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Original Research Article

A Hospital Based Cross-Sectional Assessment of the Correlation of Anemia with Left Ventricular Hypertrophy in CKD Patients

Pushp Raj Kumar

Senior Resident, Department of General Medicine, AIIMS Patna, Bihar, India

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Corresponding author: Dr. Pushp Raj Kumar
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Abstract

Aim: The aim and objective of this study were to calculate left ventricular mass index in patients of chronic kidney disease stage III-V having hemoglobin level <11 g/dl and to demonstrate development of left ventricular hypertrophy early in chronic kidney disease patients with mild to moderate anemia.

Methods: This study was done Department of General medicine, AIIMS Patna, Bihar, India over one year on 200 patients of CKD (stage III to V), aged 15-80 years, who had elevated serum creatinine and reduced glomerular filtration rate, haemoglobin <11 gm/dl with ultrasonographic evidence of renal parenchymal disease grade >2. The patients were assessed based on clinical history and a number of laboratory parameters including blood urea, serum creatinine, calcium, inorganic phosphorus, serum electrolytes, i PTH level, Hb, Hct, glomerular filtration rate and left ventricular mass index.

Results: Majority of study population i.e. 65% was male, 35% was female. Most of the male patient i.e. 73.01% of the study population are having abnormal left ventricular mass index (135 g/m2 is taken as normal value for male patients). Majority of female patients i.e., 92% have abnormal left ventricular mass index. There was strong correlation between Anemia and left ventricular mass index in both male and female patients. 36 out of 46 patients who were diabetic are having abnormal LVMI, whereas 130 out of 154 who were non diabetic were having abnormal LVMI, so there is no correlation between DM and LVMI.

Conclusion: Anemia was widely prevalent in our CKD patients. Severity of anemia is correlated to left ventricular hypertrophy in these patients. Hence correction of anemia early in these groups of patients can halt or prevent cardiovascular morbidity and mortality.

Keywords: CKD, RPD, Glomerular filtration rate, Left ventricular mass index, Intact parathormone

Introduction

Left Ventricular Hypertrophy (LVH) is a frequent occurrence in patients with CKD and is an important adverse prognostic indicator. [1,2] Anemia is also frequent finding in CKD patients and is an important determinant of cardiac hypertrophy which can be associated with progressive LV dilation, new-onset cardiac failure, and death. [3] In chronic kidney disease patients, various uremia related risk factors for cardiovascular disease includes anemia, hyperparathyroidism, abnormalities of mineral metabolism, acidosis, of note, association of anemia have been consistently described in all population of kidney disease. In our study reference value is taken as 11 g/dl for both male and female. Anemia of renal failure

mainly caused by lack of erythropoietin production, partially due to iron deficiency which can be due to increased demand, gastrointestinal bleed, ongoing blood loss and due to frequent sampling and venipuncture. Anemia has been cited as an independent risk factor for the development of left ventricular hypertrophy (left ventricular hypertrophy) in chronic kidney disease patients. [4]

Concentric LVH has been found in patients with CKD and documented by echocardiography in 42% patients when dialysis starts [5] and in as many as 75% patients who are taking dialysis from last 10 years. [6] Arterial Hypertension is associated with LVH in patients with CKD and it has been found that increase in arterial stiffness leads to LVH before start of Hemodialysis. Other risk factors for the development of LVH in patients with CKD principally include Body Mass Index, Anemia, Hypertension and Ischemic heart disease. [7] LVH is a powerful predictor for mortality of ESRD patients and is strongly related to the 60% higher risk of sudden mortality. Severe LVH may eventually lead to Left ventricular dilatation which itself is strong predictor of poor outcome. The level of hemoglobin is found to be strong enough that it can predict the severity of LVH in patients undergoing hemodialysis for prolonged time, with each 1gm/dl reduction in hemoglobin can cause a 6% upsurge in the risk of LVH. [7] The risk of the LVH was 32% more for every 0.5 gm/dl reduction in hemoglobin level. [8] Thus, anemia is proved to be the risk factor of developing LVH and adverse outcomes in cases of renal dysfunction. It may also cause compensatory rise in the cardiac output, this rise in cardiac functioning may increase the growth and dilation of left ventricular, along with the other risk factors and metabolic irregularities related to the CKD. The partial regression of LVH in dialysis depended patient is possible with correction of anemia. [9]

The aim and objective of this study were to calculate left ventricular mass index in patients of chronic kidney disease stage III-V having hemoglobin level <11 g/dl and to demonstrate development of left ventricular hypertrophy early in chronic kidney disease patients with mild to moderate anemia.

