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Incidence of Right Ventricular Dysfunction in Patients of LV Dysfunction with Coronary Artery Disease and Short Term Outcome

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ABSTRACT

Objective: To determine the incidence of RV dysfunction in patients of LV dysfunction with coronary artery disease and short term outcome.

Methodology: This prospective study was carried out on 168 patients with LV dysfunction with coronary artery disease in the Echocardiography Unit of the departments of Cardiology, Liaquat University Hospital, Hyderabad from 1st October 2017 to 31st October 2018 and followed for three months. All patients with documented CAD were included. RV evaluation was performed on echocardiography through visual evaluation of RV function, RV region measured in four-chamber perspective, and RV duration in a lengthy parasternal perspective. RV dysfunction was characterized as TAPSE of less than 1.2 cm. (RV ejection fraction < 35%). All the data was calculated on SPSS version 16.0.

Results: A total of 168 patients were included in this study based on inclusion criteria, out of the 92(54.7%) were male and 76 (45.3%) were female. The mean ± SD (range) was 52.36 ± 10.44 (30 to 60 years). The mean ± SD of RV ejection fraction was 40.73 ± 8.23% (range 25 to 52). The incidence of RV dysfunction was present in 30(17.8%) patients.

Conclusion: In patients with LV dysfunction with coronary disease, RV dysfunction is prevalent in our patients. It is an independent predictor of death and the development of HF in patients with LV dysfunction

Keywords: RV dysfunction, LV dysfunction, coronary artery disease.

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Introduction

The prevalence of heart failure continues to increase worldwide and accounts for a major part of healthcare expenditure in developed and developing economies.[1,2] The increasing burden of risk factors for heart failure seems to be a major driving force for the increase in the prevalence of heart failure.[3] While heart failure is a syndrome, which may be inclusive of symptoms of both left and right heart failure, less emphasis is placed on the right ventricular (RV) function in heart failure patients.[4]

Coronary artery disease (CAD) is the world's most common cause of morbidity and death.[5] The primary function of the Right Ventricle is to collect structural blood and pump it for oxygenation into the pulmonary circulation. Congenital heart disease, the valvular hearing disease in patients with CAD, lung hypertension, and heart failure, RV dysfunction was connected with enhanced morbidity and mortality[6]. Many types of research have

shown the cardiovascular risk value of the RV feature in CAD in the latest years.[6]

RV dysfunction is a complex disorder that can be caused by any underlying cardiovascular disease that undermines the ability of the RV to fill or expel blood. RV failure's cardinal clinical characteristics are i) Retention of fluids that can cause ascites, edema, ii) Low systolic reserve or cardiac performance, which may consequence in fatigue practice, and iii) atrial or ventricular arrhythmias.

RV Dysfunction Assessment: Echocardiography is the most appropriate RV size and feature evaluation method. The size of the RV should be likened to the size of the left ventricle (LV) for statistical evaluation. The ordinary RV size in apical four-chamber and lengthy parasternal axis opinions is about two-thirds the size of LV. If RV is larger than LV and/or shares the apex, it will be dilated. RV should be lower than LV in brief axis opinions. The RV feature is evaluated by assessing the RV region in the four-chamber perspective and the distance from the lengthy parasternal perspective.[7]

The measurement of tricuspid annular plane systolic excursion (TAPSE) is another quantitative technique for evaluating RV function. The TAPSE calculates RV systolic function by evaluating, in the four-chamber perspective.[8]

The myocardial performance Doppler index is also utilized to find out the RV feature.[9]

The cardiac rate, loading circumstances, or the existence and severity of tricuspid regurgitation do not affect this technique of RV function assessment.[9] Tissue Doppler Imaging (TDI) can even be utilized by measuring coronary artery disease as a means of quantitatively evaluating RV systolic and diastolic functions. The peak systolic speeds less than 11.5 cm / s identify RV dysfunction of 90 percent and 85 percent respectively with sensitivity and specificity.[7] Some other techniques also include echocardiography in real-time, stress rates, and MRI studies. There is a lot of other techniques for RV function evaluations. MRI has been the most exact method of quantitative RV size and function assessment.[10]

Various adaptive mechanisms which occur in left heart disease will eventually affect the right heart because they shared similar interphase in the interventricular septum. While there are many markers of RV function, most reports on heart failure are silent on the contribution of right heart dysfunction in patients with heart failure.[11] It is worthy of note that an incompetent RV will lead to poor biventricular function even at the expense of increased left ventricular (LV) adaptations.

