A study of echocardiographic changes in patients with chronic kidney disease

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Abstract

Background: Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in patients with Chronic Kidney Disease(CKD). This increased risk of CVD may begin during early stage of CKD much before the onset of kidney failure. This high burden of CVD is well illustrated by comparing CVD mortality in dialysis population to general population.

Objectives: 1. To identify the Echocardiographic changes in patients with CKD and

2. To know the prevalence of each Echocardiographic change in CKD.

Methods: A total of 50 CKD patients admitted to S. Nijalingappa Medical College Hospital from January 2013 to December 2013, were included in this study. The patients were evaluated as per the history, general physical examination, systemic examination, Blood Urea, Serum Creatinine, Urine Routine, Electrocardiograph (ECG) and Echocardiography.

Results: In the present study echocardiographically determined cardiovascular abnormalities were observed in 86% of patients. Left Ventcular Hypertrophy (LVH) in 36% patients. Ischemic heart disease (IHD) 16%, LVH and Ischemic Heart Disease in 22%, dilated cardiomyopathay in 4.0%, Pericardial effusion in 6.0%, Septal hyperthrophy in 2.0% is observed

Conclusion: LVH is the commonest morphological abnormality observed. In our centre we were able to diagnose IHD patients by echocardiogram and referred them for coronary artery intervention promptly. and we could screen CKD patients before undergoing renal transplant to detect and correct Coronary Artery Disease (CAD) and echo is a tool to detect moderate and massive Pericardial Effusion. and to advice pericardiocenteties and adequate dialysis.

Key Words: Echocardiography, Chronic Kidney Disease, Left Ventricular Hypertrophy, Ischemic Heart disease.

Introduction

Chronic kidney disease (CKD) encompasses a spectrum of different pathophysiologic processes associated with abnormal kidney function and a progressive decline in glomerular filtration rate (GFR)[1].

CKD is defined as Kidney damage for more than 3 months by structural or functional abnormalities of kidney, with or without decreased GFR, manifest by either; pathological abnormalities or markers of kidney damage, including abnormalities in composition of the blood or urine, or abnormalities in imaging tests. Cardiovascular disease (CVD) is a leading cause of mortality and morbidity in patients of CKD. Most of the patients with CKD succumb to CVD before reaching end stage CKD. Thus focus of patient care in earlier CKD stages should be directed to the prevention of cardiovascular complications[1,2].

A strong association exists between CKD and CVD, with an increase in CVD observed with declining GFR. Indeed, CVD is the main cause of morbidity and mortality in CKD patients[3].

Echocardiographic abnormalities are very

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common in patients suffering from end-stage renal disease (ESRD), determining the spectrum of echocardiographic abnormalities in these patients can help in the prevention of mortality, so periodic echocardiographic examination for diagnosis and treatment of cardiac abnormalities is highly recommended[4].

Changes in cardiac structure and function detected by echocardiography are common in patients with CKD undergoing hemodialysis, and have been recognized as key outcome predictors. The cardiovascular mortality in these individuals is 10 to 20 fold more frequent than in the general population[5].

In the present study, an attempt has been made to study various cardiovascular changes in CKD with help of 2D echocardiography and to correlate it with clinical findings and other investigations.

Materials and methods

All patients admitted to S Nijlingappa Medical College Hospital Bagalkot with CKD in the medicine department and hemodialysis unit during 1st January 2013 - 31st December 2013

The history, physical findings on examination with special emphasis on cardiovascular findings and investigations were entered in the proforma.

Sr. Creatinine was estimated by using Mod. Jaffes Kinetic Method.

Principle: Picric acid in an alkaline medium reacts with creatinine to form a orange coloured complex with the alkaline picrate. Intensity of the colour formed during the fixed time is directly proportional to the amount of creatinine present in the sample.

Creatinine + Alkaline Phosphate → Orange Colored Complex.

Reference values:

Serum creatinine

Males: 0.6-1.2 mg%

Females: 0.5-1.1mg%

Sample Material: Serum

Creatinine is stable in serum for 1 day at 2-8 degree Celsius.

Procedure: Wavelength/filter: 520nm, Reaction: Fixed Time Kin, Incubation, Temp.: 30 degree Celsius/37 degree Celsius, Delay Time: 30 sec, Read Time: 60 sec, No. of readings: 2, Interval: 60 sec, Sample Vol.: 0.10 ml, Reagent Vol.:1 ml, Units: mg/dl.

2D Echocardiography: 2D echocardiography was done by using Wipro GE, VividS5 echocardiography machine with a probe of 3 Mega hertz. Left lateral position was used while doing echocardiographic evaluation of CKD patients.

