Early detection and diagnosis of chronic obstructive pulmonary disease in asymptomatic male smokers and ex-smokers using spirometry

La frecuencia de las cardiopatías congénitas entre los recién nacidos prematuros

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) has a great role for causing long-lasting morbidity of the body, also early death in addition to great cost for healthcare system. Tobacco smoking represents the most predominant risk factor for causing this disease. The early symptoms like cough and wheeze are commonly overlooked by the patients without good screening and ate exertion and when they reach this time, about half of the ventilatory reserve can be lost. The use of Spirometry represents the best standard to diagnose and follow up of patients with chronic obstructive pulmonary disease.
Aim of study: The study aimed to early detect and diagnose chronic obstructive pulmonary disease in asymptomatic male smokers and ex-smokers by spirometry.

Patients and methods: Consecutive asymptomatic male current smokers (n=100) and ex-smokers (n=100) were participated in screening. All Participants have no history of (COPD), asthma, chronic pulmonary illness or active pulmonary symptoms. Also, all of them not on bronchodilators, inhaled corticosteroids, montelukast, or theophylline.

Results: A total of 100 asymptomatic male current smokers and 100 asymptomatic male ex-smokers were screened by using spirometer, the procedure of using spirometer was done according to the guidelines of American Thoracic Society and European Respiratory Society. Overall, airway obstruction was seen in 49% current smokers, 22% of patients had mild obstruction and 27% subjects. Thirteen patients (13%) had mild obstruction while 39% cases had moderate obstruction.
Conclusions: The early detection of COPD is very important for cessation of smoking in addition to prevent the exacerbation of COPD, improve pulmonary function, life quality and reduce mortality.

Key words: Spirometry, chronic obstructive pulmonary disease (COPD).

Resumen

Antecedentes: La Enfermedad Pulmonar Obstructiva Crónica (EPOC) tiene un gran papel como causante de morbilidad duradera del organismo, también muerte prematura además de un gran costo para el sistema de salud. El tabaquismo representa el factor de riesgo más predominante para causar esta enfermedad. Los primeros síntomas como la tos y las sibilancias suelen ser pasados por alto por los pacientes sin una buena evaluación y luego tendrán disnea después de hacer un esfuerzo leve a moderado y cuando alcanzan este momento, se puede perder aproximadamente la mitad de la reserva ventilatoria. El uso de la espirometría representa el mejor estándar para el diagnóstico y seguimiento de pacientes con enfermedad pulmonar obstructiva crónica.

Objetivo del estudio: El objetivo del estudio fue detectar y diagnosticar precozmente la enfermedad pulmonar obstructiva crónica en varones fumadores y exfumadores asintomáticos mediante espirometría.

Pacientes y métodos: Se participaron en el cribado de forma consecutiva varones asintomáticos fumadores ac-

tuales (n=100) y exfumadores (n=100). Todos los participantes no tienen antecedentes de (EPOC), asma, enfermedad pulmonar crónica o síntomas pulmonares activos. Además, todos ellos no toman broncodilatadores, corticosteroides inhalados, montelukast o teofilina.

Resultados: Un total de 100 hombres fumadores actuales asintomáticos y 100 ex fumadores masculinos asintomáticos fueron evaluados mediante espirómetro, el procedimiento de uso de espirómetro se realizó de acuerdo con las directrices de la American Thoracic Society y la European Respiratory Society. En general, la obstrucción de las vías respiratorias se observó en el 49% de los fumadores actuales, el 22% de los pacientes tenía una obstrucción leve y el 27% de los sujetos. Trece pacientes (13%) tenían obstrucción leve mientras que el 39% de los casos tenían obstrucción moderada.

Conclusiones: La detección precoz de la EPOC es muy importante para dejar de fumar además de prevenir la exacerbación de la EPOC, mejorar la función pulmonar, la calidad de vida y reducir la mortalidad.

Palabras clave: Espirometría, enfermedad pulmonar obstructiva crónica (EPOC).

Introduction

Chronic obstructive pulmonary disease (COPD) is a common progressive pulmonary disease that is characterized by permanent airways obstruction that is caused partly either by chronic bronchitis or emphysema[1].

