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Physiology

CLINICAL SIGNIFICANCE OF LUNG VOLUMES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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ABSTRACT Chronic Bronchitis , Chronic Asthamatic Bronchitis and Emphysema commonly expressed as Chronic Obstructive Pulmonary Disorders(COPD) are extremely common in india. COPD is characterized by progressive limitation of expiratory air flow which can be assessed by simple spirometry.
To establish the fact that in advanced cases of COPD there is broncho irreversibility. To study the correlation between cigarette smoking and COPD.
The dynamic lung volumes like FVC,FEV1 , FEV/FVC% , PEF and MMEFR are significantly altered in COPD.
It is prevelant the world over, In India it is one of the most common lung disorders following Pulmonary Tuberculosis. Males are more affected than females.
Cigarette smoking plays predominant role and is undoubtedly the major risk factor for the development of Emphysema and Chronic Bronchitis.
This study includes fiftyty patients of Chronic Obstructive Pulmonary Disorders(COPD) between the age group of 20-60 years of both sexes .
The values of the mean pre medication FVC , FEV1 and FEV1/FVC% are markedly lower than the mean control values suggesting a chronic airway obstructive disease.

KEYWORDS : COPD , FVC,FEV1 , FEV/FVC% , PEF

Introduction

Several studies have shown rapid decline in lung function in smokers with hyper reactive airways. Airway hyper responsiveness to histamine was associated with accelerated decline in FEV_1 , and thus was a risk factor for COPD. A comprehensive study on the epidemiology , course and prognosis of COPD gave evidence of childhood respiratory infection as a risk factor in COPD.

The Incidence of COPD is higher in Industrial areas.
Grain dust exposure has been established as a risk factor in COPD , both in smokers and non smokers.

Occupational exposure to dusts and fumes are important factors , coal dust exposure in coal miners also contributing for Chronic Bronchitis.
Heavy alcohol consumption was associated with respiratory symptoms and reduced lung function even when controlled smoking , but smoking was judged to be far more important risk factor.

Emphysema:

1. Hyperventilation of lungs
2. Flattening of the diaphragm
3. Changes in pulmonary vasculature resulting in oligemia
4. Presence of different types of bullae.

Materials and Methods:

This study includes fifty patients of Chronic Obstructive Pulmonary Disorders(COPD) between the age group of 20-60 years of both sexes from both out patient and in patient of Govt T.B.Hospital, Visakhapatnam during a period of 10 months from January 2017 to October 2017.

They were subjected to spirometry using Spirometer of Electronic Computerised variety both before and ten minutes after inhalation of salbutamol aerosol for a period of ten minutes.
No controls were taken .Out of 50cases, 30 were males and only 20 cases were females.

Criteria fixed for selection of cases were:

1. History of cough and Dyspnoea for a minimum period of five years occuring episodically throughout the year.
2. No history of Tuberculosis.
3. No complications like Cor-Pulmonale etc.

The subjects were made to breath out Vital Capacity slowly and then as Forcefully as possible after taking in a deep breath.

The other Dynamic Lung Volumes like FEV_1 , FEV_1% , PEF and $FEF_{(25-75)}$ were automatically recorded .

The same tests were repeated in the cases under study after 10 minutes of continuous nebulization with 2.5mg salbutamol aerosol.

Before undertaking the experiment, the age in years , sex , height in centimeters were recorded. The weight in kgs was recorded separately and the Body Surface Area was calculated from height and weight.

The subject was asked to take a deep breath , immediately he was asked to place the mouth piece around the vestibule of the oral cavity and lock it with the lips. There after he was asked to blow the air slowly but completely without interruptions into the mouth piece. Thus the slow vital capacity is recorded.

Next he was asked to take a deep breath as previously and blow out the mouth piece as rapidly and as forcefully as possible. This is the Forced Vital Capacity.

The Dynamic lung volumes were recorded automatically on the thermo sensitive paper.

Results

Table I

Table depicting Mean Age(years) . Height (cm) , Weight(kg), Body Surface Area(sq.m) (n=60)

	Age(years)	Height(cm)	Weight(kg)	Body Surface Area(sq.m)
Mean	42.8	160.5	47.5	1.6
Std Deviation	14.7	10.5	10.9	1.81

Table II

Comparison of the Spirometric data i.e VC , FVC, FEV1 , FEV % , PEF and FEF(25-75) in the study group (n=60)

	VC	FVC	FEV1	FEV %	PEF	FEF(25-75)
Pre NEB						
Mean	1.87	1.57	1.5	59	160	0.973
Std Deviation	0.673	0.644	0.669	20.6	92.9	0.898
Post NEB						
Mean	2.19	2.05	1.39	60.6	206	1.8

Std Deviation	0.867	0.820	0.805	21.9	129	1.19
Predicted						
Mean	3.3	3.13	2.69	79.3	443	3.9
Std Deviation	0.639	0.393	0.391	9.3	113	0.639

Table III
Spirometric parameters i.e VC , FVC, FEV1 , FEV % , PEF and FEF(25-75) in the study group Height wise (n=60) Group I (below 130cm)

	VC	FVC	FEV1	FEV %	PEF	FEF(25 -75)
Pre NEB						
Mean	1.53	1.43	1.3	79	93	0.93
Post NEB						
Mean	2.03	1.39	1.79	83	139	1.29

Group II (131 – 140 cm)

	VC	FVC	FEV1	FEV %	PEF	FEF(25-75)
Pre NEB						
Mean	1.53	1.43	1.1	79	93	0.93
Post NEB						
Mean	2.09	1.39	1.93	93	139	1.29

Group III (141 – 150 cm)

