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Original Research Article

Early Detection of Chronic Obstructive Pulmonary Disease in Smokers by Spirometry and Evaluation of Respiratory Symptoms in its Detection

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Abstract: Majority of patients with COPD don't seek medical advice until they experience dyspnea interfering with their lifestyle. By that time, much of their lung capacity has been lost. This study aims to detect COPD in smokers at an asymptomatic stage by spirometry using GOLD criteria and to see if any symptoms are consistently associated with early COPD. The present study was conducted in 100 smokers of 40-70 years of age at the department of Tuberculosis and respiratory diseases, Government medical college, Amritsar. Out of 100 subjects, 13 (13%) were diagnosed as COPD , 16(16%) as restriction and 1(1%) as early small airway obstruction. Stage wise distribution of COPD cases – Stage I: 1(8%) , Stage II: 6(46%), stage III: 2(15%), Stage IV: 4(31%). COPD prevalence was found to be significantly higher in smokers, involved in occupations with exposure to chemical fumes and/or dust like in painters, powerloom workers, factory employees and in farmers.(32% in those exposed developed COPD as compared to 9% in those unexposed). 12(90%) of COPD patients were found to have any one of cough or breathlessness or their combination but it was a non specific finding reported in 54/87(62%) of Non COPD patients also. The study shows that spirometry can be used as an early screening tool in high risk patients. Thus large number of hidden COPD cases deserving medical attention thus detected, can be offered appropriate management and also prevented from slipping into much more grave stages of the disease at which treatment options are limited.
Keywords: COPD, spirometry, smoking , breathlessness , GOLD criteria, air pollution.

INTRODUCTION:

COPD (Chronic Obstructive Pulmonary Disease) is a preventable and treatable disease with some extrapulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is characterised by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases. The diagnosis is confirmed by spirometry which measures lung functions and capacity.[1]

Most patients with COPD manifest cough, expectoration and dyspnea, but it is usually the dyspnea that causes them to seek medical attention. COPD is a progressive disease but if exposure to noxious agents is stopped at an early stage, progression to more advanced stages can be stopped.

The early stages of COPD are silent. COPD is an indolent process that develops over decades. Fully developed lungs have a tremendous reserve that is not called upon during routine daily activities or even with mild exertion. Also, people who smoke tend to ignore early symptoms viz. Cough, mucous production and wheeze that warn them of potential development of COPD, attributing these symptoms to smoking. They seek medical advice when they are dyspneic. By that time, more than half of the patient's ventilation is irreparably lost. Another point at which COPD is commonly identified is at the

time of an exacerbation, which also occurs late in the course of the disease. It is often determined that the symptoms had been present for a long time and this exacerbation is a worsening of those chronic symptoms.[2]

COPD is currently the fourth leading cause of death in the world and will become the third leading cause of death worldwide and the fifth leading cause of Disabilities Associated Life Years (DALY'S) by 2020. [1-4]

Because of high prevalence of COPD in India, its high mortality, morbidity and the monetary costs that it causes when diagnosed late, it is vital to identify such patients and treat them before they attain crippling advanced stages of the disease. Spirometry is the best screening tool for COPD and should be used to identify the disease in smokers. Significant airflow obstruction, which is often present before any symptoms of COPD develop, can be detected by simple, inexpensive, office-based spirometry. [5-13]

Abnormal spirometry is a strong predictor for rapid progression of COPD. It is also a strong predictor of morbidity and mortality due to COPD. Quitting smoking when impairment of FEV1 is moderate leads to a mean annual decline in FEV1 similar to that of healthy never smokers and a reduction in cough, sputum, and wheeze in most individuals within the first year. Because of its long preclinical course, quitting smoking early is needed to obtain reductions in morbidity and mortality due to COPD. [14,15]

As COPD is a mainly irreversible and progressive disease with serious systemic complications and a subclinical phase to these problems, precise and early diagnosis is essential. We propose a case finding method which is easy to implement by using the risk factors, age and smoking history to define a population of patients at risk of developing COPD and then perform spirometry in them for diagnosis of COPD. The best approach to reducing costs arising from COPD would be to diagnose it early and to manage it well in early stages.

MATERIAL AND METHODS:

The present study was conducted after approval from the institution's ethical Committee and informed consent of the patient in the department of Tuberculosis and Respiratory diseases, Government medical college, Amritsar.