In clinical practice, COPD is usually underdiagnosed; many studies show that more than 25-50% of patients found to have this disease accidentally after doing spirometry screening with no previous diagnosis of COPD. The recent estimates for the disease suggest that about 80 million individuals across the world have moderate to severe COPD. In 2020, the disease accounts for the third most predominant reason for death around the world[2,3]. The most prevalent risk factor for this disease is tobacco smoking, in addition to other risk factors can be involved like air pollution, airways genetic defects like alpha-1-antitrypsin deficiency, occupational dusts and chemicals, poor nutrition, respiratory tract infections that happen during childhood[4-7] as well as inflammation that had found to have a crucial role in COPD as confirmed in a recent study[8,9]. Logically the early diagnosis for COPD is very important to prevent appearance of advanced symptoms and complications. The early diagnosis is also important in smokers who have no symptoms which may lead smoking cessation and this lastly gradually causes slowing down the loss of lung function[10]. Spirometric examination represents the gold standard for diagnosis of COPD and monitoring its progression. The confirmation of diagnosis occurs when the patient with airflow obstruction has a post-bronchodilator FEV1 less than 0.70[11,12]. In most patients, the diagnosis of COPD is performed by the combination of the clinical features and spirometric examination. Any case suspected to have COPD should be confirmed by using spirometric test[13]. The National Institute of Heart, Lung, and Blood recommends to use spirometry for all smoker subjects 45 years or older, especially those who have coughing, persistent sputum production, shortness of breath, or wheezing[14,15]. The key features in spirometric examination of COPD are FEV1 and forced vital capacity (FVC)[16]. FEV1 is the volume of air can be forcefully expired in one second following a full inspiration[17]. The FVC is the maximum air volume can be exhaled after a full inspiration. COPD diagnosis is confirmed by finding a postbronchodilator FEV1/FVC ratio of less than 70% with FEV1 less than 80 percent of the predicted[18-20]. The classification of COPD severity based on spirometry findings was according to the guidelines of Global Initiative for COPD. The assessment of severity of the disease has a considerable importance in determining the suitable treatment for each patient[21,22]. This study is aimed to early detect chronic obstructive pulmonary disease in asymptomatic male smokers and ex-smokers by spirometry.

Methods

Patients and Methods

This cross-sectional study was performed at respiratory outpatient clinic in Baghdad teaching hospital from September 2018 to July 2019, the study included 200 subjects participated in our study, 100 of them were current smokers and 100 were ex-smokers. Data about (age, residence, marital status, occupational state and smoking state which include number of cigarettes per day, duration of smoking, age of beginning smoking, pack per year and duration of quitting in ex- smokers) were collected from participants and as required.

Exclusion criteria:

1.If they stopped smoking for a period less than one year according to the definition of ex-smoker [3].

2.If they have bronchial asthma, COPD, or other chronic respiratory illness.

3.If they take bronchodilators, theophylline or montelukast.

4.If they have active respiratory symptoms.

Structured questionnaire consists of socio-demographic characteristics like: age groups, marital status, residence, occupational status and smoking state which include number of cigarettes per day, duration of smoking, age of starting smoking, pack per year and duration of quitting in ex-smokers. Oxygen (O_2) saturation was measured by pulse oximeter (NINO Onyx 9500). By using a commercially available spirometer, spirometric study was done. Information was taken from each subject at the beginning of

spirometry including name, age, gender, race, in addition to measurement of weight and height. The procedure was performed according to guidelines of American Thoracic Society (ATS)[23]. Diagnosis of COPD depend on finding FEV1/FVC ratio less than 0.70 and FEV1% less than 80% with no change or trivial change after doing reversibility bronchodilator test. According to the result of spirometry and depending on classification of GOLD guidelines, the subjects were classified as the following ways:

- Stage (I): mild COPD - FEV1 80% predicted or more
- Stage (II): moderate COPD - FEV1 range from 50 to 79% predicted
- Stage (III): severe COPD - FEV1 range from 30 to 49% predicted
- Stage (IV): very severe COPD - FEV1 < 30% predicted or FEV 1 < 50% and chronic respiratory failure [24].

Statistical Analysis

The programme used to analyze the data was Statistical package for social sciences version 20 (SPSS 20). The means presented the continuous variables while discrete variables were presented as numbers and percentages. The difference in mean levels of two independent samples was analyzed by using T test. significance of associations between discrete variables was analyzed by using Chi-square test. Pearson's correlation coefficient was used to estimate the direction and degree of correlation between two continuous variables. Levels of significance was determined when P value <0.05.

Results

The mean age of the participants was (45.3±11.5) years old with an age range of (20-69) years old, 29% of them was aged (30-39) years old for current smokers and a mean age of (54.2±10.4) years old with an age range (35-69) years old, 38% of them were aged (60-69) years old for ex-smokers. All of the participants underwent spirometric screening.

1. Distribution of male smokers and ex-smokers according to age of starting smoking: Regarding current smokers 53% of them were started smoking at (20-29) years old of age while in ex-smokers 42% of them were started smoking at (10-19) years old of age.

