Pulmonary Function Tests in Hypertension

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Abstract:

Background: Many studies have shown that Hypertension is a chronic disease affecting many organs in the body. However, very few studies have been done to analyze the association between lung function and hypertension. It must be considered that antihypertensive treatment might have an effect on lung function, too. With this background the study was undertaken.

Objectives: To assess and compare the pulmonary function tests (PFTs) in controlled hypertensive patients and; age and gender matched normal healthy controls.

Materials & Methods:- Sample size of 30 for both the groups i.e. normal control and controlled hypertensives(on beta blockers) were selected. Spirometry was performed by RMS Helios Spirometer. Recording of parameters- FVC, FEV_1, FEV_1/FVC%, PEFR, FEF_{25}, FEF_{50}, FEF_{75}, FEF_{25-75}, $FEF_{0.2-1.2}$ was done in both the groups. These parameters were compared in these groups by applying unpaired t test.

Results: The mean values of all the PFT parameters were statistically significantly lesser than those in the hypertensive patients. 74% of the patients had obstructive pattern of PFTs, while 13% of patients were having restrictive pattern. 13% of patients were having normal PFTs pattern.

Conclusion: Hypertension along with Beta blockers can have deleterious effects on PFTs. These patients are more prone to Obstructive lung disease. All the patients with hypertension, especially those on beta blockers should be screened by Spirometry for early detection of pulmonary complications.

Key words: Hypertension, Spirometry, Obstructive lung disease

Background:

Hypertension (HT) affects about one billion people worldwide [1]. It is estimated that by 2025, up to 1.56 billion adults worldwide will be hypertensive. HT is estimated to cause 7.5 million deaths, which accounts for 57 million disability-adjusted life years (DALYs) [2]. Hypertension (HT) is an increasingly important public health challenge worldwide. In India, according to the World Health Organization's 'global health statistics 2012', 23.10 per cent men and 22.60 per cent women over 25 years old suffer from hypertension[3]. Very soon, with growing population, India will become capital of Hypertension along with Diabetes. Moreover, HT has been linked to multiple diseases including cardiac, cerebrovascular, renal and eye diseases. The physiological interactions between respiratory and cardiovascular system has always been the interesting areas of research. Several studies have shown that cardiovascular system and pulmonary functions are clearly associated [4,5,6]. But there are very few studies showing involvement of respiratory system in HT in India. The Framingham Study found an inverse relationship between forced vital capacity (FVC) and cardiovascular diseases and mortality [7].

There are few studies showing effects of antihypertensive medications on pulmonary function tests. Especially beta blockers are notorious in causing bronchoconstriction. The association between blood pressure, antihypertensive drug treatment and lung function parameters in Indian population is much less investigated. Thus, the aim of this study was to determine whether hypertension as well as antihypertensive medication had an adverse effect on lung function.

Objectives:

The study was planned with following objectives:

1. To assess and compare PFTs in patients of controlled hypertension and normal age and gender matched healthy controls.
2. To correlate PFTs with mean blood pressure and duration of hypertension in patients of Hypertension.

Material and Methods:

The study was carried out in collaboration with Hypertension Outpatient Department of Sassoon General Hospital. Thirty diagnosed male patients of controlled Hypertension (B.P. < 140/90) taking antihypertensive medications since 5-10 years, belonging to the age group of 40-60 years were randomly selected from the Out-Patient Department.

Exclusion criteria

1. Patients with blood pressure > 140/90 mm Hg.
2. Smokers and patients having complaints of coughing or dyspnoea.
3. Patients with cardio-respiratory illnesses or any major diseases.

Thirty normal healthy males of the same age group and socioeconomic status were selected as control group.

Written informed consent was taken. Blood pressures of all the patients were taken by Mercury Sphygmomanometer (Diamond). Pulmonary function tests of the patients as well as controls were performed with 702 Helios – Spirometer (RMS, India). All the tests were conducted according to ATS/ERS guidelines.[8] FVC,FEV_1,FEV_1/FVC,FEF_{25},FEF_{50},FEF_{75},FEF_{25-75},$FEF_{0.2-1.2}$ and PEFR were recorded in patients with HT and normal controls.

