Original Article

Right Ventricular Dysfunction with Coronary Artery Disease

Frequency of Right Ventricular Dysfunction in Patients Suffering Coronary Artery Disease

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ABSTRACT

Objective: To assess the significance of right ventricular dysfunction in patients suffering from coronary artery disease.

Study Design: Observational study.

Place and Duration of Study: This study was conducted at Karachi Institute of Heart Diseases and Dow University Hospital OJHA Campus Karachi from 1st March 2017 to 31st August 2017.

Materials and Methods: A total of 561 patients with documented CAD matched our inclusion criteria. Patients with congenital heart defects, valvular heart diseases or those with any surgical intervention were excluded. Following parameters were measured on echocardiography: ejection fraction, two-dimensional size assessment and TAPSE.

Results: It includes 381 (70%) males and 180 (30%) females. The mean age of patients was found to be 54.3 $\pm$ 11.4 years. Mean age of female patients was found to be 56.5 $\pm$ 7.8 years and those of male patients is 51.5 $\pm$ 12.3 years Mean right ventricular ejection fraction was found to be 42.7% $\pm$ 6.7%. In male patients the mean RV ejection fraction was 43.61 ± 8.11% as compared to 39.32 ± 9.14% in female patients (p=0.432). According to TAPSE measurements right ventricular dysfunction was present in 26.5% (n=149) patients. Statistically significant differences were found between RV ejection fractions of females and males with 23% and 29.6% patients respectively (p=0.021). 31.5% of patients having right ventricular dysfunction had a previous history of myocardial infarction.

Conclusion: There is moderate prevalence of right ventricular dysfunction in patients with CAD. It should be assessed and treated at the earliest for better outcomes. Further studies should be carried out on large scales in all patients with CAD.

Key Words: Prevalence, Right ventricular dysfunction, Coronary artery disease.

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INTRODUCTION

Coronary artery disease (CAD) is one of the biggest cause of deaths and long-term disabilities, accounting for 19% of all deaths worldwide. It is multifactorial and risk of acquiring disease increases with age[1]. It is responsible for one third of deaths in persons older than 35 years. CAD includes a spectrum of manifestations like myocardial infarction, angina pectoris and sudden death[2]. National heart institute established Framingham heart study which published a description "factors of risk in development of coronary heart disease".

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The description indicated that elevated blood pressure and cholesterol levels were associated with increased risk of myocardial ischemia. Atherosclerosis is the initiating event for CAD, it begins as qualitative change to the endothelial lining due to hemodynamic and biochemical stimuli. Other risk factors include decreased physical activity, consumption of unhealthy food, smoking, inherited genetic mutations and multiple chromosome loci associated with it[3]. Right ventricular dysfunction is a proficient indicator of mortality after myocardial infarction and chronic heart failure. The primary function of right ventricle is to pump blood to pulmonary circulation for oxygenation. Right ventricular dysfunction present as ascites, oedema, exercise intolerance due to low systolic reserve and arrythmias[4]. Right ventricular alterations occur in close relation to left ventricular dysfunction in patients with CAD, accounting to the post ischemic changes. Eventually ventricular dysfunction leads to symptomatic heart failure[5]. Assessment of right ventricular size and function can be done by echocardiography, normal right ventricle is two third the size of left ventricle. Evaluation of right ventricular function is done by measuring its area in

four chamber view and length in parasternal long axis[6]. Another way for quantitative evaluation of right ventricular function is measurement of tricuspid annular plane systolic excursion (TAPSE) in the four-chamber view. TAPSE was measured as the total displacement of the tricuspid annulus (mm) from end-diastole to end-systole[7]. Doppler index of myocardial performance can also be used to determine RV function. Tissue doppler imaging with peak systolic velocity of less than 11.5cm/sec indicates presence of right ventricular dysfunction. Cardiac MRI is the most accurate method for quantitative size and function estimation of right ventricle but it is not feasible to perform in a large population[8]. As RV dysfunction is a major predictor of left sided heart failure, the correlation of heart failure with reduced ejection fraction is unclear[9]. Right ventricle dysfunction has been defined as RV ejection fraction of less than 35% corresponding to mean three standard deviations of controls[10]. Chronic ischemia of left ventricle due to coronary artery disease has more pronounced symptoms than right ventricle ischemia. A study done in September 2002 in Italy suggests that ventricular dysfunction is found in less than 20% of cases of CAD. Right coronary artery disease if present has prominent clinical manifestations due to hemodynamic load of pulmonary hypertension simultaneously[11]. With the background of pulmonary hypertension, right ventricular dysfunction is linked with higher morbidity and mortality. Current researches focuses on new echocardiographic techniques to diagnose subclinical RV dysfunction and therapeutic targets can be devised to improve its management[12].

