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Research Article

PREVALENCE OF PULMONARY HYPERTENSION IN PATIENTS OF CHRONIC KIDNEY DISEASE IN WESTERN RAJASTHAN: A CROSS-SECTIONAL STUDY

SWATI VYAS[1]*, POOJA YADAV[2], AGRAWAL RP[2]

[1]Department of General Medicine, Government Medical College, Kota, Rajasthan, India. [2]Department of General Medicine, Sardar Patel Medical College, Bikaner, Rajasthan, India. Email: Vyasdrswati@gmail.com

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ABSTRACT

Objective: We organized a study to determine the prevalence of pulmonary hypertension (PHT) in individuals with chronic renal disease, because there has not been much research on this topic in our area. Studying any relationships, if any, between PHT and chronic kidney disease (CKD) stage was another goal.

Methods: A hospital-based cross-sectional study of 108 CKD cases was carried out (according to various phases based on glomerular filtration rate) and included participants over the age of 18. SPSS software was used to collect and analyze all data. Correlation was determined using the corelation coefficient.

Results: About 15.74% of people with CKD had PHT. Patients' PHT was mild in 47.06% of cases, moderate in 41.18% of cases, and severe in 11.11% of cases. The correlation between the stage of CKD and PHT was determined to be statistically negligible. Age, CKD stage and duration, and PAH were revealed to be statistically unimportant in linear regression.

Conclusion: About 15.74% of CKD patients had PHT, according to the study. The age of the patients, the length of the CKD, and the stage of the CKD were positively correlated with PHT.

Keywords: Chronic kidney disease, Pulmonary hypertension, Stage.

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INTRODUCTION

A variety of pathophysiologic mechanisms connected to poor kidney function and a steady decline in glomerular filtration rate (GFR) make up chronic kidney disease (CKD). The estimated GFR and the level of albuminuria are used to stratify the various stages of CKD. The recommendations describe CKD as kidney structural and function problems that have persisted for at least 3 months [1].

Peak systolic pulmonary artery pressure typically ranges between 18 and 25 mm Hg. With age, pulmonary artery pressure and pulmonary vascular resistance rise. This could be caused by increased wall thickness in the pulmonary arteries or decreased compliance of the pulmonary artery as a result of intimal fibrosis. The majority of CKD patients have high blood pressure, diastolic dysfunction, an AV fistula, anemia, uremia, volume overload with interstitial pulmonary edema, and a high cardiac output condition, all of which can result in elevated pulmonary vascular pressure [2].

Pulmonary hypertension (PHT) is a result of hemodialysis-specific factors such exposure to the dialysis membrane and AV fistula. Patients with uremic patients receiving hemodialysis through AV access show reduced nitric oxide generation. The inability of the pulmonary circulation to maintain the elevation of cardiac output caused by AV access due to endothelial dysfunction and prolonged endothelin elevation results in PHT [3]. Due to limited study in our region on PHT in CKD patients, we planned a study to detect the prevalence of PHT in patients with CKD. An additional objective was to study an association between PHT and CKD stage if any.

METHODS

Study design

The study was hospital-based cross-sectional study.

Study duration

The study duration was 12 months – August 1, 2019–July 30, 2020.

Study place

This was Department of medicine, S. P. Medical College and P.B.M Hospital, Bikaner

Sample size

The sample size was estimated using the proportion of PHT in CKD patients from the literature as 50%. Using the formula,

$$Sample\,size = \frac{Z_{1-\alpha/2^2}\, p(1-p)}{d^2}$$

Here, $Z_{1-\alpha/2^2}$ = Is standard normal variate (at 5% Type 1 error [p<0.05], it is 1.96; at 1% Type 1 error [p<0.01], it is 2.58). As in majority of studies, p<0.05 was considered statistically significant, and hence, 1.96 is used in the formula.
p=Expected proportion in population based on the previous studies or pilot studies
d=Absolute error or precision – has to be decided by researcher.
p=50; q=50; d=10%.

A sample size of 98 CKD patients with a 95% confidence level was required for the investigation using the aforementioned values. The study used a sample size of 98+9.8 108 people after accounting for a 10% non-response rate.

Sampling method

This was random sampling.

