



ASSESSMENT OF PULMONARY HYPERTENSION BY 2D ECHO AND DOPPLER IN PATIENT OF CHRONIC KIDNEY DISEASE.

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ABSTRACT:

BACKGROUND: Chronic kidney disease (CKD) is major public health concern that leads to renal failure, cardiovascular disease (CVD), and early mortality. One significant cardiovascular consequence of CKD is pulmonary hypertension (PH). It is small arterial disease involving pulmonary vasculature that raises pulmonary vascular resistance (PVR) and in turn pulmonary arterial pressure (PAP).

METHODS: Single centre, observational cross-sectional done from 2019-2021 in department of General Medicine and sample size was 100 CKD patients.

RESULTS: 48.99 ± 13.05 years Mean age of the patients. M:F ratio was 2:1. Out Of 100 cases having CKD, 49 were found to have pulmonary hypertension. Of 49 patients with PH, majority had moderate PH (44.89%) followed by mild (34.69%) and severe (20.41%) PH. Of 49 patients with PH, majority had Stage 5 CKD (52.56%) followed by Stage 4 (42.86%) and Stage 3 CKD (25%).

CONCLUSION: The prevalence of PH was 49%. More Duration of CKD and HD, Decrease in haemoglobin levels are associated with increased prevalence of PH. HD with AV fistula was significantly associated with PH. Age, Sex and Stage of CKD was not significantly associated with severity of PH

Keywords: Chronic kidney disease, Pulmonary hypertension, Echo, Hemodialysis, Cardiovascular Disease.

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1. Introduction

Worldwide, The consequences of chronic kidney disease (CKD) including renal failure, cardiovascular disease (CVD), and early mortality make it a major public health problem. According to KDIGO (Kidney Disease Improving Global Outcomes), CKD is defined as kidney damage or glomerular filtration rate (GFR) <60 mL/min/1.73 m² for 3 months or more, irrespective of cause.⁽¹⁾ For all stages of CKD, the global prevalence is estimated to be 9.1%, and 697.5 million cases were recorded in 2017. During the same year, 1.2 million individuals died from CKD.⁽²⁾

CKD is non-communicable disease (NCD) most frequently caused due to diabetes and hypertension.⁽³⁾ The primary cause of early morbidity and mortality in CKD patients is still CVD. Severity of CKD is quantified by estimated glomerular filtration rate (eGFR), it denotes excretory renal function and raised urinary albumin measured by the urinary albumin-to-creatinine ratio (ACR), which indicates degree of renal damage and stage of disease.⁽⁴⁾ Cardiovascular complication of CKD in ESRD is Pulmonary hypertension. It is primarily disease of the small arteries of the pulmonary vasculature, as this gradually obliterate results in raised pulmonary vascular resistance (PVR) and



pulmonary arterial pressure (PAP) .⁽⁵⁾ Raised pulmonary vascular resistance often leads to right ventricular failure hence, In CKD, Pulmonary Hypertension is Important and separate indicator of raised mortality.⁽⁶⁻⁸⁾

In studies of hemodialysis patients, mortality of 30.4% observed in CKD with PH and 8.5% in CKD without PH.⁽⁷⁾ Pulmonary hypertension, mean pulmonary arterial pressure greater than or equal to 25 mmHg, at rest or 30 mmHg, during exercise. 27%-58% patients of ESRD of had presence PH.⁽⁶⁾ In 8% to 39% patients with advanced CKD have PH.^(7, 9-10) Furthermore, it was stated that PH was more common in haemodialysis patients (18.8-68.8%) than in peritoneal dialysis (0-42%) patients.⁽¹¹⁾ The clinical and etiological profiles of PH in CKD patients were studied ⁽¹²⁻¹⁴⁾. However, from the standpoint of CKD patients living in Central India, such research are lacking. Consequently, the goal of the current investigation was to assess PH in CKD patients.

2 Materials and Methods

Institutional Ethics Committee (IEC) approved this study protocol.