Material & Methods

A cross-sectional study conducted in Department of General medicine, AIIMS Patna, Bihar, India over one year. 200 patients of either sex, age group of 15 to 80 years, from all socioeconomic status, admitted over a period of one year. Diagnosed as CKD patients with varying degree of renal failure (grade III to V) with ultrasonographic evidence of renal parenchymal disease grade II or more and haemoglobin level <11 g% diabetic or non-diabetic, hypertensive or non-hypertensive and whether the patients were on dialysis or erythropoietin replacement or not. Out of 200 patients, 120 patients were hypertensive (controlled on medications). They were diagnosed as hypertensive between 2 to 4 years before commencing our study. Patients with post renal transplant status and those with uncontrolled hypertension who are known case of hypertrophic obstructive cardiomyopathy, rheumatic heart disease etc. were excluded from the study.

Investigations

Investigations included Hb, HCT, blood urea, serum creatinine, calcium, inorganic phosphorus, bicarbonate, serum electrolytes, i PTH level, urine chest X-ray, renal ultrasound for kidney size and echotexture, left ventricular mass index calculation by Modified Devereoux formula using electrocardiogram. Initial assessment included detailed clinical history with regard to duration of renal failure (in years), diabetes/hypertension if any, and whether the patients undergoing

dialysis or erythropoietin replacement was used. Height, weight and blood pressure was noted in all patients. Laboratory tests including serum creatinine, Hb, Hct, calcium, creatinine clearance (calculated according to creatinine clearance by Cockroft-Gault equation. Calculation of left ventricular mass: As, both body size and body habitus are clearly associated with left ventricle dimension and mass, indexing for body size is required. Left ventricular mass index was calculated by using the ratio of left ventricle mass to body surface area left ventricle mass was derived by Modified Deveroux formula using 2D Echocardiography.

Left ventricle Mass = 0.8 x1.04 (IVSd + LVIDd + LVPWd)3 − (LVIDd)3 + 0.6 gms

Where IVSd=interventricular thickness in diastole in mm; LVID; d=left ventricular diameter in diastole in mm; LVPWd=left ventricular posterior wall thickness in diastole in mm, left ventricular hypertrophy is categorically defined as left ventricular mass index >135 for males and >110 for females.

Statistical Analysis

In our study, all patients had haemoglobin <11 g/dl. Looking into Indian perspective where poor diet, chronic infections and malnourishment is common, and for convenience of our study, we took Hb <8 g/dl as reference value and were taken as anemic in both male and female. Chi square test was applied to find relationship between the variables and odds ratio was calculated to determine the risk of abnormal values as compared to the normal values, $p<0.05$ was taken to be significant.

Results

Table 1: Age and Gender wise distribution of study population and distribution of normal and abnormal left ventricular mass index among male patients

Age groups (years)		**N**	**%**
15-30		48	24
31-45		42	21
46-60		70	35
61-75		34	17
>75		6	3
Gender			
Male		130	65
Female		70	35
Gender	**Left ventricular massindex (gm/m^2)**	**N**	**%**
	<135 (Normal)	35	26.93
Male	>135 (Abnormal)	95	73.07
	<110 (Normal)	7	10
Female	>110 (Abnormal)	63	90

Majority of study population i.e. 65% was male, 35% was female. Most of the male patient i.e. 73.01% of the study population are having abnormal left ventricular mass index (135 g/m2 is taken as normal value for male patients). Majority of female patients i.e., 92% have abnormal left ventricular mass index.