STUDY POPULATION:

1. Patients presenting with non specific symptoms.
2. Relatives of patients.
3. Employees of Government Medical College, Amritsar.

INCLUSION CRITERIA:

1. Active smokers between 40 and 70 years of age.
2. Smoking history of at least 15 pack years.

EXCLUSION CRITERIA:

Diagnosed cases of :

1. COPD
2. Asthma
3. Tuberculosis
4. Bronchiectasis

METHODOLOGY:

A questionnaire concerning smoking history, respiratory symptoms, exposure to dust or chemicals, and history of respiratory diseases and clinical examination was completed for all the subjects who satisfied the inclusion criteria after taking their consent.

Breathlessness was graded according to Modified Medical Research Council Questionnaire.

Subjects without known COPD were invited for spirometric testing. Informed consent was taken from all the persons included in the study.

Spirometry: The patient's data i.e. age, sex, height, weight and room temperature was entered in the spirometer. Prebronchodilator values were obtained first. Then nebulisation with a short acting β2 agonist(levosalbutamol) was given to the subject. Post bronchodilator values were obtained and the diagnosis of COPD was made according to the recent GOLD guidelines based on fixed postbronchodilator values.

The spirometric parameters used in the study were :

Forced expiratory volume in 1 sec (FEV1) : The volume of air that can be forced out in one second after taking full inspiration.

Forced vital capacity (FVC) : The total volume of air that can be forcibly and rapidly exhaled following maximum inspiration.

FEV1/FVC ratio : The percentage of the FVC exhaled in one second.

Mean forced expiratory flow between 25% and 75% of FVC (FEF25-FEF75) : Forced expiratory flow over the middle one half of the FVC; the average flow from the point at which 25% of the FVC has been exhaled.

Diagnosis of COPD and assessment of severity was made according to the GOLD guidelines.

Diagnosis of COPD: Post-bronchodilator FEV1/FVC < 70%

Diagnosis of Restriction: a FEV1 value less than the lower limit of normal, associated with a normal FEV1/ FVC ratio , was taken to indicate a restrictive defect. Severity of the restrictive defect was calculated by using FEV1 or FVC values expressed as a percentage of the predicted normal[16].

The percentage of persons newly diagnosed to have COPD was calculated. Also the variables age, pack years, exposure to dust or chemicals and respiratory symptoms(chronic cough and sputum production, dyspnea at rest or on exertion, objective or subjective wheezing and fatigue) were examined for their influence on the odds of having COPD.

OBSERVATIONS:

The present study was conducted on 100 subjects who were subjected to relevant history and clinical examination and then spirometry was done after obtaining consent. The detailed findings and their analysis has been described below under the headings of:

1. Prevalence studies of COPD
2. Association of symptoms and signs with COPD
3. Pulmonary function tests data

Prevalence Studies of COPD

The total prevalence of COPD in smokers > 40 years of age having > 15 pack years of smoking history was found out to be 13%.

The subjects were divided into three age groups (40-49 years, 50-59 years & 60-70 years). Only male subjects reported during the study period because smoking is rare in women in this part of the country. COPD was divided into four stages as per the GOLD guidelines.

Table 1: Correlation of age to COPD

AGE	COPD		TOTAL	%COPD
	NO	YES		
40-49	38	4	42	9.5
50-59	24	4	28	14.3
60-70	25	5	30	16.7
Grand total	87	13	100	13

Table 2: Correlation of age to severity of COPD

AGE	COPD STAGE				
	NO	STAGE I	STAGEII	STAGEIII	STAGE IV
40-49	38	0	4	0	0
50-59	24	0	0	2	2
60-70	25	1	2	0	2
Grand total	87	1	6	2	4

The subjects were divided into five major occupational groups. The class of technically skilled workers included painters, factory workers, brick kiln workers, and printing press workers. Rest of the classes are self explanatory. Significantly higher COPD cases were observed in technically skilled workers and farmers.

Table 3: Relationship between profession of subject and COPD

PROFESSION	COPD	
	NO	YES
Labourers	24	2
Farmers	4	2
Office workers	22	0
Business men	28	5
Technical skilled worker	9	4
Total	87	13

There was a slightly higher incidence of COPD among those exposed to dust. However, a significantly higher % age of COPD was observed in those exposed to chemical fumes.