Inclusion criteria

The following criteria were included in the study:

Table 1: Distribution of study subjects according to stage of CKD

CKD stage	Number of subject	Percentage
3	30	27.78
4	31	28.70
5	47	43.52
Total	108	100.00

Table 2: Prevalence of pulmonary hypertension in CKD subjects

Pulmonary hypertension	Number of subject	Percentage
Present	17	15.74
Absent	91	84.16
Total	108	100.00

Table 3: Distribution of study subjects according to grade of pulmonary hypertension

Grading	Number of subject	Percentage
Mild	8	47.06
Moderate	7	41.18
Severe	2	11.11
Total	17	100.00

Table 4: Distribution of PAH according to multivariate linear regression of different variable

Variable	Corelation coefficient	p-value
Age	0.92	0.01
CKD duration	0.87	0.01
CKD Stage	0.91	0.01

1. Diagnosed cases of CKD (according to different stages based on GFR).
2. Age ≥18 years.

Staging of CKD by GFR and albuminuria (KDIGO 2012)

Stage 1 kidney damage with normal or increased GFR (>90 ml/min/1.73 m^2)
Stage 2 mild reduction in GFR (60–89 ml/min/1.73 m^2)
Stage 3a moderate reduction in GFR(45–59 ml/min/1.73 m^2)
Stage 3b moderate reduction in GFR (30–44 ml/min/1.73 m^2)
Stage 4 severe reduction in GFR (15–29 ml/min/1.73 m^2)
Stage 5 kidney failure (GFR < 15 ml/min/1.73 m^2).

On basis of ALBUMINURIA

A1 Albuminuria <30 mg/g or <3 mg/mmol.
A2 Albuminuria 30–300 mg/g or 3–30 mg/mmol.
A3 Albuminuria >300 mg/g or >30 mg/mmol.

Exclusion criteria

The following criteria were excluded from the study:

1. Those not willing to participate in the study
2. Age <18 years
3. Valvular heart diseases
4. Congenital heart diseases
5. Pulmonary obstructive and restrictive diseases
6. HIV-infected patients
7. Chronic liver disease
8. Connective tissue diseases
9. Hypothyroidism and hyperthyroidism.

Ethical approval

The study begun after obtaining ethical approval from the ethical committee of the medical college.

Data analysis

Frequencies, numbers, proportions, and measures of central tendency were utilized to examine the data using Microsoft Excel and the statistical program SPSS. For qualitative data, the Chi-square test was utilized, and for quantitative data, the t-test. Correlation was determined using the corelation coefficient.

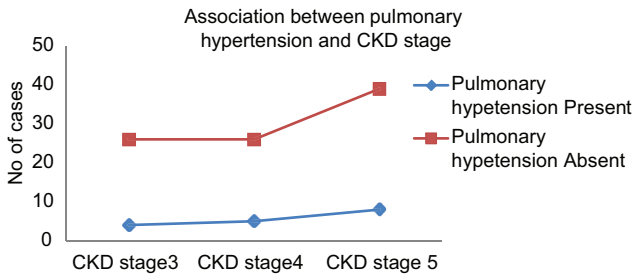
RESULTS

Out of 108 subjects in our study, the majority (53.70%) were in the 46–60 year age range, followed by 28.70% of subjects under 45 and just 17.60% of subjects over 60. Thirty-two participants (29.63%) and 76 (70.67%) were male and female, respectively. Diabetes and hypertension were present in 41.67 and 55.56% of patients, respectively. About 25.00% of subjects with CKD had it for 5–10 years, while 66.67% had it for <5 years.

In our study, out of 108 subjects, the highest percentage (43.52%) had CKD Stage 5, while the lowest percentage (26.70%) had CKD Stage 4.

Prevalence of pulmonary hypertension in CKD patients was 15.74%.

Patients with mild PHT made up 47.6% of the population, those with moderate hypertension made up 41.8%, and those with severe hypertension made up 11.1%.



The association between PHT and CKD stage was found statically insignificant.

In linear regression between age, CKD stage and duration and PAH were found statistically insignificant.

DISCUSSION

Since India is the world's diabetes capital, chronic renal disease is also on the rise. Cardiovascular disease and other consequences are more likely in those with CKD. A significant factor in CKD patients' mortality is cardiac disease. Higher cardiac output and pulmonary blood flow both contribute to the increased prevalence of PHT. Due to changes in metabolism and hormones, CKD patients also run the risk of developing PHT. As a result, the pulmonary arteries become more constricted, increasing pulmonary resistance.

Increased cardiac output and elevated pulmonary artery pressure are caused by the presence of an AV fistula, reduced hemoglobin, and volume overload. Determining the prevalence of PHT in CKD patients is the purpose of our investigation, thus. Higher cardiac output and pulmonary blood flow both contribute to the increased prevalence of PHT. In our study, 17 (or 15.74%) of the 108 CKD patients tested developed PHT as determined by 2D Echo.

