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Prevalence and Impact of Pulmonary Hypertension in Hemodialysis Patients

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[1]Provided concept/research design, data collection, project management, takes the responsibility and accountable.
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[3,4]Provided concept/research design, data collection, and project management.
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ABSTRACT

Objective: To assess the PHT prevalence and its impact on end stage renal disease (ESRD) patients on prolonged hemodialysis (HD).

Methodology: This cross-sectional study included ESRD patients on hemodialysis for at least three months at Akbar Niazi Teaching Hospital, Islamabad, between June 2023 and February 2024. The study included a total of 80 patients undergoing hemodialysis. PHT was referred as an estimated systolic pulmonary artery pressure (PAP) of 25 mm Hg or higher, as determined by echocardiograms conducted by a cardiologist. Data analysis was conducted using SPSS software, v 23. A p value ≤ 0.05 was measured significant in all the analyses.

Results: The patient's average age was 56.7±14.4 years. Hemodialysis mean duration was 40±32 months. Ejection fraction mean was 44±8%. PHT was observed in 65% of the patients. These patients tended to have a decreased ejection fraction. PHT was high prevalent in female hemodialysis patients. This study found no correlation between PHT and duration of hemodialysis, the cause of ESRD, anemia, or levels of parathyroid hormone, phosphorus, and calcium.

Conclusion: The findings indicate that PHT is prevalent issue in ESRD patients on maintenance hemodialysis and is closely linked to heart failure. Screening for this condition is essential in this patient population.

Keywords: Kidney Failure, Chronic; Renal dialysis; Hypertension, Pulmonary.

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Introduction

Pulmonary hypertension (PHT) is referred as pulmonary artery pressure (PAP) a mean of 25 mmHg or high.[1] Majority PHT patients first presented with exertional dyspnea, reduced exercise tolerance, and fatigue. If not addressed, it can progress into severe and potentially fatal condition.[2] The World Health Organization (WHO) has categorized PHT in 5 groups based on its mechanism and etiology: Group 1 – unknown pulmonary artery hypertension, Group 2 – left heart disease PHT, Group 3 – PHT associated with hypoxemia and chronic lung disease, Group 4 – chronic thromboembolism PHT, Group 5 – PHT resulting from unknown or multifactor origins.[3]

Group 5, which includes PHT of unknown or multifactor origins, encompasses patients with PHT resulting from chronic kidney disease (CKD) and other conditions such as sickle cell disease, chronic hemolytic anemia, myeloproliferative disease, metabolic diseases such as glycogen storage, and sarcoidosis.[4]

The exact PHT prevalence in patients with CKD remains idiopathic, and its occurrence is documented primarily through relative small-scale studies. Nevertheless, it appears that PHT is not only a frequent condition in the patients but also linked to decreased survival and poor outcomes.[5] Therefore, diagnosing early, preventing, and treating PHT are key strategies to improve the survival of the patients. This study objective to assess the PHT prevalence and its impact on end stage renal disease (ESRD) patients on prolonged hemodialysis (HD).

Methodology

This was a cross-sectional study conducted between June 2023 and February 2024, authorized by ethics committee of Akbar Niazi Teaching Hospital, Islamabad, Pakistan. The study adhered to Declaration of Helsinki principles. Informed consent was attained from all patients, who were withdraw from study at any time. The study included a total of 80 patients undergoing hemodialysis. A standardized proforma was utilized to gather demographic information, as well as data related to renal disease and hemodialysis, such as the cause of ESRD, the onset of renal replacement therapy (RRT), and details of hemodialysis access. Patient's labs such as hemoglobin, levels of phosphorus, serum calcium, and parathyroid hormone, were also gathered.

Patients of ESRD aged 18 years and older who had been on hemodialysis for more than 2 months at the hospital were included in the study. ESRD was referred as the permanent and advanced loss of renal function, regardless of the underlying cause, necessitating long-term RRT through hemodialysis.[6] Hemodialysis patients with following details were excluded: those with aortic or mitral stenosis, pregnant females, patients with active or chronic infections, and those with severe COPD.

At the hospital, hemodialysis for ESRD patients was done once, twice, or thrice a week, with each session lasting approximately 4 hrs, using Fresenius machine (Model 4008, USA). Majority patients were treated with a bicarbonate dialysis solution and polysulfone synthetic dialysis membrane, with a concentration ranging from 35-40 mEq/L was delivered. The rate of blood was between 200-400 mL/min, and the flow rate of dialysate was set at 500 mL/min. A cardiologist performed two dimensions (2D) Doppler echocardiograms using a digital cardiac ultrasound machine (Toshiba Xario, Japan) as a non-invasive diagnostic method. PHT was referred as pulmonary artery pressure (PAP) a mean of 25 mmHg or high.

