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Spirometric Assessment of Pulmonary Function in Non Smoker Patients of Coronary Artery Disease and/or Hypertension and Comparison with Healthy Subjects

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Abstract
Coronary artery disease and hypertension are major health problems in today's world. Recently lot of interest has been generated regarding the possible systemic and pulmonary effects of the pervasive low grade inflammation that is present in coronary artery disease and hypertension. Many studies have objectively demonstrated undisputable evidence of airflow limitation in a setting of CAD and hypertension accompanied by a low FEV1, FVC and FEV1/FVC ratio. In our study, we compared the spirometric indices of 100 patients of CAD and/or hypertension to healthy subjects. It was found that 25% of such patients suffered from undiagnosed airflow limitation as compared to only 2% in healthy patients. The difference was significant. Therefore we recommend that spirometric screening is an easy, non invasive and inexpensive tool to diagnose undetected obstructive airway disesase in such patients and treat the same.

Introduction

Coronary artery disease (CAD) refers to the narrowing of the coronary arterial lumen, mainly arising as a complication of the atherosclerotic process. In the year 2004, CAD has claimed 7.2 million lives worldwide and accounted for the loss of an astounding 63 million disability adjusted life years (DALY). Each year there are about 5.8 million new cases of coronary artery disease and presently more than 40 million people suffer from various forms of coronary artery disease and its sequelae[1]. In India alone, in the year 2004, there has been 1.46 million deaths due to coronary artery disease, that is almost 130.1 deaths per lakh population and about 207.7 age adjusted deaths per lakh population. It has caused a loss of 1,931 age adjusted DALYs per lakh population.[2]

According to the popular textbook and JNC 7 criteria, a person is said to have hypertension if his seated systolic blood pressure is more than 140 mm Hg and diastolic blood pressure is more than 90 mm Hg on at least two or more separate outpatient visits[3,4]. In India hypertension has caused loss of 9.4 million lives and 7% of DALYs in the year 2010. This silent killer is on the rise in most low and middle income countries and India is no exception. It is estimated that 16% of ischaemic heart diseases, 21% of peripheral vascular disease, 24% acute myocardial infarction and 29 % of strokes are directly or indirectly attributable to hypertensive etiologies in our country.[5]

It has been seen that these diseases affect the spirometric indices of a patient even in the

absence of detectable pulmonary diseases. These spirometric abnormalities are usually consistent with chronic obstructive pulmonary disease (COPD) which is progressive and persistent irreversible airflow limitation associated with enhanced chronic inflammatory response of the airways and the lung.COPD is at present the fourth most common cause of death in the world, and is projected to become the third most common cause of death by the year 2020 or earlier.[6] Hence there is definite requirement of early diagnosis and treatment of this condition which is frequently underdiagnosed in cardiac patients but contributes significantly to the morbidity and mortality of the said fraction. There is a definitive link between AECOPD (acute exacerbation of COPD) and ACS even at the level of precipitating factors – especially infections, hyperglycaemia, and raised levels of MMPS (matrix metalloproteinase).[7]

Therefore we can see that spirometric assessment of pulmonary functions in patients of coronary artery disease and hypertension is particularly important. Not only does it establish the presence of undiagnosed air flow limitation and obstructive airway disease in such patients, but also acts as an indicator of future risk of fatal coronary events.[8] The level of decline of pulmonary function bears a close relationship to the mortality due to cardiac causes. Also, it is a prognostic indicator of the possible outcome of interventions in such patients[9].

Aims and Objectives

To assess the spirometric indices in non smoker patients of CAD and/or hypertension and comparing them to that of healthy volunteers.

Materials and Methods

This was an observational, analytical, cross sectional comparative study comprising of 100 non smoker CAD and/or hypertensive patients and 100 healthy volunteers

The study was undertaken in R G KAR Medical College, Kolkata.

Patients of IHD were selected on the basis of catheter diagnosed CAD, or appropriate signs and symptoms with ECG and echocardiographic changes

Hypertensive patients were selected either by Blood pressure more than 140/90 mm Hg or self reported use of anti hypertensive drugs.

