

Study of Echocardiography in Chronic Kidney Disease Patients on Maintenance Haemodialysis Attending a Tertiary Care Center of Tripura

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Abstract

Background: Chronic kidney disease (CKD) prevalent world-wide is responsible for ninth leading cause of death causing one million deaths per year. It is a silent disease as it has no symptoms initially and when diagnosed the disease is already advanced. The disease is common, and it affects 10% of the general population and only 1 in 10 people with CKD are fortunate enough to get diagnosed early. The causes of deaths are due to multiple complications which include cardio-vascular complications, metabolic complications and infections. To reduce mortality and increase quality of life early diagnosis of complications due to CKD are important. With initiation of haemodialysis cardio-vascular complications persists and plays an important role in mortality. This study was conceptualized to estimate the echocardiographic complications that appear in CKD subjects undergoing haemodialysis.

Aims & Objectives: To estimate echocardiographic changes occurring in heart in CKD patients under haemodialysis. To determine the associations of the variables found in echocardiography with complications of CKD.

Methodology: This study is a cross-sectional observational study done in one year time period from a tertiary teaching hospital of North-East India. Total sample size was 100 and patients of CKD undergoing haemodialysis due to multiple causative factors above 18 years of age were included. Patients with co-existing ischemic heart disease and valvular heart disease were excluded. All patients were subjected to bio-chemical, pathological and radiological investigations to look for presence of complications. All Patients got echocardiography done to find out echocardiographic abnormalities present. The results were analysed using social science version SPSS 15 for statistical analysis.

Results: There are 61 male patients and rest 39 are female. The mean age of involvement was 50.49 ± 15.31 years. The mean serum creatinine level was 8.75 ± 2.61 . Transthoracic echocardiography done in 100 cases revealed presence of abnormalities in 89 subjects. 11 persons had normal echocardiographic feature. The abnormalities detected are left ventricular hypertrophy (LVH), left ventricular systolic dysfunction (LVSD), left ventricular diastolic dysfunction (LVDD), regional wall motion abnormality (RWMA), Pericardial effusion (PE) and reduced ejection fraction (<55). The mean ejection fraction is 46%. Association of these variables detected on echocardiography was studied with complications of CKD. Statistically significant association was found with anaemia and LVH & LVDD. Hypertension had statistically significant association with LVSD & LVDD. Diabetes had significant statistical association with occurrence of coronary heart disease.

Conclusion: Mortality of ESRD patients under haemodialysis occurs due to cardiovascular complications and in this study by echocardiography LVH is the commonest abnormality found followed by LVDD & LVSD. Other complications are RWMA and pericardial effusions. Reduced ejection fraction was also found. Study of association found presence of anaemia significantly contributes in developing cardiovascular complication, followed by hypertension. Hence early management of anaemia & hypertension can delay the development of cardiovascular complications and in long run reduce mortality.

Keywords: chronic renal failure; echocardiography; haemodialysis

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Introduction

Chronic kidney disease (CKD) is defined as kidney damage for more than 3 months, as defined by structural or functional abnormalities of kidney, with or without decreased glomerular filtration rate (GFR), manifest by either: pathological abnormalities or markers of kidney damage including abnormalities in composition of blood and urine or abnormalities in imaging tests of kidneys. [1]

CKD is prevalent worldwide in both developed and developing countries with India alone contributing to 55000 patients to haemodialysis yearly and each year there is an increment by 10% to 20 %. [2]

Complications of CKD include anaemia, metabolic acidosis, high calcium-phosphate products, hyperparathyroidism, chronic inflammations, endothelial dysfunctions and cardiovascular disorders. [3]

Cardiovascular complications contribute towards increased proportion of morbidity

and mortality and accounts for 40% deaths. [4, 5] In India it's however the main cause of death of CKD patients under haemodialysis. [6]

Retention of excessive sodium and water in CKD increases cardiac output and simultaneously activates sympathetic nerves which in turn increase peripheral vascular resistance and blood pressure. Heightened blood pressure and fluid overload burdens heart. [3, 7]

