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Original Article

Cardiac functional status of patients with Chronic Kidney Disease: A cross sectional study

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Abstract:

Background: *In the recent years, the prevalence of chronic kidney disease (CKD) has increased in the community. CKD has been associated with several cardiac diseases. The aim of the study was to assess the cardiac status of the CKD patients.*

Methods: *This cross-sectional study was done in Rangpur Medical College Hospital, Rangpur from June 2013 to November 2013. A total of 50 CKD patients were selected by convenient type of sampling. An informed written consent was taken before enrolling the patients into the study. All the data were recorded in a pre-structured questionnaire. Analysis of the data was done by SPSS V.22. A P value of <0.05 was considered as significant.*

Results: *A total of 50 cases were studied; age ranging from 23 years to 75 years and the mean age ± SD was 45.8 ± 11.56. We study showed that 30% of patients had cardiac dysfunction, among them 18% had systolic dysfunction and 12% had diastolic dysfunction. In the study, among the diastolic dysfunction 10% had slow relaxation pattern and 02% had restrictive pattern of diastolic dysfunction. In our study, we have seen that 36% patients had left ventricular hypertrophy. ECG findings showed that 36% of patients had LVH, 6% showed anterolateral ischaemia, 6% showed inferior ischaemia, 4% showed sinus bradycardia, 2% sinus tachycardia, 2% anterior ischaemia and 2% septal ischaemia. In our study chest X-ray P/A view showed 30% had cardiomegaly, 4% had pulmonary oedema, 4% had pleural effusion and 62% had normal findings. When we staged the CKD with the GFR, it was shown that 90% patients had GFR <15, 6% had GFR in between 30—59 and 4% had in between 15-29ml/min. Systolic dysfunction was more (8%) in patients having GFR < 15, whereas it was only 1% in patients having GFR in between 30—59.*

Conclusion: *This study an suggested association between chronic kidney disease (CKD) and cardiac dysfunction, both systolic and diastolic. It demonstrated a high prevalence left ventricular hypertrophy (LVH) as well. Early detection and treatment of causes of CKD should be pursued aggressively at the earliest possible time to prevent cardiovascular complications and thus reduce morbidity.*

Keywords: *Cardiac function, Chronic Kidney Disease (CKD).*

Introduction

Chronic Kidney Disease (CKD) is associated with significantly increased morbidity and mortality. Chronic Kidney Disease (CKD) affects almost every system of the body and results in various functional and structural abnormalities. Cardiac disease is the major cause of death in dialysis population accounting for 40% of deaths in international registries[1]. The prevalence of left ventricular systolic and diastolic dysfunction is less clear. Cardiac disease frequently predates the start of dialysis and LVH is common in moderate to severe chronic renal failure. Cardiac dysfunction is the major impediment to rehabilitation. Patients in developing countries are managed mainly on conservative therapy and therefore, suffer from chronic acidosis, malnutrition, anemia, and azotemia. These factors further aggravate the cardiac dysfunction in uremic patients. Cardiac disease is frequently noted in individuals around the time of commencement of dialysis, but there is little information on the prevalence and natural history of cardiac function in patients with milder degrees of chronic renal failure. The present study was aimed at assessing the prevalence of systolic and diastolic dysfunction in patients with varying degrees of chronic renal failure. Cardiovascular Complications in End Stage Renal Disease: Chronic renal failure (CRF) affects almost all systems of the body.[2,3] End stage renal disease and cardiac disease seem to be inextricably linked. Of various causes, infection and cardiovascular events contribute towards large proportion of increased morbidity and mortality.[2] As early as 1827 Richard Bright drew attention to the common presence of left ventricular hypertrophy and thickening of the aortic wall in patients with end stage renal disease.[4,5] Today, cardiovascular complications are a major clinical problem in uremic patients accounting for 44% of all deaths in this population.[6]

Death from cardiac causes is 10 - 20 times more common in patients with renal failure than in matched segments of the general population. Several structural and non-structural alterations of the heart and the vasculature are present in the uremic patients, and they presumably contribute to the increased cardiovascular risk in renal failure. Recent clinical and experimental studies clearly document that the pathogenesis of cardiovascular abnormalities in renal failure is much more complex than initially thought. Apart from elevated BP, hypervolemia and anemia, activation of local systems such as the rennin-angiotensin system (RAS) and endothelin (ET) system plays an important role.[7]

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Structural and Functional changes of the heart in renal failure[7]

Structural:

1. Left ventricular hypertrophy
2. Hypertrophy of Cardiomyocytes, alterations in myocytes number
3. Intermyocytic fibrosis
4. Coronary heart disease
5. Micro vascular disease - Arteries, capillaries

Functional:

1. Reduction of insulin mediated glucose uptake
2. Reduction in the activity of the insulin dependent glucose transporter
3. Reduced stability of the energy rich nucleotides
4. Abnormal control of intracellular calcium in cardiomyocytes
5. Reduction of the inotropic and chronotropic response to alpha adrenergic stimulation.