Blood samples from patients for the measurement of hemoglobin, levels of phosphorus, calcium, and parathyroid hormone were collected directly prior to dialysis session via the hemodialysis staff, and without delay serum was extracted. Assays of immunoradiometric (2nd generation parathyroid hormone) were used to measure serum levels of intact parathyroid hormone (iPTH).

Data analysis was conducted using SPSS software, v 23. Demographic and laboratory statistics, such as hemoglobin, levels of phosphorus, calcium, and parathyroid hormone, related to PHT prevalence, were measured. Chi square and independent t tests were performed to assess the association between qualitative and quantitative parameters and PHT. A p value ≤ 0.05 was measured significant in all the analyses.

Results

Eighty (n=80) patients of ESRD (42 males and 38 females) on hemodialysis, with average age of 56.7±14.4 years, were included. PAP ranged from 19–66 mmHg. The laboratory and other parameters of all patients are presented in Table I. Considering a mean PAP of 25 mmHg or higher as indicative of PHT. Compared to normal PAP patients, PHT was high prevalent in females ($p = 0.016$). The ejection fraction in patients ranged from 22% to 56% (Figure 1), with those having PHT showing lower ejection fractions compared to other hemodialysis patients ($p = 0.001$).

Table I: Associations of all parameters with PHT, (n=80)

Parameters		N	%	p-value
PAP	High 25 mmHg	52	65.0	.001
	Normal	25	31.25	
	Low	3	3.75	
PAP (mean)	Male	27.7±6.6		.016
	Female	33.5±10.4		
Ejection fraction	PHT patients	30%		.001
	HD patients	44%		
ESRD causes	Diabetes	32	40.0	.605
	Non-diabetes	48	60.0	
	Hypertension	56	70.0	.095
	Non-hypertension	24	30.0	
iPTH levels	Normal	21	26.25	.127
	High	27	33.75	
	Low	32	40.0	

ESRD causes were analyzed, revealing no association between the presence of diabetes or hypertension and the occurrence of PHT ($p \geq 0.05$). Hemodialysis (HD) access was examined (Figure 2), and no association was found between the type of HD access and PHT ($p \geq 0.05$).

Patients were divided into three groups according to their parathyroid hormone (iPTH) levels: those with normal iPTH (150-300 pg/mL), those with elevated iPTH (> 300 pg/mL), and those with low iPTH (< 150 pg/mL). The relationship between these groups and PHT was then evaluated using Pearson's correlation. There was no association between groups and PHT ($p \geq 0.05$). Furthermore, no association was found between age, levels of serum phosphorus, calcium, hemoglobin, frequency of dialysis sessions per week, dialysis duration, and the presence of PHT ($p \geq 0.05$).

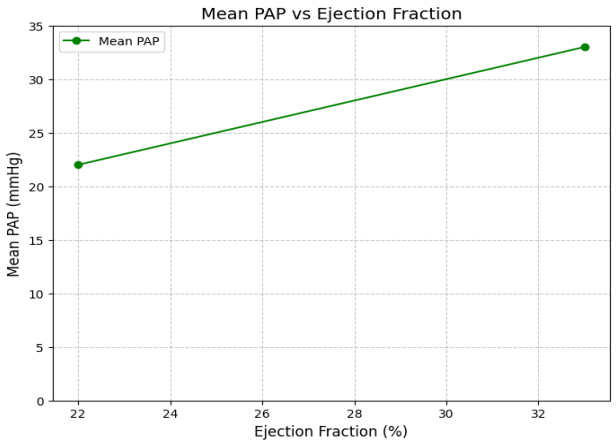

Figure 1: Association of EF with PHT.

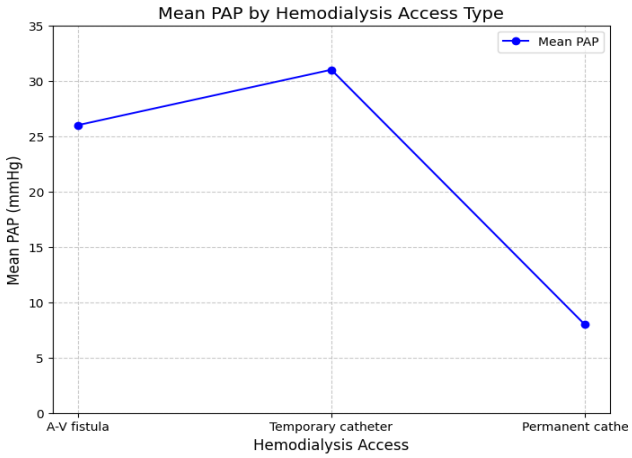

Figure 2. Association of HD access with PHT.

