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Spirometric Assessment of Pulmonary Function in The Elderly with Ischemic Heart Disease

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Abstract:
Background:*Studies have noted a high incidence of pulmonary function abnormalities in patients with coronary artery disease and no pre-existing pulmonary disease. Ageing associated impairement of lung function may further aggravate this decline in the elderly with ischemic heart disease. This impairment function in the elderly with ischemic heart disease hasnt been adequately studied in India. Hence, the need for this study .*
Objectives :*To spirometrically assess pulmonary function in the elderly patients with ischemic heart disease and detect impaired lung function, if present.*
Methodology: *Prospective study .Elderly patients with ischemic heart disease visiting Subharti Medical College, Meerut (UP) between December 2015 and September 2017 of pulmonary function testing by spirometry. Assessment of results was based on the standard accepted values of the pulmonary function variables for the Indian population.*
Results *In this study, FVC, FEV1 and PEFR were less than predicted and FEV1/FVC ratio greater than 100% of predicted in a significant number of subjects. The predominant defect was of restrictive type (57.14%). In this study, a significant decline in FVC (p <0.001), FEV1 (p <0.001), and PEF(p=0.004) respectively as percentages of predicted was noted as the number of coronary vessels involved increases. A significant increase in FEV1 (p = 0.015), FVC (p =0.004) and PEF (p = 0.009)respectively, as a percentages of predicted was noted with increases in cardiac ejection fraction*
Conclusion: *The pattern of the pulmonary function defect was of restrictive type in the majority.In this study, FEV1, FVC and PEFR values as a percentage of predicted tended to decline as the number of coronary arteries involved increased.*
Keywords: *IHD,Pulmonary function, FEV1, PEFR,Coronary artery disease*

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I. Introduction

The association between impaired lung function and ischeamic heart disease has been established by many studies. Many researchers have noted the increased incidence ofcardiovascular disease in individuals who had been earlier detected to have subnormal pulmonary function by spirometry. There is also evidence for greater recurrence of adverse cardiovascular events in those patients with ischeamic heart disease who have impaired lung function, in comparison with those with normal pulmonary function.Mortality has been found to be greater among individuals with ischeamic heart disease who had impaired lung function. Pulmonary function can be conveniently and quite accurately be assessed by spirometry in an outpatient setting. It has been speculated that a systemic inflammatory process may be contribute towards the impairment of lung function and the development of coronary artery disease. This may also explain the frequent co existence and striking association between the two disorders. So significant is this association that Forced expiratory volume in onesecond (FEV1) as assessed by spirometry has been termed not just a lung function test but a marker of premature death from ischeamic heart disease. Ischeamic heart disease, itself may be responsible for impaired lung function. This subnormal pulmonary function may in turn predispose to increased mortality in these ischeamic heart disease patients.

Association between impaired lung function and cardiovascular disease has been reported by many studies [1, 2,3,4,5]Recent research seems to indicate that a systemic inflammation may be the mechanism underlying the impairment of lung function and the development ofcoronary artery. There is also evidence for greater recurrence of adverse cardiovascular events in those patients with ischeamic heart disease who have impaired lung function, in comparison with those with normal pulmonary function. [4, 5] Mortality has been found to be

greater among individuals with ischeamic heart disease who had impaired lung function.[5]Forced expiratory volume in one second (FEV1) as assessed by spirometry has been termed not just a lung function test but a marker of premature death from ischeamicheart disease. [8,9,10]
A high incidence of pulmonary functional abnormalities in patients with coronaryartery disease, who previously had no pulmonary disease, was noted in certain studies. [11, 12] Thus, it has been suggested that ischeamic heart disease, itself may be responsible for impaired lung function. This impaired lung function may, in turn reduce survival in cases of ischeamic heart disease (especially among the elderly).[13]

II. Materials And Methods

Study Design

The prospective study was conducted on elderly patients with ischemic heart disease visiting Subharti Medical College hospitals between December 2015 and July 2017. Detailed history was elicited from the subjects of the study, followed by physical examination. Detailed history pertaining to respiratory function was recorded utilizing a questionnaire containing questions modeled after the St George Respiratory Questionnaire. Testing of pulmonary function by spirometry was done. Assessment of pulmonary function was then based on the standard accepted values of the pulmonary function variables for the Indian population. The calculations were based on the validated equations derived by Udwadia et al and Kamath et al for the Indian population.[14,15,21]

StatisticalAnalysis

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Student test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups(Inter group analysis) on metric parameters, Pearson correlation has been performed to find the relationship of age, BMI and EF with Pulmonary function tests. The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and environment ver.2.11.1 were used for the analysis of the data.

