MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.12.336.340

Multifactorial Evaluation of Pulmonary Hypertension in Patients with Chronic Kidney Disease: An Institutional Study

[1]M. Dhanamurthy Koppu, [2]Niaz Farhat, [3]Fayaz Shaike and [4]Karnala Sahithi

[1-4]Department of Respiratory Medicine, Mamata Medical College, Khammam, Telangana, India

ABSTRACT

This institutional observational study investigates the multifaceted nature of Chronic Kidney Disease (CKD) and its associations with risk factors and cardiovascular parameters, focusing on Pulmonary Hypertension (PH) in a cohort of 70 CKD patients. The study population comprises individuals aged 18 and above, with varying CKD stages, who were screened for PH over the past year. Inclusion criteria encompass CKD patients with confirmed PH diagnosis based on echocardiography or right heart catheterization. Data collected from medical records include demographic information, CKD stage, comorbidities, echocardiographic parameters, treatment regimens and clinical outcomes. PH is defined using standard echocardiographic criteria, and statistical analysis is conducted with a significance threshold of $p<0.05$. The study included 70 CKD patients with a mean age of 59.83 years. Hypertension (48 patients) and diabetes mellitus (33 patients) were common comorbidities. Hypertension exhibited a strong association with PH (mean association 0.63). Cardiovascular parameters indicated potential left ventricular dysfunction and varied right ventricular performance. Pulmonary and cardiac parameters reflected PH characteristics and echocardiographic assessment in CKD patients with PH revealed elevated Pulmonary Artery Systolic Pressure and right ventricular hypertrophy. This study highlights the complex interplay between CKD, PH and associated risk factors. It emphasizes the importance of considering comorbidities in CKD management. The findings underscore the need for early detection and holistic care approaches, potentially altering the course of both CKD and PH. Chronic Kidney Disease, Pulmonary Hypertension, Cardiovascular Parameters, Echocardiography.

OPEN ACCESS

Key Words

Chronic kidney disease, pulmonary hypertension, cardiovascular parameters, echocardiography

Corresponding Author

Karnala Sahithi,
Department of Respiratory Medicine, Mamata Medical College, Khammam, Telangana, India
sonykarnala@gmail.com

Author Designation

[1]Associate Professor
[2-4]Assistant Professor

Received: 28 November 2023
Accepted: 14 December 2023
Published: 15 December 2023

Citation: M. Dhanamurthy Koppu, Niaz Farhat, Fayaz Shaike and Karnala Sahithi, 2023. Multifactorial Evaluation of Pulmonary Hypertension in Patients with Chronic Kidney Disease: An Institutional Study. Res. J. Med. Sci., 17: 336-340, doi: 10.59218/makrjms.2023.12.336.340

INTRODUCTION

Pulmonary Hypertension (PH) is increasingly recognized as a significant comorbidity in patients who already have the burden of Chronic Kidney Disease (CKD). This coexistence of conditions creates a compounded risk, amplifying the potential for cardiovascular complications and increasing mortality rates. Recent epidemiological studies[1] have sounded the alarm, revealing a strikingly elevated prevalence of PH within the CKD population. This phenomenon highlights the pressing need to better understand and address the complex interplay between these two conditions.

The rise in PH prevalence within CKD is not a result of a single factor but rather a convergence of various elements. Among these contributors, fluid overload stands out as a key player. In CKD the compromised kidney function often leads to fluid retention, which, in turn, places undue stress on the pulmonary vasculature. Furthermore, endothelial dysfunction, another hallmark of CKD, contributes to the cascade of events that ultimately lead to the development of PH. These multifaceted factors interact and create an environment ripe for PH to emerge[2].

The relationship between CKD and PH is far from simple. It is bidirectional and characterized by complexity[3]. As CKD progresses and renal function deteriorates the risk and severity of PH escalate. This sets in motion a detrimental feedback loop where each condition exacerbates the other's progression, resulting in a challenging clinical scenario. What's more the presence of PH in CKD patients spells trouble, often leading to more frequent hospitalizations and a heightened mortality risk[4].

Despite the dire consequences associated with PH in CKD, it remains significantly under diagnosed and undertreated. Part of the problem lies in the fact that its early clinical manifestations are often subtle and can easily be overlooked[5]. This underlines the critical importance of identifying PH in CKD patients during its earlier stages when treatment options are more effective.

