Research Article

A Cross Sectional Study of Pulmonary Hypertension in Chronic Kidney Disease Patients by Echocardiography at MGM Medical College, Aurangabad, Maharashtra

Manjiri Naik*, Rajiv Naik, Vinayak Bangi, Sohel K Khan, Sagar Jaiswal and Sachin Patel

Dept. of Medicine, MGM Medical College and Hospital, Aurangabad, India

Corresponding author:
Manjiri Naik,
Dept. of Medicine,
MGM medical college and hospital
Aurangabad, India
E-mail: drmanjirinaik@gmail.com

Received: 20-May-2022,
Manuscript No. AMHSR-22-63991;
Editor assigned: 22-May-2022,
Pre QC No. AMHSR-22-63991 (PQ);
Reviewed: 05-Jun-2022,
QC No. AMHSR-22-63991;
Revised: 13-Jun-2022,
Manuscript No: AMHSR-22-63991 (R);
Published: 20-Jun-2022,
DOI: 10.54608.annalsmedical.2022.s1

Abstract

Introduction: CKD refers to a variety of pathophysiological conditions that are linked to poor kidney function and a progressive decline of Glomerular Filtration Rate (GFR). Most oftenly in End-Stage Renal Disease (ESRD), PH is an underappreciated cardiovascular complication of CKD. The prevalence of PH in ESRD patients is upto 27 to 58 percent. Objective: To study and evaluate severity of pulmonary hypertension in different stages of CKD patients using echocardiography and to evaluate progression or decline in pulmonary hypertension with evolving CKD stages those who are on maintenance dialysis. **Material and Methods:** A cross sectional study was conducted in department of general medicine and nephrology, MGM Medical college Aurangabad on 126 patients >18 years, diagnosed for CKD on maintenance dialysis for at least 3 months attending OPD/ IPD of Tertiary care Hospital were included. Presence of pulmonary hypertension in all cases of CKD was assessed by echocardiography. **Results:** Majority of the patients (30.2%) were in the age group of 61-70 years with male preponderance of 70.6% cases. Incidence of Pulmonary Hypertension (PH) was 15.1% of which 42.1% patients had mild Pulmonary Hypertension (PH). The prevalence of heart failure with preserved EF (HFpEF,) was 85.1% while heart failure with reduced EF (HFrEF) was present in 27 (25.2%) patients. Right atrial dilatation and right ventricular dilatation was present in 41 (38.3%) and 38 (35.5%) patients respectively while left ventricular hypertrophy was present in 15 (14.1%) patients. **Conclusion:** We concluded that fair number of patients with CKD develops PH and incidence of PH has a positive correlation with the stage and duration of CKD withseverity of PH being directly proportional to the duration of CKD.

Keywords: CKD, Pulmonary hypertension, Echocardiography, ESRD.

Introduction

Chronic Kidney Disease (CKD) is an inevitable terminal event of chronic renal parenchymal disease due to various causes and is known more for its morbidity and mortality. The effects of the altered functioning of the renal system are reflected in every organ system of the body. The severity of the consequences of CKD has however undergone profound changes since the advent of dialysis. CKD refers to a variety of pathophysiological conditions that are linked to poor kidney function and a progressive decline of Glomerular Filtration Rate (GFR). Unless treated, it may lead to grave consequences; CKD leads to impairment of excretory, metabolic and endocrine functions o f the kidney that leads to the development of clinical syndrome of uremia which includes features like anemia, metabolic bone disease, neuropathy, myopathy, endocrine abnormalities, hypertension, dyslipidemia, acidosis susceptibility to infections and various cardiovascular diseases. In terms of the number of people affected and the cost of treatment, CKD is a global public health issue. The community based volunteer health screening programme India in 2006 known as "Screening and Early Evaluation of Kidney disease" (SEEK), revealed a relatively high incidence of CKD of 17.2%, with 6% having CKD stage 3 or worse. CKD is the world's 12th largest cause of death and the 17th major cause of disability. Patients with CKD are far more likely to die from cardiovascular illness than from End-Stage Renal Disease, therefore this figure is grossly understated. [1] As per available information, is at least 20%, or about the same as the risk observed in those who have had a cardiovascular disease. [2] Pulmonary Hypertension (PH) is "A mean pulmonary artery pressure more than or equal to 25 mmHg at rest or 30 mmHg during activity". [3-4] In CKD, the pathophysiology of PH is still unknown. It's thought to be caused by the combination of several different characteristics of altered cardiovascular physiology. The most common cause of PH in CKD is myocardial dysfunction, which results in higher left ventricular filling pressure and pulmonary venous hypertension. [5-7] There is a limited availability of epidemiologic and long-term outcome data on the effects of PH, particularly in patients with early-stage CKD. [7-8] Despite the growing recognition, PH as a leading cause of death in CKD patients, little is known about the aetiology of PH in thesepatients. [6] There is a limited availability of epidemiologic and longterm outcome data earlyon the effects of PH, particularly