Inclusion Criteria

• Age above 60 years
• Presence of coronary artery disease which has been proven by coronaryangiographyorAny patient with a documented history of myocardialinfarction/acute coronary syndrome will be recruited for the study, irrespectiveof whether angiogram has been done.

Exclusion Criteria

• Age below 60 years.
• Patients who are known cases of chronic pulmonary disease.
•Occurrence of myocardial infarction, acute coronary syndrome or CABGwithin a period less than 4 weeks prior to pulmonary function testing.
• Patients who have congestive cardiac failure.
• Patients who have spinal deformities.
• Patients who are morbidly obese.

III. Observations

Table 1: Age distribution of patients studied

Age in years	No of patients	%
60-69	33	58.9
70-79	20	35.7
80 & above	3	5.4
Total	56	100

Table 2: Assessment of Pulmonary function variables according to number ofvessels

Pulmonary Function variables	Number of vessels	Number of vessels	Number of vessels	P value
	One	Two	Three	
FVC	3.30±10.44	7.92±13.56	1.11±14.03	<0.001**
FEV1	8.85±18.71	4.38±10.16	0.22±13.36	0.001**
EV1/FVC	0.85±15.45	6.38±21.01	1.22±21.64	0.763
PEF	7.70±20.89	4.53±14.58	34.6±6.42	0.004**

Table 3: Assessment of Pulmonary function variables according to variations inejection fraction(EF)

Pulmonary Function Variables	Variations in EF	Variations in EF	Variations in EF	P value
	50-54	**55-59**	**60 & above**	
FVC	5.13±13.38	9.50±15.93	8.75±10.78	0.004**
FEV1	5.36±20.54	0.13±18.44	5.75±12.97	0.015*
EV1/FVC	0.14±18.86	7.83±18.11	5.75±14.88	0.692
PEF	7.82±14.72	1.13±17.41	6.25±14.15	0.009**

FVC, FEV1 and PEF are significantly increasing with increase in ejectionfraction(EF)

IV. Discussion

Lung function begins to decline slowly and steadily from middle age into old age. The deterioration may accelerate in old age. It is thought that a loss of elastic tissue maylead to mild subclinical emphysema even in healthy non smokers.FEV1 declines 30 – 35 ml per year. Vital capacity decreases while the residual volume increases leaving total lung capacity in charged functional residual capacity also increases with age. This may leave the diaphragm at a mechanical disadvantage, particularly if there is associated loss in height of the thorax due to osteoporosis collapse of thoracic vertebrae etc.

The diffusing capacity declines linearly with age. [16] This loss is compounded by decline of pulmonary function associated with ischemic heart disease in the elderly. Much evidence has been gathered in recent times indicating a decline in lung function consequent to coronary artery disease.Enright et al found that coronary artery disease, on an average was associated with 40– 100 ml decrements in FEV1and 50-150 ml decrements in FVC in the elderly, eveninnon smokers, and in the absence of heart failure.[17]Low FEV1 has been shown to be a significant risk factor for cardiac and all cause mortality.Thus, the elderly patients with ischeamic heart disease and sub optimal lung functionrepresents a group at very hig h risk for cardiac and all cause mortality, including fatalarrhythmias.The study involved 56 subjects – 41 males (73.2%) and 15 females (26.8%), who metthe inclusion and exclusion criteria. (A total of 75 subjects had met the inclusion andexclusion criteria. However, spirometry which met the acceptability and reproducibility criteria of the American Thoracic Society could not be successfully performed in [19] subjects, so they were excluded.) Detailed history was elicited from the subjects of the study, followed by physical examination. Detailed history pertaining to respiratory function was recorded utilizing a questionnaire containing questions modeled after those contained in the St George Respiratory Questionnaire.[18] In addition to routine investigations, testing of pulmonary function by spirometry was done. Assessment of pulmonary function was then based on the standard accepted normal values of the pulmonary function variables for the Indian population. The calculations were based on the validated equations derived by Udwadia et al and Kamath et al for the Indian population.[19, 20, 21]

All the subjects were non smoker and essentially asymptomatic at the time of spirometry.Most of the subjects of this study were aged between 60 – 69 years (58.9%) mean age 69.29 ± 5.66 years. The mean body mass index of the subjects of 22 subjects this study was 25.78 ± 3.67 kg/m2 (39.3%) had an optimum BMI <25 kg/m2 but ≥ 18.5 kg/m2. 25 subjects (44.6%) were verweight (BMI 25 – 30 kg/m2) and 9 (16.1%) individuals were obese (BMI > 30 kg/m2) Coronary angiogram had here done for 42 subjects while the remaining 14 had documented history of MI/ACS .Of the subject who had undergone angiography 20 had single vessel disease (35%) 13 had double vessel disease (23.2%) and 9 had triple vessel disease (16.1%).