Table 4: Relationship of COPD to occupational dust

EXPOSURE TO DUST	COPD	
	YES	NO
NO	4	35
YES	9	52

Table 5: Relationship of COPD to chemical fumes

EXPOSURE TO CHEMICAL FUMES	COPD	
	YES	NO
NO	9	80
YES	4	7

100 subjects who were studied were either smoking cigarette or bidi or both. Other means of smoking were not encountered. The subjects were arbitrarily divided into having 15-30, 30-45, 45-60 , >60 pack years of smoking. They were also divided on the basis of their age at which they started smoking.

Table 6: Relation between number of pack years and COPD

	COPD STAGE				
NO. OF PACK YEARS	**NO**	**STAGE I**	**STAGE II**	**STAGEIII**	**STAGE IV**
15-29	69	1	6	0	1
30-44	11	0	0	1	2
45-60	2	0	0	1	1
>60	5	0	0	0	0

Table 7: Relation between age of starting smoking and COPD

	COPD STAGE				
AGE SINCE WHEN SMOKING	**NO**	**STAGE I**	**STAGE II**	**STAGEIII**	**STAGE IV**
<15	0	0	0	0	1
15-19	13	0	0	2	1
20-24	20	0	4	0	1
25-30	22	0	1	0	1
>30	32	1	1	0	0

Table 8: Relationship between cigarette or bidi smoking to COPD

	COPD	
	NO	**YES**
Cigarette	48	7
Bidi	52	6

No significant correlation was found between number of pack years to either the incidence or severity of COPD. Also cigarette and bidi smoking were found to have almost equal effect on incidence of COPD. But an association was found between the age at which the patient started smoking and to both the incidence and severity of COPD.

Association of signs and symptoms with COPD.

COPD patients were usually found to have any one of cough or breathlessness although these symptoms were also present in a large number of Non- COPD patients.

Auscultatory findings were also present in both COPD as well as Non- COPD patients.

Table 9 – Relation between various symptoms and COPD

	COPD				
	NO	**STAGE I**	**STAGE II**	**STAGE III**	**STAGE 1V**
COUGH ABSENT	46	0	4	0	1
COUGH PRESENT	41	1	2	2	3
BREATHLESSNES GRADE 0	48	1	3	0	0
BREATHLESSNES GRADE I	28	0	2	0	0
BREATHLESSNES GRADE II	10	0	0	2	2
BREATHLESSNES GRADE III	1	0	1	0	0
BREATHLESSNES GRADE IV	0	0	0	0	2

Table 10 – Relation between auscultatory findings and severity of COPD

GRADE OF COPD	DIMINISHED BREATH SOUNDS	NAD	RHONCHI
NON COPD	6	77	4
STAGE I	0	1	0
STAGE II	1	5	0
STAGE III	1	0	1
STAGE IV	4	0	0

Barrel shaped chest and hyperresonant note when present indicated advanced stages of the disease. Although was observed in very few non COPD patients also.

Table 11 : Relation between chest examination and severity of COPD

GRADE OF COPD	Barrel shaped	Normal shape	Hyperresonant	Resonant
NON COPD	1	86	4	83
STAGE I	0	1	0	1
STAGE II	0	6	0	6
STAGE III	1	1	2	0
STAGE IV	4	0	4	0

Pulmonary Function Tests Data

COPD, early small airway obstruction and restriction all were observed in the present study. The %age of patients found in various stages in our study are 1(8%) in Stage I, 6(46%) in Stage II, 2(15%) in Stage III and 4(31%) in stage IV.

Table 12: Distribution of subjects according to pulmonary function data

Pulmonary Function Test Report	No. Of Subjects
Normal	70
COPD	13
Restriction	16
Early small airway obstruction	1

DISCUSSION:

The prevalence of COPD in the general population has been compared to an iceberg. The visible part of the iceberg represents patients known to either the general practitioner or the pulmonologist. The submerged part represents people with respiratory symptoms and other objective signs of COPD who are not known to the health care system but can be detected during screening surveys.[17] Hence, the present study was undertaken to evaluate the role of spirometric screening in the early detection of COPD in chronic smokers. We performed spirometric testing in 100 eligible subjects along with their relevant history and clinical examination.