Table 2: Hb with left ventricular mass index in males and females

Variables	**Hb<8**	**Hb>8**	**Odds ratio**	**95% CI**	**P value**
Left ventricular mass index (male)					
<135	10	25			
>135	60	35	0.040	0.0047-0.3350	0.002

Left ventricular mass index (female)					
<110	12	16	0.067	0.0081-0.2940	0.03
>110	20	22			

Relation of anemia (reference value for this study population being taken as 8 g/dl with left ventricular mass index in both male and female patients of study population, p value is significant for both male and female population. There was strong correlation between Anemia and left ventricular mass index in both male and female patients.

Table 3: Diabetes mellitus verses LVMI

Variables	Present	Absent
Male		
LVMI		
<135	10	20
>135	30	70
Female		
LVMI		
<110	0	4
>110	6	60

36 out of 46 patients who were diabetic are having abnormal LVMI, whereas 130 out of 154 who were non diabetic were having abnormal LVMI, so there is no correlation between DM and LVMI.

Discussion

The incidence and prevalence of Chronic Kidney Disease (CKD) are on the rise globally and it has grown into an important public health problem. [10] The ultimate outcome of CKD in majority of patients is End Stage Renal Disease (ESRD) requiring renal replacement therapy (RRT), which necessitates ever-growing dialysis and transplants and imposes huge economic burden on the healthcare systems. [11] The social and financial inferences of CKD are considerable not only because of morbidity and mortality, related to its conversion to ESRD, but also with accelerated cardiovascular disease (CVD). [12,13] Cardiovascular Disease is the leading cause of mortality in patients with CKD accounting for 10 to 100 times higher in Hemodialysis patients. [14] It is important to note that the majority of patients with CKD die of CVD before reaching ESRD. [15] LVH is the most prominent structural cardiovascular alteration in CKD patients and is found in approximately 30 to 45 percent of patients with CKD and more severe LVH is noted with decreasing glomerular filtration rate (GFR). [16,17]

The percentage of female in the study group was 35 and male was 65. Left ventricular hypertrophy was measured using echocardiography of heart by using Devereux formula. [18] Around 79% of the patients in this study had increased left ventricular mass on echocardiography. The limit for left ventricular hypertrophy for females was >110 g/m2. 31.05% of the female cases had increased left ventricular mass. 47.5% of the male cases had increased left ventricular mass according to Devereux formula. In our study, there is association between different age groups and increased left ventricular mass. The difference between the age groups for normal and abnormal left ventricular mass index was statistically significant for male. In a study by Hamett et al the age was associated with the development of left ventricular hypertrophy after the initiation of dialysis. [19] They found that cases that developed left ventricular hypertrophy were significantly older than controls at

baseline; the reason cited was that the aging ventricle is more sensitive to the hypertrophic stimulus of an elevated systolic blood pressure. There was significant relation between anemia with left ventricular mass index in both male and female patients. The reference value taken was 8 g/dl for Hb. [20,21]

Among male patients 80 out of 102 with Hb<8 g/dl had abnormal left ventricular mass index and 57 out of 98 with Hb>8 g/dl had abnormal left ventricular mass index, odd's ratio being 0.040 (p value=0.002). Among female patients 20 out of 32 with Hb<8 g/dl had abnormal left ventricular mass index and 22 out of 38 with Hb>8 g/dl had abnormal left ventricular mass index, Odd's ratio being 0.067 (p value=0.03). [22] In our study, hypertensive patients who were under control with medications were taken as the study population; to eliminate the bias of uncontrolled hypertension inducing left ventricular hypertrophy. Elevated systolic blood pressure is a well-known independent factor for left ventricular mass index. [23]

Severity of anaemia could very well predict the left ventricular dimension and thickness in both male as well as female patients, and therefore risk of CVDs.10,11 This study points towards importance of timely administration of anaemia correcting measures in form of EPO or blood transfusion which could herald or reverse left ventricle remodelling. In the study by Jesuorobo et al the hemoglobin levels of the study population had a negative correlation with left ventricular mass index and it was statistically significant. [24,25]

Conclusion

Severity of anemia significantly influences the left ventricular wall thickness in chronic kidney disease patients. These predictors of left ventricle mass could be easily measured and are highly sensitive and specific for the same. On arriving at a suspicion of possible left ventricle hypertrophy, rigorous measures should be taken to correct anemia by EPO with or without iron administration and blood transfusion, to improve the patient's survival from the deadly cardiovascular diseases.

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