Regardless of its genesis, PHT, a condition marked by raised pulmonary artery pressure, is a progressive problem worsening heart, lung, or systemic diseases and is associated with increased morbidity and death [4]. PHT has recently been discovered to be a potent independent predictor of morbidity and mortality in hemodialysis patients [5].

PHT patients had a death rate of 30.4% compared to 8.5% among patients without PH (p 0.03) in an observational study of 58 hemodialysis patients with a mean follow-up of 30 months [6]. With 1 year, 3 year, and 5 year, survival rates of 78.6% compared 96.5%, 42.9% versus 78.8%, and 25.2% versus 66.4%, respectively (p<0.0001).

Yigla *et al*. [7], samples of CKD patients, showed considerably shorter survival than those without PHT. The prevalence of PHT in CKD patients has been the subject of very few Indian studies. PHT has been identified as a common condition in ESRD patients and is thought to exist independently of the prevalence of cardiovascular illness.

In our study, 15.74% of the patients with CKD had PHT. The prevalence of PH was observed to range between 26.74% by Tarras *et al*. [8] to 68.6% by Moniruzzaman *et al*. [9].

In a different Indian study, Patel *et al*. [10] examined 100 patients (69 men and 31 women) who were receiving hemodialysis, continuous ambulatory peritoneal dialysis, or conservative treatment (CAPD). The prevalence of PH in this cohort was 41%, with the hemodialysis group having the greatest frequency (33%). The differences in the ethnic composition of the population studied as well as in the study group, regarding stage of CKD, mode of dialysis (HD vs. PD), comorbid conditions such as COPD/CHF, and inclusion criteria, can be used to explain the variation in the prevalence of PH among CKD patients in different studies [11,12]. Even though these studies looked at different factors and are not really comparable, the majority of them found that PHT was highly prevalent among CKD patients.

In our investigation, age had no bearing on the occurrence of PH. This outcome was comparable to that of the research by Mazdeh *et al.* [13] (p=0.58) (p=0.37). Tarras *et al*., Age and PHT, did not correlate, according to Patel *et al*. [10] (p=0.402). Due to the small number of study participants, there was a positive link between CKD stage and PH in the current investigation, although it was not statistically significant. All of the patients in our study group were in stages III, IV, or V because we are a tertiary referral center, and most of our patients are late referrals.

The alarming finding by Yang *et al*. [14] that PH exists and may be prominent before the decline in GFR to 60 ml/min/1.73 m^2 was reached which was the PH prevalence of 23.76% (24/101) in Stage II and 48.15% (13/27) in the GFR 60 mL/min/1.73 m^2 group. In a study by Li *et al.* [15], severe PH was found at CKD patients in Stage – V along with rising PH prevalence and cardiovascular morbidity as renal disease progressed.

Poor understanding persists of the precise mechanisms underlying PH in advanced CKD. Left ventricular dysfunctions and CKD-related risk factors, such as volume overload, AVF, sleep apnea, contact with dialysis membranes, endothelial dysfunction, vascular calcification and stiffening, and severe anemia, may cause or exacerbate PH [9]. The World Symposium of PH classified ESRD-related PH for the 1st time as the 5th subtype of PH (PH with unknown multifactorial causes) (WSPH) [11]. PH in CKD without major cardiac and pulmonary illnesses is included in this group. Chest radiography, pulmonary function tests, CT scans, and ventilation/perfusion scans are frequently used to rule out these concomitant disorders, which were discovered in 40%–70% of patients in most cohorts.

After this study, we discovered a positive correlation between PHT in CKD patients, which increase with stage and duration of CKD. By detecting it in its early stages by a non-invasive method like 2 D Echo, we can treat it early, thereby reducing related mortality and morbidity and producing a better patient outcome.

CONCLUSION

About 15.74% of people with CKD had PHT. The age of the patients, the length of the CKD, and the stage of the CKD were positively correlated with PHT.

Limitations of the study

1. There is a tiny sample size.
2. Patients on peritoneal dialysis and those with CKD Stages I and II were not included in the study.
3. Rather than using the gold standard of right heart catheterization, the diagnosis of PH was made using indirect echocardiographic estimates of PA systolic pressure.
4. Coronary angiography and a stress test did not rule out significant coronary artery disease.
5. There is no ongoing patient monitoring.

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AUTHORS' CONTRIBUTIONS

All the authors have contributed equally.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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