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Assessment of Cardiac Function in Patients of Chronic Kidney Disease

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Abstract

Introduction-The prevalence of CKD and End Stage Renal Disease (ESRD) are increasing worldwide. They are associated with decreased quality of life, increased morbidity and mortality, leading to higher economic costs. Mortality due to CVD is high in patients with CKD and is associated with many structural and functional abnormalities.Therefore, it is necessary to characterize these abnormalities, understand the underlying pathophysiology, assess risk and/or target their specific management. The **Aim**here is to evaluate cardiac function in patients of chronic kidney disease (CKD) by Two-dimensional echocardiography. The **Method** that we have adopted for our research isCross sectional study.This study was conducted at Krishna Institute of Medical Sciences, Karad. This was in patient department based study.The Study duration was18 months (carried out from October 2018 to March 2020).**Result**indicate Mean age of patients in the present study was 56.44 ± 15.99 years. Majority of the patients belonged to age group of 60 years or more 35 (50%) followed by 40-59 years 23 (32.9%) and less than 40 years 12 (17.1%).Majority of the patients in our study were males 47(67.1%) and rest were females 23 (32.9%).The study C**oncludes** thatIn present study half of the patients were in stage 4 and 5 of CKD. All patients in CKD stage 4 and 5 had diastolic dysfunction by echocardiogram. Significant proportion of patients also had systolic dysfunction in stage 4 and 5 CKD compared to early stages of CKD.

Key Word: Cardiac, Chronic kidney disease, End stage renal disease, Cardiovascular disease

Introduction

The prevalence of CKD and End Stage Renal Disease (ESRD) are increasing worldwide.[1,2] They are associated with decreased quality of life, increased morbidity and mortality, leading to higher economic costs.[3,4] The prevalence of global CKD ranges between 11 - 13%.[5] In India it ranges from 0.79% to 1.4%.[6] The incidence of ESRD in India is 181 per million population (2005).[6] Not all CKD patients progress to ESRD and many may die due to other co-morbidities like cardiovascular disease (CVD) and cerebrovascular disease. Around 30- 45% patients of CKD reaching stage 5 already have advanced cardiovascular complications. [7] Patients with comorbidities may die prematurely and not survive till the need of dialysis or transplantation.[8,9]

Mortality due to CVD is high in patients with CKD and is associated with many structural and functional abnormalities. Therefore, it is necessary to characterize these abnormalities, understand the underlying pathophysiology, assess risk and/or target their specific management. Thus, apart from management of CKD, assessing cardiovascular function is of great importance in CKD patients. This study aims to assess the systolic as well as diastolic function of heart by 2-D Echo Doppler examination in CKD patients in a tertiary care hospital. Even though the results cannot be generalized to the state or the country, the valuable information obtained from this research cannot be overlooked.

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A through literature review has been conducted in an attempt to summarize, synthesize, and compare the existing research in the field. Both Medline and Cochrane databases were searched for studies. Appropriate Mesh terms and operators were used to streamline the search. Selection of relevant studies was done. Reference texts & systematic reviews of randomized controlled trials were also included.

The prevalence of global CKD ranges between 11 - 13%.[5] In India it ranges from 0.79% to 1.4%.[6] The incidence of ESRD in India is 181 per million population (2005).[6] In a study by Mani MK, the reported prevalence of CKD was 0.86 %. However, the study did not include an urban population which is more likely to have higher prevalence of CKD risk factors. Therefore, results may not be a true representation of the existing scenario.[10]

Aim:

To evaluate cardiac function in patients of chronic kidney disease (CKD) by Two-dimensional echocardiography.

Objectives:

1. Echocardiographic evaluation of cardiac functions (LV systolic function, diastolic function) in patients with CKD.

2. To find relation of cardiac dysfunction by echocardiography according to stages of CKD.

Method

Study design: Cross sectional study

Sample Size:

The prevalence of cardiac dysfunction in patients with chronic kidney disease was noted from previous studies, based on which the sample size was calculated.

