USE OF SPIROMETRY IN DETECTING AIRWAY OBSTRUCTION IN ASYMPTOMATIC SMOKERS

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ABSTRACT

Objectives: To detect spirometric abnormalities in asymptomatic smokers in relation to duration of smoking.

Study Design: Cross sectional study.

Place and Duration of Study: The study was carried out at PNS Shifa from Oct 2006 to June 2007.

Subjects and Methods: Hundred individuals were included in this study who fulfilled the required criteria. Spirometry was done after briefing the patient about the procedure. Smokers were divided into two groups. Group I (5 to 9 pack years) and group II (≥ 10 pack years). All relevant information were recorded on Performa (Annex-A). The data was analyzed through SPSS-10, in terms of Mean ± SD (Standard Deviation) for numeric response variables and independent sample T test was applied to compare significance of proportion for numeric response variables at $p < 0.05$. Categorical variables were compared by applying Chi-square test at $p < 0.05$ level of significance.

Results: Significant statistical difference was found between the mean age in the two groups with p-value of 0.011. This may be due to the longer duration of smoking history in Group II. Strong association was found between number of cigarette smoked and the pattern of airway obstruction as significant statistical difference of airway obstruction and early airflow limitation was found between the two groups of smokers at p value of 0.004.

Conclusion: There is strong association between duration of smoking and development of airway obstruction even before the smoker become symptomatic.

Keywords: Asymptomatic smokers, Chronic Obstructive Pulmonary Disease, Cigarette smoking, Spirometry.

INTRODUCTION

"Chronic obstructive pulmonary disease" is currently the fourth leading cause of death in the world[1]. It is defined as "A disease state characterized by airflow limitation that is not fully reversible. Airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases[2]".

Studies have proven an accelerated decline in the value of the first second forced expiratory volume (FEV1) in relationship to the intensity and duration of cigarette smoking[3-5]. The disease usually is not diagnosed until the patient experiences dyspnea with only mild exertion, interfering with the patient's quality of life. The disease process is initially asymptomatic when lung function deteriorates without associated symptoms. The onset of the subsequent symptomatic phase is variable but often does not occur until the FEV1 has fallen to approximately 50 percent of the predicted normal value[2]. Substantial deterioration in airflow has already occurred by the time most patients become symptomatic. To identify asymptomatic patients earlier in the course of the disease, spirometry should be performed in asymptomatic chronic smoker and in patients who have chronic cough and sputum production. Spirometry provide objective means for determination functional impairment of the respiratory system[6]. The most important aspects of spirometry are the forced vital capacity (FVC), which is the volume delivered during an expiration made as forcefully and completely as possible starting from full inspiration, and the forced expiratory volume in one second (FEV1), which is the volume delivered in the first second of an FVC manoeuvre[7]. The presence of a FEV1<80% of the predicted value in combination with an

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FEV1/FVC <70% confirms airflow limitation that is not fully reversible. The FEV1/FVC is a more sensitive measure of airflow limitation, and an FEV1/FVC <70% is considered an early sign of airflow limitation in patients with normal FEV1 (> 80% predicted)[2,8,9] .

Cigarette smoking is very common in our society especially in the young and middle age group. The objective of this study was to asses the lung function in adult asympyomatic smokers and to measure the association between the duration of cigarette smoking and deterioration in lung function. This study helped us to reasonably establish the role of spirometry as a screening test by detecting the frequency of early air flow limitation in asymptomatic adult smokers. This should prompt the physicians to initiate agressive smoking cessation intervention.

MATERIALS AND METHODS

The study was conducted at Pakistan Navy Hospital PNS Shifa which serves as tertiary care referral hospital for Armed forces and also provides health services to civil sector. It was a cross sectional study. The duration of study was 9 months, from October 2006 to June 2007. A total of 100 individuals underwent this study hat were selected by Nonprobability convenience sampling technique. The individuals recruited in the study included personnel serving in Pakistan navy, working at PNS Shifa and male patients presenting to OPD with non respiratory and non acute problems. They were between 20 & 45 years of age, with smoking history of 5 pack years or more and have not been to doctor for complaints of cough or breathlessness for last 2 years. Informed consent was taken from these individuals and OPD numbers were allotted to them.