MATERIALS AND METHODS

This study was carried out at Karachi Institute of Heart Diseases and Dow University Hospital OJHA Campus Karachi, from from 1st March 2017 to 31st August 2017. This study has been carried out in the cardiology department. Inclusion criteria were all patients visiting outpatient department having documented coronary artery disease for more than three months, irrespective of their age and gender. Patients with congenital heart defects, valvular heart diseases, pulmonary artery hypertension. A total of 561 patients with documented CAD matched our inclusion criteria. Patients who have undergone any intervention for management of CAD were also off the list. All patients were examined clinically, and comprehensive echocardiography was performed.

While performing echocardiography, following parameters were measured:

i) Evaluation of right ventricular size and ejection fraction
ii) Two-dimensional measurement of right ventricular in four chamber view and parasternal long axis view
iii) Tricuspid annular plane systolic excursion (TAPSE) with an M-mode cursor placed at lateral annulus

If TAPSE measurement is 5mm, it denotes 20% RV function

If TAPSE measurement is 10mm, it denotes 30% RV function

If TAPSE measurement is 15mm, it denotes 40% RV function

If TAPSE measurement is 20mm, it denotes 50% RV function

RESULTS

In the given time interval, there were total 561 patients fulfilling our inclusion criteria for right ventricular function assessment at our centre. This data included 381 (70%) males and 180 (30%) females. The mean age of patients was found to be 54.3 + 11.4 years. Mean age of female patients was found to be 56.5 + 7.8 years and those of male patients is 51.5 + 12.3 years. Mean left ventricular ejection fraction measured was 49.83 + 7.4. Mean right ventricular ejection fraction was found to be 42.7% + 6.7%. In male patients the mean RV ejection fraction was 43.61 ± 8.11% as compared to 39.32 ± 9.14% in female patients (p=0.432). According to TAPSE measurements right ventricular dysfunction was present in 26.5% (n=149) patients. Statistically significant differences were found between RV ejection fractions of females and males with 23% and 29.6% patients respectively (p=0.021). Patients having right coronary artery occluded was associated with more severe right ventricular dysfunction (<37%). 31.5% (n=47) of patients having right ventricular dysfunction had a previous history of myocardial infarction.

DISCUSSION

Right ventricular function is a sensitive predictor of exercise tolerance and its contribution in chronic heart failure cannot be overlooked. Owing to its complex geometry and functional assessment the right ventricular function is important in determining post-operative survival in CAD[13]. Right ventricular dysfunction in coronary artery disease is due to right coronary artery occlusion leading to dilation. Multivessel artery disease causes significant ischemia, ultimately affecting cardiac output. Dilation causes stiffening of ventricles, they're unable to pump blood and become volume dependent[14]. TAPSE continued an independent predictor of survival, suggesting that twice the TAPSE value was associated with reducing 26% of death, whereas left ventricular ejection fraction had no independent prognostic information when TAPSE was included[15].

Our study focuses on prevalence of right ventricular dysfunction as its contribution to cardiac output is frequently neglected. RV infarction responds provocatively responds to volume treatments and early

reversal of occlusion improves clinical outcome[11]. Our study shows that right ventricular dysfunction was present in 26.5% patients with the background of coronary artery disease. As compared to a study done by La Vecchia, our study concludes that right ventricular dysfunction is present in more male patients than female patients (23.9% versus 29.6%) with a p-value of 0.021. A research conducted in April 2017 studied the effect of right ventricular dysfunction on surgical left ventricular restoration. The presence of right ventricular dysfunction adversely affected the surgical outcome of left ventricle. They had 139 study participants having mean left ventricular ejection fraction of 27% + 7% eligible for left ventricular surgical intervention. Echocardiography demonstrated 39% patient had impaired right ventricle functional parameters. Impaired right ventricle functional parameters were associated with increased 30-day mortality so it's important to diagnose this condition[16]. Right ventricular function needs to be assessed separately as it has weak correlations with left ventricular ejection fraction. A study done in May 2002 on right ventricular dysfunction and heart failure showed that each 5% RV fractional area change was associated with 16% increased risk of cardiovascular mortality. After adjusting for age, gender, diabetes mellitus, hypertension, previous MI, LVEF, infarct size, cigarette smoking and treatment assignment, RV function remained an independent predictor of total mortality, cardiovascular mortality and HF[17]. Another study indicates increased prevalence of cardiovascular events in patients with COPD. In COPD, RV ejection fraction is preserved at early stage but hemodynamic instability is present in advanced cases[18].

CONCLUSION

Our study concludes that right ventricular dysfunction is moderately present along with coronary artery disease. It is as frequent in our setup as in western population. If appropriate investigations are carried out, right ventricular dysfunction can be diagnosed at subclinical stage. Early diagnosis leads to better management and good survival. In our population, right ventricular dysfunction is more common in common in males than females. Large scale studies should be carried out to study more about prognostic significance of early right ventricular dysfunction in CAD.

Author's Contribution:

Concept & Design of Study:	Muhammad Inam Qureshi
Drafting:	Afzal Qasim
Data Analysis:	Nadeemuddin, Muhammad Umar Khan
Revisiting Critically:	Afzal Qasim,Muhammad Inam Qureshi
Final Approval of version:	Muhammad Inam Qureshi

Conflict of Interest: The study has no conflict of interest to declare by any author.

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