Some of the studies looked into were,

Table: 1

Author	Sachdeva et al[11]	Ladha et al[12]	Singal et al[7]
D	10	10	10
n by DD	94	94	100
n by SD	68	73	70
Diastolic Dysfunction (DD)	38.33%	61.4%	50%
Systolic Dysfunction (SD)	21.67%	24.3%	23%

According to the study by Singal et al, the prevalence of Systolic dysfunction was23%.[7]

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Hence, taking p=23%, q= 1-p i.e. 77%. Taking the formula for cross-sectional studies, with an absolute precision of 10 percentage points (L) at 95% confidence interval and p=23%, the sample size was up to 70 patients.

Study duration: 18 months (carried out from October 2018 to March 2020)

Study setting: This study was conducted at Krishna Institute of Medical Sciences, Karad. This was in patient department based study.

Exclusion criteria:

Patients with ischemic heart disease, cardiomyopathy and congenital heart diseases.

Investigations: All the enrolled patients were subjected to serum creatinine, electrocardiography, ultrasonography abdomen and pelvis, urine albumin and Two Dimensional transthoracic echocardiography.

Two-Dimensional Echocardiographic Examination:

Study was done on GE Vivid E 95 echocardiography machine with facilities of M mode, Doppler and Two-dimensional echocardiography. Patients were examined in left lateral decubitus position for optimal acoustic window. Systolic and Diastolic function assessment was done. Parameters studied were E/E', IVRT, 'E' Wave 'DT' for diastolic function and EF, FS for systolic function.

Systolic function assessment:

Four Chamber view was obtained. Screen was divided into two screen view. In the 1st screen 4-Chamber left ventricle diastolic frame was obtained and image was freezed. In the 2nd screen 4-Chamber left ventricle systolic frame obtained and image was freezed. .Simpson's formula was selected from the menu, diastolic and systolic left ventricle was mapped for calculation of volumes. Plax view was obtained. Cursor was placed precisely perpendicular to left ventricle.

Result

Mean age of patients in the present study was 56.44 ± 15.99 years. Majority of the patients belonged to age group of 60 years or more 35 (50%) followed by 40-59 years 23 (32.9%) and less than 40 years 12 (17.1%).Majority of the patients in our study were males 47(67.1%) and rest were females 23 (32.9%).Mean eGFR levels in patients were 29.99 ± 27.44 ml/min/1.73m2. Majority of the patients belonged to stage 5 CKD 24 (34.3%) followed by stage 4 18 (25.7%), stage 3 12 (17.1%), stage 2 10 (14.3%) and stage 1 6 (8.6%). There was no significant difference in the CKD staging among males and females (p=0.196)Mean creatinine levels were 4.83 ± 4.74mg/dl. Serum creatinine levels were raised in 57 patients (81.4%) and normal in 13 patients (18.6%).No albumin was detected in 1 patient (1.4%). Albumin levels were normal in 33 patients (47.1%). Albumin levels were raised in 36 patients (51.42%).

Mean E/E' ratio were 11.27 ± 3.33. E/E' ratio rise with increasing age but the increase is however statistically insignificant (p=0.080). The mean E/E' ratio increases significantly with advancing CKD stage (p<0.001)IVRT shows gradual decrease with advancing age but the decrease is however statistically insignificant (p=0.806). IVRT shows gradual decline with advancing stage of CKD and the difference is

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statistically significant. (p<0.001)'E' wave 'DT' values are decreasing with advancing age but the decrease is however statistically insignificant (p=0.815). 'E' wave 'DT' shows decline with advancing stage of CKD and the difference is statistically significant (p<0.001).Diastolic dysfunction was present in 61 (87.1%) CKD patients. Majority of the patients had diastolic dysfunction Grade 2 23 (32.9%), followed by Grade 1 20 (28.6%), Grade 3 12 (17.1%) and Grade 4 6 (8.6%). No diastolic dysfunction was seen in 9 (12.9%) patients. Diastolic dysfunction is present in greater proportion in later stages of CKD. There is significant difference between diastolic dysfunction in CKD stages. (p<0.001)

Mean EF is lower than normal. However, there is no significant difference in EF among age categories (p=0.500). EF shows decline with advancing stage of CKD and the difference is statistically significant (p=0.023).The mean FS value is 30.24 ± 5.34%. There is no significant difference in FS among age categories (p=0.349). FS % shows decline with advancing stage of CKD but the difference is not statistically significant. (p=0.509)Systolic dysfunction is present in 29 (41.4%) patients. It is present in greater proportion in later stages of CKD and the difference significant. (p=0.022)

Discussion

Chronic kidney disease (CKD) is a public health problem compounded by increased morbidity and mortality due to its effect on other systems. Heart failure (HF) in CKD patients can result from any structural or functional cardiac disease and occur as a result of either systolic or diastolic dysfunction. Two- dimensional (2D) echocardiography is done to assess the cardiac function. This cross-sectional study was conducted on 70 patients of CKD to assess the cardiac function in them.