All data was collected in a Data Collection Form and then transferred to an Excel sheet by two independent data entry operators. Discrepant values were corrected by checking the data collection form. Clean data was then analyzed statistically.

Statistical analysis was done by using Graphic Prism pad version-5 software. Unpaired Student's t test was applied to compare the PFTs in both the groups. Association between mean arterial pressure and FVC and FEV_1 were analyzed by applying Pearson's coefficient.

Results:

The study population included 30 healthy controls and 30 diagnosed patients of Hypertension. The demography of the study subjects is summarized in Table 1. There were no statistically significant differences between the mean ages, heights and weights of the control subjects and HT patients ($p>0.05$). The respiratory parameters i.e. FVC, FEV_1, FEV_1/FVC%, PEFR, FEF_{25}, FEF_{50}, FEF_{75}, FEF_{25-75}, $FEF_{0.2-1.2}$ were significantly lower in HT patients when compared with control population ($p<0.05$), (Table 2, fig-1). On comparison, we found that 74% patients of HT were having obstructive pattern, while 13% of the patients were having restrictive pattern of their pulmonary function test parameters. However 13% of HT patients had normal PFTs (Fig-2). On correlating the pulmonary function parameters i.e. FVC with mean B.P., we found no significant correlation between them ($r^2=0.072$, $p>0.05$, Fig-3). Similarly on correlating FEV_1 with mean B.P., there was no significant correlation ($r^2=0.037$, $p>0.05$, Fig-4).

Discussion:

Our study showed that pulmonary function test parameters in patients with HT were statistically significantly lesser than the normal controls ($P<0.05$); [Table 2, Fig-1]. On comparison, we found that 74% patients of HT were having obstructive pattern, while 13% of the patients were having restrictive pattern of their pulmonary function test parameters. However 13% of HT patients had normal PFTs (Fig- 2). On correlating FVC and FEV_1 with Mean arterial pressure, we did not find any significant correlation between them.

There was no statistical difference between age, height and weight of the two study groups ($p>05$). Hence both these groups were comparable. All our patients of HT were taking beta blockers as antihypertensive medication. Hypertension is a disease, which affects various systems of the body. Complications of this disease are varied and well studied, but still further research is ongoing.

Studies by Engstorm et al showed that the incidence of cardiovascular disease and mortality associated with hypertension is increased, in patients with compromised lung function [4]. Study by Schnabel has shown that there was decrease in FVC and FEV_1 in patients of hypertension[9]. However, the association between blood pressure, antihypertensive treatment and impaired lung function has been studied mainly in patients with already existing pulmonary diseases and in a population-based setting.

On the other end, many of the studies have demonstrated that patients with Chronic Obstructive Pulmonary Disease (COPD) had hypertension as one of the chronic co-morbid condition [5,10,11].

However, one of the studies by Margretardottir OB et al found no difference in FEV_1 and FVC between hypertensive subjects that used or did not use beta blocking antihypertensive as compared to normal controls, but they did not specifically address the effect of antihypertensive medication independent of high blood pressure on lung function[5].

Beta-adrenergic receptors play a key role in the regulation of bronchomotor tone, Some studies have shown that beta blockers even relatively cardioselective beta blockers do produce bronchoconstriction[12]. This can be the probable cause of Obstructive pattern in these patients. It is known that beta agonists improve the performance of skeletal as well respiratory muscles[13,14,15]. Study by Frankenstein et al has shown that beta blockers reduce the performance of respiratory muscles. Beta blocker medication may result in a slight reduction of expiratory muscle strength causing a proportional decrease of FEV_1 and FVC[16]. This could be one of the

reasons behind the restrictive pattern in some of our patients. However, further studies directly addressing this issue are required.

