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A STUDY OF THE CARDIOVASCULAR COMPLICATIONS IN CHILDREN WITH CHRONIC KIDNEY DISEASE IN TERTIARY MEDICAL CENTRE OF BIHAR

Paediatrics

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ABSTRACT

Introductin : Children with chronic kidney disease (CKD) are at substantially higher risk of morbidity and mortality from cardiovascular disease (CVD). CVD is regarded by many as the most important cause of death among patients receiving chronic renal replacement therapy. Aim and objective: To study prevalence of Left Ventricular Dysfunction in children with CKD using Echocardiogram as a tool. Methodology: This was a prospective cross-sectional study conducted in the Pediatric Department of Nalanda medical college and hospital. Children, aged 1-18 years with Chronic Kidney Disease who presented to the General Pediatric OPD or Inpatient Facilities of NMCH Patna were recruited. **Result:** Ejection fraction was 60.89±5.9 in group of patients without dialysis whereas 54.79±9.99 in dialysis group of patients and also statistically significant with p value= 0.006. LVMHT was 0.80±0.453 in grp without dialysis whereas 0.86±0.66 in patients of grp of dialysis. There was statistical difference between fractional shortening between two groups 32.15±4.04, and 28.36±5.81 with p value= 0.007. **Conclusion :** Children with CKD are at very high risk for cardiovascular morbidity (Hypertension and Left VentricularDysfunction).

KEYWORDS

CKD, ECHO, CVD, Ejection fraction

INTRODUCTION

Kidney disease can adversely affect cardiovascular health in the general population is well established fact. However, it increases when evidence suggests that the largest share of mortality in renal disease patients is related to cardiovascular insults. Although these diseases has been throughly discussed in the adults, there is no consensus whether similar relation exists in the pediatric population. In the current literature review, we emphasis to find potential connections between these two entities in patients of childhood age, and to find such associations if exists.[1]

Children with chronic kidney disease (CKD) are at substantially higher risk of morbidity and mortality from cardiovascular disease (CVD). CVD is regarded by many as the most important cause of death among patients receiving chronic renal replacement therapy. A Task Force on CVD of the National Kidney Foundation has compared the mortality rate from CVD in dialysis patients (≈50 thousand deaths) with those in the general population (≈2 million deaths). It concluded that annual mortality from CVD is higher in dialysis patients, in spite of stratification for race, gender, or age group.[2]

CKD affecting approximately 10% of the general population. Due to worldwide aging of population The prevalence of CKD has increased over the past decades. Indeed, CVDs in patients with CKD constitute a premature form of CVD observed in the general population. On searching literature many studies indicate that patients with renal disease undergo accelerated aging, which increases the appearance of pathologies, including CVDs, usually related with advanced age. In this review, we discuss several aspects that characterize CKD-associated CVDs, such as etiopathogenic elements that CKD patients share with the general population, changes in the cellular balance of reactive oxygen species (ROS), and the associated process of cellular senescence[3]

CKD-associated cardiovascular morbidity (CVM) was more commonly reported in the form of diastolic cardiac dysfunction.it was defined as clinicopathological phenomenon manifested by clinical manifestations of cardiac failure with a preserved ejection fraction (EF), and abnormal diastolic cardiac function by echocardiographic examination. It has been reported that diastolic cardiac function was disturbed and left ventricular mass (LVM) was increased in patients with CKD.[4]

The exact etiology of the increased risk of CVD in CKD is unknown, but may be due to some common CVD risk factors, including diabetes, hypertension, obesity, lipid abnormalities, and smoking. The burden of CVD risk factors among patients who have not undergone dialysis and those who have is extremely high. Patients with CKD are generally undertreated with respect to cardioprotective medications (including -blockers, aspirin, angiotensin- converting enzyme inhibitors, and lipid-lowering medications) even in settings of congestive heart failure, prior myocardial infarction, and coronary artery bypass graft surgery[5]

With the above background this study was conducted with following aim and objectives

Aims and objectives

1. To study the prevalence of Hypertension both manifest (clinic BP Readings) and masked (Ambulatory BP monitoring).
2. To study prevalence of Left Ventricular Dysfunction in children with CKD using Echocardiogram as a tool.

Methodology

This was a prospective cross-sectional study conducted in the Pediatric Department of Nalanda medical college and hospital. NMCH is a tertiary care center located in Bihar which is also a referral center.

This study was conducted from October 2019 to July 2020 on 60 study subjects selected from OPD/IPD of NMCH as per inclusion and exclusion criteria.

Study Subjects:

Children, aged 1-18 years with Chronic Kidney Disease who presented to the General Pediatric OPD or Inpatient Facilities of NMCH Patna were recruited . Chronic Kidney Disease as defined by the National Kidney Foundation in 2002: (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 <60 mL /min/ 1.73 m^2 for >3 months, with or without kidney damage 14.

