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Smoking related early lung injury and detection of airway obstruction in Asymptomatic Smokers

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Abstract

Background: According to World Health Organization estimates, 65 million people have moderate to severe COPD. More than 3 million people died of COPD in 2005 corresponding to 5% of all deaths globally and are now the third most common cause of death worldwide. The reported prevalence estimates have ranged from 2 to 22% in men and from 1.2 to 19% in women. The standard spirometry maneuver is a maximal forced exhalation (greatest effort possible) after a maximum deep inspiration (completely full lungs). Several indices can be derived from this blow.

Objectives: (i) To know the hospital and community-based incidence and prevalence of early features of COPD in asymptomatic male smokers. (ii) To make awareness in the society as smoking is the leading cause of COPD.

Methods: The participants were asked to stop bronchodilator drugs if any, for at least 12 hours before initial spirometry testing. Before doing pre-drug spirometry, all the baseline parameters (height, weight, abdominal and hip circumference, pulse) were measured. The quantum of smoking exposure will be calculated based on Smoking index. All the patients were subjected to spirometry. Spirometry was performed by an experienced respiratory technician as per the recommendations of American Thoracic Society.

Results: The study revealed COPD in 12.5% of total studied subjects. Most of our studied subjects (41.4%) belonged to age group of 30-40 years with a median age of 43.9 years. Obstructive pattern in Spirometry was higher in subjects with smoking index of more than 200 as well as in subjects with longer duration of smoking, both results were statistically significant. Smoking appears to be related to COPD in our studied population other risk factors such as BMI, biomass exposure appeared to be less statistically significant. Early diagnosis provides an excellent opportunity to implement various smoking cessation measures and the earlier the smoker quits the larger the benefits for lung function, by delaying the diagnostic screening one may lose out on the health benefits of smoking cessation.

Conclusion: Recognition of COPD symptoms, including mild limitations of physician activity, as well as others which are overlooked in early disease, needs to be at the forefront of physicians" minds when examining patients at risk of COPD, who often present for other ailments.

Keywords: COPD, Spirometry, BMI, lung function.

Introduction

Chronic Obstructive Pulmonary Disease (COPD), a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients[1]. This definition does not use the term chronic bronchitis and emphysema and excludes asthma (reversible airflow limitation). According to World Health Organization estimates, 65 million people have moderate to severe COPD. More than 3 million people died of COPD in 2005 corresponding to 5% of all deaths globally and is now the third most common cause of death worldwide[2,3]. The reported prevalence estimates have ranged from 2 to 22% in men and from 1.2 to 19% in women[4]. The recent „Indian Study of Asthma, Respiratory Symptoms and Chronic Bronchitis (INSE ARCH) " study of 85,105 men and 84,470 women from 12 urban and 11 rural sites reported the prevalence of chronic bronchitis to be 3.49% (4.29% in males reported the prevalence of chronic bronchitis to be 3.49% (4.29% in males and 2.7% in females) in adults >35 years. The national burden was thus estimated to be 13.84 million[5].

In BOLD study conducted in Srinagar city (Kashmir, India) in 2010-11 involving 763 subjects, the prevalence of obstruction (FEV1/FVC ratio <LLN) was estimated at 17.3% in men and 14.8% in women[6]. Between 12 and 13 million Americans have a current diagnosis of COPD[7], but due to persistent under-diagnosis of the condition, the true prevalence of the disease is probably closer to 24 million[8]. Newly released data show that 6.3% of U.S. adults over age 18 have COPD (6.7% of women and 5.2% women); 9.2% of adults aged 55 to 64[9].

Spirometry is a method of assessing lung function by measuring the volume of air that the patient can expel from the lungs after a maximal inspiration. The indices derived from this forced exhaled maneuver have become the most accurate and reliable way of supporting a diagnosis of COPD. When these values are compared with predicted normal values determined on the basis of age, height, sex, and ethnicity, a measure of the severity of airway obstruction can be determined. It is on these values that COPD guidelines around the world base the assessment of mild, moderate, and severe disease levels. Spirometry is however only one way of interpreting COPD disease severity. Other measures, such as the MRC dyspnea scale for measuring breathlessness, exacerbation frequency, body mass index, quality of life assessment, and exercise capacity all help to build a more complete picture[10].