The risk of cardiovascular disease (CVD) in patients with Chronic renal failure appears to be far greater than in the general population.[8] Patients with CRF should be considered in the highest risk group for subsequent cardiovascular disease CVD events. Treatment recommendations based on CVD risk stratification should take into account this "highest risk" status of the patient with CRF.[8] Among patients treated by hemodialysis or peritoneal dialysis, the prevalence of coronary artery disease is approximately 40% and the prevalence of Left Ventricular Hypertrophy is approximately 75%.[6,8]

Patients with end-stage renal disease (ESRD) are at a much higher risk of Cardiovascular disease than the generalpopulation.[9] Evaluating the Cardiovascular organs of potential recipients for the purpose of preventing or, at least, delaying the development of cardiac abnormalities, understanding the determinants of Cardiovascular disease, and careful preparation of interventions aimed at correcting them is very important in the management of ESRD patients.[9]There is growing evidence suggesting that prevalence of CV disease among ESRD patients is already high by the time renal replacement treatment is initiated the results of a number of studies suggest that factors leading to the development of CV abnormalities begin to operate very early in the progression of chronic kidney disease, well before patients reach ESRD.[9]The annual mortality from cardiovascular disease in CRF patients is substantially higher in the general population.[10]

The objective of this study was to assess cardiac functional status of the CKD patients. In the recent years, the prevalence of chronic kidney disease (CKD) has increased in the community. Even in advanced countries, CKD remains a major health problem causing cardiovascular diseases such as congestive cardiac failure, myocardial infarction, hypertension, stroke, and sudden cardiac death. In 1997, annual report of US renal data system (USRDS) revealed that morbidity in patients with CRF is attributed mainly to cardiac causes, which accounts for 49% of the cases. Cardiac disease is the major cause of death in dialysis population accounting for 40% of death in international registries and left ventricular hypertrophy is an independent predictor of survival present in approximately 70% of patients at the initiation of dialysis. Cardiac functional status abnormalities including left ventricular hypertrophy (LVH) is a major finding in chronic kidney disease (CKD) and there is scanty information on the prevalence of cardiac functional abnormalities in these patients. Aim of the present study was to estimate the prevalence of cardiac functional abnormalities in patients with Chronic Kidney Disease and to find out correlation of cardiac functional status with the severity of Chronic Kidney Disease.

Methods

This cross-sectional study was done in Rangpur Medical College Hospital, Rangpur from June 2013 to November 2013. Convenient type of sampling technique was applied. All the CKD patients who were of more than 18 years of age and were willing to give voluntary consent were included in the study. Patients unwilling to take part in the study were excluded. Detailed history was taken and thorough examination was done in each case. Relevant investigations were done in every individual including an ECG (12 leads), Chest X-ray and an Echocardiography.

Statistics

All the data were collected in a predesigned questionnaire. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as means, and categorical variables as frequencies and percentages. A p-value <0.05 was considered as significant.

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Results

In our study, mean age with standard deviation was 45.80 ±11.46 years. Out of 50 CKD patients, 32 were male (64%) and rest were female (36%).

Table 1: eGFR of the study populations (N=50)

eGFR	Frequency	Percentage
30---59	03	06
15---29	02	04
<15	45	90

Table 2: Cardiac dysfunction of the study populations(N=50)

Cardiac dysfunction	Frequency	Percentage
Absent	35	70
Present	15	30
Systolic dysfunction	Frequency	Percentage
Absent	41	82
Present	09	18
Diastolic dysfunction	Frequency	Percentage
Absent	44	88
Present	06	12

Table 3: Relation between stages of CKD with cardiac dysfunction

Stage (with eGFR)	Cardiac dysfunction		Percentage	P value
	Absent	Present		
Stage 5(<15)	31	14	31.11	<0.001
Stage 4(15-29)	02	00	00	
Stage 3(30-59)	02	01	33.33	

Table 4: Relation between stages of CKD with systolic dysfunction

Stage (with eGFR)	Systolic dysfunction		Percentage	P value
	Absent	Present		
Stage 5(<15)	37	08	17.77	<0.05
Stage 4(15-29)	02	00	00	
Stage 3(30-59)	02	01	33.33	

Table 5: Relation between stages of CKD with diastolic dysfunction

Stage (with GFR)	Diastolic dysfunction		Percentage	P value
	Absent	Present		
Stage 5(<15)	38	07	15.55	<0.005
Stage 4(15-29)	02	00	00	
Stage 3(30-59)	03	00	00	

Patients with a BMI of < 18.5 had greater cardiac dysfunction (35.71%) than those who had a BMI between 18.5—24.9 (28.57%). Lower BMI was associated with a higher prevalence of cardiac dysfunction. With increasing severity of anaemia, the prevalence of cardiac dysfunction increased. 44.44% patients with a Hb Level of less than 6 had cardiac dysfunction, whereas 30% patients with a Hb. Level between 6—9 mg/dl had cardiac dysfunction. In patients who had pedal edema, cardiac dysfunction was observed in 38.70% cases and 15.78% cardiac dysfunction was seen in patients without any pedal oedema.

