Original Article

Comparison of forced expiratory volume in one second (FEV1) among asymptomatic smokers and non-smokers

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Abstract

Objective: To compare the forced expiratory volume in first second (FEV1) among asymptomatic smokers and non-smokers for evaluating the effect of cigarette smoking on healthy subjects.

Methods: This was a Comparative cross-sectional study done at military hospital Rawalpindi from June 2006 till June 2007. Two hundred male subjects, 100 smokers and 100 non-smokers were included using non-probability convenience sampling. SCHILLER SPIROMETER (SP-1A) was used to measure forced expiratory volume in one second in all individuals. Best FEV1 was obtained after three efforts.

Results: FEV1 was measured in a population of male smokers less than 45 years of age, and compared with a matched group of non smokers, mean age being 35.08 ± 4.73 years (n=200) and mean height of 170.73 ± 5.76 cm (n=200). The prevalence rates of previously undetected airflow obstruction were studied according to the British Thoracic Society (BTS) criteria. This study showed that 16 out of 100 smokers had mild airway obstruction while only 01 non smoker out of 100 had FEV1 levels below 80%. The prevalence rate of airway obstruction was associated with age and the number of pack years of smoking.

Conclusion: The prevalence of undetected airflow obstruction is high among asymptomatic smokers. Targeted screening therefore, especially in smokers needs to be considered. Since lung function declines with time, therefore best time to prevent morbidity and mortality from smoking-related illness should be early in life (JPMA 60:209; 2010).

Introduction

Smoking is a malicious curse of world today. In Pakistan the highest prevalence of cigarette smoking among males was seen in the age group 24-44 years, whereas in women it is not known.[1]

Smoking related diseases kill one in ten adults globally. Smoking is the single largest preventable cause of disease and premature death. It is a prime etiologic factor in heart disease, stroke and chronic lung disease. There is mounting evidence of the harmful effect of passive smoking.[2] Smoking causes airway obstruction, chronic expectoration and decline in lung functions.[3] All these effects are directly proportional to number of pack years and there is definite tendency to narrowing of both the larger and smaller airways.[4]

Spirometry can be helpful in determining effects of smoking on ventilatory functions.[5] It is the best method to detect borderline to mild airway obstruction, which occurs early without appearance of any symptoms or signs.[6] FEV1 is the most important spirometric variable for assessment of airflow obstruction.[7] Smokers have excessive loss of FEV1 of 7.4-12.6 ml/pack year for males and 4.4-7.2 ml/pack year for females.[8]

The prevalence of undetected persistent airflow obstruction in middle-aged smokers is high. Earlier detection of airflow obstruction and smoking cessation may result in significant health gain.[9] Smoking cessation reduces the accelerated rate of decline of FEV1 found in smokers compared to non-smokers.[10] These results can be used to convince people to quit smoking.

Methods

This was a comparative cross-sectional study done at the department of medicine, Military Hospital Rawalpindi. Two hundred individuals were included using non- probability convenience sampling. These were then divided into two equal and matched groups of hundred each. Only males were included with ages between 25 to 45 years and 07 to10 pack years of smoking. Passive smokers and huqqa smokers were excluded from study. Similarly patients with history of pulmonary, cardiac, musculoskeletal, neurologic or any systemic disease which could decline lung functions were excluded and so were the patients with occupational risks.

The study was based on a hypothesis that though the asymptomatic smokers are apparently in good state of health but they may still have more decline of FEV1 as compared to non-smokers for that age group and it might cause them health problems later in the life. The objective of this study was to compare FEV1 among asymptomatic moderate smokers and a matched group of non-smokers. Moderate smoking, for the purpose of this study, was defined as cigarette smoking of 07 to 10 pack years. Pack year was calculated using following formula.

Pack year = cigarettes smoked per day X years smoked / 20

Asymptomatic smokers and non-smokers were selected from hospital staff, attendants of admitted patients and healthy volunteers. Informed consent was obtained from each participant and approval of hospital ethical committee was obtained. A proforma was filled for each participant and Forced expiratory volume in one second (FEV1) was measured using SCHILLER SPIROMETER (SP-1A). Predicted values depended upon age and height. Best FEV1 was obtained after three efforts. These results were compared with reference values for Asians. British Thoracic Society guidelines for COPD were applied to detect the abnormalities and were interpreted as follows.[8]

FEV1: > 80% was considered normal

Between 60-80% as mild decrease

Between 40-59% as moderate decrease

Less than 40% as severe decline

Statistics:

Data was analyzed using SPSS 10.0. Mean ± Standard deviation was calculated for age, weight and height. Frequencies and percentages were presented for pack years of smoking. A Chi-square test was used to compare groups, smokers and non-smokers, for percentages of predicted FEV1. A P-value < 0.05 was considered statistically significant.

Results

A total of 200 subjects were included in the study, 100 smokers and 100 non-smokers. FEV1 was measured in all the participants using Schiller (SP-100) spirometer. Only males were included with the mean (± SD) age of 35.08 ± 4.73 years and mean (± SD) height 170.73 ± 5.76 centimeters. The minimum, maximum and mean values of age, height, weight and percentage of FEV1 are shown in the Table.