While current therapeutic approaches for PH in CKD are primarily centered on managing underlying causes and alleviating symptoms[6] there's a growing consensus among experts. Many in the medical field advocate for a more proactive approach that involves early detection and targeted interventions aimed at altering the course of both PH and CKD[7]. Such an approach has the potential to not only improve clinical outcomes but also enhance the overall quality of life for individuals facing the dual challenges of these conditions.

This study aims to conduct a comprehensive analysis of pulmonary hypertension (PH) in patients with chronic kidney disease (CKD) at our institution. We seek to determine the prevalence of PH in the CKD population, identify key risk factors contributing to its development, assess the impact on clinical outcomes and evaluate the effectiveness of current treatment approaches. The ultimate goal is to enhance the understanding of PH within CKD, inform clinical practice and guide future research.

MATERIALS AND METHODS

Study design and population: This institutional, observational study involved a cohort of 70 patients diagnosed with chronic kidney disease (CKD) at our healthcare facility. The study included patients aged 18 and above, with varying stages of CKD, who have been screened for pulmonary hypertension (PH) over the past 12 months. The study was conducted with approval obtained from the Institutional Ethics Committee. As this is a retrospective study, patient consent is waived but patient confidentiality was strictly maintained.

Inclusion and exclusion criteria: Inclusion criteria include CKD patients with a confirmed diagnosis of PH based on echocardiographic findings or right heart catheterization. Patients under 18 years of age, those with primary pulmonary hypertension or those with incomplete medical records were excluded.

Data collection: Patient data was retrospectively collected from medical records, including demographic information, CKD stage, comorbid conditions, echocardiographic parameters, treatment regimens for CKD and PH and clinical outcomes such as hospitalization and mortality rates.

Assessment of pulmonary hypertension: PH was defined according to standard echocardiographic criteria, including pulmonary artery systolic pressure estimates.

Statistical analysis: Descriptive statistics was used to summarize patient characteristics. The prevalence of PH was calculated as a percentage of the total study population. All analyses was conducted using statistical software, with a p-value of less than 0.05 considered statistically significant.

RESULTS

This Table 1 provides an overview of the age distribution and gender composition of the study population. The mean age of the participants is approximately 59.83 years with a standard deviation of 10.48 years and there are 26 males and 44 females in the study. Results of the Table 2 shows the mean CKD stage of the participants is approximately 3.07 with a standard deviation of 1.27, indicating a range of

Table 1: Demographic characteristics of the study population (N = 70)

Characteristic	Data
Age (years)	59.83 (±10.48 SD)
Gender	
Male	26
Female	44

Table 2: Summary of clinical characteristics in the study population (N = 7)

Characteristic	Data
CKD stage	3.07 (±1.27 SD)
Hypertension	48 (Yes)
Diabetes mellitus	33 (Yes)

Table 3: associations of risk factors with key variables in the study population

Risk factor	Mean association	SD association
Age association	0.30	0.10
Gender association	-0.26	0.97
CKD stage association	0.38	0.14
Hypertension association	0.63	0.49
Diabetes mellitus association	0.40	0.49

Table 4: Cardiovascular parameters and their descriptive statistics in the study population

Cardiovascular parameter	Mean	SD
Left ventricular ejection fraction (LVEF)	49.12%	±11.06%
Right ventricular function (RVF)	1.15	±0.17
E/A ratio	1.10	±0.17

Table 5: Pulmonary and cardiac parameters in the study population

Parameter	Mean	SD
FEV1 (%)	74.33	±15.64
FVC (%)	80.61	±13.72
Pulmonary Artery Pressure (mmHg)	35.02	±4.70
Pulmonary Capillary Wedge Pressure (mmHg)	15.23	±5.06
Cardiac Output (L/min)	5.09	±1.02

Table 6: Echocardiographic assessment of pulmonary and cardiac function in ckd patients with pulmonary hypertension

Echocardiographic Parameter	Mean	SD
Pulmonary artery systolic pressure (PASP)	35.41	±4.94
Right ventricular size and function	1.20	±0.19
Right atrium size	1.11	±0.15
Tricuspid annular plane systolic excursion (TAPSE)	18.19	±3.89

disease severity. Out of 70 participants, 48 have hypertension (HTN) and 33 have diabetes mellitus (DM) reflecting common comorbid conditions associated with CKD.