How to Cite this Article: Manjiri N, et al. A Cross Sectional Study of Pulmonary Hypertension in Chronic Kidney Disease Patients by Echocardiography at MGM Medical College, Aurangabad, Maharashtra. Ann Med Health Sci Res. 2022;12:S1:121-124.

in patients with stage CKD. This method is limited because echocardiography cannot accurately detect left ventricular filling pressure, which is required to differeniate capillary from postcapillary PH. Navaneethan et al. observed a higher mortality in a cohort of PH patients with CKD in the biggest study till date using invasive Right Heart Catheterization (RHC) data, but did not explore CKD patients for the existence of PH. The prevalence and severity of PH was found to be directly proportional CKD, as observed by Mehta KS, et al. When comparing patients on HemoDialysis (HD) to those on conservative therapy, the frequency, incidence and severity of PH was significantly higher in HD patients. As the length of HD grew, the prevalence and severity of PH worsenedas well.

Endothelial dysfunction leading to pulmonary vasoconstriction, reduced compliance of the pulmonary vasculature, vascular calcification and stiffening, elevated thromboxane B2, and pro-brain natriuretic peptide are all potential causes for the development of PH in people with CKD [9] along with increased flow through arterio-venous shunts, exposure to dialysis membranes, and elevated left ventricular filling pressure. [7] The majority of studies done to find the relationship between CKD and PH used Doppler echocardiography to detect PH. [10-11] Hence the present study was done at our tertiary care centre to assess pulmonary hypertension in Chronic Kidney Disease patients by echocardiography method and evaluate progression or decline in pulmonary hypertension with evolving CKD stages those who are on maintenance dialysis.

Material and Methods

This cross sectional study was done at our tertiary care centre on 126 diagnosed patients attending OPD/IPD of CKD with aged more than 18 years in the department of general medicine and nephrology, MGM Medical college & Hospital Aurangabad. of CKD with COPD. Patients of CKD with structural Lung disease,structural heart disease and hepato-renal and cardio-renal syndrome were excluded from the study. Sample size was calculated using 30% prevalence of pulmonary hypertension in CKD patients in study conducted by Suresh H, et al. A valid informed consent was obtained following approval from the Institutional Ethics Committee. Following patient enlistment in the study, a thorough history and physical examination were performed in accordance with the protocol. Patients' or patients' attendants' written informed consent was obtained. The presence of pulmonary hypertension was determined, all cases of CKD were subjected to echocardiography on patients who had dialysis or who had stopped taking diuretics for at least 72 hours . 2D ECHO – [GE model-vividS5] was done in all patients and (PASP) pulmonary artery systolic pressure was measured by T.R. JET (tricuspid regurgitation jet) by applying colour Doppler done 1hour after dialysis and after 3 months of follow up. The procedure was done by same person to avoid observer variation. The study included patients who had at least two dialysis sessions per week for at least three months. The tricuspid regurgitation jet velocity [3] was used to calculate the Pulmonary Artery Systolic Pressure (PASP) using transthoracic Doppler echocardiography and Bernouillie's equation. It was performed on all patients. Those on dialysis underwent echocardiography 4 hours post dialysis. PH was defined when mean pulmonary artery pressure exceeded 30 mmHg. PH was further categorized as mild (>30 to<35 mmHg), moderate (35 to 50 mmHg), and severe (>50 mmHg). [12]

Statistical analysis

MS Excel and SPSS software version 20 were used to analyse and compile the data.Quantitative data was presented with the help of Mean and Standard deviation. Comparison among the study groups was done with the help of unpaired t test as per results of normality test. Qualitative data was presented with the help of frequency and percentage table. Association among the study groups was assessed with the help of Fisher test, student 't' test and Chi-Square test. 'p' value less than 0.05 is taken as significant.