Left ventricular dysfunction (LVD) is an independent marker of mortality in patients of coronary artery disease. Other associated factors like diabetes mellitus, hypertension, smoker, and obesity further increase mortality. RV dysfunction has been associated with mortality and morbidity in patients having LV dysfunction with coronary artery disease. Assessment of the RV function became possible with advanced diagnostic techniques in Echocardiography, Doppler tissue imaging, strain imaging, 3D imaging. The purpose of our study was to assess the frequency of RV dysfunction in patients with LV dysfunction with coronary artery disease and short term outcome.

Methodology

This cross-sectional study was carried out on 168 patients of LV dysfunction with coronary artery disease in the Echocardiography Unit of the departments of Cardiology, Liaquat University Hospital, Hyderabad from 1st October 2017 to 31st October 2018 and followed for three months. Those patients were enrolled who had coronary artery diseases.

Echocardiography RV evaluation was done through a vis ual RV function evaluation, RV area measured in four-chamber views, and RV length in parasternal long-axis view. RV dysfunction was characterized as TAPSE of less than 1.2 cm. (RV ejection fraction < 35%). SPSS version 22.0 was used to analyze the data.

The cardio catheterization, LV, and RV angiography were performed through a femoral method using proven techniques in all patients. The RV volume determination and the expulsion fraction was earlier detailed.

The RV dysfunction was described as an o35% RV expulsion fraction, which corresponds to the mean three control standard (SD) deviations.

RCA angiography abnormalities were classified as total occlusion (100% obstruction by TIMI grade 0 to 1). Important stenosis (X50% luminal narrowing) or non-significant stenosis (o50%)

Right coronary artery collateral flow was divided into 0: present; 1: faint; 2: mild; and 3: wide.

The obstacle location is described as proximal where it is situated before the source of the first left marginalized br

anch. It is midway between the first and second correct m arginal branches.

Regurgitation of the atrioventricular valve was angiographically quantified in the respective ventriculogram as grade 0 to 4. Two seasoned operators who sought agreement when doubted conducted a visual evaluation of these factors.

During this assessment, separate categorizations were used for the connection between Right Coronary Artery Dysfunction and RV Dysfunction.

Statistical Analysis: The data was analyzed and entered using SPSS version 22.0. Number and percentage was calculated for qualitative data (categorical variables) such as gender, symptoms of heart failure, Angina, Silent ischemia, Previous MI, LV aneurysm, One-vessel disease, Two-vessel disease, Three-vessel disease, and RV dysfunction, and chi-square test was used to compare the percentages of Cardiac index (l/min per m^2), Right coronary artery: normal or stenosis, Stenosis and total occlusion between the group of RV dysfunction (Absent & present).

The numerical parameters like age in years, LV end-diastolic volume (ml/m^2), LV end-systolic volume(ml/m^2), LV ejection fraction(%), RV end-diastolic volume(ml/m^2), RV end-systolic volume(ml/m^2), RV ejection fraction (%) were presented as Mean ± Standard Deviation and student "t" was applied to compare the means between two groups (Occluded proximal RCA & Non-occluded proximal RCA). A p value $\leq$0.05 was considered as statistical significant level.

Results

A total of 168 patients were included in this study based on inclusion criteria, out of the 92(54.7%) were male and 76 (45.3%) were female. The mean age ± SD (range) was 52.36 ± 10.44 (30 to 60 years). The mean ± SD of RV ejection fraction was 40.73 ± 8.23% (range 25 to 52). The incidence of RV dysfunction was higher i.e. 48(52.1%, n = 92) in male patients as compared to female it was 28(36.8%, n = 76) with statistically significant difference (p-value < 0.05).

The major clinical and angiographical results in the population of the research are presented in Table I.