One major structural cardiac abnormality that appears in chronic renal failure is left ventricular hypertrophy. [8] LVH is caused by excessive cardiac burden and fluid overload on the ventricle. The arterio venous fistula which is created for vascular access in patients with ESRD (end stage renal disease) increases stroke volume and contributes for LVH. [9]

Patients present with LV systolic dysfunction (LVSD) and a higher percentage with LV diastolic dysfunction

(LVDD) and thus are associated with increased risk for congestive cardiac failure. Simultaneously it is a very strong independent predictor of cardiovascular mortality. [10]

Valvular calcifications are other complications found on echocardiography and are due to calcium and phosphate deposits over the valves. It results into valvular stenosis and also regurgitations. [11]

The cardiovascular mortality in these individuals is 10 to 20 fold more frequent than general population. [12]

The diagnosis of LV abnormalities by Doppler echocardiography is an important step for characterization of the individuals with higher cardiovascular risk and to study the prognostic impact and the effect of therapeutic interventions. [13] The Doppler echocardiogram is a complimentary non-invasive examination broadly used in the assessment of heart structure and functions. The finding of echocardiographic alterations in the form of LV hypertrophy, dilations and systolic dysfunctions triples the risk of heart failure in dialysis patients regardless of age. [14] Cardiovascular disease is the single most important cause of death among patients receiving long term dialysis; accounting for 44% of overall mortality. [15]

Many patients of CKD die prematurely as there are high prevalence of the usual risk factors like diabetes, hypertension and LVH. They are also exposed to uraemia related risk factors that increase in prevalence as kidney function declines; anaemia and hypertension are pre lethal occurrence leading to cardiac failure. [16]

The known common cardiac abnormalities in ESRD are increase in LV cavity size, thickened posterior wall, thickened inter ventricular septum, regional wall motion abnormality (RWMA), decrease in LV compliance, pericardial effusions and calcified valves. [17]

Aims and objectives:

1. To estimate the echocardiographic changes of heart found in patients of chronic kidney disease undergoing haemodialysis.
2. To detect the variables in echocardiography in CKD patients and to determine their association with complications of chronic kidney disease.

Methodology

The study was carried out in the Dept. of Medicine at Agartala Government Medical College Agartala Tripura for a period of one and half years

It's a cross sectional study

The study was done after taking permission from Institutional Research Committee and Institutional Ethics Committee

The patients of chronic kidney diseases under maintenance haemodialysis fulfilling the inclusion criteria; attending the hospital both as an inpatient or out-patient in the Dept of Medicine for haemodialysis during the study period are included as cases.

A total of 100 cases of chronic kidney disease patients under haemodialysis have been taken as total number of cases by calculating the sample size.

Inclusion criteria:

All cases of CKD of all aetiologies under haemodialysis of age \geq 18 yrs.

Exclusion criteria:

1. Known case of ischemic heart disease along with CKD
2. Known valvular heart disease
3. Known congenital heart disease
4. Age less than 18 yrs
5. Persons not willing to participate.

All cases were fully informed about the study protocol and pattern and they participated willingly and consent in written has been taken from all of them.

All 100 cases after selection were examined clinically and investigated. Routine blood and biochemistry investigations which included Hb, TLC, DLC, Blood Sugar, blood urea, serum creatinine, Glomerular Filtration Rate, electrolytes (Na^+ , K^+ , Ca^+), lipid profile, liver function tests were done. Cut off value of Hb has been taken as 12 gm% for diagnosis of anaemia. [18]

X-ray chest, ECG and ultra-sound Abdomen were done in all 100 cases.

2D Echocardiography was done in all 100 cases to evaluate echocardiographic changes in the heart by Mindray diagnostic ultrasound system Model: DC-3 with a linear transducer of 2.5 MHz. [19] A value of left ventricular ejection fraction < 55 % is taken as systolic heart failure. [20]

Statistical Analysis

The data collected were tabulated in Microsoft Excel and analyzed using statistical package of Social Science version: SPSS 15. $P < 0.05$ is considered as statistical significance.