Table: Demography of study subjects.

Parameters of patients	Minimum S	Minimum N	Maximum S	Maximum N	Mean S	Mean N
Age (years)	26	26	45	45	35.31 ± 4.53	34.85 ± 4.93
Height (cms)	157	162	183	186	169.38 ± 5.58	172.07 ± 5.64
Weight (kgs)	53	53	98	100	67.59 ± 0.08	71.01 ± 11.02
% FEV1	72.6	79.1	122.3	119.3	93.483 ± 11.63	100.46 ± 9.06

S: Smokers. N: Non-smokers.

FEV1 was normal in 183 (91.5%) subjects out of 200 (n=200). Signs of airway obstruction (FEV1 < 80% predicted) were found in 17 (8.5%) subjects, among which 16 subjects were smokers and 01 was non-smoker. Smokers had 07 to 10 pack years of smoking with a mean of 8.51 pack years. This was also noted that 11 out of 16 smokers who had airway obstruction (FEV1< 80%) were having 10 pack years of smoking, i.e. maximum pack years included in the study (Figure). All the subjects who demonstrated airway obstruction were having mild decline i.e FEV1 between 60-80%.

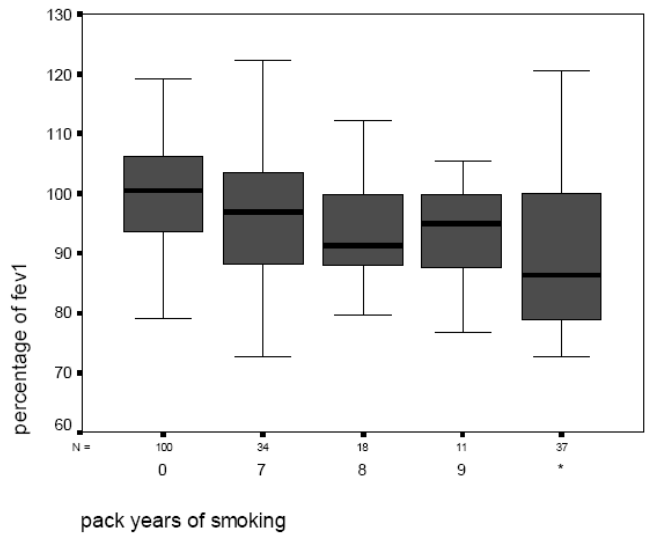

Figure: % of FEV1 with respect to pack years of smoking.

Discussion

In the present study a population of male smokers less than 45 years of age, were compared with a matched group of non smokers. The prevalence rates of previously undetected airflow obstruction were studied according to the British Thoracic Society (BTS) criteria. We found that 16 out of 100 smokers had mild airway obstruction while only 01 non-smoker out of 100 had FEV1 levels below 80% (of predicted). The prevalence rate of airway obstruction was associated with the number of pack years of smoking. It was found that asymptomatic smokers, who are otherwise fit and healthy, may still have mild airway obstruction.

BTS criteria are currently widely accepted and can be relatively easily applied. Clinicians and patients understand the semi quantitative terms mild, moderate, and severe better than percent predicted when discussing the relative severity of diseases. Tracking of lung function over time has potential advantages over a single test.[11] However, there are no published data demonstrating that when the results of the first spirometry test are normal in a high-risk patient, the measurement of annual changes in lung function (tracking) is better than simply repeating spirometry at 3 to 5 year intervals.

In Pakistan most of secondary and even some tertiary care centers do not have facilities of lung function testing. In very few diagnostic centers/hospitals, well-trained nurse practitioners are available. In several countries spirometry in primary care has been advocated and is facilitated in recent years.[12] In the UK 2004 General Practice contract, the focus on respiratory disease has increased and the use of spirometry in order to actively detect airflow obstruction is encouraged.[13]

The early and common symptoms of chronic cough and sputum production usually are ignored by the patient (and often their physicians) as normal or expected for a smoker, and no intervention is deemed necessary. The disease usually is not diagnosed until the patient experiences dyspnoea with only mild exertion, which interferes with the patient's quality of life. Some limitations of this study should be considered. Firstly, study included only men because of limited resources and the known higher smoking rate and prevalence rate of airflow obstruction in men. Secondly, we used only FEV1 to detect the airflow obstruction and ratio of FEV1/FVC was not done. Similarly bronchodilator testing was not performed in individuals. Thirdly the survey was performed in a population representative mainly of military origin and most of them were not the permanent residents of Rawalpindi. They had higher fitness level in general as compared to ordinary civilian of same age and socioeconomic background. Thus, selective response seems likely and degree of fall in FEV1 might have been under estimated.

There are a number of possible confounding influences on the measured data. The indices of low socio-economic disadvantage were not measured but subjects with potentially detrimental occupational exposures, pre-existing asthma, COPD and heart diseases were excluded. Other confounders such as reporting bias, differences in the amount of inhaled smoke per cigarette, or differences in unmeasured exposure to environmental tobacco smoke outside the home were not measured. We did not measure nicotine levels to verify the reporting of cigarette smoking.

