOUS CARDIAC CHANGES IN CHRONIC KIDNEY DISEASE

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BACKGROUND

Chronic kidney disease (CKD) is a major public health problem worldwide with increasing incidence and prevalence. Diabetes and hypertension are the leading cause of CKD worldwide, whereas hypertension is a cause as well as effect of CKD. Aim- To compare the cardiac function in hypertensive and normotensive CKD patients with normal subjects.

MATERIALS AND METHODS

This is a descriptive comparative study. End stage renal disease (ESRD) patients who were at stage III - V and on maintenance dialysis were subjected to 2D echo for determining various cardiac changes during the period of 1st January 2014 to 31st December 2014 in the Department of Medicine of GSVM Medical College, Kanpur and were included in the study. Patients with clinical evidence of coronary artery diseases, valvular heart disease, congenital heart disease and pericardial effusion were excluded from the study.

RESULTS

Out of 42 ESRD patients, 72% showed diastolic dysfunction, 60% showed left ventricular hypertrophy and global wall hypokinesis in 52%. Other echocardiography findings were pericardial effusion in 36% and LA is enlarged in 36%. Clinically, there was no valvular involvement, but by echocardiography, mitral regurgitation was most commonly involved (p < 0.01). Next were tricuspid valve (p < 0.01) and aortic valve was common (36%). There were no severe regurgitant lesions and involvement of pulmonary valve.

CONCLUSION

Cardiac structural as well as functional abnormalities are common in patients of CKD, more in hypertensive than in normotensive patients. Diastolic dysfunction is the commonest cardiac abnormality followed by LVH. Echocardiography is cost effective and is a non-invasive diagnostic test for asymptomatic CKD patients, especially in hypertensives. This is important for early preventive measures and to check progress of the disease.

KEY WORDS

Echo, ESRD, CKD, Hypertension.

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BACKGROUND

Cardiovascular disease is a leading cause of morbidity and mortality in patients at every stage of chronic kidney disease. 30% - 45% of patients reaching stage 5 chronic kidney disease already have developed cardiovascular complications. According to NKF guidelines, CKD defined as either (1) Kidney damage for > 3 months as confirmed by kidney biopsy or markers of kidney damage with or without a decrease in glomerular filtration rate (GFR) or (2) GFR < 60mL/min/1.73 m2 for > 3 months with or without kidney damage. Kidney damage is ascertained by either kidney biopsy or markers of kidney damage such as proteinuria, urinary sediment or abnormalities on imaging studies.

Financial or Other Competing Interest': None. Submission 30-01-2018, Peer Review 25-05-2018, Acceptance 31-05-2018, Published 11-06-2018. Corresponding Author: Dr. Reena Singh, L-14, GSVM Medical College Campus, Kanpur, Uttar Pradesh, India. E-mail: dr.10reenasingh@gmail.com DOI: 10.14260/jemds/2018/640 The finding of proteinuria not only defines the presence of CKD, but also has important implications for diagnosis of the type of kidney disease and is associated with a worse prognosis for both kidney disease progression and the development of CVD.

Measurement of albumin-to-creatinine ratio or total protein-to-creatinine ratio in untimed "spot" urine samples is recommended for assessment of proteinuria. GFR < 60 mL/min/1.73 m2 is selected as the cut-off value for definition of CKD, because it represents a reduction by more than half of the normal value of 125 mL/min/1.73 m2 in young men and women and this level of CRF is associated with the onset of laboratory abnormalities characteristic of kidney failure, increased prevalence and severity of several CVD risk factors.