Age Association shows a positive mean correlation of 0.30, indicating a potential link between age and PH severity. Gender Association has a mean value of -0.26, suggesting a variable impact of gender on PH. CKD Stage Association has a mean of 0.38, implying a positive correlation between the stage of CKD and the presence of PH. Hypertension Association, with a mean of 0.63, indicates a strong potential link between hypertension and PH. Diabetes Mellitus Association has a mean of 0.40, suggesting a considerable association between diabetes mellitus and PH (Table 3).

Table 4 shows the mean Left Ventricular Ejection Fraction (LVEF) is approximately 49.12%, with a standard deviation of 11.06%. This suggests a lower average LVEF than the normal range, indicating possible left ventricular dysfunction in the cohort. The mean value for Right Ventricular Function (RVF) is 0.45, within the lower end of the normal range, suggesting varied right ventricular performance among participants. The E/A ratio a measure of diastolic function, has a mean value of 1.10 with a standard deviation of 0.17, which is within the normal range but indicates potential diastolic function variability within the study group.

Table 5 shows the mean FEV1 (Forced Expiratory Volume in 1 sec) is approximately 74.33%, suggesting some degree of restrictive or obstructive lung disease in the cohort. The mean FVC (Forced Vital Capacity) is around 80.61%, which is slightly below the normal range. The mean Pulmonary Artery Pressure (PAP) is 35.02 mm Hg, indicative of elevated pressure common in pulmonary hypertension. The mean Pulmonary Capillary Wedge Pressure (PCWP) is 15.23 mm Hg, suggesting potential left heart involvement or fluid overload. The mean Cardiac Output (CO) is 5.09 Liters per minute, within the normal range for adults.

The mean Pulmonary Artery Systolic Pressure (PASP) is 35.41 mmHg, indicating elevated pressures typical of pulmonary hypertension. The mean Right Ventricular Size and Function, represented as a ratio to the normal size, is 1.20, suggesting right ventricular hypertrophy and dilation. The mean Right Atrium Size, also as a ratio to the normal size, is 1.11, indicating right atrial enlargement which can be associated with elevated right heart pressures. The mean Tricuspid Annular Plane Systolic Excursion (TAPSE) is 18.19 mm, within a normal range, which assesses right ventricular function Table 6.

DISCUSSIONS

The findings of this study provide valuable insights into the intricate and multifaceted nature of Chronic Kidney Disease (CKD) and its associations with various risk factors and cardiovascular parameters. The study population, consisting of 70 individuals, offers a representative sample for analysis. One striking observation is the mean age of approximately 59.83 years among the study participants. This demographic characteristic is noteworthy as it aligns with the global trend of CKD prevalence increasing among aging individuals[8]. The fact that the study cohort predominantly comprises older individuals underscores the pressing healthcare challenge posed by CKD in this age group. It also emphasizes the importance of addressing CKD as a significant public health issue, particularly in the context of the aging population. Moreover the distribution of gender within the study population reveals a gender disparity, with 44 females and 26 males. This gender distribution may reflect differences in CKD prevalence between men and women a phenomenon that has been observed in epidemiological studies. Understanding these gender-related disparities is essential for tailoring healthcare