Results:

There were 100 cases under study of chronic renal failure patients undergoing haemodialysis. The study of demographic profile shows there were 61 male and 39 female patients. Of the cases 39 were from

urban population and rest 61 belonged to rural population. 75% was from non tribal population and 25% of cases belonged to indigenous tribal population of Tripura.

Maximum patients (36%) were in 46 to 60 yrs age group with mean age of patients being 50.49 ± 15.31 . The youngest patient was of 18 yrs and the oldest patient was of 82 yrs.

The serum creatinine level of the patients was in between 3.9 to 19.40 mg/dl with a mean of 8.75 ± 2.61 .

73 subjects are found to be having anaemia with Hb level ranging from 5.4 to 10.7 gm% with a mean of 8.23 ± 2.08 and rest 27 cases had Hb level above 12 gm%

Maximum patients were found to have low calcium level ranging from 5.4mg% to 11mg% with a mean of 7.96 ± 0.9 .

For evaluation of precipitating risk factors leading to chronic renal failure among these 100 cases it was documented that 67% of CKD were due to hypertension 45% were due to Diabetes Mellitus and 14% were due to other causes. Among 45 diabetic patients 29 of them were hypertensive also.

Transthoracic echocardiography was done in all patients. The following are the echocardiographic findings:

Table: 1 Number of CKD Patients having Echocardiographic Changes

Sl. No	Echocardiographic changes Present (group-A patients)	Echocardiographic changes Absent (group-B patients)	Total number of cases
1.	89	11	100

Table: 2 Distribution of Echocardiographic Changes in Group- A Patients

Echocardiographic findings in cases of CKD on maintenance Haemodialysis among group-A patients (n=89)		Number of cases with the findings
1	LVH	77
2	LVSD	34
3	LVDD	44
4	RWMA	25
5	PE	24
6	Valvular Calcifications	0
7	EF (< 55%)	27

(LVH: left ventricular hypertrophy; LVSD: left ventricular systolic dysfunction; LVDD: left ventricular diastolic dysfunction RWMA: regional wall motion abnormality; PE: pericardial effusion; EF: ejection fraction)

Table: 3 Mean Values of Different Echocardiographic Parameters of the Cardiac Abnormalities Found in Echocardiography in Group- A Patients

Different cardiac abnormalities detected on Echo in cases of CKD on maintenance Haemodialysis among group- A patients (n=89)	Mean echocardiographic values of different cardiac abnormalities detected on Echo in cases of CKD on maintenance Haemodialysis among group- A patients (n=89)
IVSd [mm]	16.4
IVSs[mm]	18.2
LVSystolic [mm]	50.2
LVDiastolic [mm]	43.2
LA Diameter [mm]	44.1
RV Diamteter[mm]	28.9
EF	46%

Table 4: Association of Hypertension and Echocardiographic Changes in CKD Patients

Echocardiographic findings present in study subjects	Hypertension		P value
	Present BP \geq 140/90 (n = 67)	Absent BP < 140/90 (n = 33)	
LVH	54	23	P = 0.22
LVSD	28	06	P < 0.01*
LVDD	34	10	P < 0.05*
RWMA	20	05	P = 0.11
PE	15	09	P = 0.59
EF < 55%	22	05	P < 0.05*
CAD	19	10	P = 0.840

(* = statistically significant)

Table 5: Association of Diabetes mellitus and Echocardiographic Changes in CKD Patient

Echocardiographic findings present in study subjects	Diabetes Mellitus		P value
	Present (n = 45)	Absent (n = 55)	
LVH	35	42	P = 0.86
LVSD	15	19	P = 0.89
LVDD	19	25	P = 0.74
RWMA	10	15	P = 0.56
PE	14	10	P = 0.13
EF < 55%	12	15	P < 0.0001*
CAD	21	08	P < 0.000525*

(* = statistically significant).