All the patients underwent detailed echocardiographic examination by following views:

1. Left parasternal long axis.
2. Left parasternal short axis.
3. Apical- 4 chambers, 5 chambers (for aortic valve flow), 2 chambers & 3 chambers.
4. M mode

GFR estimation: Was done using Cockcroft Gault equation ,

$$GFR = \frac{(140 - Age) \times body\ weight\ in\ kg}{72 \times PCr\ (mg/dl)}$$

(Multiply by 0.85 in females)

Staging of CKD was done as per GFR[1]

Table 1. Staging of CKD

Stages of CKD	GFR ml/min per 1.73 m²
0	>90[a]
1	≥90[b]
2	60-89
3	30-59
4	15-29
5	< 15

a. With risk factors for CKD

b. With demonstrated Kidney damage

Selection Criteria:

1. Azotemia for ≥ 3 months
2. Symptoms and signs of uremia
3. Presence of broad Casts in urinary sediment

Study Type: Observational study

Inclusion criteria

Patients with chronic kidney diseases admitted under medicine department and hemodialysis unit excluding those below

Exclusion criteria

1. Documented ischemic heart disease
2. Valvular heart disease.
3. Documented Congenital heart disease
4. Patients who are on chronic alcoholism
5. Patients with acute kidney injury
6. Patients who are Hepatitis B Surface antigen (HBsAg) Positive, Human Immuno-dificiency Virus (HIV) positive and Hepatitis C Viral (HCV) antibody positive
7. Patients in whom Renal Biopsy is required for diagnosis

Results

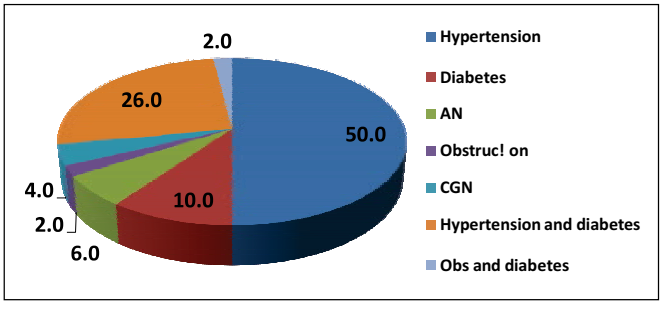
In the present study, cardiovascular involvement was studied in 50 patients of CKD during period of 1st of January 2013 to 31st of December 2013 in the Department of Medicine hemodialysis unit. The observations made were as follows:

The age of the patients in the present study ranged from 18 years to 80 years. The mean age was 47.58± 15.3 years with male: female ratio 1.08:1.

Table 2. Distribution of study subjects based on age & gender

Age in years	Gender		Total
	Male	Female	
<= 20	1 (3.8%)	1 (4.2%)	2 (4%)
21-40	8 (30.8%)	7 (29.2%)	15 (30%)
41-60	12 (46.2%)	10 (41.7%)	22 (44%)
>=61	5 (19.2%)	6 (25%)	11 (22%)
Total	26 (100%)	24 (100%)	50 (100%)

Etiology of chronic kidney disease: The most common cause of CKD was hypertension i.e. 25 (50%) patients.



AN – Analgesic Nephropathy, CGN – Chronic Glomerulonephritis Obs - Obstetrics

Fig.1.Distribution of study subjects according to etiology

Table 3. Distribution of patients based on dialysis

Type of management		
Dialysis	Number	Percent
On Dialysis	46	92.00%
Not on Dialysis	4	8.00%
Total	50	100.00%

Echocardiographic manifestations:

Out of 50 cases of CKD studied by echocardiography, 43 (86%) patients showed presence of echocardiographic manifestations. Most of them 18 (36%) showed LVH alone, combined LVH and IHD were 11(22%), while 7 (14%) patients did not reveal any echocardiographic manifestation.

Other echocardiographic manifestations like IHD alone 8 (16%), Pericardial Effusion 3(6%), Dilated Cardiomyopathy 2(4%) & Septal Hypertrophy 1(2%).

Table 4. Distribution of study subjects based on Echo interference

	Frequency	Percent
Normal	7	14.0
LVH	18	36.0
IHD	8	16.0
LVH and IHD	11	22.0
Dilated cardiomyopathy	2	4.0
Pericardial Effusion	3	6.0
Septal hypertrophy	1	2.0
Total	50	100.0

The lowest ejection fraction observed in this study was 30 % and highest ejection fraction observed in this study was 55 %.

Maximum number of patients i.e. 34(68%) had ejection fraction between 41% to 50 %.

Table 5. Distribution of study subjects based on Left Ventricular Ejection Fraction (LVEF)

LVEF %	Frequency	Percent
<= 30.0	2	4.0
31.0 - 40.0	7	14.0
41.0 - 50.0	34	68.0
51.0+	7	14.0
Total	50	100.0

Discussion

Chronic kidney disease causes multisystem involvement. Echocardiography can detect cardiac

changes in early stages. Echocardiography is safe, simple and sensitive method to detect small pericardial effusion, helping to analyze the cause of chest pain and cardiomegaly and thus guide anticoagulant therapy in patients who are on haemodialysis. Early detection and treatment of major cardiac complications in patients of chronic renal failure may change the outcome.