interventions and promoting equitable access to care. The study's focus on CKD stages is another critical aspect. The average CKD stage in the cohort is approximately 3.07, indicating that participants represent a spectrum of disease severity. This diversity in CKD stages underscores the need for a multifaceted approach to managing CKD patients. Individuals with varying degrees of kidney function impairment require tailored care plans that consider their specific needs and disease progression. Furthermore the study highlights the presence of common comorbidities among the participants, with 48 individuals having hypertension and 33 individuals having diabetes mellitus. These findings align with existing research that has consistently shown a strong association between CKD and these chronic conditions[9,10]. The coexistence of CKD with hypertension and diabetes mellitus underscores the importance of holistic management approaches that address not only kidney health but also the management of these concurrent conditions. Comprehensive care strategies are crucial for optimizing patient outcomes and preventing complications associated with CKD. The associations of risk factors with key variables are of particular interest. Notably, hypertension (HTN) and diabetes mellitus (DM) demonstrate strong associations with pulmonary hypertension (PH) as indicated by mean association values of 0.63 and 0.40, respectively. These findings are consistent with recent studies highlighting the interplay between CKD, HTN, DM and the development of PH[11]. Cardiovascular parameters are essential indicators of cardiac health. The study reveals that while left ventricular ejection fraction (LVEF) is lower than the normal range, right ventricular function (RVF) falls within the lower end of normal. The E/A ratio a measure of diastolic function, is within the normal range but shows variability within the study group. These findings suggest the presence of cardiac dysfunction, which is common in CKD and PH patients[12]. Echocardiographic assessment further elucidates cardiac function in CKD patients with PH. Pulmonary artery systolic pressure (PASP) and right ventricular size and function are elevated, while right atrium size is enlarged. Tricuspid annular plane systolic excursion (TAPSE) remains within the normal range. These echocardiographic findings are consistent with the development of PH and associated cardiac remodeling in CKD patients[13,14]. In conclusion, this study provides a comprehensive overview of the clinical and cardiovascular characteristics of CKD patients with a focus on pulmonary hypertension. The findings underscore the complexity of CKD and its associations with risk factors and cardiovascular comorbidities. It emphasizes the need for early detection and multidisciplinary management in CKD patients to mitigate the risk of PH and associated cardiac complications.

REFERENCES

1. Travers, A., H.W. Farber and M.J. Sarnak, 2021. Pulmonary hypertension in chronic kidney disease. Cardiol. Clin., 39: 427-434.
2. O'Leary, J.M., T.R. Assad, M. Xu, K.A. Birdwell and E. Farber-Eger *et al*., 2017. Pulmonary hypertension in patients with chronic kidney disease: Invasive hemodynamic etiology and outcomes. Pulm. Circulation, 7: 674-683.
3. Thenappan, T., 2017. Pulmonary hypertension in chronic kidney disease: A hemodynamic characterization. Pulm. Circulation, 7: 567-568.
4. Sise, M.E., A.M. Courtwright and R.N. Channick, 2013. Pulmonary hypertension in patients with chronic and end-stage kidney disease. Kidney. Int., 84: 682-692.
5. Abdelwhab, S. and S. Elshinnawy, 2008. Pulmonary hypertension in chronic renal failure patients. Am. J. Nephrology, 28: 990-997.
6. Walther, C.P., V. Nambi, N.A. Hanania and S.D. Navaneethan, 2020. Diagnosis and management of pulmonary hypertension in patients with ckd. J. Kidney. Dis., 75: 935-945.
7. Rangaswami, J. and P.A. McCullough, 2018. Heart failure in end-stage kidney disease: Pathophysiology, diagnosis, and therapeutic strategies. Seminars. Nephrology., 38: 600-617.
8. Jha, V., G. Garcia-Garcia, K. Iseki, Z. Li and S. Naicker *et al*., 2013. Chronic kidney disease: Global dimension and perspectives. Lancet, 382: 260-272.
9. Kobayashi, S., K. Maesato, H. Moriya, T. Ohtake and T. Ikeda, 2005. Insulin resistance in patients with chronic kidney disease. J. Kidney Dis., 45: 275-280.
10. Alicic, R.Z., M.T. Rooney and K.R. Tuttle, 2017. Diabetic kidney disease. Clin. J. Am. Soc. Nephrology, 12: 2032-2045.
11. Navaneethan, S.D., J. Roy, K. Tao, C.S. Brecklin and J. Chen et al., 2016. Prevalence, predictors, and outcomes of pulmonary hypertension in ckd. J. Am. Soc. Nephrology, 27: 877-886.
12. Feinstein, J.A., S.Z. Goldhaber, J.E. Lock, S.M. Ferndandes and M.J. Landzberg, 2001. Balloon pulmonary angioplasty for treatment of chronic thromboembolic pulmonary hypertension. Ovid Technologies (Wolters Kluwer Health), Circulation., 103: 10-13.

13. Kovacs, G., A. Berghold, S. Scheidl and H. Olschewski, 2009. Pulmonary arterial pressure during rest and exercise in healthy subjects: A systematic review. Eur. Respir. J., 34: 888-894.
14. Yigla, M., F. Nakhoul, A. Sabag, N. Tov, B. Gorevich, Z. Abassi and S.A. Reisner, 2003. Pulmonary hypertension in patients with end-stage renal disease. Chest., 123: 1577-1582.