



FREQUENCY OF PULMONARY HYPERTENSION IN PATIENTS WITH LEFT VENTRICULAR SYSTOLIC DYSFUNCTION AT MAYO HOSPITAL

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SK:Conducted the study and wrote the article. FY:Helped in review the article.BA:Re-arranged data and corrected article.FK:Tables and figures and corrections and did the proof reading.

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ABSTRACT

BACKGROUND:Pulmonary hypertension (PH) is the commonly seen phenomenon in the patients of left ventricular systolic dysfunction. The literature available in Pakistan is sparse on PH with heart failure. This study was implemented to see the frequency of PH in patients of LV systolic dysfunction .

METHODS:The transthoracic echocardiography of a total of 100 patients having heart failure was conducted. The diagnosis of PH was established using the jet of tricuspid regurgitation and IVC indices profile.

RESULTS: 70% of the patients having LV systolic dysfunction had PH.

CONCLUSION: PH is very common in LV systolic dysfunction in patients presenting in Mayo Hospital.

KEYWORDS: Pulmonary hypertension, Left ventricular systolic dysfunction

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INTRODUCTION

The definition of heart failure according to National Institute is a clinical syndrome that occurs due to any pathology impairing the capability of heart to eject or fill the blood, in order to maintain a normal circulatory circuit. In the beginning left heart is involved more commonly and ultimately the right heart involved later on, hence a biventricular picture came into being. Overall, the heart failure has got a poor prognosis. The pulmonary hypertension is a noticeable predictor of all-cause mortality and cardiovascular mortality in patients having cardiac failure.¹⁻³

The classification of PH according to the World Health Organization (Venice 2003) has been declared into five main categories. PH due to left heart disease comes under second category.⁴

From haemodynamic perspective, the definition of PH includes the mean arterial pulmonary pressure in resting state of more than 25 mmHg and/or pulmonary Vascular Resistance in resting state of more than 3 Wood Units.⁵

The PH's pathological mechanisms secondary to left heart disease may certainly be multifactorial and is not fully understood.⁶

The series of events initiates with the augmentation in LV filling pressures, which leads to rise in backward pressures in the pulmonary veins which finally results in the rise in pulmonary capillary wedge pressure. This subsequently give rise to acute pulmonary edema which initially is known as "reactive PH".⁷⁻⁹ If left untreated, rise in filling pressures in left side of heart transforms into "fixed PH" which possesses the characteristics of pulmonary vascular remodeling, which successively cause the maintenance of transpulmonary gradient to elude decompensated heart failure.¹⁰

As the PH persists, the alveolar membrane develops irreversible remodeling in addition to the deposition of collagen type IV occurs.¹¹ As a result of which rise in transpulmonary gradient & PVR occurs.¹² Due to all these pathological transitions in pre- and postcapillary vasculature, PH development occurs.¹⁰

Contrary to the latest advancements in management of PH in current era for idiopathic PH, a little breakthrough has been established for second type of PH.⁶

Very sparse literature on PH is found in the people of Pakistan suffering from systolic dysfunction of LV, which might serve as a basis to perform our own research regarding the development of advanced trends in treatment of this group of

patients.

This study was conducted to ascertain the frequency of PH in the patients of LV systolic dysfunction.

METHODOLOGY:

One hundred patients having heart failure who were clinically diagnosed using Framingham's criteria¹³, over a time period of one year that is from January 2018 to December 2018, were included into the study. The clinical and the demographic data relevant to the study were obtained, and the transthoracic echocardiography was conducted by using GE Vivid E9& S6 echocardiography machine. The measurements obtained on echocardiography were according to the recommendations of the American Society of Echocardiography and an average of three consecutive cardiac cycles were obtained.

The pulmonary artery systolic pressure (PASP) assessment was performed by identifying a coaxial

Table-1: Aetiology of LV systolic dysfunction with PH.

	Frequency	Percent	Cumulative- Percentage
Ischamic Heart Disease	66	66.0	66.0
Dilated Cardiomyopathy	20	20.0	86.0
Rheumatic Mitral Stenosis	1	1.0	87.0
Post-CABG Cardiomyopathy	4	4.0	91.0
Post MVR with DCM	5	5.0	96.0
Post DVR with DCM	2	2.0	98.0
Peripartum Cardiomyopathy	2	2.0	100.0
Total	100	100.0	

Abbreviations: HFrEF, heart failure with reduced ejection fraction; DCM, dilated cardiomyopathy; MVR, Mitral Valve Replacement; DVR, Dual Valve Replacement; CABG, Coronary Artery Bypass Grafting

Table-2: Range, mean and the standard deviation of Left Ventricular Ejection Fraction.

	Number of patients (N)	Minimum LVEF(%)	Maximum LVEF(%)	Mean LVEF(%)	Std. Deviation
LVEF	100	15.00	48.00	33.8800	8.44385

Table-3: Grading of LV systolic dysfunction in study subjects.