Results

Majority of the patients 30.2% were in the age group of 61-70 years followed by 27.8% in the age group of 51-60 years, 22.2% patients in the age group of 41-50 years, 15.9% in the age group of >70 years and 3.9% in the age group of 31-40 years [**Table 1**]. The mean age of the patients was 58.80 ± 11.07 years. There was male preponderance (70.6%) while female patients constituted 29.4% of the study group [**Table 2**].

The duration of Chronic Kidney Disease (CKD) was 3-6 months in 05 (3.9%) patients while it was 6 months – 1 year and 1-3 years in 15 (11.9%) and 37 (29.4%) patients respectively. The duration of CKD was 3-5 years and >5 years in 38 (30.2%) and 31 (24.6%) patients respectively. There were 39 (30.9%) Stage 3, 36 (28.6%) Stage 4 and 50 (40.5%) Stage 5 patients in our study [**Table 3**].

Table 1:Distribution of patients according to Age and gender

Age (years)	Number	Percentage
31-40	05	3.9%
41-50	28	22.2%
51-60	35	27.8%
61-70	38	30.2%
>70	20	15.9%
Total	**126**	**100**
Gender	**Number**	**Percentage**
Male	89	70.6%
Female	37	29.4%
Total	**126**	**100%**

Table 2. Distribution of patients according to duration of Chronic Kidney Disease (CKD) and stage of CKD

Duration of CKD	Number	Percentage
3-6 months	05	3.9%
6 months – 1 year	15	11.9%
1-3 years	37	29.4%
3-5 years	p-38	30.2%
>5 years	31	24.6%
Total	126	100%
Stage of CKD	**Number**	**Percentage**
Stage 3	39	30.9%
Stage 4	36	28.6%
Stage 5	51	40.5%
Total	**126**	**100**

Table 3. Distribution of patients according to incidence of Pulmonary Hypertension (PH) and severity of Pulmonary Hypertension

Incidence of PH	Number	Percentage
Yes	19	15.1%
No	107	84.9%
Total	126	100%
Severity of PH	**Number**	**Percentage**
Mild (Grade 1)	08	42.1%
Moderate (Grade 2)	09	47.4%
Severe (Grade 3)	02	10.5%
Total	**19**	**100%**

Table 4. Distribution of patientsaccording to Echocardiographic findings

Echocardiographic findings	Number	Percentage
Heart failure with preserved EF (HFpEF)	91	85.1%
Right atrial dilatation	41	38.3%
Right ventricular dilatation	38	35.5%
Heart failure with reduced EF (HFrEF)	27	25.2%
Left ventricular hypertrophy	15	14.1%

Table 5. Association of stage of CKD and Pulmonary Hypertension (PH) in patients

	Incidence of PH			
Stage of CKD	Yes N(%)	No N(%)	Total N(%)	X^2 p Value
Stage 3	0(00)	39(37.3%)	39(30.9%)	
Stage 4	6(31.6%)	30(28.1%)	36(28.6%)	
Stage 5	13(68.4%)	37(34.6%)	50(40.5%)	**0.009***
Total	**19(100%)**	**107(100%)**	**126(100%)**	

Pulmonary Hypertension (PH) was seen in 19(15.1%).Out of these 19 cases, 8 (42.1%) patients had mild Pulmonary Hypertension (PH) while 9 (47.4%) and 2 (10.5%) patients had moderate and severe PH respectively [**Table 4**].

The prevalence of heart failure with preserved EF (HFpEF,) was 85.1% while heart failure with reduced EF (HFrEF) was present in 27 (25.2%) patients. Right atrial dilatation and right ventricular dilatation was present in 41 (38.3%) and 38 (35.5%) patients respectively while left ventricular hypertrophy was present in 15 (14.1%) patients [**Table 5**].