Table:1 Patients' clinical and hagiographical characteristics (n = 168)

	N(%)
Age (years)	52.36 ± 10.44
Gender:	
Male	148(88.0%)
Female	92(54.7%)
Symptoms of heart failure	
Angina	42 (25.0%)
Silent ischemia	34 (20.2%)
Previous MI	119 (70.8%)
LV aneurysm	30 (17.8%)
One-vessel disease	32 (19.0%)
Two-vessel disease	64 (38.0%)
Three-vessel disease	72 (42.8%)
LV ejection fraction (%)	31 ± 8
RV ejection fraction (%)	46 ± 11
RV dysfunction	30 (17.8%)

**** P-value is statisticaly insignificant calculated by student "t" test***

150/168 patients were dominated by the right coronary artery. Stenotic in 36 (44%) and occluded in 27 (35.5%). Compared with the remaining patients with proximal total occlusion of the right coronary artery. The findings are presented in Table II. In patients with an occluded proximal right coronary artery, a suitably lower RV expulsion fraction (38712 v. 47±10%; P = 0.009) was discovered, whereas the LV expansion fracture in both groups was similar.

The comparison of patients with RV dysfunction and without this is presented in Table III. The result was not influenced by collateral circulation.

The relationship between RV and age, gender, myocardial infarction, coronary artery disease expansion, cardiovascular insufficiency, and angina was not established.

Table II: Comparison of angiographic data in patients with and without a totally occluded proximal right coronary artery (n = 168)

	Occluded proximal RCA	Non-occluded proximal RCA	P value
LV end-diastolic volume(ml/m^2)	128± 41	141± 57	0.476*
LVend-systolic volume(ml/m^2)	92± 38	98± 46	0.772*
LV ejection fraction(%)	30± 8	32± 9	0.444*
RV end-diastolic volume(ml/m^2)	120± 48	115± 43	0.703*
RViend-systolic volume (ml/m^2)	79± 42	62± 32	0.078*
RV ejection fraction (%)	38± 12	47± 10	0.009**
Mitral regurgitation grade 2	6 (55%)	29 (42%)	0.653*
Tricuspid regurgitation grade 2	2 (18%)	12 (17%)	0.936*

**** P-value is statisticaly significant calculated by student "t" test**

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Table III: Univariate predictors of right ventricular dysfunction (n = 168)

	RV dysfunction		
	Present (n = 76)	**Absent (n = 92)**	**P-value**
LV end-diastolic volume (ml/m2)	152±48	136±53	0.294
LV end-systolic volume (ml/m2)	113±40	92±42	0.082
LV ejection fraction (%)	26±7	33±8	0.003*
Mean right atrial pressure (smmHg)	10±4.6	5.8±3.2	<0.0001*
Mean pulmonary artery pressure (mmHg)	37±11	23±11	<0.0001*
Wedge pressure (mmHg)	24±7.3	16±8.3	0.002*
Transpulmonary gradient (mmHg)	13±7.8	7.8±4.3	0.002*
Pulmonary vascular resistance (dyne/sec/cm5)	279±218	151±122	0.014*
LV end-systolic pressure / volume ratio	1.2±0.5	1.7±0.8	0.029*
RV end-systolic pressure / volume ratio	0.7±0.5	0.8±0.4	0.419
Mitral regurgitation Xgrade 2	7 (50%)	29 (44%)	0.906
LV stroke work index (g/beat per m2)	24±13	34±13	0.015*
RVistrokeiworkiindexi(g/beatiperim2)	7.9±2.3	6.7±3.1	0.175
Cardiaciindex (l/min per m2)	2.1±0.4	2.4±0.6	0.078
Right coronary artery:normal or stenosis	22 (28.9%)	21 (22.8%)	0.491
Stenosis	22 (28.9%)	44 (47.8%)	
Total occlusion	32 (42.1%)	30 (32.6%)	

**P-value is statristically significant calculated by student "t" test*
***P-value is statristically significant calculated chi-square test*

The important forecasters of RV dysfunction were increased correct blood pressure, enhanced lung resistance, decreased LV expulsion fraction, decreased LV stroke index, and proximal correct coronary artery (Table III). The univariate assessment was used in univariate analyses.

