

Prevalence of Pulmonary Hypertension in Patients Undergoing Hemodialysis

Abbas Fadaii,¹ Homayoun Koochi-Kamali,² Bahador Bagheri,³ Fatemeh Hamidimani,¹ Bahar Taherkhanchi⁴

¹Department of Internal Medicine, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

²Department of Cardiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran

³Department of Pharmacology, School of Pharmacy, Tabriz University of Medical Sciences, Tabriz, Iran

⁴Department of Pediatrics, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Keywords. pulmonary hypertension, cardiovascular disease, hemodialysis

Introduction. Pulmonary hypertension (PH) is one of the most important accompanying comorbidities with hemodialysis in patients with end-stage renal disease. The prevalence of hemodialysis-induced PH is still a subject of debate. The goal of the present work was to determine the prevalence of PH in patients undergoing hemodialysis.

Materials and Methods. This study was carried out on patients undergoing hemodialysis for at least 6 months. Pulmonary artery pressure (PAP) was measured by a cardiologist using echocardiography, and a value equal to or higher than 35 mm Hg was considered PH. The relationship of a high PAP with demographic and clinical characteristics of the patients was assessed.

Results. A total of 102 patients were included in the study. The mean of age was 59 ± 18 years. The most common cause of end-stage renal disease was diabetes mellitus (35%). The mean duration of hemodialysis was 24 ± 17 months. The mean ejection fraction and PAP were $57 \pm 5\%$ (range, 44% to 73%) and 39 ± 9 mm Hg (range, 25 mm Hg to 70 mm Hg), respectively. Overall, 66% of the patients had PH. These patients were more likely to be on dialysis for a longer duration and to have low ejection fractions. They were also older than other patients.

Conclusion. Our findings show that PH is associated with duration of dialysis, age, and ejection fraction. Due to the high prevalence of PH among hemodialysis patients, it is necessary to screen this disorder and minimize its effects.

IJKD 2013;7:60-3
www.ijkd.org

INTRODUCTION

Normal systolic blood pressure of pulmonary artery is 30 mm Hg. Generally, pulmonary blood flow has low pressure. There is no global agreement for the exact definition of pulmonary hypertension; however, a value of 35 mm Hg and higher is mostly considered as a pulmonary hypertension (PH). Right heart catheterization is a standard method to measure pulmonary artery pressure. As ventricle catheterization is an invasive method, echocardiography is regarded as a safe

alternative method in many clinical studies. Since sensitivity and specificity of echocardiography is 83% and 72%, respectively, it is possible to use this method for screening.¹

Increase in pulmonary artery pressure can be primary, idiopathic, or secondary due to concomitant diseases.¹⁻³ According to new etiological classification of PH, chronic kidney failure (CKF) is ranked as the fifth cause of PH.³ Pulmonary hypertension can cause many untoward effects on the quality of life of patients that are usually

overwhelming. Pulmonary hypertension and CKF have similar signs and symptoms, and diagnosis of PH needs strong clinical suspect.⁴ Early diagnosis of the disease and appropriate treatment can improve the course of the disease over the time.⁴

Although hemodialysis has widespread application for the treatment of CKF, its long-term effects on the respiratory system and its mechanisms of action are not known with certainty.⁵ Metabolic and endocrine abnormalities which result from CKF can contribute to constriction of pulmonary vessels and increase vascular resistance and subsequently increase PH.^{6,7} Increase in cardiac output due to arteriovenous fistula may increase the likelihood of PH.⁸ Moreover, anemia and volume overload are regarded as other causes of PH.^{8,9} Pulmonary hypertension as one of the most important causes of mortality and morbidity in CKF patients has gained prominence during the recent years.⁵ In the present work, we studied the prevalence of and characteristics associated with PH in patients who underwent hemodialysis.

MATERIALS AND METHODS

Our prospective study was carried out in the hemodialysis unit of Shahid Labbafinejad Hospital, in Tehran. The inclusion criterion was hemodialysis by arteriovenous fistula for at least 6 months. The exclusion criteria were as follows: kidney transplantation, heart disease with an ejection fraction less than 40%, respiratory illness with occlusive view of spirometry, and use of calcium channel blockers medications. Patients' clinical and baseline characteristics were recorded. Echocardiography was done for all of the patients and all of important parameters including pulmonary artery pressure were measured. This investigation was approved by ethics committee of Shahid Beheshti University of Medical Sciences, and all of the patients signed an informed letter of consent.

For data analysis, we used the SPSS software (Statistical Package for the Social Sciences, version 13.0, SPSS Inc, Chicago, Ill, USA). The independent *t* test was applied for comparison of mean values between groups. *P* values less than .05 were considered significant.

RESULTS

Of 400 patients who were undergoing

hemodialysis in 2010, a total of 102 patients were included in the study. Fifty-four patients were men (53%) and 48 patients were women (47%). Baseline characteristics of the study patients are presented in Table 1. The mean of age was 59 ± 18 years. The most common cause of kidney failure was diabetes mellitus (35%). Dialysis duration was 7 to 72 months (mean, 24 ± 17 months).