Discussion

While dialysis extends the survival of ESRD patients, their outcomes remain poor and significantly worse than those of general population.[7] For instance, previous studies indicate that the survival rates for patients with ESRD are nearly 8 years for those aged 40-44 and 5 years for those aged 60-64, significantly lower than those of general population.[8] The primary factor contributing to poor outcomes in ESRD patients is high prevalent and cardiovascular diseases severity, such as PHT.[9]

Several studies have examined the relationship between PHT and the survival rate of patients with ESRD. The findings of the studies indicate that PHT is associated with increased all causes of mortality in patients. It is also recommended that this relation with poor survival persists beyond the dialysis period and continues after renal transplantation.[10-12]

This study demonstrated that PHT is a prevalent condition in patients with ESRD. The findings of this study revealed that 65% of ESRD patients on maintenance hemodialysis have PHT, with a higher prevalence in females. Additionally, this study demonstrated that patients of ESRD with PHT have a low ejection fraction compared to other hemodialysis patients.

PHT prevalence in ESRD patients on hemodialysis, as reported in other studies, is similarly high, consistent with the findings of this study.[13-15] For instance, Nagaraju et al examined ESRD patients on prolonged hemodialysis for PHT using Doppler echocardiogram. In that study, PHT was referred as a PAP greater than 35 mmHg, which is a high threshold compared to the one used in this study. They found that 54% patients with ESRD on prolonged hemodialysis had PHT.[16]

The findings of Nithiya et al study validated this hypothesis, showing that parathyroid hormone can lead to calcified of pulmonary artery, then causing PHT. Whereas, the findings of this study, along with those of several others, such as Nithiya et al, did not reveal any association between hyperparathyroidism and PHT.[17]

This is suggested that increases in cardiac output resulting from AV access may contribute to PHT incidence in patients.[18] The findings of Junior et al validated the AV fistula role, showing that ligation of AV fistula functioning led to back of high PAP and cardiac output toward normal levels.[19]

PHT is linked to adverse outcomes, decreased survival rate, and increased all causes of mortality in ESRD. This is recommended that the association to reduced survival rate extends beyond the dialysis duration and continues even after renal transplantation. Whereas, diagnosing early, preventing, and treating PHT are key strategies to enhance the survival rate.

This study had some limitations. The findings of this study are noteworthy; however, its limitations include a short period and a small sample size. Whereas, a multiple centers study with a longer period and a larger patient is essential to better evaluate PHT in ESRD patients.

Conclusion

The findings of this study indicated that PHT is a frequent condition, with 65% of ESRD patients on hemodialysis having PHT. It is more prevalent in females undergoing hemodialysis. The study found no association between cause of ESRD, hemodialysis types, duration, frequency of hemodialysis sessions per week, levels of parathyroid hormone, phosphorus, calcium, or hemoglobin and the presence of PHT.