	VC	FVC	FEV1	FEV %	PEF	FEF(25-75)
Pre NEB						
Mean	1.69	1.539	1.593	69.3	169	0.999
Post NEB						
Mean	2.039	1.999	1.69	79.9	219	1.639

Group IV (151-160 cm)

	VC	FVC	FEV1	FEV %	PEF	FEF(25-75)
Pre NEB						
Mean	1.79	1.329	0.939	54.99	127.9	0.79
Post NEB						
Mean	1.99	1.909	1.199	50.9	139	0.899

Group V (161 – 170 cm)

	VC	FVC	FEV1	FEV %	PEF	FEF(25-75)
Pre NEB						
Mean	2.39	1.939	1.439	63.99	199.9	1.3
Post NEB						
Mean	2.79	2.39	1.899	63.79	269.9	1.339

Group VI (171 – 180 cm)

	VC	FVC	FEV1	FEV %	PEF	FEF(25-75)
Pre NEB						
Mean	1.93	1.93	1.193	53.19	169	0.693
Post NEB						
Mean	2.93	2.39	1.993	40.99	169	0.369

This Table shows that all values except FEV1 and FEV % are slightly higher in Group V i.e 161-170 cm height. Whereas FEV1 and FEV % are slightly higher in the Group III i.e 141-150 cm.

This suggests that height of the individual has no significant effect on the lung function.

Discussion

The values of the mean pre medication FVC , FEV1 and FEV1/FVC% are lower than the mean control values suggesting a chronic airway obstructive disease.

The mean FEV1 in the present study is 1.1 litres before broncho dilator nebulization and 1.37 litres ten minutes after bronchodilator nebulization.

Both the values are significantly lower than the predicted normal values of 3.2 litres in the study group.

The values are significantly lower than the reported normal values of 3.8 litres of Kamat and 3.4 litres of Rastogi.

The value of the paired 't' for pre and post medication cases 0.0065 which is markedly lower than the statistically tabulated value of 0.001. This indicated that the medication has no effect and suggested a Chronic Obstructive Airway Disease.

Pencock reported a bronchodilator response of 17% as significant for FEV1/FVC%. The present value of 7.8% is much lower than the above reported value.

The pre-medication mean value of 159 litres of PEFR is much lower than the mean predicted normal value of 447 litres.

This value indicates the status of large airways and it is insensitive to early obstructive changes which occur in small airways.

The broncho dilator response to PEF is of the order of 26% in this study.

Paired 't' for PEFR is done, because PEFR is a purely effort dependent test. The observed value of 5.9 is significantly higher than the statistical value.

However this value is not taken into consideration as the value of PEFR may underestimate the degree of airflow obstruction.
The mean premedication value of FEF(25-75) of 0.9 is also significantly lower than the mean predicted value of 3.8 in the study group.

This co-relates with the observation of Hogg and his colleagues and that of Mackleam and Mead who showed that the major site of increased resistance in COPD is the small airways and that FEF(25-75) is a good indicator of small airways status.

In the present study the mean post-medication values of all the dynamic lung parameters are significantly lower than the mean control values. There was no significant improvement of the parameters following broncho dilator therapy.

All the values except PEFR improved by less than 20%.

This is in contrast to the observation of Snider and Shapiro who reported 20% increase as significant. This once again suggested a Chronic Obstructuve Airway Disease.

There was a progressive decrease with age of the FEV1 and PEFR values which are the most effort dependent values.

The FEV1, showed values of 1.19 , 1.6 , 1.27 , 0.761 , 0.908 and 0.907 in the different age group age from below 20 years to above 60 years.

The PEFR also showed a similar progressive decrease in the values with 213 , 174.3 , 137.5 , 139 and 132 litres in the age group of below 20 to above 60 years.

The pre-medication mean value of FEV1 and PEFR in smokers are 1.02 and 147.5 litres respectively. In contrast non smokers showed a slightly higher value of 1.39 and 170 litres respectively for these volumes.

Thus non-smokers showed a slightly higher values of 0.37 litres for FEV1 and 20.5 litres for PEFR over the smokers.

These values go with the reported observation of the impact of smoking on COPD by various research studies.

The Lung Health study conclusively proved that cigarette smoking is an important factor in the aetiology of COPD.

Males showed a slightly higher value over females in FEV1 , by 0.07 litres and in PEFR of 28 litres. Though these values are not statistically very high nevertheless they reflect on the effort dependency of these tests and that females because of their weak built have slightly lower values.

There is a variable variation of the values with height in the different groups. This does not make it possible to co-relate height and lung volumes in this study.

Summary and Conclusions:

In COPD there is significantly narrowing of the airways due to

inflammation oedema and fibrosis. So all the dynamic lung parameters under consideration are significantly lower than the predicted normal values.

There was no significant improvement of the parameters following broncho dilator therapy. This suggests irreversibility of the obstruction. Salbutamol is a Beta-2 agonist which acts on the Beta-2 receptors of the bronchial smooth muscle and produces relaxation.

As there is no improvement with salbutamol this suggests that bronchospasm is not the only contributory factor to the airway obstruction in COPD.

The FEV1 and the PEFR are the most effort dependent tests. These values are absolutely low when compared to the predicted normal values. This suggested Chronic Obstructive airway Disease in which the FEV1, FEV1/FVC% & PEFR are less than 80% of the normal values.

In the study there is a slightly decrease of the values with age which suggests that the disease progressed with age. Smokers showed slightly lower values as compared to non smokers which reflects that smoking has impact on the natural course of the disease.

Females showed slightly lower values which reflects on the effort dependency of these tests. No correlation was found between height and spirometric values.

Further research is required for the evaluation of various factors that cause broncho irreversibility and the effect of cessation and intervention of smoking.

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