There were 06(31.6%) cases of stage 4 CKD and 13(68.4%) cases of stage 5 CKD with pulmonary hypertension. There was significant increase in Incidence of PH with increase in CKD Stage as per Chi-Square test (p=0.009).

Discussion

A hospital based prospective, observational study was conducted with 126 patients to analyse study the incidence of pulmonary hypertension in different stages of CKD patients. PH, or pulmonary hypertension, is a progressive disorder that complicates heart, lung, or systemic diseases, with greater morbidity and mortality regardless of the etiology. [13] It was recently discovered that PH is a powerful independent predictor of morbidity and mortality in HD patients. [14] There was male preponderance (70.6%) while female patients constituted 29.4% of the study group. This is similar to the studies of Jameel FA, et al. Zhang Q, et al. [16] and Suresh H, et al. [17] Jameel FA, et al. [15] comparative cross-sectional study evaluating PH in ESRD patients found mean age of 46.23 (±20.45 SD) having higher female participation of 108 (52.9%), whereas 96 (47.1%) were males. Zhang Q, et al. retrospective study investigating prevalence of PH in different stages of CKD found 400 males and 305 females with a mean age of 48.97 ± 16.74 years. Suresh H, et al. [17] study assessing prevalence, severity and risk factors of PH in CKD found mean age of the study population was 44.53 ± 14.63 years.

The prevalence of Pulmonary Hypertension (PH) was 15.1%. This is comparable to the studies of Suresh H, et al. [17], Mehta KS, et al. [18], Tarras F, et al. [19] and Patel P, et al. [20]. Tarras F, et al. discovered a PH prevalence as low as 26.74 percent. Patel P, et al. [20] examined 100 patients (69 men and 31 women) who were on conservative care, HD, or Continuous Ambulatory Peritoneal Dialysis (CAPD). The prevalence of PH in this cohort was 41%, with the HD group having the highest prevalence (33 percent). CKD was associated with a 1.4-fold greater risk of acquiring PH, and mortality improved exponentially as PH status increased. Further to that, the presence of PH was associated with a significant risk of mortality in patients with stage 3 or worse CKD. [21] It was observed in our study that the prevalence of heart failure with preserved EF (HFpEF,) was 85.1% while heart failure with reduced EF (HFrEF) was present in 27 (25.2%) patients. Right atrial dilatation and right ventricular dilatation was present in 41 (38.3%) and 38 (35.5%) patients respectively while left ventricular hypertrophy was present in 15 (14.1%) patients. This is in concordance to the studies of Jameel FA, et al. [15] and Suresh H, et al. [17]

In advanced stages of CKD, the specific processes of PH are yet unknown. Volume overload, AVF, sleep disordered breathing, dialysis membrane exposure, endothelial dysfunction, vascular calcification and stiffness, and severe anemia are all risk factors for PH. The longer patients are exposed to altered cardiovascular physiology, including the synergistic effects of increased PVR, increased cardiac output, and raised PCWP, the more likely they are to develop severe pulmonary hypertension. [7]

Suresh H, et al. [17] study reported among patients with CKD stage 3 and 4, majority had mild PH, but in stage 5, it was predominantly moderate PH (23 of 97 [23.7%]) patients. This indicates that PH increased in severity with progression of CKD, although not statistically significant, since there were few patients in stage 3 and stage 4.

Suresh H, et al. [17] found that Haemoglobin (Hb) and EF were considerably lower in persons with PH compared to those without PH. This suggests that anaemia and LV failure are linked to an increased risk of PH.

Conclusion

Our study concludes that a fair number of patients with CKD develop PH. PH can be regarded as a reflection of cardiorenal syndrome and incidence of PH rises substantially with the

deterioration of renal function. Incidence of PH has a positive correlation with the stage and duration of CKD with severity of PH being directly proportional to the duration of CKD. Anaemia, volume overload, heart failure, calcium, phosphorus are found to be significantly higher in CKD patients with PH, thereby contributing to pathogensis of PH in CKD patients. Doppler echocardiography as a tool for evaluation of PASP and follow up may be used in all the patients with CKD, especially in ESRD.

