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Original Research Article

Correlation of Pulmonary Function Test and 2 D Echocardiography in Patients of Acute Myocardial Infarction

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Abstract

Background: Atherosclerotic vascular disease, which lowers left ventricular function and raises pulmonary vascular pressure, is the most common cause of AMI. Although pulmonary function tests are a non-invasive and generally available method of assessing pulmonary function, their association with left ventricular function following AMI warrants further exploration. For complete investigation, advanced tools such as sophisticated spirometry and 2D echocardiography are required. Understanding the heart-lung relationship is critical, especially in resource-constrained environments.

Methods: In this investigation, pulmonary function tests were combined with 2D echocardiographic data in AMI patients. The literature lacked baseline data on pulmonary function tests. To further understand left ventricular function, the researchers examined LVEF and spirometry characteristics, stratifying individuals based on pulmonary function.

Results: The study found that AMI patients had poorer LVEF values, especially those with front wall MI. FEV1 and PEFR decreased significantly as LVEF decreased, showing the impact of decreased left ventricular performance on pulmonary function. The FEV1/FVC ratio study revealed a restrictive pattern, with FVC falling faster than FEV1.

Conclusion: This study examines the relationship between pulmonary function tests and left ventricular performance in patients with acute myocardial infarction. Pulmonary function tests can be used as a stand-in for assessing left ventricular function.

Keywords: Acute Myocardial Infarction, Pulmonary Function Tests, Left Ventricular Ejection Fraction.

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Introduction

The most common cause of acute myocardial infarction (AMI) is atherosclerotic vascular disease. With or without diastolic dysfunction, the left ventricular systolic function decreases after AMI, which hemodynamically causes an increase in pulmonary vascular pressure, which is measured using various invasive and non-invasive methods that require expensive equipment and skilled personnel, both of which are not always available [1].

This increase in pulmonary vascular pressures, whether large or minor, will have an impact on pulmonary functions

(spirometry). Pulmonary function tests are non-invasive, simple to administer and interpret, and widely available. Patients who have had an AMI can be stratified and monitored based on their pulmonary functions, which can provide information concerning left ventricular functioning [2].

In the published literature, very few investigations have been conducted in this field. Although Peabody published the first known investigation in this approach in 1917, and Bean WB published the second in 1938, no definitive conclusion has been achieved [3]. This task can be redone using new technology such as sophisticated spirometry and 2D echocardiography [4].

Because the heart and lungs are so closely linked, alterations in one will have a significant impact on the other. As a result, knowledge about one will provide information about the other [5]. To monitor the performance of various lung functions and cardiac chambers, sophisticated equipment is now available; however, operator dependence and availability have sometimes prevented their use; additionally, data from these equipments is complex to apply by medical personnel working in rural and sub-urban areas [6].

It was unexpected to see that the baseline data for our population's pulmonary function tests were not published in the literature. The literature on the relationship between pulmonary function tests and 2-D echocardiography in patients with acute myocardial infarction or with impaired left ventricular performance due to other reasons such as cardiomyopathy was likewise limited. However, few extremely prestigious research that highlighted the issue were discovered, but their applicability in day-to-day wards and outdoors is insufficient [7].

In our investigation, we compared pulmonary function test results with 2D echocardiographic findings in patients with acute MI [8]. This study provides a straightforward way for stratifying AMI patients for the development of left heart failure in the future [9]. These observations and correlations can be used to evaluate the cardiac status of ischemic heart disease patients or any patient with impaired ventricular performance. It is intended that comparable large-scale research will be conducted to provide conclusive explanations for medical personnel who do not have access to advanced testing like 2D echocardiography in their daily practice [10].

Materials and Methods

The present study was conducted in Rukmani Devi Beniprasad Jaipuria Hospital, Jaipur.

Methods

The present study was conducted in the Department of Cardiology of a tertiary care hospital comprising a study of cases with signs and symptoms pertaining to acute myocardial infarction who will undergo 2D echocardiography and pulmonary function tests in this hospital. Detailed history, clinical examination & 2Dechocardiography and pulmonary function tests findings were noted.

