

To assess the Correlation of Arteriovenous Fistula Flow with Pulmonary Hypertension in End Stage Renal Disease

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ABSTRACT

Background: Chronic kidney disease (CKD) is a global health care issue and a major burden on health care system. Pulmonary hypertension (PH) is an increase of blood pressure in pulmonary artery, vein or capillaries, it is a progressive disorder effecting heart, lung and other systems with increased morbidity and mortality regardless of etiology. The AVF is low resistance outflow tract in dialysis patient causing increased in cardiac output to maintain blood pressure which leads to development of PH.

Aim: To assess the correlation of Arteriovenous Fistula Flow with Pulmonary Hypertension in End Stage Renal Disease.

Methods: This cross-sectional descriptive study was conducted for one year. Patients were included by using Non probability purposive sampling technique. All patients had Doppler Ultrasound of fistula and graft to measure flow and at the same time was evaluated for PH by echocardiography. The data was collected for age, gender, location of AV fistula, duration of AV fistula and AV access flow.

Results: In our study the age varies between 20 to 69 years, 88 were male, 141 had AV fistula as access and 84 had brachial access location. The cases above 45 had 44.3% with pulmonary hypertension as compared to <45 years with 32.3% (p-value = 0.194). The prevalence of pulmonary hypertension was insignificant for two genders, AV access type, location and duration of AV access. Among cases with AV flow more than 890 ml/min 53 (89.8%) had pulmonary hypertension while only 3 (3.5%) among those with AV flow <890 ml/min (p-value <0.001).

Conclusion: The AV flow above 890 ml/min was clear indication of pulmonary hypertension, and the pulmonary hypertension had no significant relation with gender, age, AV access, location and duration.

Keywords: Pulmonary hypertension, Arteriovenous Access Blood Flow, Hemodialysis.

INTRODUCTION

Chronic kidney disease (CKD) is prevalent worldwide and has a huge burden on limited health care resources. Cardiovascular disease is a common in CKD and associated with high mortality¹⁻³. The incident of Cardiovascular disease exceed 50% in Hemodialysis patients⁴. Coronary artery disease is most common cardiovascular disease complication in CKD but other cardiovascular complication e.g., PH is also prevalent.

Pulmonary hypertension (PH) is common in ESRD patients and is an independent predictor of mortality in this population^{5,6}. The prevalence of PH in Hemodialysis patients is 39.7%⁷. Etiology of pulmonary hypertension (PH) can be secondary to Systemic, Heart or Lung diseases., PH is associated with high morbidity and mortality irrespective of etiology^{8,9}.

PH clinical symptoms usually masked by the underlying etiology, that is why diagnosis of secondary PH is difficult and only confirmed when patient has right ventricular failure. Pulmonary hypertension (PH) is usually defined as a pulmonary artery pressure (PAP) greater than 30mmHg using echocardiography¹⁰.

The etiology of PH is multifactorial^{11,12}. The predisposing factors of PH in ESRD are chronic fluid overload, pulmonary vasculature affected by metabolic

derangement, calcium and phosphate metabolic derangement resulting in metastatic pulmonary artery calcification, anemia, decreased nitric oxide production, left ventricular diastolic dysfunction and chronically increased blood flow from Arteriovenous (AV) fistula or Arteriovenous (AV) graft¹³.

The creation of low-resistance outflow tract through the Arteriovenous fistula and subsequent cardiac compensation result in increased cardiac output to maintained blood pressure (BP) this is a underlying mechanism involved in development of PH in ESRD patients¹⁴.

Secondary PH can be developed in ESRD patients due to high blood flow through Arteriovenous fistula, this complication can be resolved after AVF fistula closure¹⁵. The reversal of Arteriovenous Fistula after kidney transplant results insignificant improvement in cardiac output and PAP to normal range^{11,16,17}.

The correlation between Arteriovenous fistula blood flow with PH in ESRD patients has not been studied in our population. This serious complication is usually overlooked by physicians resulting in permanent heart failure leading to increased risk of mortality in ESRD patients. The aim is to conduct a study, to determine the frequency of PH in patients on Hemodialysis patients and its relationship with Arteriovenous fistula blood flow, to stress the importance of early and timely detection of PH by performing routine echocardiography and Doppler ultrasound of Arteriovenous fistula. Those patients where PH is diagnosed, this

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complication can be prevented by shifting patients to peritoneal dialysis, closure of AV fistula or advised patient to opted for renal transplant if organ is avialable.¹⁷

The objective of the study was to assess the correlation of Arteriovenous Fistula Flow with Pulmonary Hypertension in End Stage Renal Disease.

MATERIAL AND METHOD

This cross sectional descriptive study was conducted at Shaikh Zayed Hospital's dialysis department, Lahore for one year. Non probability purposive sampling technique was used. Sample size of 144 is estimated by using 95% confidence level, 90% power of test with expected prevalence of PH among Hemodialysis patients of 39.7% with 10% margin of error. Patients of both genders, 18 or above undergoing Hemodialysis through Arteriovenous fistula, Arteriovenous grafts. ESRD was defined as Patients whose Creatinine clearance are less than 15ml/min/1.73m² and are on regular Hemodialysis. Arteriovenous blood flow was measured by using Doppler Ultrasound. Blood flow measurement was done 1-3 cm proximal to the fistula on nourishing artery side: patients having history of chronic obstructive pulmonary disease, chest wall deformities, known parenchyma lung disease, previous history of pulmonary embolism, symptoms and previous diagnosis of collagen vascular Disease, Echocardiography abnormalities i.e. left ventricular ejection fraction below 50%, left-to-right shunt, moderate to severe mitral or aortic valve disease, symptoms of obstructive sleep apnea were excluded.