References

1. Agarwal R. Prevalence, determinants and prognosis of pulmonary hypertension among hemodialysis patients. Nephrol Dial Transplant. 2012;27:3908-3914.
2. Badesch DB, Champion HC, Sanchez MA. Diagnosis and assessment of pulmonary arterial hypertension. J Am Coll Cardiol. 2009;54(1 suppl):S55-S66.
3. Bolignano D, Rastelli S, Agarwal R. Pulmonary hypertension in CKD. Am J Kidney Dis. 2013;61:612-622.
4. Center for Disease Control and Prevention (CDC): Prevalence of chronic kidney disease and associated risk factors-United States, 1999-2004. MMWR Morb Mortal Wkly Rep. 2004;56:161-165.
5. Galie N, Humbert M, Vachiery JL. ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension: The joint task force for the diagnosis and treatment of pulmonary hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS): Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC), International Society for Heart and Lung Transplantation (ISHLT). European Heart Journal. 2016;37 67-119.
6. Hamer RA, El Nahas AM. The burden of chronic kidney disease. BMJ. 2006;332:563-564.
7. Jameel FA, Junejo AM, Ejaz A. Association of pulmonary hypertension with end-stage renal disease among the obese population. Cureus. 2020;12(8):e9722.
8. Kasiske B, Cosio FG, Beto J, Bolton K, Chavers BM, Grimm R Jr, et al. Clinical Practice Guidelines for managing dyslipidemias in kidney transplant patients: a report from the managing dyslipidemia in chronic kidney disease work group of the national kidney foundation kidney disease outcomes quality initiative. Am J Transplant, 2004;4Suppl7:13-53.
9. Kawar B, Ellam T, Jackson C. Pulmonary hypertension in renal disease: epidemiology, potential mechanisms and implications. Am J Nephrol. 2013;37:281-290.
10. KDIGO 2012 Clinical practice guideline for the evaluation and management of chronic kidney disease. 2013;3(1).
11. Martin KB, Klinger JR, Rounds SIS. Pulmonary arterial hypertension: New insights and new hope. Respirology. 2006;11:6-17.
12. Mehta KS, Shirkande AK, Bhurke SP. Pulmonary hypertension in various stages of chronic kidney disease in indian patients. Indian J Nephrol. 2019;29:95-101.
13. Patel P, Abraham G, Pratap P. Clinical and biochemical parameters in chronic kidney disease with pulmonary hypertension. Indian J of Nephrol. 2007;17:4-6.
14. Simonneau G, Robbins IM, Beghetti M. Updated clinical classification of pulmonary hypertension. J Am Coll Cardiol. 2009;54(1 suppl):S43-S54.
15. Sise ME, Courtwright AM, Channick RN. Pulmonary hypertension in patients with chronic and end-stage kidney disease. Kidney Int. 2013;84:682-692.
16. Suresh H, Arun BS, Moger V. A prospective study of pulmonary hypertension in patients with chronic kidney disease: A new and pernicious complication. Indian J Nephrol 2018;28:127-134.
17. Tarrass F, Benjelloun M, Hachim K. Pulmonary hypertension in patients with end-stage renal disease. Indian J Nephrol. 2005;15:223-226.
18. Veerappan I, Abraham G. Chronic Kidney Disease: Current status, challenges and management in India. In: Murugnathan A, Geetha T, editor. Associations of Physicians of India: Medicine Update. Mumbai: Jaypee brothers; 2013;23:593-597.
19. Yigla M, Fruchter O, Aharonson D al. Pulmonary hypertension is an independent predictor of mortality in hemodialysis patients. Kidney Int. 2009;75:969-975.
20. Yigla M, Nakhoul F, Sabag A, Tov N. Pulmonary hypertension in patients with end-stage renal disease. Chest, 2003;123:1577-1582.
21. Zhang Q, Wang L, Zeng H. Epidemiology and risk factors in CKD patients with pulmonary hypertension: A retrospective study. BMC Nephrol. 2018;19:70.