The standard spirometry maneuver is a maximal forced exhalation (greatest effort possible) after a maximum deep inspiration (completely full lungs). Several indices can be derived from this blow[1]. FVC – Forced Vital Capacity – the total volume of air that the patient can forcibly exhale in one breath. FEV1 – Forced Expiratory Volume in One Second – the volume of air that the patient is able to exhale in the first second of forced expiration. FEV1 /FVC – the ratio of FEV1 to FVC expressed as a fraction (previously this was expressed as a percentage).

Primary care physicians are in an ideal position to be able to detect COPD in its early stages and perform Spirometry to confirm the diagnosis[11,12]. Early identification of COPD is important as the disease is progressive, so steps to prevent or slow down further deterioration need to be taken as soon as possible. Most cases of COPD are due to smoking, and we agree with recent recommendations that physicians should perform an office spirometry test on all high-risk patients who smoke or have recently quit smoking in order to detect COPD[13].

Aims and objectives

1. To know the hospital and community-based incidence and prevalence of early features of COPD in asymptomatic male smokers.
2. To make awareness in the society as smoking is the leading cause of COPD.

Material and methods

After obtaining the ethical clearance from the Institutional Ethical Committee, the present prospective study was conducted in the Department of Medicine, Government Medical College, Srinagar.

Inclusion criteria

Included regular male smokers with no significant respiratory symptoms except for occasional cough and willing to undergo Spirometry.

Exclusion criteria

1. Subjects with smoking cessation greater than one year or more before enrollment.
2. History suggestive of bronchial asthma or on bronchodilators or inhaled corticosteroids
3. Patients with cardiac or respiratory illness.
4. Female smokers.

The participants were asked to stop bronchodilator drugs if any, for at least 12 hours before initial spirometry testing. Before doing pre-drug spirometry, all the baseline parameters (height, weight, abdominal and hip circumference, pulse) were measured. The quantum of smoking exposure will be calculated based on Smoking index[7].

All the patients were subjected to spirometry. Spirometry was performed by an experienced respiratory technician as per the recommendations of American Thoracic Society[8]. FVC, FEV1 and FEV1% was measured after administration of 400mcg of salbutamol as per guidelines given by GOLD. Based on spirometry, In patients with FEV1/FVC < 0.70, subjects was classified as Mild FEV1 > 80% predicted, Moderate 50 < FEV1 < 80% predicted, Severe 30% <FEV1 <50% predicted and Very severe FEV1 <30% predicted as per GOLD guidelines (1). All finding were entered in the detailed proforma.

Method of Doing Spirometry

1. Tight clothing and waist belt were loosened and prosthetic loose dentures (if any) were removed.
2. The participant was seated comfortably.
3. The participant was asked to take a deep breath and a spirette was inserted into the mouth with lips closed tightly.
4. The participant was asked to blow out the air as rapidly, forcibly and completely as possible.

While performing the FVC man oeuvre, a cough, an inspiration, a Valsalva man oeuvre, a leak or an obstructed mouth piece disqualified the trial and the test was repeated.

Administration of Bronchodilatr

After at least 3 acceptable and 2 reproducible man oeuvres, two puffs (200 µg) of salbutamol from a metered dose inhaler through a spacer were administered to the participant using a spacer. A timer was set up to 15 minutes after the last administered puff and subsequently post bronchodilator test was performed.

Post-bronchodilator test

post-bronchodilator test was done after 15 minutes using the same criteria of at least 3 acceptable and 2 reproducible maneuvers. Patients were diagnosed and categorized as per standard GOLD guidelines.

Stage-I: FEV1 / FVC <70% and FEV1 ≥80% predicted with or without chronic or sputum production.

Stage-II: FEV1 / FVC <70% and 50% ≤FEV1 <80% predicted with or without chronic cough or sputum production.

Stage-III: FEV1 / FVC <70% and 30% ≤FEV1 <50% predicted with or without chronic cough or sputum production.