The Glomerular Filtration Rate was calculated according to the Schwartz Formula for children < 15 years old. For older children the Cockcroft-Gault formula would be used to estimate GFR. The children were divided into the following groups according to their Glomerular Filtration Rates:

Stage 3 disease — GFR between 30 and 59 mL/min per 1.73 m^2

Stage 4 disease — GFR between 15 and 29 mL/min per 1.73 m^2
Stage 5 disease — GFR of less than 15 mL/min per 1.73 m^2 or end-stage renal disease (ESRD)
Children with GFR < 15 ml/min/1.73 m^2 on Dialysis

Inclusion Criteria:
All children with CKD and GFR < 60 ml/min/1.73 m^2 aged 1-18 years will be recruited after parental consent

Exclusion Criteria:
Any child with Renal, other solid organ, Bone marrow Transplantation Cancer/ HIV diagnosed during the past 12 months Genetic Syndromes Presence of any congenital/structural heart disease or myocardial disease

Methodology:
Informed consent was taken from all parents by the Principal Investigator. A detailed history including demographic data, duration and course of disease, treatment details was taken. A complete physical examination was done including anthropometric data, edema, Clinic Blood Pressure recordings.

Routine Blood tests were noted using the P 800 Roche Hitachi Modular System. The mean of 3 clinic BP readings over the previous 3 visits were recorded. Ambulatory BP recording was performed for each child over a 24 hour period using the Spacelabs Healthcare (040-1546-00) machine. ECHO was done to determine Left Ventricular Dysfunction (LV mass, LV Mass Index, Relative Wall Thickness). The Philips IE 33 model with 12 size pediatric probe was used. 30

Ambulatory BP Monitoring:
ABPM was monitored for every child using the Spacelabs Healthcare (040-1546-00) machine. The appropriate sized BP cuff was attached to the non-dominant arm of the child. BP readings were recorded for a 24 hour period. The exact sleep and wake timings of children were not determined, and it was assumed that they sleep between 10 pm to 6 am. Subjects were asked to continue all their normal daily activities. BP recordings were measured every 20 minutes during the day time and every hourly at night time. BP load was calculated as the percentage of BP readings above the 95th centile. Ambulatory BP Index was calculated as the average BP of the child divided by the 95th centile Ambulatory BP for that particular age, height and gender.

ECHO:
ECHO was done for every child using the Philips IE 33 model with 12 size pediatric probes. The ECHO was performed by a trained technician or doctor according to their protocol. The parameters recorded were LVID, LV Posterior Wall thickness, Inter Ventricular Septal Thickness, Relative Wall Thickness, Fractional Shortening, Ejection Fraction. LV Hypertrophy was defined as the LV Mass greater than the 95th centile for age, sex and Height as shown in Annexure IV. These were used to calculate the LV Mass according to the Devereox formula. The LV Mass Index was calculated as well as the LVM/Ht^2.7.

Data Analysis:
The data collected was analyzed using SPSS software and t tests of significance were done.

Table 1 shows basic characteristics of patients in two groups. Group 1 represent patients with CKD without dialysis whereas group 2 represent patients of CKD without dialysis.

PARAMETERS	CKD without Dialysis Mean (SD) N= 46	CKD with Dialysis Mean (SD) N=14	P-value
Age (yrs)	11.61±3.32	11.36±3.43	0.81
Sex (male)	76.08%	92.86%	
Height (cm)	134.52±18.71	136.14±20.84	0.78
Weight (kg)	30.22±11.12	29.14±11.84	0.77
BMI (kg/m^2)	16.09±3.07	14.93±2.27	0.19
BSA	1.02±0.26	1.07±0.267	0.53
Stated Duration of CKD (month)	57.85±44.96	64.14±55.33	0.66
Duration of HT	8.61±17.02	9.57±7.48	0.84

Table 2: Cardiac characteristics of study subjects as per Dialysis status

Cardiac characteristics	CKD without Dialysis Mean (N=46)	CKD with Dialysis Mean (N=14)	P value
LV Mass	98.91±49.61	131.71±59.06	0.042
ABPM	85.28±10.36	89.57±11.84	0.19
Ejection Fraction	60.89±5.9	54.79±9.99	0.006
LVMHT	0.80±0.453	0.86±0.66	0.69
Fractional shortening	32.15±4.04	28.36±5.81	0.007

Table 2 shows cardiac characteristics of study subjects. In group of patients without dialysis LVmass was 98.91±49.61, whereas it was 131.71±59.06 in other group. Statistically significant difference was there in these two groups with p value= 0.042, ABPM was 85.28±10.36 and 89.57±11.84 in two groups. Ejection fraction was 60.89±5.9 in group of patients without dialysis whereas 54.79±9.99 in dialysis group of patients and also statistically significant with p value= 0.006. LVMHT was 0.80±0.453 in grp without dialysis whereas 0.86±0.66 in patients of grp of dialysis. There was statistical difference between fractional shortening between two groups 32.15±4.04, and 28.36±5.81 with p value= 0.007.