The ejection fraction ranged from 44% to 73% ($57 \pm 5\%$). Pulmonary artery pressure (PAP) was 25 mm Hg to 70 mm Hg (39 ± 9 mm Hg). Table 2 shows the association of the PAP with baseline factors. Regarding a PAP of 35 mm Hg and greater as a PH, 67 patients (66%) had pulmonary hypertension. In comparison with patients with normal PAP, PH patients were older (63 ± 16 years, $P < .001$). Patients with PH had longer duration of hospitalization in comparison with other hemodialysis patients (29 ± 18 days, $P = .01$). A lower ejection fraction was linked with a higher PAP (56 ± 5 mm Hg). On

Table 1. Baseline Characteristics of Patients*

Characteristic	Value
Mean age, y	59 ± 18
Males	54 (53)
Cause of kidney failure	
Diabetes mellitus	36 (35)
Hypertension	21 (20)
Urological disease	9 (9)
Glomerulonephritis	8 (8)
Other	5 (5)
Unknown	4 (4)
Medications	
Angiotensin-converting enzyme inhibitors	79 (77)
Nitrates	18 (17)
Diuretics	9 (9)
Beta blockers	12 (12)

*Data are shown as number (%) or mean ± standard deviation.

Table 2. Comparisons of Patients With High and Normal Pulmonary Artery Pressure (PAP)*

Parameter	Normal PAP	High PAP	<i>P</i>
Age, y	52 ± 20	63 ± 16	.008
Gender			
Male	19 (54)	35 (52)	
Female	16 (46)	32 (48)	.84
Duration of dialysis, mo	14 ± 8	29 ± 18	.001
Ejection fraction, %	59 ± 5	56 ± 5	.01
Cause of kidney failure			
Diabetes mellitus or hypertension	25 (71)	51 (76)	
Other	10 (29)	16 (24)	.61

*Data are shown as number (%) or mean ± standard deviation.

the other hand, patients with normal PAP showed a mean ejection fraction of $59 \pm 5\%$ ($P = .01$). No significant association was observed in the use of medications and causes of CKF between the two groups.

DISCUSSION

Patients with CKF who undergo hemodialysis are markedly prone to various diseases such as PH. It is not elucidated how PH develops. Akmal and colleagues showed that parathyroid hormone could cause calcification of the pulmonary artery in dogs and concluded that right ventricle failure was because of increased pulmonary artery pressure secondary to pulmonary artery wall calcification and stiffness.¹¹ Additionally, Barak and Katz understood that microbubbles created during dialysis might entrap into the arteries of the lung and cause PH.¹² In our study, two-third of the patients had PH. In Mousavi and colleagues' study on 62 patients, the prevalence of PH was 51.6%, and reduction in serum albumin and anemia were considered as contributing causes of PH.¹³ They failed to reach a significant relationship between age and duration of hemodialysis with PAP. On the contrary to our findings, they showed that patients with PH had higher ejection fraction than the other group. Abdelwhab and Elshinnawy, in their study on 45 patients on hemodialysis using arteriovenous fistula, revealed that the prevalence of PH was 44.4% and it was linked to systolic dysfunction of the left ventricle. It was shown that increase in serum levels of thromboxane b2 and pro-brain natriuretic peptide and high flow in the arteriovenous fistula could be related to PH.¹⁵ In that study, the role of ejection fraction and duration of hemodialysis were not investigated. Dagli and colleagues found that 21.6% of 116 patients who underwent hemodialysis through arteriovenous fistula had PH.¹⁶ An increase in PAP was in concert with increase in the flow of arteriovenous fistula, reduced output of the left ventricle, and smoking. Moreover, none of the patients had primary respiratory disease.¹⁶ One study showed a higher prevalence of PH in women.¹⁷

In the present study, the prevalence of PH was 66% yet in other studies it ranged from 29% to 56%.¹³⁻¹⁷ In comparison with a number of investigations, our study and two similar studies in Iran^{13,14} demonstrated that prevalence of PH is

higher than other countries. Differences in subjects' characteristics, protocols of hemodialysis, and also environmental and genetic differences may explain the higher prevalence of PH in Iranian populations.

In contrast to Mousavi and colleagues' study,¹³ we found that age, duration of hemodialysis, and lower ejection fraction are linked to the high prevalence of PH. Blood flow of the fistula can serve as one of the major causes of PH.¹⁵⁻¹⁷ Interestingly, Yigla and coworkers proved that an increase in the flow of the fistula is positively correlated with increase in ejection fraction and subsequently increase in PAP. They also confirmed that surgery on the place of arteriovenous fistula decreased PH.¹⁸ Compared with Havlucu and colleagues' study,¹⁹ we observed an important difference; they demonstrated that patients with PH had high ejection fraction and attributed this finding to increase in blood flow of the fistula, anemia, and secondary hypervolemia due to CKF. In contrast to their findings, we found that our patients had lower ejection fraction. Higher prevalence of coronary artery disease and ischemia of the left ventricle may be the basis of this difference. It seems that further studies should provide more insight into PH in such patients.

CONCLUSIONS

Our findings show that PH is associated with duration of dialysis, age, and ejection fraction. Due to the high prevalence of PH among hemodialysis patients, it is necessary to screen this disorder and diminish its effects.

ACKNOWLEDGMENTS

The authors wish to thank the hemodialysis staff of Shahid Labbafinejad Hospital for their continuing efforts.

CONFLICT OF INTEREST

None declared.

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Correspondence to:
 Abbas Fadaii, MD
 Department of Internal Medicine, Labbafi Nejad Hospital, Tehran, Iran
 Email: abbasfadaii@gmail.com

Received April 2012
 Revised September 2012
 Accepted September 2012