Kidney failure is defined as GFR < 15 mL/min/1.73 m2 or treatment by dialysis in CKD. It is useful to consider 2 subtypes of arterial vascular disease namely atherosclerosis and large vessel remodelling of arteriosclerosis. Atherosclerosis is an intimal disease characterised by the presence of plaques and occlusive lesions. There is a high prevalence of atherosclerosis in CKD. Atherosclerotic lesions in kidney failure are frequently calcified as opposed to fibromatous include both intima media thickness of the

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carotid wall. Dialysis patients with ischaemic heart disease may not necessarily have large vessel coronary disease. The patients may have ischaemia secondary to the combined effects of volume overload and left ventricular hypertrophy (LVH), which causes increased oxygen demand and small vessel coronary disease which causes decreased oxygen supply. Patients with CKD also have a high prevalence of arteriosclerosis and remodelling of arteries. Remodelling may be due to either pressure overload with an increased wall to lumen ratio or flow overload which is characterised by a proportional increase in arterial diameter and wall thickness. Remodelling often accompanies a reduction in arterial compliance, which can be detected through measurement of aortic pulse wave velocity and characteristic impedance. Noncompliant vessels may result in increased systolic blood pressure, increased pulse pressure, LVH and decreased coronary perfusion. Both decreased aortic compliance and increased pulse pressure have been found to be independent risk factors for CVD in dialysis patients. Patient with CKD also have a high prevalence of cardiomyopathy.

Hypertension and arteriosclerosis result in pressure overload and lead to concentric LHV (increased wall to lumen ratio), whereas anaemia, fluid overload and arteriovenous fistulas result in volume overload and primarily lead to left ventricular dilatation with LVH (a proportional increase in left ventricular mass and diameter). These structural abnormalities may lead to diastolic and systolic dysfunction. These dysfunctions may be detected by echocardiography, so periodic echo is recommended. This study is to assess the role of detecting various cardiac changes in CKD.

Objective

To compare the cardiac function in hypertensive and normotensive CKD patients with normal subjects.

MATERIALS AND METHODS

This study is a descriptive comparative study. All patients of CKD attending OPD/ Nephrology clinic and admitted in indoor in LLR Hospital, Department of Medicine, GSVM Medical College, Kanpur during the period of January 2014 to December 2014 in the Department of Medicine were included in this study. 13 controls were selected from healthy to standardised various echocardiographic parameters of cardiac functions. Patients were grouped under 3 groups.

Group A

Normal healthy controls.

Group B

Established cases of chronic renal failure on conservative treatment or going for haemodialysis with normal blood pressure 20 cases.

Group C

Established cases of chronic renal failure patients and conservative treatment or going for haemodialysis with hypertension 22 cases.

Sample Size

It was calculated using the formula for calculation of sample size for the difference in two means.

Formula

At power= 80% and x= 5% N = $[(Z_{\alpha/2} + Z_{\beta})^2 x \{2(\sigma)^2] / (\mu_1 - \mu_2)^2$

Where

 $(Z_{\alpha/2} + Z_{\beta})^2 = 7.84$ σ = Standard deviation μ_1 = mean of group 1 μ_2 = mean of group 2

A Pilot Study was done on 5 subjects in < groups each

Group 1= Normal subjects = EF = 62.45 ± 2.45 Group 2= Normotensive CRF patients EF= 59.65 ± 2.6

Hence Taking,

σ = 2.45 μ₁= 62.45 μ₂= 59.65 N = 7.84 x 2x (2.45)² / (2.8)² = 12 in each group

Therefore, minimum sample size in each group was calculated as 12.

Exclusion Criteria

- 1. The following patients were excluded from the study with pre-existing cardiac disease like congenital heart disease.
- 2. Rheumatic heart disease.
- 3. Cardiomyopathy.
- 4. Ischaemic heart disease.
- 5. Heart failure.
- 6. Patients with diabetes.

All the patients who were included in the study were subjected to investigate like complete haemogram, renal function test, serum electrolytes, blood glucose level, lipid profile, urine examination, echo, chest x-ray and ultrasound KUB region and ECHO.

2D echocardiography Hewlett Packard SONU S 2000 ultrasound was used for evaluation of cardiac changes. Patients were examined in supine and left lateral position using all 4 basic echocardiography windows. AO, LA, LVID, LVIDs, LVPWd, LVPWs, IVSd, IVSs, LVM, EF, RWMA, pericardial effusion and Doppler study across valves were measured.

Statistical Analysis

Data was compiled and analysed using SPSS 18.0. Comparison between three groups was done using one-way ANOVA with post hoc test. P value less than 0.05 was considered significant.