Individuals with history of cough or breathlessness, chest injury, exposure to organic dust, those with direct involvement in ship breaking, painting and sand blasting were excluded.

General physical and systemic examination was done to exclude individuals with clubbing, cyanosis, pedal edema, chest and spinal deformity or any abnormal finding on Respiratory and Cardiovascular examination.

The procedure was explained and demostrated to each individual. Spirometry was done using computer based pulmonary function analyzer. All relevant information including weight, height, age, chest expansion, pack years of smoking and reading of spirometry etc. were recorded on Performa (Annex-A).

On the basis of smoking history, two groups were made. Group I included smokers with 5 to 9 pack years of smoking and group II included smokers with 10 or more pack years.

On the basis of Spirometry, patterns of airway obstuction was divided into Four groups, in accordance with European Respiratory Society (ERS) criteria[10]. They included, normal (FEV1/FVC> 70%)[11], mild (FEV1 ≥70%), moderate (FEV1 50 to 70%) and severe(FEV1< 50%). Maximum mid expiratory flow or Forced Expiratory Flow between 25% to 75% of the Vital capacity(FEF 25-75%) is indicative of early obstructive disease when the FEV1/FVC ratio is normal11. The readings of FEF25-75 were divided into two groups: normal≥80% of predicted and low < 80% of predicted[12].

Statitistical analysis was done through SPSS-10, in terms of Mean ± SD for numeric response variables and independent sample T test was applied to compare significance of proportion for numeric response variables at $p < 0.05$. Categorical variables were compared by applying Chi-square test at $p < 0.05$ level of significance

RESULTS

The mean of weight and height for group I (n=63) with 5 to 9 pack years of smoking and group II (n=37) with greater than 10 pack years of smoking, were calculated and compared by using independent sample t-test. The p-value of mean weight and height in the two groups is 0.458 and 0.599 respectively. This indicates that the difference of mean weight and height between the two groups is not statistically significant.

The mean and standard deviation for age in the two groups is shown in Table I. The comparison of mean age of the two groups revealed statistically significant difference with a p-value of 0.011.

The above analysis suggests that the height and weight of the individuals did not influence the results, however age was an important factor effecting Spirometer analysis.

The comparison of maximum mid expiratory flow (FEF25-75) in the two groups is shown in Table II. The values of FEF25-75 in two groups were evaluated by applying Chi-square test and the p-value was 0.004 which proves that the difference of FEF25-75 between the two groups is highly significant.

Within the two groups there was significant difference in the pattern of airway obstruction (Table III). The Spirometry results were compared by applying Chi-square test that revealed p value of 0.004, indicating a highly significant statistical difference between patterns of airway obstruction in the two groups.

DISCUSSION

Chronic Obstructive Pulmonary Disease causes 29 million disability-adjusted life-years and 1 million years of life lost per annum around the world. Thus COPD is placed as the fifth most significant global health problem and expected to become the third leading cause of death in the first quarter of the next century13. However, even these figures are not true indicator of the disease burden, as there is a relative paucity of data available to determine the prevalence and burden of COPD.

In its milder form it is very difficult to clinically diagnose and detect COPD without the use of spirometry. Spirometry has been used as a diagnostic test, with the usefulness and accuracy of its measurements which depends on both the equipment and proper test performance[7,14]. Although simple to learn, spirometry is an effort-dependent test. It requires both cooperation of the patient and a trained staff capable of administering the test. Abnormal spirometry (limitation of expiratory airflow, airways obstruction, or a low FEV1/FVC ratio) is a strong predictor for rapid development and progression of COPD. The degree of airways obstruction correlates closely with pathologic changes in the lungs of smokers and patients with COPD. Spirometry

Table-1: Mean and Standard deviation of age of individuals

	Pack years of smoking	N	Mean	Std.Deviation		Std. Error Mean
Age of individual	5-9 years	63	**30.70**	**6.80**		.87
	10 years and greater	37	**34.14**	**5.75**		.94

Table-2: Maximum mid expiratory flow rate(FEF_{25-75}) in the two groups

		Max. mid exp. Flow(FEF_{25-75})		Total
		Greater than 80%(normal	less than 80%(low)	
Pack years of smoking	**5-9 yrs**	34	29	63
	10 years and greater	9	28	37
Total		43	57	100

FEF_{25-75} Forced Expiratory Flow between 25-75% of Forced Vital Capacity

Table-3: Pattern of Airway Obstruction in the two groups

		Airway obstruction assessed by spirometry				Total
		Normal	mild	Moderate	severe	
Pack years of smoking	**5-9 yrs**	**60**		**3**		**63**
	10 years and greater	**26**	**2**	**6**	**3**	**37**
Total		**86**	**2**	**9**	**3**	**100**

results also help to predict morbidity and mortality due to COPD, mortality due to cardiovascular disease, lung cancer and all-cause mortality[14].