The present study was conducted in the Department of Medicine from January 2013 to Dec 2013. This study consisted of 50 patients of chronic renal failure.

Age of the patients in this study ranged from 18 years to 80 years with mean age being 47.58±15.3 years. Majority of patients (44%) belonged to age group of 41 years to 60 years.

Age group of patients is comparable to studies of Shivendra et al[6] - 21 to 70 years.

In the present study, 26(52%) patients ware males and 24(48%) patients were females. Male to female ratio being 1.08:1.

Gender of the patients was comparable with Owen et al[7] who found it to be 2:1, study of Foley et al[8] who found male to female ratio as 2:1 and study of Ladda et al[2] found that Male to female ratio was 3:1.

Male gender was more in all studies except in study of D' Cruz et al[9] who had male to female ratio as 2:3

Commonest etiology of chronic kidney disease (50%) was hypertension. Other studies also showed a similar trend. Lewis et al[10] who observed 46 % incidence of hypertension, 60 % incidence by Jkaheimo et al[11], 24% incidence by Greaves et al[12] 30% incidence by Levin et al[13]. While, in contrast with our study, Gupta et al[14] and Owen et al[9] reported chronic glomerulonephritis as most common etiology in 50% & 65% cases respectively.

Other causes of chronic kidney disease observed in the present study were diabetes mellitus (10%), Obstructive uropathy (2%), Chronic Glomerulo nephritis (4%), Hypertension & Diabetes combined (26%), Obstructive uropathy & Diabetes combined (2%).

Maximum number of patients i.e. 45 (90%) belonged to stage 5 CKD while 5(10%) belong to stage 4. No cases were found to be in stage 1,2 and 3 .

Out of 50 patients studied 4 (8%) patients were on conservative line of management without dialysis and 46 (92%) patients were on dialysis.

Percentage of dialysed and non-dialysed patients in the present study is comparable with the study of Greaves et al (1994)[12] who reported 30% patients on conservative treatment and 70% patients on dialysis treatment.

Pericardial effusion was reported in 3 (6%) patients which is consistent with a study by Barrionuevo JDA et al (2010)[15] where they found 6.5% patients with pericardial effusion. Laddha M et al (2014) [2] reported an incidence of pericardial effusion of 14.3% . Shvendra et al reported an incidence of 17.14%. While Menon et al (1998)[16] who reported 32 % incidence and Achari et al (1989)[17] who reported 50% incidence of pericardial effusion in chronic renal failure patients.

In the present study ischemic heart disease was documented in 8(16%) patients echo, in contrast to Parfrey et al[18], who reported 20% incidence of ischemic heart disease in chronic renal failure patients and 25 % in the study of Greaves et al[12].

Etiology of myocardial ischaemia in the chronic renal failure is unclear but atherosclerosis, left ventricular hypertrophy and anaemia are proposed causes.

Left ventricular hypertrophy was reported in 18 (36%) patients. It is consistent with the study of Menon et al who reported 40 % incidence and Raut et al[19], who reported 30 % incidence.

Out of 50 patients studied only 15(30%) patients had left ventricular hypertrophy on electrocardiogram and 35 (70%) patients had no evidence of LVH on electrocardiogram. By echo we had 18(36%) had evidence of LVH. Thus echo cardiogram is superior to electrocardiogram in detecting LVH.

In the present study no statistically significant correlation was observed between left ventricular hypertrophy and either hemoglobin level or duration of the chronic kidney disease or Serum creatinine levels. There was significant association18 (36%) between LVH and presence of hypertension.

Cause of left ventricular hypertrophy in chronic kidney disease remains unclear but is usually associated with modifiable factors. i.e. anaemia, systemic hypertension, uremia.

Conclusion

In the present study, Patient's age ranged from 18 years to 80 years with mean age was 47.58 ± 15.3 years. Hypertension was commonest etiology (50%) Other etiologies were diabetes (10%), obstructive uropathy (2%), CGN (4%), HTN with DM(26%), AN (6%), DM with OBS(2%). Duration of CKD as well as adequacy of dialysis were significantly associated with presence of pericardial effusion. There was significant association between duration of CKD and left ventricular hypertrophy. Maximum number of patients i.e. 45 (90%) belonged to stage 5 CKD while 5(10%) belonged to stage 4 CKD. No cases were found to be in Stage 1, 2 & 3. LVH was present in 30% patients on electrocardiogram in contrast to 58% patients showing LVH on echocardiogram. Echocardiography is a sensitive investigation to study morphology and functional abnormality of heart in chronic kidney disease.

In our centre, we were able to diagnose IHD patients by Echocardiogram and refer them for coronary artery intervention promptly. All patients undergoing renal transplant are screened by Echo to detect and correct CAD. Echo is a tool to detect moderate and massive PE and to advice pericardiocentesis and adequate dialysis. Hence, we advice periodic Echo once in 3-6 months as and when necessary in our centre.

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