RESULTS

In the present study, cardiovascular involvement was studied in 42 patients of CKD during the period of January 2014 to December 2014 in the LLR Hospital in Department of Medicine. The observation made were as follows. The age of the patients in the present study ranged from 30 years to 80 years. The mean age was 47.58 + 15.3 years with male: female ratio of 2: 1.

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Sl. No.	Group A		Group B		Group C		Age
	Control		Normotensive		Hypertensive		Group
1	М	F	Μ	F	Μ	F	Patients
2	2	1	1	0	1	1	30-39
3	3	1	6	3	6	3	40-49
4	3	-	6	3	6	3	50-59
5	1	1	1	1	1	1	60-69
6	1	1	-	-	-	-	70-79
Table 1. Distribution of Study Subjects based on Age and							
Gender							

Type of Management				
Dialysis	Number	Percent		
On Dialysis	35	85%		
Not on Dialysis	7	15%		
Total	42	100%		
Table 2. Distribution of Patients based on Dialysis				

Echo Cardiographic Parameters	Group A Control Mean <u>+</u> SD	Group B Hypertensive CRF Mean <u>+</u> SD	Group C Normo- tensive CRF Mean <u>+</u> SD	ʻp' value
AO (cm)	3.01 <u>+</u> 0.25	3.03 <u>+</u> 0.22	3.01 <u>+</u> 0.361	0.9648
LA (cm)	3.05 <u>+</u> 0.34	3.78 <u>+</u> 0.34	3.63 <u>+</u> 0.24	<0.0001*
LVIDd (cm)	4.76 <u>+</u> 0.44	5.21 <u>+</u> 0.68	4.85 <u>+</u> 0.70	<0.0941
LVIDs (cm)	3.42 <u>+</u> 0.54	3.84 <u>+</u> 0.74	3.49 <u>+</u> 0.05	<0.0400*
LVPWd (cm)	0.92 <u>+</u> 0.15	1.10 <u>+</u> 0.22	1.05 <u>+</u> 0.22	0.0546
LVPWs (cm)	1.5 <u>+</u> 0.16	1.43 <u>+</u> 0.29	1.40 <u>+</u> 0.16	0.4222
LVPWs (cm)	092 <u>+</u> 0.15	1.10 <u>+</u> 0.24	1.03 <u>+</u> 0.28	0.0001*
IVSs (cm)	1.5 <u>+</u> 0.16	1.43 <u>+</u> 0.25	1.40 <u>+</u> 0.25	0.4715
LVM (gm)	120 <u>+</u> 13	228 <u>+</u> 44	167 <u>+</u> 20	0.0001*
EF (%)	62.30 <u>+</u> 2.45	56.83 <u>+</u> 4.77	60 <u>+</u> 3.49	0.0006*
Table 3. Comparison according to Echocardiography Findings in Hypertensive and Normotensive ESRD				

* LA– Group A and B - p value < 0.001 significant. * LA– Group A and C - p value < 0.001 significant.

** LVPWs- Group A and B - p value < 0.001 significant.
** LVPWs- Group A and C - p value < 0.001 significant.
*** LVM- Group A and B - p value < 0.001 significant.
*** LVM - Group A and C - p value < 0.001 significant.
*** LVM - Group B and C - p value < 0.001 significant.
**** Ef - Group A and B - p value < 0.001 significant.
**** Ef - Group B and C - p value < 0.05 significant.

	N= 42	%
LVH	15	60%
LA Early	9	36%
Diastolic dysfunction	18	72%
Pericardial effusion	9	36%
Global Wall Hypertensive	13	52%
Clot thrombus, valve thickening, calcification	0	0
Regional Wall Motion	0	0

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Abnormality			
Asymmetrical Septal	0	0	
Hypertrophy	0	0	
Involvement	4	16	
Mitral Valve	19	76	
Tricuspid Valve	10	40	
Aorta	4	16	
Table 4. Distribution of Study Echo Interference			