One of the strengths of our study was that all subjects were current smokers. Spirometry is a relatively simple, noninvasive test. FEV1 takes only a few minutes of the patient's and technician's time. There are no adverse side effects of testing, other than occasional minor discomfort. However, investigation and confirmation of abnormal spirometry results will cost both time and money and may also result in psychological and social harm in some subjects. The possible psychological impact of being labeled as "ill" by self and others related to false-positive or even true-positive test results could lead to alterations in lifestyle and to seeking medical attention. Another potential adverse effect is the unmeasured risk of reinforcing the smoking habit in some adult smokers who are told that they have normal results. However, the clinician should counteract this possibility by taking the opportunity to tell the patient that normal results for FEV1 testing do not mean that the patient's high risk of dying from a heart attack, lung cancer, or other smoking-related diseases is substantially reduced. Therefore, smoking cessation remains very important.

In literature the prevalence rates of airflow obstruction vary widely because of differences in the study populations, especially concerning age, smoking habits and health status, as well as use of different reference values or various definitions of airflow obstruction. In general practice active detection of airflow obstruction by means of spirometry in smokers should be encouraged and smokers with newly diagnosed airflow obstruction should be offered smoking cessation intervention. However, there are no evidence-based guidelines how physicians can effectively identify airflow obstruction in smokers. Different strategies are advocated such as case finding among smokers attending the physicians as well as screening in smokers, who are persistently symptomatic. But when case finding is limited to symptomatic smokers, we might miss quite a significant number of subjects who are at risk of developing airway obstruction.

The use of FEV1 alone in place of the traditional lung function tests to detect airways obstruction during spirometry testing performed by primary care providers would reduce time and patient effort. The degree of airways obstruction, as determined by the FEV1, is an independent predictor of subsequent decline in lung function and therefore, may be used to detect smokers at higher risk of developing airway disease.

Smoking is more common among the economically underprivileged and those with a poor educational status. Health education programmes aimed at reducing the smoking habit would be more difficult to implement and would need to be developed especially to cater to these segments of the population.

When airway obstruction is identified in a smoker, the primary intervention is smoking cessation. Referral to a sub specialist for further diagnostic testing should be considered in some patients, as those with suspected bronchiectasis or other lung diseases. Pre and post bronchodilator diagnostic spirometry is indicated if asthma is suspected.

The effects of smoking on levels of lung function are not evident at the age of 19 years but appear to contribute to reduced lung function in later life by increasing the rate of decline in FEV1 with age.[14] Prevalence rates of low lung function increase with age and are highest in current smokers, intermediate in former smokers, and lowest in never smokers. Studies have shown that rates are similar in men and women.[15] Surveys to determine the prevalence of smoking in Pakistan are deficient. The only reported studies have been carried out in small, defined groups such as doctors and medical students.

Extensive literature is now available on the harmful effects of smoking.[16] Cigarette smoke has diverse effects on lung structure and function. Previous studies of lung function testing in the general population have had mixed results, with some showing no effect and others suggesting that knowledge of an abnormal lung function test doubled the likelihood of quitting smoking, even when no other interventions were applied.[17]

Lung health studies recommend an office spirometry test for patients $\geq$ 45 years old who report smoking cigarettes (current smokers and those who quit during the previous year) in order to detect COPD.[15] The primary and secondary prevention of smoking related lung disease is through early recognition and intervention which is a key strategy.

Results from the National Health and Nutrition Examination Survey (NHANES) III and the multicenter Lung Health Study (LHS) have provided a new basis for early identification and intervention in COPD.[18,19] The LHS was the first study to demonstrate prospectively that early intervention in smokers identified to be at risk for COPD could modify the natural history of the disease. Both the NHANES III and the LHS also documented the ability of spirometry to detect mild airflow abnormalities in thousands of cigarette smokers, many of whom did not have symptoms that would have prompted them to seek medical attention. Those who continued to smoke were documented to have faster rates of decline in lung function. Importantly, participation in a smoking cessation programme significantly decreased the rate of decline in lung function in these individuals relative to those who continued to smoke. Thus, the rate of decline of FEV1 following successful smoking cessation was very similar to that seen in healthy nonsmoking adults (28 to 35 ml/yr).[20,21]

It is likely that the reversibility of smoke-induced changes differ between smokers without chronic symptoms, smokers with non-obstructive chronic bronchitis and smokers with COPD. Smoking cessation clearly improves respiratory symptoms and bronchial hyper responsiveness, and prevents excessive decline in lung function in all three groups.[22]

Conclusion

The prevalence of undetected persistent airflow obstruction is high. Targeted screening therefore, especially in smokers needs to be considered. A low FEV1 predicts not only an increased rate of decline in FEV1, but also morbidity and mortality from smoking-related illnesses (COPD, lung cancer, and cardiovascular disease).[23] Since lung function declines with time, the best time to prevent morbidity and mortality from smoking-related illness should be early in life. Smoking is common in Pakistan and there is no clear policy on tobacco control. It also highlights the need to help young smokers quit the habit, by providing them healthy choices that may include counseling, and nicotine replacement therapy, among many others.

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