Stage-IV: FEV1 / FVC <70% and FEV1 <30% predicted with or without chronic cough or sputum production or FEV1 <50% predicted with respiratory failure or signs of right heart failure.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by pie and bar diagrams. Student's independent t-test was employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

Results

The study included a total of 712 male subjects. The age of the subjects ranged from 30 to ≥60 years with mean age of 43.9±12.73 years. There were 295 (41.4%) subjects in the age group of 30-40 years. In the age group of 40-50 years, there were a total of 243 (34.1%). 129 (18.1%) patients belonged to the age group of 50-60 years and in the age group of more than ≥60 years, there were 45 (6.3%) individuals. There were 525 (73.7%) subjects with smoking index ≤ 200 and 187 (26.3%) subjects with smoking index with >200. Among 712 subjects which underwent spirometry, obstructive pattern in spirometry was seen in 89 (12.5%) subjects, while as non-obstructive pattern in spirometry was seen in 623 (87.8%) patients. Among 89 with obstructive pattern, mild obstruction (GOLD stage 1) was seen in 86 (96.6%) subjects. Among these, 31 (34.8%) were between the age group of 30-40 years, 36 (40.4%) were in the age group of 40-50 years, 11 (12.4%) were in the age group of 50-60 years, 8 (9.0%) were in the age of more than or equal to 60 years. Among 623 with non-obstructive pattern, moderate obstruction (GOLD stage 2) was seen in only 3 (3.4%) subjects who were all 30-40 years of age.

When pattern of spirometry was compared on smoking index, obstructive pattern was observed in 7 (1.3%) with smoking index ≤200, with smoking index >200 and 82 (43.9%) subjects with smoking index of >200 obstructive pattern was observed. Smoking index was 334.7±91.85 in subjects with obstructive pattern, which was significantly higher than the smoking index of non-obstructive pattern which was 167.4±68.43. Smoking duration (in years) was 27.61±9.83 in subjects with obstructive pattern in Spirometry which was significantly higher than the subjects with non-obstructive pattern, 23.74±12.75 (p value 0.006). Body mass index in 89 obstructive disease subjects were mean 22.83±3.87, which was 23.14±4.15 in non-obstructive pattern subjects (p value 0.506).

There were 7 (7.9%) subjects with BMI less than 18.5, between 18.5-25 were 63 (70.8%) subjects and 19 (21.3%) subjects were with BMI more than 25 in obstructive disease. In non-obstructive pattern there were 24 (3.9%) subjects with BMI less than 18.5, between 18.5-25 were 453 (72.7%) subjects and 146 (23.4%) subjects were with BMI more than 25 (p value 0.216). Effects of biomass exposure in the form of LPG, kerosene, household smoke etc. on early detection of COPD were also included, among obstructive pattern of Spirometry total of 13 (14.6%) subjects were exposed to biomass, rest 76 (85.4%) subjects of obstructive group were not exposed to biomass, when these results were compared to the effect of biomass exposure to subjects with non-obstructive pattern of Spirometry results shows statistically non-significant correlation (p 0.594).

Discussion

We selected subjects 30 years and above, since although most of the smokers start smoking at much early stage, yet the compromise of lung function progresses with age and COPD is more prevalent in more elderly populations[14]. Most of the population-based studies have taken subjects above 30-40 years of age for screening early COPD. In DIDASCO (Differential Diagnosis between Asthma and COPD) study, a population-based study, individuals aged 30 to 70 years were subjected to spirometry for early detection of airflow limitation[15]. Most of Indian studies have screened population for COPD above 30 years of age[16,17]. Previous studies have used two methods for early detection of COPD: high risk population screening[18-21] and case finding[15,22]. Both methods have their advantages and disadvantages making them complimentary. We chose the high-risk population screening method because of better infrastructure and resources. In our study age of subjects were between 30 to ≥60 years with mean age 43.9±12.73 years.

In our study, total airflow obstruction was seen in 12.5% of total subjects. Mild obstruction (GOLD Stage 1) was seen in 86 (96.6%) and moderate obstruction (GOLD Stage 2) was seen in 3 (3.4%). Barthwal MS and Singh S[23], conducted study on early detection of COPD in asymptomatic smokers using spirometry. In this study overall airway obstruction was seen in 58 (12.60%) subjects. Mild obstruction was seen in 40 (68.9%) and moderate obstruction 18 (31%) subjects. The results of this study are concordance with our study. In Lung Health Study (LHS)[24], a multi-centric study conducted in Canada and USA, spirometry screening of more than 73,000 smokers aged 35 to 60 years was performed in 10 centers. Airway obstruction was seen in 21.8% to 35.7% (mean 25%) cases and severe obstruction (FEV1 <50% of predicted) was seen in 5% of total cases. The lower prevalence of airflow obstruction in our study was because of inclusion of only asymptomatic smokers whereas in LHS study symptomatic smokers were also included and the population group in LHS study was quite large as compared to our study group.