We excluded patients with history of smoking (active or passive), biomass fuel exposure, pregnancy, morbid obesity, any symptomatic pulmonary disease. Also, patients whose spirometry revealed an FEV1 reversibility of more than 12% and 200 ml on bronchodilator inhalation.

We recorded basic anthropometric indices of these patients like age, sex, standing height, weight and BMI. We also recorded their blood pressure.

Next they underwent spirometry which was performed by rigorously following the ATS protocols.

Appropriate statistical methods were applied and tests of significance adopted to analyse the data as appropriate.

Results and Analysis

There were 100 diseased participants, there were 38 patients having only hypertension, 6 patients having only IHD and 56 patients with both diseases. The total number of hypertensive patients (with or without IHD) was 94 and the total no of IHD patients was 62.

The principal characteristics of the diseased and non diseased group were

Mean Age: 58.34 years in diseased group and 57.60 in non diseased group

Mean Height: 158.3 cm in diseased group and 153.3 in diseased group

Mean Weight: 56.66 in diseased group and 53.22 in non diseased group

Mean BMI: 23.12 kg/m2 in diseased group and 19.20 in the non diseased group.

Mean SBP: 121.26 mm Hg in diseased and 112.3 mm Hg in non diseased

MEAN DBP: 82.22 mm Hg in diseased and 74.38 mm Hg in non diseased.

Regarding the spirometric indices we found that average FEV1 was 2.12 L in the non diseased group whereas it was only 1.53 L in the diseased group. FVC was 2.89 L in the non diseased group and 2.33 litres in the diseased group. This is further demonstrated in the following TABLE NO 1:

Parameter	Non Diseased Group	Diseased Group
FEV1	2.12 L	1.53 L
FVC	2.89 L	2.33 L
FEV1/FVC	.72	.71

Out of 100 patients in the diseased group, we found that 25 had an obstructive spirometric pattern. In the non diseased group, however, only 8 patients had abnormal spirometric pattern. On a chi square test, this difference turned out to be significant,(p value<.05).

	Obstructive	Non Obstructive	Total
Coronary Artery Disease And Hypertension	25	75	100
Non Diseased	8	92	100

The odd's ratio is 3.88. the chi square statistic is 10.08. p value < 0.05.

When we further analysed our data, we found

Table Distribution of Obstructive Spirometry Pattern in Coronary Artery Disease and/or Hypertensive Patients and the Relevant Percentages

Numbers And Percentages	Only Hypertension	Only Cad	Combined
Total No	38 (M: 22 F: 16)	6 (M:2 F:4)	56 (M:32 F: 24)
No of Obstructive PFTS	6 (M: 4 F: 2)	1 (M:1 F:0)	18 (M: 14 F: 4)
Percentage	15.79% (M: 10.5% F : 5.29%)	16.67% (M: 16.67% F: 0%)	32.14 (M:25% F: 7.14%)

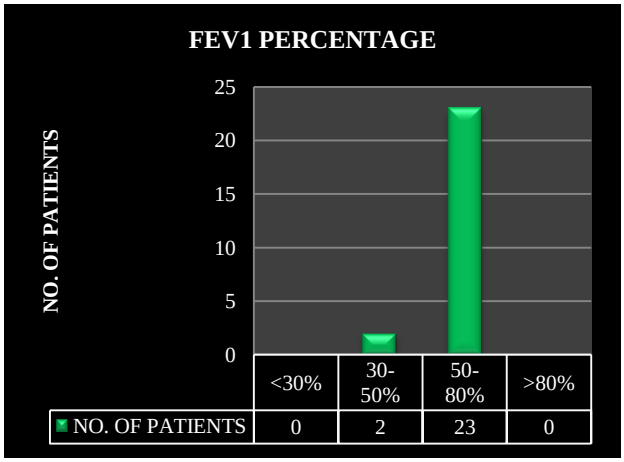
Here we see that maximum prevalence of symptomatic airflow limitation occurs in the combined group (32.14%), followed by the IHD only group(16.67%) followed by the hypertension only group(15.79%).

Another noticeable thing is that the percentage prevalence of obstructive airway disease seems to be higher in the male patients is almost twice that of female patients in every category.