In our present study we detected 13% cases of COPD while screening smokers in the age group of 40-70 years having more than 15 pack years of smoking history. The percentage of patients found in various stages in our study are 1(8%) in stage I, 6(46%) in Stage II , 2 (15%) in Stage III and 4(31%) in Stage IV. This is considerably higher than most studies from India which have relied on the clinical symptoms and signs to assess the prevalence of COPD. Based on the analysis of various studies of COPD in India , Jindal et al calculated the presence of COPD in men to be 5% and women 2.7% aged more than 30 years.[18] But is more consistent with a recent study by Jamneja AK which found COPD in 15.2% of smokers above 40 years with smoking index [SI] of more than 100.[12] The data is also comparable to studies by Tecumseh MI which found a prevalence of 14%[19], Glenwood Spring which found incidence of 13%[20]. Also the data obtained is considerably lower than that of study in Salzburg; Austria(26%)[21], South-East Sweden(27%)[9].

A confounding factor for late diagnosis of COPD is the lack of awareness as well as the non availability of spirometry at the primary care level, the level at which the patient first presents. The high prevalence of pulmonary tuberculosis in our country and the similar symptoms chronic cough and breathlessness which it produces often delays the diagnosis. Also the general physicians usually do not have a high index of suspicion for diagnosing COPD.

According to GOLD guidelines, age at starting to smoke, total pack years smoked and current smoking status are predictive of COPD mortality[1]. In our study, a positive correlation between age at which the subject started smoking and development of COPD was found. Although ,no significant correlation could be established between the number of pack years smoked or which of the two cigarette or bidi is more harmful. Few reports, however, have shown a consistent quantitative relationship between the intensity of smoking or the number of cigarettes consumed and the degree of physiologic abnormality. In Gregg's data only those smokers who had bronchial hypersecretion appeared likely to develop functional abnormalities[22], suggesting that the effects of smoking on lung function are indirect. On the other hand, Fletcher and co-workers reported no relationship between rates of functional decline and productive cough when smoking habits were taken into account[23].The inconsistencies in dose-effect relationships in some other studies have been explained by a tendency for the most susceptible subjects to smoke less or to discontinue smoking, implementing that there is a wide variability in individual responses to cigarettes.

According to GOLD guidelines, occupational exposure are an underappreciated risk factor for COPD. These exposures include organic and inorganic dusts and chemical agents and fumes.[1]NHANES III survey in USA estimated the fraction of COPD attributable to work to be 19.2%[20]. In our study COPD was found in 31% of workers exposed to chemical fumes alongwith smoking.

In the present study 12(90%) of COPD patients were found to be symptomatic although the symptoms were also found in 54/87 (62%) of Non COPD patients, although no single symptom was found to be consistently associated with COPD. This is consistent with a study by Dickson et al where 78% of COPD patients were found to be symptomatic[24].

In our study no consistent relationship could be seen between the cough and COPD although in Stage III and IV of COPD it was usually present. This is consistent with the British Hypothesis which stated that patients who have cough and/or sputum production experience greater decline in FEV1 as compared to those who do not have cough[23].This theory was subsequently shown to be true by studies of Banerjee et al[25] and de Marco[26].

Similarly for breathlessness, individually no significant relation was observed between its presence or absence with COPD although it was consistently found to be associated with Stage III and Stage IV disease. No association was found between wheeze and COPD. This is consistent with the study by Wolkove who showed poor correlation between subjective and objective data and suggested that measurement of dyspnea may yield information complimentary to that obtained by spirometry[27].

Thus our study indicates that the main symptoms which should give alarm for development of COPD are cough/ expectoration and breathlessness although these tend to be more often present in severe disease.

The finding of barrel shaped chest tends to indicate fairly advanced disease, was found in 5/6(83%) of stage III and IV COPD and was absent in Stage I and II COPD.

Also, hyperresonant chest and diminished breath sounds were associated with advanced stage disease.

CONCLUSION:

Present study has shown that COPD case detection rate by performing spirometric screening in high risk cigarette smokers is significantly higher as compared to its diagnosis just based on clinical signs and symptoms. Thus large number of hidden COPD cases deserving medical attention thus detected, can be offered appropriate management and also prevented from slipping into much more grave stages of the disease at which treatment options are limited.

Thus, the study shows that spirometric screening of smokers is a very useful tool to detect COPD in early stages among subjects included in the present study. The economic and social impact of COPD is immense, and simply waiting until the affected individuals are noticed by the health care system is not an option. Changes in our attitude to cigarette smoking and the development of effective smoking cessation strategies should help prevent early disease progression.

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