2. Distribution of male smokers and ex-smokers according to smoking history: Regarding current smokers, the mean duration of smoking was (24.7±10.2) years and a range of (3-50) years. A large proportion (34%) of them had a range of (21-30) year's duration of smoking. A large proportion of them (49%) smoked cigarettes at a range of (20-39) cigarettes per day (Figure 6). The mean pack years was (37.0±28.3) at a range of (2-150) pack years. A large proportion (35%) of them had a range of (21-40) pack years. While in ex-smokers, the mean duration of smoking was (25.3±9.2) years and a range of (10-46) years. A large proportion (38%) of them had a range of (11-20) year's duration of smoking. A large proportion of them (48%) smoked cigarettes at a range of (40-59) cigarettes per day. The mean pack years was (45.0±26.1) at a range of (10-115) pack years. A large proportion (36%) of them had a range of (21-40) pack/year.

3. Mean differences of variables between current smokers and ex-smokers

   Table (1) shows the mean value and range of age, age of beginning smoking, duration of smoking, number of cigarettes smoked per day, and pack/year. There was significant difference in mean value between current smokers and ex-smokers according to age, number of cigarettes per day and number of pack years (p value ≤0.05)

4: Distribution of Participants according to the results of spirometry

   Table (2) shows distribution of participants according to results of spirometric tests. In current smokers (49%) had obstructive pattern (FEV1/FVC ratio <70), from those (44.9%) had mild COPD (FEV_1 ≥80) and (55.1%) had moderate COPD (FEV_1 79-50) according to GOLD staging, about 52% of ex- smokers had obstructive pattern, from those (25%) had mild COPD and (75%) had moderate disease according to GOLD staging.

Table 1. Descriptive data for current smokers and ex-smokers

Variables		Total No.	Current Smoker	Ex- smoker	P value
Age (y)	Min -Max	20-69	20-69	35-69	---
	Mean ±SD	49.8±11.8	45.3±11.5	54.2±10.4	<0.001
Age at starting smoking (y)	Min -Max	8-43	11-33	8-43	---
	Mean ±SD	20.5±6.2	20.6±5.1	20.4±7.2	0.821
Duration of smoking (y)	Min -Max	3-50	3-50	10-46	---
	Mean ±SD	25.0±9.7	24.7±10.2	25.3±9.2	0.701
Cigarette/day	Min -Max	6-60	6-60	10-60	---
	Mean ±SD	31.5±14.4	27.9±13.9	35.1±14.0	<0.001
Pack/year	Min -Max	1.5-150	2-150	10-115	---
	Mean ±SD	41.0±27.5	37.0±28.3	45.0±26.1	0.040

Table 2. Distribution of participants according to the results of pulmonary function tests

	FEV1/FVC for Current Smoker				FEV1/FVC for Ex-smoker			
	< 70%		≥ 70%		< 70%		≥ 70%	
FEV1%	N=100	100%	N=100	100%	N=100	100%	N=100	100%
≥ 80	22	44.9%	51	100.0%	13	25.0%	48	100.0%
79 – 50	27	55.1%	0	0.0%	39	75.0%	0	0.0%
< 50	0	0.0%	0	0.0%	0	0.0%	0	0.0%
P value	< 0.001*				< 0.001			
*p value ≤ 0.05 is significant								

5: Correlation of spirometric results with study variables

Table (3) shows the correlation of both FEV_1 % and FEV_1/FVC ratio with study variables (age, age of beginning smoking, duration of smoking, number of cigarettes per day, number of pack years and O_2 saturation). All of the variables were significantly inversely correlated to both FEV_1 % and FEV_1/FVC ratio except O_2 saturation which was directly correlated.

Figure)1 (illustrates the inverse correlation of FEV_1/FVC ratio with duration of smoking in the two study groups, so when duration of smoking increases, the ratio will decrease.

Figure (2) shows the inverse correlation of FEV_1/FVC ratio and number of pack years in the two study groups, so when number of pack years increases, the ratio will decrease.

6. Mean differences of O_2 saturation, FEV_1 % and FEV_1/FVC ratio and between current smokers and ex-smokers

Table (4) shows the mean O_2 saturation was (96.3±1.8) in current smokers and was (96.3±1.8) in ex-smokers, with a range of (93-99) in both groups. The mean FEV_1% was (82.2±6.6) in current smokers which is significantly higher than that of ex-smokers which was (79.9±7.2). The mean FEV_1/FVC ratio was (75.0±9.9) in current smokers and was (73.7±8.7) in ex-smokers.