CKD staging was done in the study participants based on eGFR levels using Cockcroft-Gault formula. Mean eGFR levels were 29.99 ± 27.44 ml/min/1.73m2. Majority of them belonged to stage 5 CKD 24 (34.3%) followed by stage 4 18 (25.7%), stage 3 12 (17.1%), stage 2 10 (14.3%) and stage 1 6(8.6%). Previous studies have combined stages 1,2 and 3 as Mild/moderate CKD and stages 4 and 5 as severe.[13,14,15] In our study, 42 (60%) patients belonged to severe and28 (40%) patients belonged to mild/moderate stage. Similar to our study, in a study by Sachdeva et al, 58.33% patients belonged to severe category and rest belonged to mild/moderate category.[11] Debnath et al conducted a study where they included 54% patients of Mild/moderate CKD and 46% with severe CKD.[15] In a study by Rathod et al, out of 50 patients in the study group, 27 were of Mild/Moderate CKD and 23 were of severe CKD.[14] Compared to these studies the proportion of severe cases were higher in our study.

Albumin is a major protein normally present in blood. Low serum albumin levels are strongly associated with cardiovascular disease, heart failure and mortality especially in elderly population.[16–19] Albumin levels are not present in urine if kidney is functioning normally. Therefore, this is also used as a screening test for kidney disease. Higher amounts of albumin in urine indicate a more severe disease. In our study, Albumin levels were raised in 36 (51.42%) and normal (up to 30mg/dl) in 33(47.1%). No albumin was detected in 1 (1.4%) participants. As there can be other causes for raised levels of albumin in urine it is not specific for kidney disease.

LeszekGromadziński and Piotr Pruszczyk assessed the echocardiographic changes in 3rd, 4th and 5th stage of CKD and found all these parameters predicted LVDD and were greatly deranged with advancing CKD stage.[20] On the basis of these parameters diastolic dysfunction was assessed. Diastolic dysfunction of varying degrees was present in 61(87.1%) of CKD patients. It was present in greater

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proportion in later stages of CKD. There was significant difference between diastolic dysfunction in CKD stages ($p<0.001$). Majority of the patients had diastolic dysfunction of grade 2 23 (32.9%), followed by grade 1 20 (28.6%),grade 3 12 (17.1%) and grade 4 6 (8.6%). No diastolic dysfunction was seen in 9 (12.9%) patients. Previous studies have reported diastolic dysfunction in range of 38-82%. Sachdeva et al reported that based on echocardiographic changes, LVDD was present in 38.33% patients, Krishna et al reported LVDD in 38%, Ladha et al reported LVDD in 61.4% and Singal et al reported in 50%.[11,21,12,7] In a study by Rathod et al, none of the controls had diastolic dysfunction, 51.85% patients with mild/moderate chronic kidney disease had diastolic dysfunction while 82.6% patients with severe chronic kidney disease had diastolic dysfunction.[14] In another study by Agarwal et al, none of the controls had diastolic dysfunction, 66.6% patients with mild/moderate CKD and 53.2 % of patients with severe CKD had diastolic dysfunction.[13]

Conclusion

Chronic kidney disease (CKD) and cardiovascular diseases are interrelated in long term. CKD patients are more likely to develop heart failure (HF). In present study half of the patients were in stage 4 and 5 of CKD. All patients in CKD stage 4 and 5 had diastolic dysfunction by echocardiogram. Significant proportion of patients also had systolic dysfunction in stage 4 and 5 CKD compared to early stages of CKD. Diastolic dysfunction was present in more number of patients as compared to systolic dysfunction. CKD patients have a high prevalence of diastolic and systolic dysfunction, which are more pronounced in CKD stage 4 and 5. Also, the higher proportions of diastolic and systolic dysfunctions in CKD patients imply that these patients need thorough cardiovascular evaluation and timely interventions to control development of heart failure.

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