The patients were considered in two groups-those aged between 60 and 70years andthose aged above 70 years. All respiratory function parameters in this study have beenexpressed as a percentage of the normal predicted value in the Indian population.In this study, 18 out of 36 subjects (50%) aged between 60 and 70 years had a ForcedVital Capacity less than 70% of predicted. In those aged above 70 years, 8 out of 20 subjects (40%) had a Forced Vital Capacity less than 70% of predicted.8 out of 36 subjects (22.22%) aged between 60 and 70 years had a FEV1 less than 70% of predicted.In those aged above 70 years, 5 out of 20 subjects (25%) had a FEV1 less than 70% of predicted.

Enright et al studied a cohort of elderly (over age 64 years) subjects who weresomewhat healthier than average for that population. They excluded subjectswhowere current smokers or had smoked more than 20 pack-years. They also eliminatedsubjects with asthma, chronic bronchitis, and emphysema.The measurements weremade at least 3 months after cardiac surgery or myocardial infarction. In this healthierthan average cohort, the authors found slightly decreased values of FEV1 and FVC insubjects with coronary heart disease. They found that coronary artery disease, on anaverage was associated with 40 – 100 ml decrements in FEV1and 50-150 mldecrements in FVC in the elderly , even in non smokers, and in the absence of heartfailure. [17] 23 out of 36 subjects (63.88%) aged between 60 and 70 years had a FEV1/FVC ratio greater than 100% of predicted and 1 individual (2.77%) had a ratio less than 70% of predicted.In those aged above 70 years, 16 out of 20 subjects (80%) had a FEV1/FVC ratiogreater than 100% of predicted none had a ratio less than 70% of predicted.The predominant defect was of restrictive type (57.14%). The other patterns noted inthis study were normal

(12.51%), obstructive (13%) and combined (7.14%).Scanlon has speculated that ischemic heart disease can cause pulmonary restriction.[11]All the subjects in this study had a PEFR which was less than that predicted in normals.The Peak Expiratory Flow Rate (PEFR) reflects the strength and condition of respiratory muscles and the degree of airflow limitation in large airways.

Studies have shown PEFR to be a predictor of mortality in the elderly.[22] PEFR is alsoa predictor of mortality in ischeamic heart disease. Zureik M; Kauffmann F, et al havesuggested that low PEFR may be related to the development of atherosclerotic plaques. Thereby, it could possibly further aggravate coronary artery disease.[23]In this study, a significant decline in FVC as a percentage of predicted ($p < 0.001$),FEV1 as a percentage of predicted ($p < 0.001$), and PEF as a percentage of predicted($p = 0.004$) was noted as the number of coronary vessels involved increases.However the FEV1/FVC ratio as a percentage of predicted ($p = 0.763$) remainedalmost similar irrespective of the number of vessels involved and suggested apredominantly restrictive type of defect.The average ejection fraction among the study subjects was 51.752%.The spirometrically assessed variables FEV1 as a percentage of predicted ($p = 0.0.015$), FVC as a percentage of predicted ($p = 0.004$) and PEF as a percentage ofpredicted ($p = 0.\ 0.009$) increase significantly with increases in cardiac ejectionfraction.However cardiac ejection fraction did not have any significant influence on theFEV1/FVC ratio as a percentage of predicted ($p = 0.692$), the overall pattern beingpredominantly restrictive.

V. Conclusions

In this study subnormal pulmonary function was detected in elderly individuals withischeamic heart disease, as evidenced by FEV1, FVC and PEFR values which weresignificant lower than that predicted for normal subjects.The pattern of the pulmonary function defect was of restrictive type in the majority.In this study, FEV1, FVC and PEFR values as a percentage of predicted tended todecline as the number of coronary arteries involved increased.In this study, FEV1, FVC and PEFR values as a percentage of predicted tended toincrease as the ejection fraction increased.

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