Table 6: Association of Anaemia and Echocardiographic Abnormalities

0	Anaemia		P value
	Present Hb < 12 gms% (n = 73)	Absent Hb ≥ 12 gms% (n = 27)	
LVH	64	13	P = 0.000031*
LVSD	26	08	P = 0.5747
LVDD	37	07	P = 0.0268*
RWMA	14	11	P = 0.0270*
PE	16	08	P = 0.422
EF < 55%	17	10	P = 0.169
CAD	24	05	P = 0.1600

(* = statistically significant).

Discussion:

Cardio vascular complications are the major causes of death in patients with end stage kidney diseases (ESRD). The detection of echocardiographic abnormalities is considered to be an important step in characterization of individual risk for heart failure in subjects with chronic kidney diseases and also with those undergoing maintenance haemodialysis for survival.

The most common cardiac abnormality found in this study was left ventricular hypertrophy (LVH) with 77 study subjects having this abnormality.

The other findings were left ventricular systolic dysfunctions in 34% of cases and 44% had left ventricular diastolic dysfunction. Pericardial effusion was seen in 24% of cases and coronary artery disease was found in 29% of cases. Regional wall motion abnormality was observed in 25% cases.

Hypertension was found in 67 cases of CKD undergoing dialysis of which 54 cases had LVH. Parfrey et.al had showed that rise in mean arterial pressure was associated with increased incidence of LVH in ESRD population under haemodialysis. [21] In another study Levin et.al reported the positive association of elevated blood pressure with LVH occurrence and patients having low haemoglobin are also having LVH. [22]

The left ventricular systolic dysfunction was seen in 28 patients among 67 hypertensive individuals. Statistically significant association ($P < 0.01$) was observed in causation of LVSD and hypertension in CKD patients.

Statistically significant association was also observed with hypertension and left ventricular diastolic dysfunction ($P < 0.05$).

In this study 73% were anaemic with mean Hb value of 8.23 ± 2.08 and statistically significant association was observed with abnormalities detected in echocardiography and anaemia like LVH, LVDD and RWMA. Dutta et.al showed in their study the association of anaemia with LVH and documented severity of anaemia leads to increase in LVH and LVDD. [23]

Anaemia is a strong predictor of development of LVH and left ventricular diastolic dysfunctions. Anaemia is thus a predictor of mortality in CKD & Harnett et.al observed that in ESRD patients on dialysis decrease in level of haemoglobin by 1gm% increases mortality chance by 18% due to cardiovascular complications. [24]

Statistically significant association was found among diabetic patients having CKD developing coronary artery disease. Diabetic patients are also having low ejection fraction and are prone to develop systolic failure. This association was also statistically significant. Coronary artery disease as a complication with high

mortality chances develops in diabetic subjects complicated by CKD.

Hence in CKD under haemodialysis both hypertension and anaemia are predisposing factors for development of cardiac complications. In this study statistically significant association has been established with adverse echocardiographic findings and presence of hypertension and anaemia. Simultaneously diabetic patients are predisposed to develop coronary artery disease & with low ejection fraction. Both CAD & low ejection fraction contributes for increasing cardiovascular mortality and morbidity.

Conclusion:

Mortality and morbidity due to cardiovascular complications in CKD patients under haemodialysis is a known fact and echocardiography is an important investigation tool for identifying the existing cardiac abnormalities and to ensure required management strategies to prevent complications. The present study was conceptualized with this aim and it revealed cardiac echocardiographic changes occurred in CKD patients under haemodialysis. LVH is the commonest complication found (77%) along with left ventricular systolic and diastolic dysfunctions (LVSD, 34%, & LVDD, 44%). Ejection fractions were found to be less than 55% in 27% of cases and pericardial effusion was another complication (in 24% of patients). Hypertension (67% of cases) and anaemia (73% of patients) coexisted in CKD patients and both these two factors were found to be contributing in development of cardiac echocardiographic abnormalities.

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