On multiple regression analysis, FEV1 was negatively correlated with SBP(-0.567) and DBP(-0.721).

When we analysed the severity of the obstruction we found,

FEV1 Percentage	No. of Patients
<30%	0
30-50%	2
50-80%	23
>80%	0



Here we see that most of the patients had severe obstruction. Here we see, that out of 25 patients with undiagnosed airflow limitation in the diseased group, 23 patients had GOLD CLASS III COPD which has almost 12-25% and would necessitate treatment with more than one drug.

Discussion and Comparison with Other Studies

The famous Framingham Heart Study found an inverse relationship between blood pressure and spirometric indices. This is in corroboration with our study.[7]

Since 1970s Higgins and Keller[10], Stavem et al[11], and Enright et al[12] has showed through the years that cardiovascular diseases can cause low FEV1 and this decrease in FEV1 is almost always associated with increased risk of mortality.

Among the more recent studies, Al-eldin et al in Turkey performed a study where it was shown that 28% of the patients had FEV1 less than 80% of the predicted[13]. In our study, we found 25% of the diseased group had an FEV1 less than 80%. However their study included both smokers and non smokers. But in our study, we chose non smokers as study subjects. Thereby, eliminating

any effect of smoking on the airway function. Therefore, it is interesting to notice that even in the absence of smoking, coronary artery disease and hypertension are causing pulmonary function changes.

Patil et al [14] performed a case control study in KIMS, Karad, where they showed 18% of the patients with coronary artery disease and hypertension presents with undiagnosed airway obstruction. In our study, there was 25% prevalence of obstruction among the diseased group. Eleven subjects out of 66 patients from the case population with HTN had FEV_1 /FVC ratio <70%. Twelve subjects out of 62 patients from the case population with IHD had FEV_1 /FVC ratio <70%. In the present study, 18% subjects from the case population had FEV_1 /FVC% ≤70%. Patients with HTN and IHD were having significantly low FEV_1 /FVC %. In our study, we found that 15.79% of those with hypertension only, and 16.62% of those with IHD only had airflow obstruction. However the percentage was much higher in the combined group, ie 32%.

The average FEV1 AND FVC recorded in various studies in this regards are given as follows :

Study Name	FEV1(HealthY)	FEV1(Diseased)
Patil Et Al[14]	2.42	1.53
Pramod Et Al[15]	2.48	2.24
Yadav Et Al[16]	3.18	1.336
Our study	2.12	1.65

Thus , we see that our study is in corroboration of the other studies in the fact that there is a net decrement of almost 1l in FEV1 in the diseased group, when compared to a non diseased group. The differences in the spirometric indices can be attributed to the anthropometric differences in population composition.

Summary/Conclusion

Taking into account all of these, we can say that hypertension and coronary artery disease has a detrimental effect on the spirometric indices irrespective of smoking. It also accentuates the negative effects of age on spirometric indices. Patients with coronary artery disease have 16.62% chance of undiagnosed airflow limitation, whereas patients with hypertension only have chance of 15.59%. However the risk is highest in the people who suffer from both diseases simultaneously, almost 32%, that is almost double that o the other groups. It was also seen that majority of patients with airflow limitation had severe COPD (GOLD III) without much symptoms. This level of obstruction in a patient warrants treatment with multiple drugs and can cause significant mortality if left untreated. Therefore, we recommend that spirometry should be undertaken in all patients of hypertension and CAD and repeated periodically. It is not only easy to perform in outdoor settings, but also non invasive and relatively inexpensive and if the patient is diagnosed as having previously undiagnosed air flow limitation, he can be treated, thereby decreasing his morbidity burden.

Limitations of the Study

The study was performed in a hospital setting. Due to resource constraints, we could not examine various other aspects of pulmonary functions like DLCO and small airway functions. Also there were a dearth of earlier studies on this subject matter. The pathophysiology of the interaction between the two diseases should be further explored and corroborated by other studies. Finally longitudinal studies are needed to study these trends in long term. Moreover, we need other studies that would evaluate the impact of treating undiagnosed air flow limitation in these subset of patients, especially any beneficial effect on their morbidity and mortality.

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