Additive effect of both treatment with beta blockers and persistent high blood pressure could be responsible for compromised pulmonary function tests However, the cross-sectional study design makes it difficult to segregate the effects of high blood pressure and antihypertensive medication.

Beta blockers are the most commonly prescribed antihypertensive medication and it should be considered that BBL medication might be prescribed for other indications than hypertension, as for example, coronary heart diseases or heart failure, too[9].

Subjects with currently normal blood pressure with medication might have had high blood pressure for long duration before it was recognized and treated. The high blood pressure could have detrimental effects on the lung function. One possible hypothesis is that chronic hypertension causes left ventricular dysfunction. This results in increased left atrial pressure. This might lead to an increase in pulmonary artery pressure resulting into an increase in interstitial edema in the lung causing a decrease in FEV_1 and FVC values [19]. This may explain the restrictive pattern in 13% of our patients.

In our study, we did not get any significant association between FVC and FEV_1 and mean blood pressure. Studies by Sparrow et al and Selby et al have reported significant association between FVC and incidence of hypertension [6,18]. Forced vital capacity has been suggested by Selby et al as one of the markers of susceptibility or intermediate steps in pathways leading to hypertension [6]. While, study by Wu Y et al have reported weaker associations between FVC and FEV_1 and incidence of hypertension [19]. Smaller sample size in our study can be the reason for non significant association.

Therefore, it is necessary to evaluate the temporal sequence, effects and the causality between high blood pressure, its medical treatment and lung function in further prospective studies.

Several prospective studies have shown that not only hypertension is a risk factor for reduced lung function, but compromised pulmonary function tests increases the risk of development of hypertension [6,18].

Identification and control of raised blood pressure is currently the main strategy for prevention of stroke, heart failure and other complications of HT. Therefore measurements of PFTs may be useful as are certain other conventional risk factors currently used to guide the management of patients with hypertension.

Limitations and Scope:

The cross-sectional study design makes it difficult to establish the temporal association and causality between high blood pressure, its treatment and lung function. Thus, our findings may serve as a basis for experimental testing in 'hypertensive' trials.

Conclusions:

Our study has shown that the pulmonary function test parameters decrease in patients of Hypertension. Predominantly obstructive pattern was observed in these patients (74%). However restrictive (13%) as well as normal (13%) patterns were also observed amongst them. Beta blockers are probably the contributory factors for the compromised lung function.

Since hypertensive patients are at an increased risk of developing respiratory pathology in the form of obstructive lung diseases, they should be advised different respiratory exercises, in addition to antihypertensive medication. This will definitely help them to live better quality of life.

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Table 1. Physical Characteristics of subjects

Parameter	HT patient n = 30 Mean ± S.D.	Controls n = 30 Mean ± S.D.	p Value
Age (yrs)	53.90 ± 8.45	54.88 ± 8.28	p > 0.05
Height (cms)	159.23 ± 7.86	161.28 ± 7.33	p > 0.05
Weight (kgs)	61.57 ± 7.38	64.42 ± 8.70	p > 0.05
Mean B.P.(mm Hg)	156.12 ± 8.36	146.32 ± 9.31	p < 0.05
Duration of HT (yrs)	6.56 ± 5.86	-	-

Table 2: Comparison of PFTs in patients of HT and Controls

Parameter % Predicted values	Control Mean ± S.D.	HT Subjects Mean ± S.D.	p Value
FVC	89.36 ± 9.71	64.63 ± 6.60	p < 0.05*
FEV1	88.03 ± 6.69	44.90 ± 8.94	p < 0.05*
FEV1/FVC	111.36 ± 10.62	68.96 ± 8.64	p < 0.05*
PEFR	77.70 ± 12.81	58.76 ± 8.68	p < 0.05*
FEF25	81.60 ± 8.69	56.33 ± 9.01	p < 0.05*
FEF50	84.10 ± 11.35	58.5 ± 8.66	p < 0.05*
FEF75	85.00 ± 10.28	59.10 ± 7.44	p < 0.05*
FEF25-75	73.83 ± 10.28	58.16 ± 11.71	p < 0.05*
FEF0.2-1.2	91.06 ± 11.46	55.76 ± 10.94	p < 0.05*