Table 3. Correlation of FEV_1% and FEV_1/FVC ratio with study variables

Variables	Total		Current Smokers		Ex-smokers	
	r	P value	*r*	P-value	*r*	P value
A) Correlations of FEV1% with study variables						
Age	-0.787*	< 0.001**	-0.832	< 0.001	-0.758	< 0.001
Age at starting smoking	-0.005	0.947	-0.151	0.134	0.087	0.390
Duration of smoking	-0.768	< 0.001	-0.865	< 0.001	-0.688	< 0.001
Cigarette/day	-0.794	< 0.001	-0.820	< 0.001	-0.758	< 0.001
Pack/year	-0.951	< 0.001	-0.944	< 0.001	-0.961	< 0.001
O_2 Saturation	0.950	< 0.001	0.945	< 0.001	0.962	< 0.001
B) Correlations of FEV1/FVC ratio with study variables						
Age	-0.760	< 0.001	-0.844	< 0.001	-0.734	< 0.001
Age at starting smoking	-0.074	0.299	-0.212	0.034	0.032	0.756
Duration of smoking	-0.736	< 0.001	-0.847	< 0.001	-0.595	< 0.001
Cigarette/day	-0.741	< 0.001	-0.749	< 0.001	-0.754	< 0.001
Pack/year	-0.853	< 0.001	-0.837	< 0.001	-0.875	< 0.001
O_2 Saturation	0.932	< 0.001	0.944	< 0.001	0.923	< 0.001

r: Pearson's correlation coefficient., negative sign means the correlation is invers, and p value ≤ 0.05 is significant

Figure 1. Correlation between FEV_1/FVC ratio and duration of smoking according to each study group

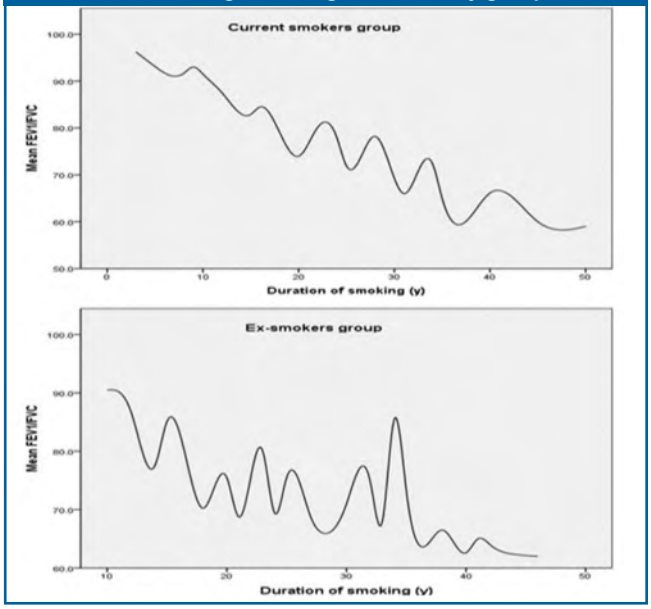
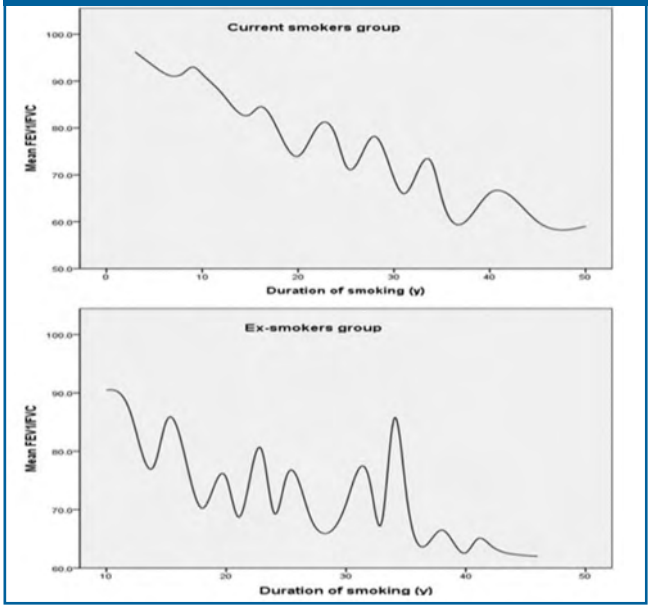


Figure 2. Correlation of FEV1/FVC ratio and pack years



7. Association between spirometric diagnosis and number of pack years in both study groups

Table (5) and Table (6) shows significant association between results of spirometry and number of pack years in current smokers and ex-smokers respectively, participants in both groups with a range of (21-40) pack years show obstructive pattern in spirometry.