In our study obstructive pattern was observed in 82 out of 187 subjects with smoking index >200 and 7 out of 525 subjects with smoking index of ≤200 ($p < 0.05$) which was statistically significant. Barthwal MS and Singh S[23] in this study obstruction was noticed in 42 (24.70%) out of 170 subjects with smoking index >200 and 16 (5.51%) out of 290 subjects with smoking index of <200 ($p < 0.005$). The reason for more percentage in group with smoking index more than equal to 200 in our study is because duration of smoking in our subjects were very high. Smoking duration (in years) which was 334.7+91.85 in subjects with obstructive pattern was significantly higher than the subjects with non-obstructive, 167.4+68.43 ($p < 0.005$). Stralelis G et al[18] in a study to evaluate a method to detect COPD at an early stage conducted spirometry in 512 smokers, aged 40-55 years with pack-years more than 30 years (equivalent to smoking index of 600) and found obstruction in 27% cases. Similarly in our study we found obstructive pattern in 82 out of 187 subjects with smoking index >200 and 7 out of 525 subjects with smoking index of <200, which was statistically significant ($p < 0.005$).

Zielinski et al[25] of "Know the age of your lung study group" evaluated the efficacy of mass spirometry in detection of airflow obstruction in high-risk population above 39 years of age. 11027 subjects were screened with mean age of 51.8+12.5 years and mean smoking history of 26.1+16.8 pack-years (equivalent smoking index 522+336). Overall obstruction was found in 24.3% cases. Mild obstruction was seen in 9.5%, moderate in 9.6% and severe in 5.2% subjects. The difference from our study is again explained by high mean age, high smoking index and large study group in this study. Analysis of sub-groups in the study showed that obstruction seen in 30.6% of smokers above 40 years of age with smoking history of more than 10 pack years (equivalent to smoking index >200) as compared to 8.3% of smokers below 40 years of age and having smoking history of less than 10 pack years (equivalent to smoking index <200). The same correlation was observed in our study, i.e., airway obstruction was seen in 82 out of 187 subject with smoking index >200 and 7 out of 525 subjects with smoking index of <200 ($p<0.005$).

Body mass index (BMI) also were compared between subjects of obstructive and non-obstructive pattern of spirometry which included 7 (7.9%) subjects with BMI less than 18.5, between BMI 18.5-25 were 63 (70.8%) subjects and 19 (21.3%) subjects were with BMI more than 25 in obstructive disease. In non-obstructive pattern there were 24 (3.9%) subjects with BMI less than 18.5, between BMI 18.5-25 were 453 (72.7%) subjects and 146 (23.4%) subjects were with BMI more than 25 (p value >0.216) which shows statistical non-significant results.

Effect of biomass exposure in the form of LPG, kerosene, household smoke etc. also studied, 13 (14.6%) subjects with obstructive pattern of spirometry were exposed to biomass, rest 76 (85.4%) subjects of obstructive group were not exposed to biomass. When these results compared to the effect of biomass exposure to subjects with nonobstructive pattern of spirometry results showed statistically non-significant correlation (p value = 0.594), thus multiple risk factors such as smoking, occupational exposure, air pollution, and biomass exposure can lead to the development of COPD. In our study subjects with COPD, only smoking was a risk factor, which has been shown to be the most important risk factor in the development of COPD, smoking is responsible for 90% of COPD cases in developing countries[26].

Conclusion

In conclusion, primary care physicians should have adequate training and should be equipped with spirometric instruments for the accurate and early diagnosis of COPD, as well as for effective treatment initiation. Mounting evidence suggests that early detection, diagnosis, and maintenance treatment of COPD, alongside smoking cessation and exercise, may help provide the best symptom control, disease progression (whether spirometric or symptomatic) and outcomes in COPD. Recognition of COPD symptoms, including mild limitations of physician activity, as well as others which are overlooked in early disease, needs to be at the forefront of physicians‟ minds when examining patients at risk of COPD, who often present for other ailments.

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