Single-centre, cross-sectional and observational study. It was conducted in Medicine Department and Nephrology Unit of NKPSIMS & RC, NAGPUR. It was performed from October 2019 to September 2021. All chronic kidney disease (CKD) patients from the outpatient department (OPD) or patients from the medical wards of a tertiary care teaching hospital, regardless of whether they needed dialysis or not, were included in this study. Criteria for inclusion in study was patients >18 years; of either sex and with stage 1-5 CKD* with or without hemodialysis. Patients excluded were Pregnant

A) Age distribution among the patients:

Age groups (Years)	N(=100)	%
18-30	6	6
31-40	21	21
41-50	30	30
51-60	23	23

females; Left side valvular heart diseases; Patients with congenital or ischemic or rheumatic Heart diseases; Collagen vascular diseases; Human-immunodeficiencyVirus; Chronic- obstructive airway disease; Pulmonary embolism; Scleroderma; Patient not willing to participate.

3 Results and Discussions

Initially, 112 patients having CKD in stages 1-5 were screened for study and given information about the protocol in their native tongue. Of the 112 patients, 4 had ischemic heart disease, 1 had COPD, 7 did not provide consent. Those patients who were willing to participate and gave their consent were enrolled for the study after these 12 patients were excluded. All patients were then given a thorough medical history and examination. Then, laboratory tests, a chest x-ray, a 2D ECHO, and ECG were performed on the patients. All of the findings were then recorded in the CRF.

The modified Bernoulli equation used to determine the pulmonary artery pressure:

$$PAP=4X(\text{tricuspid systolic jet})^2+10 \text{ mm Hg}$$

(estimated right atrial pressure)

Graphs and data were created using Microsoft Office Excel 2013. With the assistance of a statistician, this was analysed using SPSS (IBM, Armonk, NY, USA) version 23.0 for Windows. The mean, standard deviation (SD), and frequency are used to represent continuous and categorical variables, respectively (percentage). To ascertain the association between pulmonary hypertension and other clinico-demographic risk factors, the Chi-Square test was performed. Two-tailed probability value of < 0.05 was deemed to be statistically significant.



>60	20	20
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The bulk of the patients in the current study (30%) were between the ages of 41 and 50, and their average age was 48.99 13.05 years. In accordance with the current study, Rajapurkar et al. revealed that the average age of CKD patients was 50.1 14.6 years.⁽¹⁵⁾

B)Distribution of patients according to sex :

In the current research, majority were male (N=68) and females were (N=32). Different studies reported prevalence of PH is detected as women > men. Study by **Amin** observed higher prevalence of PH in women(48%).⁽¹⁶⁾

C)Distribution of patients according to PH:

Pulmonary Hypertension	N(=100)	%
NO	51	51
YES	49	49

Of 100 patients with CKD, 49 were found to have pulmonary hypertension.

C)Patients' distribution according on PH severity:

Severity of Pulmonary Hypertension	N(=49)	%
Mild	17	34.69
Moderate	22	44.89
Severe	10	20.41

Of 49 patients with PH, majority had moderate PH (44.89%) followed by mild (34.69%) and severe (20.41%) PH.

D)Distribution of patients based on stage of CKD and PH,:

CKD stage	Pulmonary Hypertension	
	Present(N=49)	Absent (N=51)
Stage 3(N=8)	2(25%)	6(75%)
Stage 4(N=14)	6(42.86%)	8(57.14%)
Stage 5(N=78)	41(52.56%)	37(47.44%)

Of 49 patients with PH, majority had Stage 5 CKD (52.56%) followed by Stage 4 (42.86%) and Stage 3 CKD (25%). Similar to this, Rajapurkar et al. showed that Stage 5 CKD made up the bulk of CKD cases (48.1%), followed by Stages 4 (25.9%), Stages 3 (19.6%), Stages 2 (4.4%), and Stage 1 (4.4%). (2.1 percent).⁽¹⁵⁾