Fig 1: Comparison of PFTs in patients with HT and normal controls

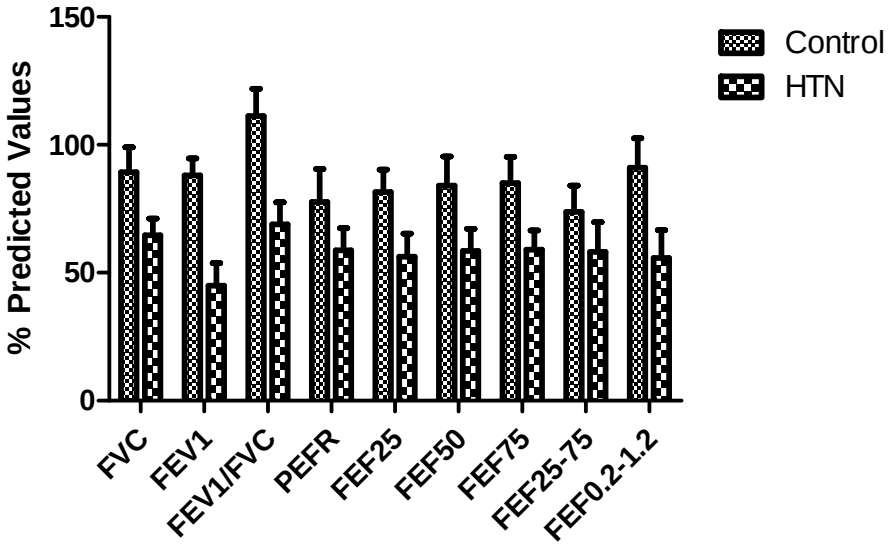


Fig 2: Percentage-wise distribution of pattern of PFTs in patients of HT

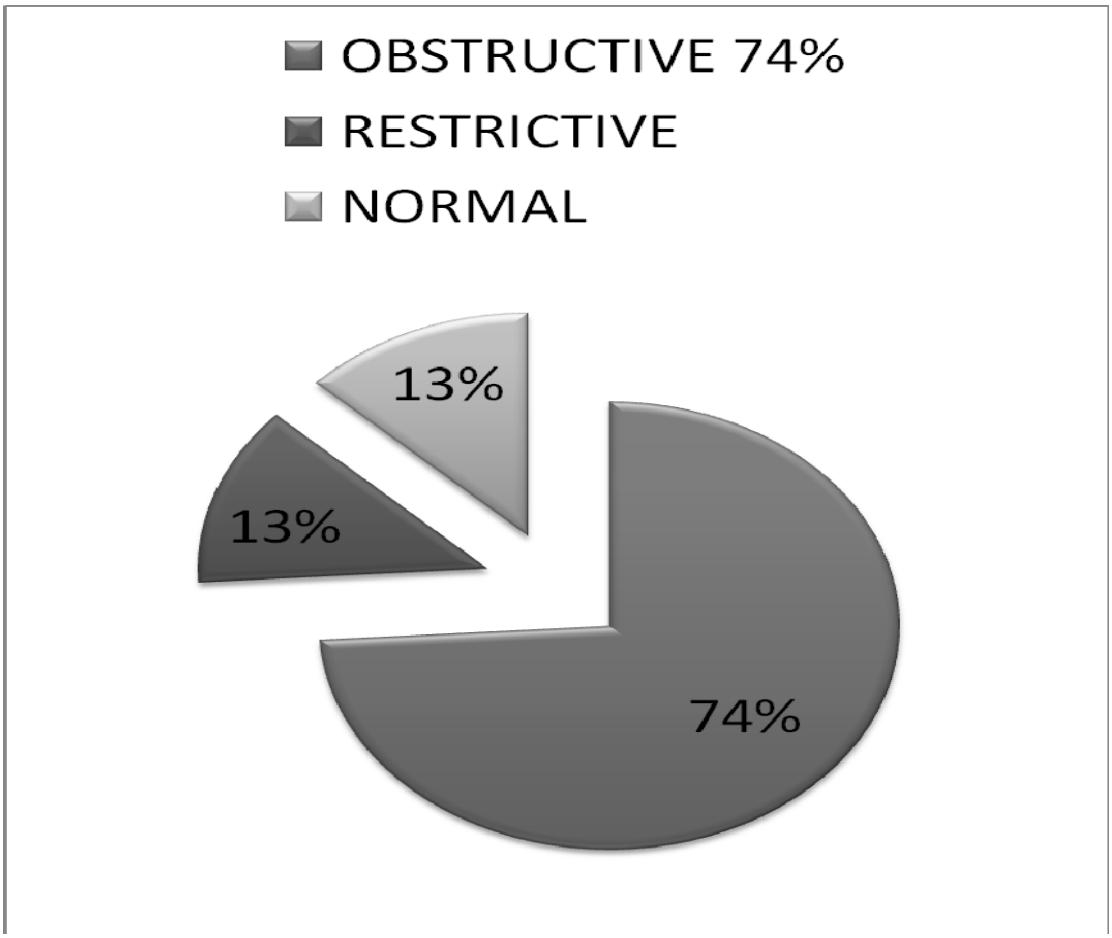