Effects of cigarette smoking and smoking cessation on rate of FEV1 decline were examined in 4,451 Japanese- American men who were 45 to 68 years of age at baseline[15]. Rates of FEV1 decline increased significantly with age and varied strongly with smoking status. Overall, men who continued to smoke experienced faster rate of decline as compared to non smoker (33 ml /year versus 22ml/year, respectively; p=0.0001). After quitting smoking, the rate of decline diminished to a level (19 ml/year) similar to that of men who had never smoked (21ml/year). These results support other reports of accelerated rate of decline of FEV1 in the person who continue to smoke, and they indicate that smoking cessation leads to decrease in lung function.

The Lung Health Study (LHS)[16] was a randomized clinical trial that demonstrated that COPD could be detected in its early stages in smokers with few symptoms. The LHS documented the ability to successfully intervene with an intense smoking cessation program in relatively asymptomatic smokers. At least 35% of the subjects were able to quit smoking for extended periods of time, and 22% of the subjects were able to sustain smoking cessation for 5 years.

Data from a random sample of 8,191 men and women selected in six U.S. cities and examined on three occasions over a 6-year follow-up period were analyzed to describe the effect of smoking history and current smoking behavior on rate of loss of pulmonary function during adult life. The rate of decline of FEV1 in smokers was 52ml/year compared to 37.8 ml/ year in never smoker. The faster decline of FEV1 among smokers depended on the number of cigarette smoked per day during the interval between examinations[17]. The estimated increase in rate of loss of FEV1 associated with smoking was 12.6 ml per year per pack per day for men and 7.6 ml per year per pack per day for women[17]. In this study age-specific rates of loss suggested that the benefits of cessation may be greatest among the young individuals and those who stop smoking will experience only a small recovery in pulmonary function level, but the rate of pulmonary function loss will be slowed.

In a cross-sectional study of large cohort of Japanese males[18], the difference in FEV1 between never smokers and current smokers was small at younger age but increased with age. Current smokers showed a more rapid decline in FEV1 over the five year period than non smokers.

The aim of this study was to check the relation between pack years of smoking and airway obstruction by doing spirometry in asymptomatic smokers. Strong association was found between number of cigarette smoked and the pattern of airway obstruction. In group I with less than 10 pack years of smoking, out of 63 individuals 3 had moderate airway obstruction whereas in group II with 10 or more pack years of smoking 11 out of 26 had mild to moderate airway obstruction (p=0.004). Similarly significant number of individuals in group II had low FEF25-75 as compared to group I (p=0.004).

The mean of age in group II was higher than in group I (p=0.011). The difference of mean age in the two groups is because of longer duration of smoking history in group II. The difference of age in the two groups has effects on airflow obstruction, as there is 20ml per year decline in FEV1 after 25 years of age[18-20] and rate of decline of FEV1 increases with age in smokers as compared to younger individuals[18], but in this study the difference of results of airway obstruction and FEF25-75 between the two groups is also statistically highly significant (p=0.004) indicating that cigarette smoking results in airway obstruction, potentiated by increase in duration of smoking and increase in age which is consistent with much larger studies carried out which were discussed earlier in the text[15].

CONCLUSION

Despite various shortcomings, our study reaffirms the well established correlation between smoking and development of COPD.

What this study has high lightened is that asymptomatic smokers develop statistically significant spirometric abnormalities after approximately 10 pack years or more of smoking. Unfortunately upto this point, the smoker remains blissfully unaware of his progressive lung damage and in the absence of any symptoms does not seek any medical advice. Spirometry and professional advice regarding smoking cessation intervention at this point is likely to motivate the smoker to quit his habit with positive dividents.

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