	Frequency	Percentage (%)	Valid- Percent	Cumulative- Percent
Mild LVSD	25	25.0	25.0	25.0
Moderate LVSD	30	30.0	30.0	55.0
Severe LVSD	45	45.0	45.0	100.0
Total	100	100.0	100.0	

Table-4: The mean, minimum and the maximum values of the Estimated Pulmonary artery pressure in mmHg.

	N	Range	Minimum	Maximum	Mean	Std. Deviation
EPASP (in mmHg)	100	66.00	19.00	85.00	43.4100	16.15524

Table-5: Distribution of grading of PH in LV systolic dysfunction population.

	Frequency	Percent	Valid -Percent	Cumulative-Percent
0 (No PH)	30	30.0	30.0	30.0
Mild PH	22	22.0	22.0	52.0
Moderate PH	40	40.0	40.0	92.0
Severe PH	8	8.0	8.0	100.0
Total	100	100.0	100.0	

Table-6: Cross tabulation of Grades of LVSD & Grades of PH.

		GradeofLVSD			Total
		Mild LVSD	Moderate LVSD	Severe LVSD	
Grade of PH	0	10	14	6	30
	Mild PH	6	7	9	22
	Moderate PH	8	8	24	40
	Severe PH	1	1	6	8
Total	25	30	45	100	

Table.7. Grades of PH & grades of LVSD. (Showing co-relation between variables is significant i.e P <0.005)

	Value	df	Asymptotic Significance (Two-sided)
Pearson Chi-Square	14.579 ^a	6	.024
Likelihood Ratio	15.290	6	.018

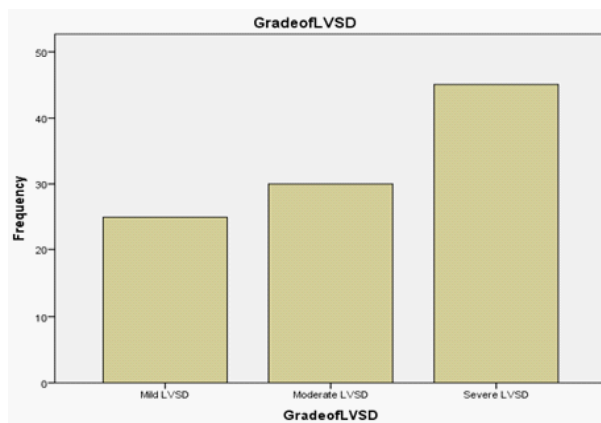


Figure-1 : Categorisation of the patients of cardiac failure according to the severity of LV systolic dysfunction.

TR jet in apical 4-chamber view by applying continuous wave Doppler and then measuring maximal tricuspid regurgitation velocity, and afterwards applying the modified Bernoulli equation to convert this value into pressure values. Estimated right atrial pressure (RAP) was added to this obtained value. Therefore, EPASP was calculated by adding TVPG to eRAP.

eRAP (estimated RA pressure) was estimated by ASE (American Society of Echocardiography) Guidelines 2010, using Collapsibility Index & maximum width IVC. When maximum IVC (Inferior vena cava) diameter is <2.1cm with the collaps-

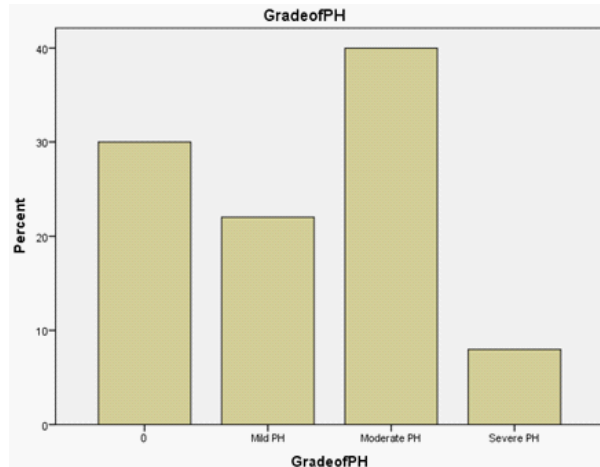


Figure-2: Distribution of patients in specific grade of PH.

ibility index of >50% then eRAP is normal i.e 0-5 mmHg. When maximum IVC width is less than or equal to 2.1cm & collapsibility index is <50% then the eRAP is 10mmHg. When maximum IVC diameter is >2.1 cm & collapsibility index is <50% then the eRAP is 15mmHg.^{14,15} The severity of PH on the basis of EPASP is categorized as ,mild PH when EPASP is >40mmHg, moderate PH when EPASP is >50mmHg and severe PH is defined as when EPASP is >60mmHg.^{14,15}

Patients who had not detectable jets of TR were excluded from the study.