Data Collection Procedure: Patients visiting the dialysis unit were enrolled after taking informed consent. These patients had Doppler Ultrasound of fistula and graft to measure flow by single observer (Assistant professor of Radiology department and primary investigator will be present during these procedure) and at the same time was evaluated for PH by echocardiography by single observer (Senior Registrar of Cardiology department and primary investigator will be present during these procedure). The data was collected for age, gender, location of AV fistula, duration of AV fistula and AV access flow. Pulmonary artery pressure (PAP) was defined as > 30mmHg using Echocardiography.

Data Analysis: The data were entered and analyzed by using SPSS version 20.0. Data for gender, AV Access, location and duration and presence of pulmonary hypertension were described by using frequency and percentages. Data for Age, AV flow and pulmonary arterial pressure were described by using mean and SD.

RESULTS

The mean age for these cases was 45±14 years, Av flow was 918±97 ml/min. There were 88(61.1%) males, 141(97.9%) had AV fistula as access and 84(58.3%) had brachial access location. The duration of dialysis was <1 year, 1 – 2 years and more than 2 years each for 48 cases. The Pulmonary hypertension was found in 56(38.9%) of the cases. Table 1

The cases with age above 45 had 44.3% with pulmonary hypertension as compared to <45 years with 32.3% but the difference was insignificant with p-value

0.194. The prevalence of pulmonary hypertension was insignificant for two genders, AV access type, location and duration of AV access. Among cases with AV flow more than 890 ml/min, 53(89.8%) had pulmonary hypertension while only 3(3.5%) among those with AV flow <890 ml/min. this difference was highly significant with p-value <0.001. Table 2

Table 1: Basic characteristics of patients on hemodialysis with Pulmonary hypertension status

Age		45±14
Gender	Male	88 (61.1%)
	Female	56 (38.9%)
AV access	AV fistula	141 (97.9%)
	AV Bridge graft	3 (2.1%)
AV flow		918±197
Location	Radial	60 (41.7%)
	Brachial	84 (58.3%)
Duration of AV access	< 1 Year	48 (33.3%)
	1 - 2 Years	48 (33.3%)
	> 2 Years	48 (33.3%)
PAP (mmHg)		30.5±3.1
Pulmonary Hypertension	Yes	56 (38.9%)
	No	88 (61.1%)

Table 2 Comparison of characteristics between groups with and without pulmonary hypertension

		Pulmonary Hypertension					P-value (N ²)
		Yes		No		Total	
		N	%	N	%	N	
Age	> 45	35	44.3	44	55.7	79	0.194
	≤ 45	21	32.3	44	67.7	65	
Gender	Male	37	42.0	51	58.0	88	0.424
	Female	19	33.9	37	66.1	56	
AV access	AV fistula	53	37.6	88	62.4	141	0.057
	AV Bridge graft	3	100.0	0	0.0	3	
Location	Radial	19	31.7	41	68.3	60	0.184
	Brachial	37	44.0	47	56.0	84	
Duration of AV access	< 1 Year	23	47.9	25	52.1	48	0.285
	1 - 2 Years	16	33.3	32	66.7	48	
	> 2 Years	17	35.4	31	64.6	48	
AV Flow (ml/min)	> 890	53	89.8	6	10.2	59	< 0.001
	≤ 890	3	3.5	82	96.5	85	

DISCUSSION

Pulmonary hypertension (PH) has a high morbidity and mortality regardless of etiology. PH is serious complication in ESRD patients and is independent predictor from cardiovascular risk related mortality in this population.

In our study the among cases with AV flow more than 890 ml/min, 53(89.8%) had pulmonary hypertension while only 3(3.5%) among those with AV flow <890 ml/min. this difference was highly significant with p-value <0.001. The prevalence of PH was 38.2 % study conducted by Yigla at al¹⁸ that performed small prospective study looking prevalence of PH in ESRD patients. Another study conducted by Mazdeh at al¹⁹ found prevalence of PH in long standing dialysis patients was 52% which was slightly higher as compare to we find in our study. The prevalence was highest among patients with ESRD receiving long-term hemodialysis (41.53%) especially in patients with older age, longer duration of dialysis, higher AV fistula flow, cardiac output was observer by Emara M at al²⁰.

Another study conducted in Egypt by Khamis et al.²¹ showed a very high prevalence of PH (60%) among CKD and it was higher among Hemodialysis patients (76.7%). Beigi AA et al.²² conducted study on 34 patients found statistically significant positive correlation between fistula flow and PH. It may be because they observe high fistula flow of > 1200 ml/min strongly associated with PH; where as in our study mean fistula flow is lower than their study. Unal A et al.²³ conducted study to assess the long-term effects of AVF on development of PH and the relationship between AVF flow with PAP in the ESRD patients observe no significant correlation between AVF Flow with PAP in development of PH Mehdi et al observe that there was high fistula flow in ESRD patients with PH, he also observed the main reason of high fistula flow are its location and artery diameter of fistula.

Arteriovenous fistula formation ESRD patients have strong association with development of PH. Increased systolic PAP initially sign appear which fistula is formed. This increased in systolic PAP is associated with fistula flow as a result ligation of the fistula partial or total is associated with a decrease in systolic PAP.

The Vascular and systemic calcifications due to altered in calcium and phosphate metabolism in ESRD result in increased rigidity and thickening of the pulmonary vessels as well as endothelial dysfunction. This result in excessive vasoconstriction or altered vasodilatation leading to increased vascular pulmonary resistance. Uremia is associated with extensive calcium depositions in the bronchial tree and the lung interstitium as well as the pulmonary vasculature.

CONCLUSION

The AV flow above 890 ml/min was clear indication of pulmonary hypertension, and the pulmonary hypertension had no significant relation with gender, age, AV access, location and duration.

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