Study Design: It is observational type of study.

Study Area: Study was conducted in Rukmani Devi Beni Prasad Jaipuria Hospital, Jaipur.

Study Period: It is one year study, from 2019 to 2020.

Sample Size: It is a time bound study; study includes cases in a given period of time.

Selection Criteria of Patients

Inclusion criteria:

1. Patients were selected regardless of the age group and sex.
2. Patients who had an acute myocardial infarction in recent past.

Exclusion Criteria: Patients who were suffering from Bronchial asthma, COPD, Interstitial lung disease, Diabetes mellitus, Hypertension, Hyper and Hypo thyroidism, significant hepatic and renal disease were excluded from the study.

Informed consent: Written informed consent was obtained from all patients .The protocol was approved by the appropriate institutional review board.

Study variables

The following variables were included in the study. Age, sex, weight, height, body mass index (BMI), blood pressure, blood glucose, blood urea, serum creatinine, Spirometric and 2D echocardiographic parameters.

Results

Table 1: Age and FVC, FEV1/FVC of studied patients

Age Group (Years)	Number of patients	Mean FVC	Mean FEV1/FVC
30-40	05	57.00	109.00
41-50	12	59.83	113.75
51-60	14	58.93	115.80
61-70	09	53.56	120.22
Total	**40**	**57.75 ± 10.73**	**115.33 ± 10.21**

The mean FVC and FEV1/FVC of all 40 patients who suffered from acute myocardial infarction in recent past was 57.75 and 115.33 respectively. Mean FVC was lower than the mean normal reference value.

Table 2: Mean values of studied parameters according to location of myometrial infarction (MI)

Studied parameter	Anterior MI	Inferior MI
Age	53.10±6.79	55.11± 10.94
LVEF	40.25±9.38	45.54±5.68
FEV1	61.74±12.19	67±15.52
PEFR	66.16±24.66	64.64±22.65
FVC	57.33±9.96	58.21±11.79
FEV1/FVC	112.93±10.97	117.98±8.83
BMI	23.41±3.81	22.46±2.97

This table categorizes 40 patients based on the location of acute myocardial infarction: anterior wall and inferior wall. Out of the 40 patients, 21 had anterior wall MI, while 19 had inferior wall MI. The mean LVEF values were 40.25% and 45.54% for the anterior and inferior wall MI groups, respectively. Patients with inferior wall MI had a significantly higher LVEF compared to those with anterior wall MI ($t=2.13$, $p<0.05$). However, there were no significant differences in other parameters like BMI, FEV1, PEFR, and FEV1/FVC ($p>0.05$).

Table 3: Mean values of studied parameters according to FEV1

FEV1 Group	Number of patients	AGE	LVEF	FVC	PEFR	FEV1/FVC	BMI
30-40	03	58	34.33	37.00	38.00	107	22.86
41-50	04	52	42.75	44.75	72.25	108.75	23.40
51-60	08	52	38.44	53.75	58.50	109.88	22.33
61-70	09	50	41.78	60.89	66.78	113.89	22.36
71-80	11	57	48.45	63.45	67.04	120.86	23.84
<80	05	58	44.00	68.80	81.62	124.74	22.82

The table displays the distribution of patients based on the FEV1 group, along with their corresponding numbers, age, LVEF, FVC, PEFR, FEV1/FVC, and BMI values. The age range varied from 30-40 to below 80 years. The LVEF values ranged from 34.33% to 48.45%. The FVC values ranged from 37.00 to 68.80. PEFR values ranged from 38.00 to 81.62. FEV1/FVC values ranged from 107 to 124.74. The BMI values ranged from 22.33 to 23.84.

Table 4

Fev1 group	Number of patients	Mean fev1	Mean lvef
=>80(NORMAL)	05	85.60	44.00
60-80(MILD)	20	69.83	45.45
80-60(MODERATE)	12	52.83	39.87
<40(SEVERE)	03	37.00	34.33

The table shows the number of patients in each FEV1 group (Normal, Mild, Moderate, Severe) along with their corresponding mean FEV1 and mean LVEF values.