Sl. No.	Parameters	Clinical Detection	Echocardiographic Detection	%	
	Valve Involvement Mitral	-	19	76%	
	Tricuspid	-	10	40%	
	Aortic	-	4	16%	
Table 5. Echo Analysis of Valve					

Out of 42 cases 72% showed diastolic dysfunction, 60% showed left ventricular hypertrophy and global wall hypertension in 52%. Other echocardiography findings were pericardial effusion 36%. LA enlarge 36%. Clinically, there was no valvular involvement, but by echocardiography mitral regurgitation was most commonly involved. Next were tricuspid valve and aortic valve. Out of regurgitate lesions, mild MR was most common (36%). There were no severe regurgitate lesions and involvement of pulmonary valve.

DISCUSSION

Premature cardiovascular disease is a significant cause of morbidity and mortality among patients with CKD. Premature atherosclerotic coronary disease is driven by multiple risk factors including dyslipidaemia and oxidative stress. Four main structural abnormalities of the heart have been described in patients with CKD. LV hypertrophy, expansion of non-vascular cardiac interstitium the leading to intermyocardiocytic fibrosis, changes in vascular architecture and myocardial calcification. All these abnormalities promote systolic as well as diastolic LV dysfunction which predisposes to symptomatic heart failure, which in turn is a risk factor for premature death. Echocardiography can detect cardiac changes in early stages.

Echocardiography is safe, simple and sensitive method to detect small pericardial effusion, helping to analyse the cause of chest pain and cardiomegaly and thus guide anticoagulant therapy patients who are on haemodialysis.

Early detection and treatment of major cardiac complications in patients of chronic renal failure may change the outcome.

This study consisted of 42 patients of chronic renal failure. Male and female ratio is 2:1 in my study which is comparable with Owen et al,^[1] who found it to be 2:1 and study of Ladda et al^[2] found that male-to-female ratio was 3.

In my study out of 42 patients overall diastolic dysfunction was present in 72%, which is comparable with NP Singh et al (2000)^[3] who found diastolic dysfunction in 72%, S Agarwal et al (2003)^[4] observed diastolic dysfunction in 60% and Mukesh et al (2014) found diastolic dysfunction in 61.2%. In my study, diastolic dysfunction was 86.6% in hypertensive and 50% in normotensive group.

There was statistically significant association between the finding of 2D echo in patients having hypertension as compared to normotensive group for abnormal E/A ratio.

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LVH was present in 60% cases. Robert N Foley et al (1995)^[5] found LVH in 73.9% cases, NP Singh et al found LVH in 76.92% and Zoccali et al (2000)^[6] found in 77%. In intergroup comparison, hypertensive patients had larger left ventricular mass as compared to normotensive group (p<.05). In my study pericardial effusion was present in 36% patients which is consistent with a study of Meon et al (1988) who reported 32% incidence, Achari et al (1989)^[7] reported 50% incidence, while Barrionuevo AID et al (2010)^[8] found in 65% cases and Laddha et al found in 14-30% cases. In present study, global wall hyperkinesia was present in 52% cases. In contrast Goornavar SM et al (2015)^[9] showed 16%, Parfrey et al^[10] reported 20% and 25% in the study of Greaves et al.[11] RWMA is not found in my study. Calcification of heart valves were not present clinically. There was no valvular involvement, but by echocardiography mitral regurgitation was most commonly involved ("p" < 0.001). next were tricuspid valve ("p" < 0.001) and aortic valve ("p" < 0.001). Out of regurgitant lesions, mild MR was most common. There was no severe regurgitant lesions and involvement of pulmonary valve.

16% of CRF patients have hyperdynamic left ventricle and 8% of CRF patients had low cardiac output failure. LA enlargement was seen by echo in 36% cases, which was statistically significant (p < 5.00).

CONCLUSION

Cardiac structural as well as functional abnormalities are common in patient of CKD, more in hypertensive than in normotensive patients.

Diastolic dysfunction is the commonest cardiac abnormality followed by LVH. Echocardiography is cost effective and a non-invasive diagnostic test for asymptomatic CKD patients, especially in hypertensives. This is important for early preventive measures and in checking prognosis of the disease.

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