E)Duration of CKD and severity of PH Association:

Severity of Pulmonary Hypertension	Duration of CKD (months)		
	<6(N=2)	6-12(N=21)	>12(N=26)
Mild (N=17)	1 (50%)	15(71.43%)	1 (3.85%)
Moderate (N=22)	1 (50%)	4(19.05%)	17(65.38%)
Severe (N=10)	0 (0%)	2(9.52%)	8(30.77%)
p-value	<0.0001		

We detected a relationship between longer CKD duration and higher PH severity, and this association was statistically significant (p-value 0.0001). Similarly, **Mehta et al.** observed that severity of PH increased significantly by increase in CKD Duration(p-value = 0.011).⁽¹²⁾

F)Association between mode of HD and PH :

Mode of HD	Pulmonary Hypertension		p-value
	Yes (N=49)	No (N=51)	
AV fistula (N=45)	28(62.22%)	17(37.78%)	0.017



HD Catheter (N=45)	19(42.22%)	26 (57.78%)	0.220
NO HD (N=10)	2 (20%)	8 (80%)	0.053

Significantly greater number of patients with AV fistula had PH (p-value =0.017). Nevertheless, there is no statistically significant link between dialysis using an HD catheter and the likelihood of getting PH (p-value = 0.220). Like present study, **Mehta et al.** observed that HD through AV fistula was significantly associated with PH (p-value = 0.002).⁽¹²⁾

G)Duration of HD and severity of PH Association:

Severity of Pulmonary Hypertension	Duration of HD (months)			
	<6(N=0)	6-12(N=23)	>12(N=24)	No HD (N=2)
Mild (N=17)	0 (0%)	16 (69.57%)	0 (0%)	1 (50%)
Moderate (N=22)	0 (0%)	5 (21.74%)	16 (66.67%)	1 (50%)
Severe (N=10)	0 (0%)	2 (8.69%)	8 (33.33%)	0 (0%)
p-value	<0.0001			

We discovered statistically significant connection between length of HD and severity of PH (p-value 0.0001). Similar to this, Mehta et al., found a statistically significant connection (p-value 0.001) between HD duration and PH.⁽¹²⁾

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H)Haemoglobin levels and PH Association:

Haemoglobin levels (gm%)	Pulmonary Hypertension		p-value
	Yes (N=49)	No (N=51)	
<10 (N=52)	35(71.43%)	17(33.33%)	<0.0001
>=10 (N=48)	14(28.57%)	34 (66.67%)	

Significantly greater number of patients with PH had haemoglobin levels < 10 gm% than those with levels ≥ 10 gm% (p-value < 0.0001). Same as of present study, **Zhang et al.** found strong and statistically significant association, in low haemoglobin and PH.⁽¹⁷⁾ Contrarily, **Mehta et al.** reported that haemoglobin <1 gm% was not significantly associated with PH (p-value = 0.08).⁽¹²⁾

significantly correlation with raised severity of PH.

- 90% patients needed HD, and an equal proportion received HD via an AV fistula and an HD catheter (45 percent each). Significantly, HD with an AV fistula was linked to PH (p = 0.017). The likelihood of getting PH was not significantly correlated with HD catheter use, though (p-value = 0.220).

LIMITATIONS: This observational study conducted at single centre having small sample size.

- Majority of the patients were on HD for 6 – 12 months (52%). Duration of HD was significantly associated with severity of PH (p-value < 0.0001) and Decrease in haemoglobin levels (< 10 gm%) was significantly associated with PH.

4 Conclusion

The prevalence of PH was 49% and PH was not significantly associated with age (p-value = 0.665) and sex (p-value = 0.155).

References

- Most of the patients had moderate PH with Stage 5 CKD. Stage of CKD was not significantly associated with severity of PH (p-value = 0.590).
- Majority of the patients had CKD for the past 6 – 12 months. Duration of CKD was

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