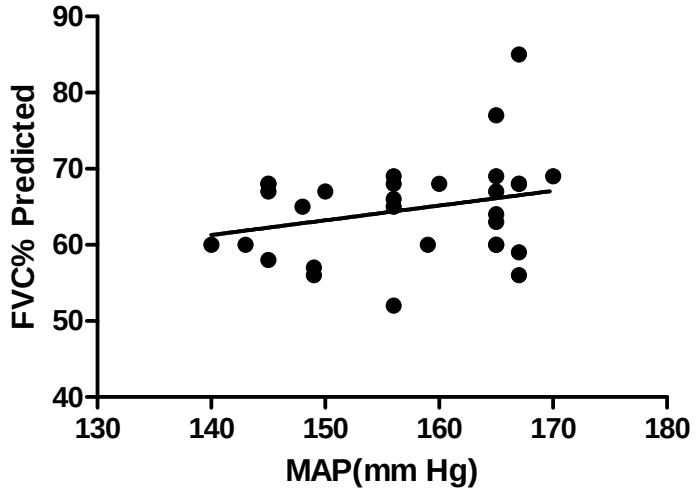
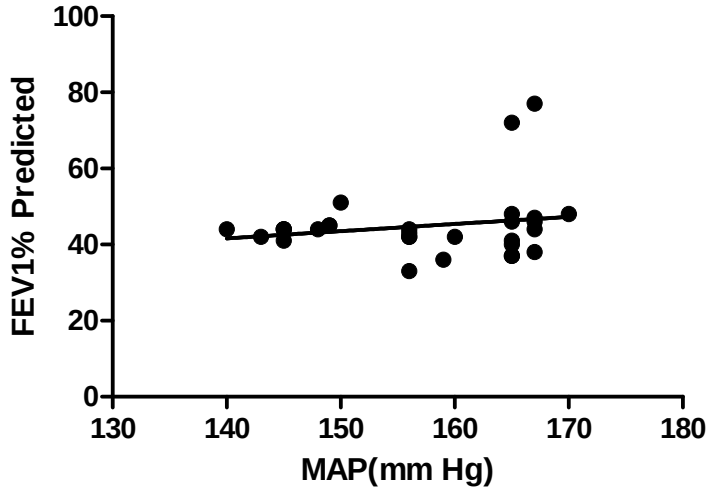


Fig 3: Correlation of FVC(% predicted) with Mean B.P.



r^2=0.072, p>0.05

Fig 4: Correlation of FEV_1 (% predicted) with Mean B.P.



r^2=0.037, p>0.05