Discussion

Although there is increasing evidence of the vital role of RV in heart failure, medical evidence about RV's function in patients with cardiac insufficiency is often lacking.[12]

We conducted this study to assess the incidence of RV dysfunction in patients of LV dysfunction with coronary artery disease and short term outcome. There are very little data about the incidence of acute CAD RV dysfunction. The incidence of RV dysfunction ranges from 28 to 41 percent by extrapolating information from accessible research.[13]

While these findings could be influenced by various screening methods, two further variables contribute significantly to those distinctions: (1) the cut-off value used to describe RV dysfunction (30%- 38%) and (2) the seriousness (middle 22%-29%) of the concomitant LV-dysfunction.

More care was taken on the relationship between pulmonary hypertension and RV dysfunction. As a stress-sensitive cell, the RV adapts to enhanced sequence, lowering systematic work, and enhanced end-diastolic quantity.[13] This is verified by clinical observations, which have shown an important inverse connection between pulmonary stress and the RV expulsion percentage.[13] The inverse correlation from CAD to idiopathic cardiomyopathic dilated cardiomyopathy has earlier been noted. [14]

Pulmonary hypertension, as illustrated by Micha T. Maeder et al.[15], was primarily related to LV dysfunction and mitral regurgitation

The idea of a lower RV expulsion in acute CAD is a key to more serious pulmonary hypertension is supported by our research.

Whether changes in load circumstances can lead to RV efficiency improvements as well as giving understanding into RV physiology is still to be evaluated and whether these differences can forecast reactions to acute treatment or long-term predictions. [16]

In the early after the cause of myocardial infarctions, but less in the environment of acute postischaemic LV dysfunction, the connection between RI and RV interference was explored.

It is not yet clear whether the dynamics of the RV are similar to the processes of continuous remodeling in the occluded artery following an acute myocardial infarction in the LV

After RV infarction sequential radionuclide tests found a substantial rise in the RV expulsion factor over a long period (from 30.77% to 43.78% after more than 1 year). [17]

This research shows that after ischaemic injury, RV can enhance systolic function. [17] However, the question of whether this happened with a patent or the right coronary artery occluded does not become clear.

In Hennes et al. [18], a median of 1174 days after acute myocardial infarction, the link between correct coronary artery injury and RV activity was examined.

Patients with visually evaluated RV deficiency in 7 percent of instances were shown to have a patent correct coronary artery as opposed to 30% of those with RV feature that suggested that the correct occluded coronary artery was linked to a decreased RV systolic function.

However, both of these research have registered comparatively maintained patients with LV feature (average 55 and 52%, respectively), [17,18]

In contrast, our research was conducted secondary to CAD in acute LV dysfunction. We discovered that RV ejecting percentage was significantly reduced relative to remains in patients with a completely occluded proximal right coronary artery,

It suggested that a long-term adverse effect on RV function is the right coronary artery obstruction. While our research aimed to deal with acute heart disease,

There is one selection bias in favor of patients who can be preferably targeted in revascularisation processes due to ischemia, feasible myocardium, or the two.

This data cannot thus be transferred automatically to the general population of acute CAD and cardiac failure patients. RV dysfunction is found in less than 20% of patients with acute ischemic LV dysfunction.

A decreased RV expulsion percentage is correlated with the proximal right coronary artery occlusion. The hemodynamic burden of pulmonary hypertension, which is the sole autonomous indicator of VR dysfunction in our population, however, overwhelms the position of right coronary artery illness

Conclusion

In cases of LV dysfunctions with coronary heart disease, we found that RV dysfunction is more prevalent in our patients. In less than 20% of instances, RV dysfunction is identified in patients with acute ischaemic LV disease. A decreased RV expulsion percentage is related to the proximal right coronary artery occlusion. The right coronary artery illness, however, plays a hemodynamic part, as it is the only autonomous predictor of RV dysfunction of our population. RV dysfunction is an independent predictor of death and the development of HF in patients with LV dysfunction.

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