References

1. Dong TX, Zhu Q, Wang ST, Wang YH, Li GY, Kong FX, et al. Diagnostic and prognostic value of echocardiography in pulmonary hypertension: an umbrella review of systematic reviews and meta-analyses. BMC Pulm Med. 2023;23(1):253. https://doi.org/10.1186/s12890-023-02552-y
2. Maron BA, Abman SH, Elliott CG, Frantz RP, Hopper RK, Horn EM, et al. Pulmonary arterial hypertension: diagnosis, treatment, and novel advances. Am J Respir Crit Care Med. 2021;203(12):1472-1487. https://doi.org/10.1164/rccm.202012-4317SO
3. Ruopp NF, Cockrill BA. Diagnosis and treatment of pulmonary arterial hypertension: a review. JAMA. 2022;327(14):1379-1391. https://doi.org/10.1001/jama.2022.4402
4. Yaghi S, Novikov A, Trandafirescu T. Clinical update on pulmonary hypertension. J Investig Med. 2020;68(4):821-827. https://doi.org/10.1136/jim-2020-001291
5. Maron BA, Brittain EL, Hess E, Waldo SW, Baron AE, Huang S, et al. Pulmonary vascular resistance and clinical outcomes in patients with pulmonary hypertension: a retrospective cohort study. Lancet Respir Med. 2020;8(9):873-884. https://doi.org/10.1016/S2213-2600(20)30317-9
6. Isom RT, Chertow GM. Preparing for hemodialysis. In chronic renal disease. 2020:1157-1173. Academic Press. https://doi.org/10.1016/B978-0-12-815876-0.00070-X
7. AlRashed H, Miele J, Prasad J, Adenikinju D, Iloegbu C, Patena J, et al. Systematic review of end stage renal disease in Pakistan: Identifying implementation research outcomes. PLoS One. 2023;18(12):e0296243. https://doi.org/10.1371/journal.pone.0296243
8. Siddiqa M, Kimber AC, Shabbir J. Multivariable prognostic model for dialysis patients with end stage renal disease: An observational cohort study of Pakistan by external validation. Saudi Med J. 2021;42(7):714-720. https://doi.org/10.15537/smj.2021.42.7.20210082
9. Muhammad A, Zeb MA, Ullah A, Afridi IQ, Ali N. Effect of haemodialysis on haematological parameters in chronic kidney failure patients Peshawar-Pakistan. Pure Appl Biol. 2020;9(1):1163-1169. https://doi.org/10.19045/bspab.2020.90121
10. Balqees N, Hussain S, Yusuf R, Jalal-ud-Din M, Ali J, Muzaffar T, et al. Echocardiographic Findings in Hemodialysis Patients in a Tertiary Care Hospital. Pak Armed Forces Med J. 2022;72(Suppl-3):S678-S682. https://doi.org/10.51253/pafmj.v72iSUPPL-3.9547
11. Iqbal K, Hasanain M, Rathore SS, Iqbal A, Kazmi SK, Yasmin F, et al. Incidence, predictors, and outcomes of early hospital readmissions after kidney transplantation: Systemic review and meta-analysis. Front Med. 2022;9:1038315. https://doi.org/10.3389/fmed.2022.1038315
12. Ahmed J, Khan MF, Augustine R, Siddini V, Ballal S. Prospective Study of Prevalence and Clinical Determinants of Pulmonary Hypertension in Patients on Maintenance Hemodialysis. Indian J Kidney Dis. 2023;2(3):84-89. https://doi.org/10.4103/ijkd.ijkd_13_24
13. Anees M, Akbar H, Ibrahim M, Saeed MS, Ismail M. Pulmonary functions and factors affecting them in patients with chronic kidney disease. Age (years). 2020;30(10):1082-1085. https://doi.org/10.29271/jcpsp.2020.10.1082
14. Sarfraz A, Moon F, Wahid A, Tofique M. Echocardiography Findings in Hemo Dialysis Patients. Pak Heart J. 2022;55(4):331-335.
15. Khalid H, Riaz M, Shafiq S, Ali S, Shahzad A, Bano R. Pathological Pulmonary Manifestations in Chronic Kidney Disease Patients Undergoing Hemodialysis: Pulmonary Manifestations in Hemodialysis Disease. Pak J Health Sci. 2024:20-24. https://doi.org/10.54393/pjhs.v5i05.1415
16. Nagaraju SP, Bhojaraja MV, Paramasivam G, Prabhu RA, Rangaswamy D, Rao IR, et al. Risk factors of pulmonary hypertension in patients on hemodialysis: A single center study. Int J Nephrol Renov Dis. 2021:487-494. https://doi.org/10.2147/IJNRD.S346184
17. Nithiya N, Indhumathi E, Jagadeswaran D, Jayaprakash V, Jayakumar M. Pulmonary hypertension-prevalence, risk factors, and its association with vascular calcification in chronic kidney disease and hemodialysis patients. Saudi J Kidney Dis Transpl. 2020;31(2):380-387. https://doi.org/10.4103/1319-2442.284012
18. Sobh MA, Abdel Aziz EM, Maghraby MH, Herez AM. Pulmonary hypertension in hemodialysis patients. J Curr Med Res Pract. 2022;7(1):39-44.
19. Junior AM, Junior AK, Paschoal EH, Jeha SA. Three extremely rare findings in the same patient: Harlequin syndrome, thyrocervical trunk aneurysm, and systemic-pulmonary arterio-arterial fistula. Ann Vasc Surg. 2017;45:267-e7. https://doi.org/10.1016/j.avsg.2017.06.146