The determination of left ventricular systolic function by deriving left ventricular ejection fraction (LVEF) was carried out from two dimensional M Mode. When LVEF was less than 50%, it is called LV systolic dysfunction(LVSD).The further LVSD is classified into three groups, mild (when EF is between 41-49%), moderate has cut off value between 30-40% ,and severe (when EF is less than 30%).¹⁶

SPSS 17 software of computer was used to enter all variables of data. Mean, standard deviation, were used to express the continuous variables and chi square analysis was applied to express associations between categorical variables. Figure and graphs were made to depict results. P value less than or equal to 0.05 was of statistical significance.

Ethics committee of hospital cleared the study's ethical issues. After the permission of Cardiology department, Mayo Hospital, the research was carried out. Consent was taken from the patients.

RESULTS:

The sample size of the study consisted of one



hundred patients of whom 69 were males and 31 were females. The proportion of subjects having PH was found to be 70% in subjects with LV systolic dysfunction. Regarding the symptoms, shortness of breath was the commonest symptom present in 51% of subjects, chest pain in 29%, palpitations in 8%, generalized body swellings in 7%, syncope in 3% and fatigue in 2% of the patients. The most common cause of LVSD was ischemic heart disease accounting for 66% cases, which was followed by dilated cardiomyopathy (20%) and others are shown in Table 1.

The range of LVEF was from 15% to 48% with a mean value of 33 (Table 2).

Table 3 depicts the grading of LVSD in the study. 25% patients had mild LVSD, 30% patients were in moderate LVSD, and 45% patients had severe LVSD.

The values of estimated pulmonary artery systolic pressures are represented in Table 4. The range of estimated pulmonary artery pressure was from 19 to 85 mmHg while the mean value of 43.41 mmHg.

According to severity of LV systolic dysfunction the patients are categorized as shown in Figure 1. 25 patients (25%) had mild systolic dysfunction, 30 (30%) subjects were known to have moderate systolic dysfunction, and 45 (45%) patients were suffering from severe LV systolic dysfunction.

30% of patients have no PH, 22% of patients have mild PH, 40% have moderate PH and 8% have severe PH as shown in Table 5.

DISCUSSION:

The results of the current study showed that PH's prevalence in patients of heart failure visiting our institution is about 70%. The comparable prevalence is seen in few studies done on Caucasian population having heart failure. The prevalence of PH about 72% which was identified by Butler et al in heart failure population.¹⁷ 79% patients had PH in heart failure which was reported by Fowler and Costard Jackle.¹⁸ Bursi et al mentioned in his community based research that PH is seen in 79% of heart failure patients.¹

Though the catheterization of the right heart is the gold standard investigation regarding diagnosis of PH. On the contrary, Doppler modality of transthoracic echocardiography is proved to be an appropriate screening tool for the diagnosis of PH.¹⁹

The left ventricular systolic dysfunction serves

to raise the grade of PH. In our study, it has been analysed that augmenting the values of pulmonary artery pressures with increasing severity of LV systolic dysfunction. It has been analysed that EPASP correlated inversely with left ventricular ejection fraction. Enriquez-Sarano et al²⁰ have noticed the same findings that the severity of PH correlated with LVEF ($P=0.02$). Enriquez-Sarano et al.²⁰ also stressed that a significant inverse correlation between pressure of PA and LV dysfunction is seen in heart failure patients. Lam et al reported that EPASP is a noticeable indicator of haemodynamic status and can be precisely evaluated via a non-invasive investigation i.e transthoracic echo. Whereas, EPASP is also an independent prognostic indicator of increased LV filling pressures.

Genetic polymorphism has role in emergence of PH due to left heart pathology, but it has not got marked attention. Genetically determined predisposition to neuro-hormonal abnormalities can cause PH in pathologies of left heart.²¹

The report by Lam et al revealed that increased PA pressure was seen in subjects having systemic hypertension as compared to those having systemic hypertension but without heart failure, despite having the same value of pulmonary capillary wedge pressure. This depicted the strong evidence that LV systolic dysfunction influences the increased value of PA pressure.²²

One of the significant predictor of one year mortality of cardiac failure is severe PH derived from echocardiography.²³ Elevated values of estimated pulmonary artery pressure obtained from echocardiography is reported that it is a noticeable predictor of one year mortality in heart failure subjects.²³ Hence, there are evidences that link increased PA pressures and raised mortality in heart failure patients.²⁴⁻²⁶ Nonetheless, it is evident that there is association of elevated PA pressures, and increased mortality in heart failure.²⁴⁻²⁶

CONCLUSION:

In this study, PH is very common in patients of heart failure which accounts to the prevalence of 70%. There is contribution of LV systolic dysfunction which leads to the presence and severity of PH. The basis to carry out the studies aiming at PH secondary to cardiac failure in our clinical setups should be done, as there is high burden and consequential effects of PH in cardiac failure. Therefore, longitudinal studies are suggested to determine the PH effects on patients with cardiac failure.



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