Discussion

A study was conducted in the medicine wards of Rukmani Devi Hospital in Jaipur, focusing on the relationship between left ventricular ejection fraction (LVEF) and pulmonary function tests in patients who had experienced acute myocardial infarction (AMI). The researchers aimed to determine if the deterioration of left ventricular performance due to AMI would affect the lungs, leading to excess pulmonary water and a restrictive pattern in pulmonary function tests [11].

In situations where advanced diagnostic equipment like 2D echocardiography is unavailable, simple devices like a peak flow meter could provide insights into left ventricular performance for healthcare providers managing AMI patients. The study recognized that the pathophysiological status of such patients is dynamic and can show unpredictable changes during the first few weeks after AMI [12]. The researchers reviewed literature dating back to 1917, which highlighted the correlation between reduced vital capacity (VC) and the clinical condition and life expectancy of cardiac patients [13]. Other studies from the 1930s emphasized dyspnea and reduced vital capacity in patients with AMI. These findings further supported the researchers' interest in exploring the relationship between pulmonary function and left ventricular performance [14].

Despite the availability of literature reinforcing the connection between pulmonary function and left ventricular performance, pulmonary function tests have not become a standard part of the cardiac patient workup and follow-up, both in India and other developing countries. Limited access to diagnostic equipment and the subjectivity and variability of pulmonary function tests have hindered their widespread adoption [15].

The study included 40 patients who had recently experienced AMI. The researchers found that the mean LVEF of the patients was 42.76%, significantly lower than the normal range of 55 to 60%. Among the patients, 21 had anterior wall AMI, while 19 had inferior wall AMI. The mean LVEF values were lower in the anterior wall AMI group compared to the inferior wall AMI group, with the difference being statistically significant [16].

Spirometry was used to assess pulmonary function in the patients. The mean values of forced expiratory volume in one second (FEV1) and peak expiratory flow rate

(PEFR) were lower than normal values, indicating reduced lung compliance due to increased pulmonary water content. The correlation analysis showed that as LVEF declined in AMI patients, FEV1 and PEFR values also decreased significantly [17].

The researchers also analyzed forced vital capacity (FVC) and FEV1/FVC ratio. The mean FVC values were reduced, but the reduction was not statistically significant. However, the FEV1/FVC ratio indicated the absence of an obstructive pattern. The reduction in FVC was greater than that of FEV1. A strong correlation was observed between FEV1 and FVC [18].

Previous studies have highlighted the significance of vital capacity in predicting heart failure, and improvements in vital capacity have been associated with recovery from congestive heart failure. The FEV1/FVC ratio was reduced in patients with AMI and pulmonary congestion, while FVC was reduced proportionately more in obstructive patterns [19].

In conclusion, the study conducted in the medicine wards of Rukmani Devi Hospital aimed to investigate the relationship between LVEF and pulmonary function tests in AMI patients. The findings demonstrated a significant correlation between declining LVEF and reduced FEV1 and PEFR values, indicating the impact of left ventricular performance on pulmonary function [20]. However, further research and the availability of advanced diagnostic equipment are necessary to establish pulmonary function tests as a standard tool in the assessment and follow-up of cardiac patients, especially in resource-limited settings like rural India.

Conclusion

In conclusion, this study of patients with acute myocardial infarction (AMI) found that the mean Left Ventricular Ejection Fraction (LVEF) was lower than the normal range, with anterior wall MI having a higher reduction than inferior wall MI. The influence of diminishing left ventricular performance on pulmonary function was demonstrated by a statistically significant decrease in Forced Expiratory Volume in One Second (FEV1) and Peak Expiratory Flow Rate (PEFR) as LVEF decreased. The FEV1 to Forced Vital Capacity (FVC) ratio study revealed a restricted pattern of abnormalities, with FVC falling faster than FEV1. These findings support the use of pulmonary function tests as a surrogate marker in AMI patients to assess left ventricular functioning. Further research is needed to establish the role of pulmonary function tests in the routine assessment and follow-up of cardiac patients, particularly in resource-limited settings.

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