In this study, 36% patients had Left Ventricular Hypertrophy (LVH) and 26% patients had pericardial effusion. ECG findings showed that 36% patients had LVH, 6% showed anterolateral ischaemia, 6% showed inferior ischaemia, 4% showed sinus bradycardia, 2% sinus tachycardia, 2% anterior ischaemia and 2% septal ischaemia. In our study chest X-ray P/A view showed 30% had cardiomegaly, 4% had pulmonary oedema, 4% had pleural effusion and 62% had normal findings.

Discussion

Premature cardiovascular disease is a significant cause of morbidity and mortality among patients with CKD. Four main structural abnormalities of the heart have been described in patients with CKD: LV hypertrophy, expansion of the nonvascular cardiac interstitium leading to inter-myocardiocytic 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 is a risk factor for premature death. Various diagnostic modalities, both invasive and noninvasive such as electrocardiography, echocardiography and radionuclide scans are utilized for diagnosing left ventricular hypertrophy and dysfunction. Echocardiography provides an excellent non-invasive method to delineate details of the anatomy of cardiac cavity, wall dimensions and wall movements. It is now increasingly used in the assessment of cardiac performance and is also invaluable in the demonstration of structural abnormalities such as LVH and pericardial effusion. Left ventricular hypertrophy is the single strongest independent predictor of adverse cardiovascular events and is a major echocardiographic finding in uremic patients. In our study, most CKD patients are of in the age group of 46 to 55 years (40%). In our study 66.66% patients of more than 55 years age had cardiac dysfunction. It is showed that with increasing age there is increase in the cardiac dysfunction. Kotchen et al. showed the prevalence of cardiac dysfunction among individuals aged >60, is 65.4 percent.[11]Our study is consistent with these studies. In our study male patients had more (34.37%) cardiac dysfunction than female (22.2%). Ruixin et al. showed that sex differences in the prevalence of cardiac dysfunction may be mainly attributed to the differences in dietary habits, lifestyle choices, sodium and potassium intakes, physical activity level, and some genetic polymorphisms.[12]

In our study 30% patients had cardiac dysfunction, whereas 70% had no cardiac dysfunction, in which 18% patients had systolic dysfunction and 12% patients had diastolic dysfunction. In the present study, out of 50 patients 18 (36%) patients had Left Ventricular Hypertrophy on Echocardiography which is comparatively similar to the study done by Parfrey P S et al [6] (41%), Rachel J Middleton, et al[13] (41%) but lower to the study done by Tomilina N A et al[14] (52.6%), Kale S A et al [15] (54.7%), Goran J Paunovic et al [9] (56.9%), Sanchari Datta et al [16] (77%). In the present study, we found that LVH was more common in patients in the advanced stages of CKD. This is in concordance with the study done by Dangiri P et al [2], Agarwal S et al [3], Adeera Levin et al [17] who also found a similar trend of LVH in patients of CKD.

In our study, stage 3 and stage 5 CKD patient had more or less same percentage of cardiac dysfunction (33.33% and 31.11% respectively) (Table 3).In respect of systolic dysfunction, stage 3 patients had more (33.33%) systolic dysfunction than stage 5 (17.77%). In respect of diastolic dysfunction, stage 5 patients had 15.55% diastolic dysfunction, where other stages had no diastolic dysfunction. In relation with BMI those with a BMI of < 18.5 had greater cardiac dysfunction (35.71%) and those who had a BMI of 18.5—24.9 had 28.57% cardiac dysfunction. Lower BMI was associated with a higher prevalence of cardiac dysfunction.[18]

With increasing the severity anaemia, the prevalence of cardiac dysfunction is increasing e.g. 44.44% cardiac dysfunction on in Hb. Level <6, 30% in Hb. Level 6—9 mg/dl, all of which is in concordance with study done by Agarwal S et al [3] and Tomilina et al.[14] In patients those who had pedal edema, had cardiac dysfunction of 38.70% and those who did not, had 15.78%cardiac dysfunction. Oliveria et al.[19] observed that 40% patients associated with pedal edema had the cardiac dysfunction, which is very much consistent with this study. In this study, 26% patients had pericardial effusion. Roccella et al. shown that 30% of the patients had pericardial effusion[20], this is more or less similar with our study.

Conclusion

Cardiac dysfunction was very common among patients with CKD. This study suggests that there is association between advancing stages of CKD and the presence of cardiac dysfunction. Further study with regression analysis is needed to confirm our findings. It demonstrated a high prevalence left ventricular hypertrophy (LVH) as well. Early detection and treatment of causes of CKD (Chronic Kidney Disease) should be pursued aggressively at the primary prevention level, as has been advocated by the international society of nephrology to reduce the effect of CKD and its attendant cardiac complication in the society. Various efforts aimed at prevention and control of left ventricular hypertrophy should be started early during the course of renal insufficiency.

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