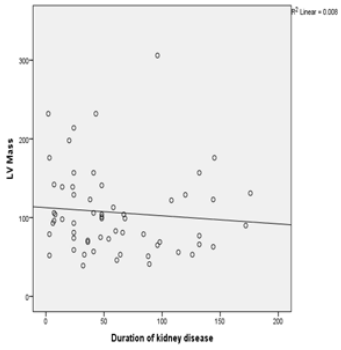

Fig 1: Correlation between LVM vs Stated Duration of Renal Failure

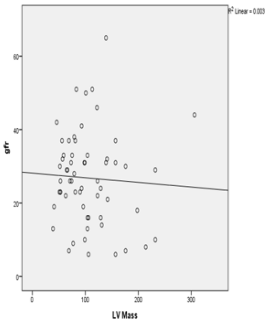

Fig 2: Correlation between GFR and LV mass

Fig 1 shows Correlation between LVM vs Stated Duration of Renal Failure. There was very mild correlation between LV mass and duration of kidney diseases with R square 0.008.

Discussion
This study was conducted in the Pediatric department of Nalanda medical college and hospital Patna, which is a tertiary referral hospital situated in Bihar. The study was conducted in the time period from October 2019 to July 2020.

This present study looked at the cardiovascular risk factors amongst children with Chronic Kidney Disease who had an estimated GFR of <60 ml/min/1.73m2. Children with Chronic Kidney Disease have improved prognosis due to renal replacement therapy in the form of dialysis and renal transplantation. As their life spans increases, they are more prone to developing cardiovascular risks. Many studies have done which shows that cardiovascular risks are the leading causes of

death amongst children with CKD6. Thus early identification of cardiovascular risks and their appropriate management can prolong life and prevent mortality.

In the present study total 60 children with CKD were recruited. Out of these 48/60 (80.0%) were males, while 12/60 (20.0%) were females. The Male: Female ratio was found to be 4:1. Other study done on this topic such as by Hari et al7 from AIIMS India who reported 225/305 (73.7%) males in their study. This unequal gender distribution can be explained by the gender selective health care seeking behavior of parents. In India, generally there is a bias towards the male child, thus once detected to have a chronic disease like CKD; parents are more likely to seek health care for male children than for female children.

We had divided the patient into two parts one group who require dialysis whereas other group those did not require dialysis.

The age distribution of the children was from 3 to 17 years. In dialysis group mean age 11.61±3.32 yrs, whereas for non-dialysis group it was 11.36±3.43 yrs with range 5-16 yrs. overall mean age was 11.55±3.32 yrs with range 3-17 yrs. Other study such as study by Mudi A et al8 shows The overall median age was 11 years (range 8 - 14), and the male/female ratio was 2.1:1.

In present study all children with CKD were divided into two groups.
1. Those with CKD not requiring Dialysis (46/60 76.66%)
2. Those with CKD with Dialysis (14/60 23.34%)

In the present study the complications of children on CKD were compared between the two groups.

In our study Correlation between LVM vs Stated Duration of Renal Failure. There was very mild correlation between LV mass and duration of kidney diseases with R square 0.008. Correlation between LVM vs GFR. There was very mild correlation between LV mass and GFR with R square 0.003. Other studies done on similar topic such as Malikenas et al.9 have noticed an association between the CKD causes and LVH. They found that patients with acquired renal diseases had significantly higher LVMI than those with congenital renal abnormalities. This can be explained by the fact that these cases are usually presented late to our centre. Left ventricular hypertrophy (LVH) is regarded by many as an adaptive response to long-lasting volume or pressure overload. Initially, it is beneficial because it allows for increasing work capacity, maintains systolic function and decreases energy consumption & wall stress. However, with time, LVH becomes detrimental as it alters LV diastolic function, decreases coronary perfusion reserve and predisposes to arrhythmias & sudden death. Study by Tian J et al10 shows The present review concludes that altered cardiac function and remodeling are a concurrent part of the CKD process, start early in the disease development, and persist after renal transplantation. The findings suggest that children with CKD or CKD-T are at high risk for future CVD where younger patients with elevated BMI and slightly increased blood pressures

Conclusion

Children with CKD are at very high risk for cardiovascular morbidity (Hypertension and Left Ventricular Dysfunction). ABPM is a very useful tool to detect hypertension. LV Dysfunction is also common in children with CKD. L V Mass had almost no correlation with duration of kidney disease and GFR.

Conflict of Interest: No
Funding: No
Ethical approval : No

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