Table 4. Mean differences of O_2 saturation, FEV_1% and FEV_1/FVC ratio between the two study groups

Variables		Total No	Current smokers	Ex- smokers	P-value
O_2 saturation	*Min -Max*	93-99	93-99	93-99	---
	Mean ±SD	96.2±1.8	96.3±1.8	96.1±1.8	0.328
FEV1%	*Min -Max*	65-97	65-97	66-94	---
	Mean ±SD	81.0±7.0	82.2±6.6	79.9±7.2	0.018*
FEV1/FVC	*Min -Max*	55-97	59-97	55-93	---
	Mean ±SD	**74.4±9.3**	**75.0±9.9**	**73.7±8.7**	0.335

***p value ≤ 0.05 is significant**

Table 5. Association between spirometric diagnosis and number of pack years in current smokers

Characteristics	Spirometric diagnosis		P value
	Normal (%)	Obstructive (%)	
Number of pack year			
< 20 pack years	33 (100%)	0 (0.00%)	
(21-40) pack years	19 (52.8%)	17 (47.2%)	<0.001*
(41-60) pack years	0 (0.00%)	15 (100%)	
> 60 pack years	**0 (0.00%)**	**16 (100%)**	

***P value ≤ 0.05 is significant**

Table 6. Association between spirometric diagnosis and number of pack years in ex-smokers

Characteristics	**Spirometric diagnosis**		P value
	Normal (%)	Obstructive (%)	
Number of pack year			
< 20 pack years	20 (100%)	0 (0.00%)	
(21-40) pack years	17 (47.2%)	19 (52.8%)	<0.001*
(41-60) pack years	0 (0.00%)	18 (100%)	
> 60 pack years	**0 (0.00%)**	**26 (100%)**	

***P value ≤ 0.05 is significant**

Discussion

Chronic obstructive pulmonary disease is a highly prevalent disease that leads to high morbidity, early mortality and high expenditure for healthcare. The disease is commonly detected lately after failure of medical treatment to stop the disease progression, so, screening in order to early detect this disease is very important to for smoking cessation campaign and to reduce the bad sequel of COPD[1,2,24,25]. In this study, we did evaluation for the results of spirometric examination of 200 asymptomatic male smokers and ex-smoker subjects. The age of study subjects was young and middle age group and this is important for the early screening of asymptomatic cases because the COPD will appear clear at elderly age group in addition to that the lung function will deteriorate gradually with increase in age, so the disease is more predominant in older age people although the highest percentage of the smoker subjects begin smoking at early period[26, 27]. Many studies that were done for early detection of COPD took the subjects who were above 30 years old. In our work, the prevalence of underdiagnosed airway obstruction was found in 50.5% in total sample (49.0% in current smokers and 52.0% in ex-smokers) and this was significantly related to the smoking duration and number of pack years. This finding illustrated the great importance of identifying asymptomatic smokers and ex-smokers with undetected airway obstruction. There was a significant reduction in prevalence of smokers after the national program for prevention and treatment of COPD in Finland in 2003 that led to early diagnosis for COPD in 1998 with aid of spirometry and this was followed by management in smoking cessation clinics. This gives a clue for the high benefit of the effects of early diagnosis on natural deleterious development of COPD[28]. In a similar way, Giovino et al found that smoking cessation rate increased after early detection of airways limitation together with the increases in advice of smok-

ing cessation[24]. In this work, the higher percentage of airflow obstruction was because the study was performed on randomized samples that had high number of pack years in smokers and ex-smokers. Many previous studies had many various percentages and prevalence that depend on the features and criteria of the study subjects and on spirometer used in diagnosis. In a study done by Anto et al., they had found presence of airway obstruction in 18% of patients with only 4% among subjects without symptoms[28]. In the epidemiologic study conducted by Churg et al for early detection of COPD by using spirometry, they found that airway limitation is present in about 23% of the subjects tested for detecting COPD[27]. In a case finding study performed by Schane and colleagues in 1960 over 40 years of age using a questionnaire, physical examination and spirometry, they found that 9% of the involved subjects had airways limitation mild obstruction was found in 63.3% of smokers who had smoking history more than 20 pack years. No airways obstruction detected in those who smoke less than 20 pack years[29].

Conclusions

From this study, we conclude that use of spirometry is very useful for early diagnosis of patients with COPD and this represents a great benefit for the patient and the community. The early COPD diagnosis will enhance smoking quitting and help in prevention of COPD exacerbations, limit the rapid decline in lung function, enhance life quality and reduce mortality.

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