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51

Original Research Article

Study of pulse oximetric and spirometric parameters in smokers

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Abstract

Objective: To study the symptoms, pulse oximetric and spirometric parameters in smokers with respect to pack years and to know the effects of smoking on lung function, in adults, by measuring the FEV_1, FVC, FEV_1/FVC, FEF_{25-75}.

Patients and Methods: The current study was an observational cross sectional study conducted in a tertiary care hospital over a period of one year. 100 subjects more than 21 years of age, smokers, who had been smoking for 2 years or more, whether symptomatic or asymptomatic were recruited. Spirometry and pulse oximetry were done.

Results: 93% of our subjects had no physical findings, 5% had clubbing, 1% had thyroid swelling and kyphoscoliosis each. Fall of FEV_1 came out to be significant in subjects with a history of >10 pack years of smoking (p<0.0001). FEV_1 <80% was observed in 21% of 43 subjects with a <10 pack years of smoking, 65% of 40 subjects with a smoking history of 11-20 pack years, 73% of 11 subjects with a smoking history of 21-30 pack years and 80% of 5 subjects with a smoking history of 31-40 pack years. 43 subjects in the 1-10 pack years group had SpO_2 of 95% , 40 in the 11-20 pack years group had 95% SPO_2, 11 in the 21-30 pack years group had 96%, 5 in the 31-40 pack years group had 97% and 1 in the >40 pack years, group had 97%.

Conclusion: Smoking remains a potential hazard to life as it severely affects lung functions as demonstrated by changes in spirometric and oximetric values.

Keywords: Pulse Oximetric; Spirometric; Smokers.

1. Introduction

Tobacco smoking was initially practiced by burning of tobacco leaf but now people smoke cigarette, bidis and other indigenous products. 52% of adult males in India are smokers. A cigarette contains around 4000 chemicals, out of which 43 are known carcinogens and another 400 toxins. List of ingredients found in cigarettes- nicotine, tar, formaldehyde, lead, acetone, ammonia, carbon monoxide, benzene, arsenic, cadmium, chromium, hydrazine, angelica root extract, butane, DDT, ethyl furoate, methoprene, maltitol, naphthalene, methylisocyanate, polonium, radon[1][2]. Smoking alone is responsible for more deaths every year than fire accidents, AIDS, alcohol, road traffic accidents, cocaine, murders and suicides combined.

Smoking accelerates the rate of decline of lung function in adulthood. Smoking has by far been known to be hazardous to human health in more ways than one. It affects many systems of the body viz. respiratory system, cardiovascular system, gastro intestinal tract and the genitor-urinary system. In the respiratory system it is mainly responsible for causing diseases like COPD (chronic obstructive pulmonary disease) and lung cancers, which both result in high fatality rates. The natural history of COPD is characterized by a slow, progressive limitation of maximal expiratory airflow. This can be well assessed by simple spirometry, and only two parameters, the FEV_1 and FVC, need to be measured to obtain the most useful information [3][4]. Oxygenation and gaseous exchange is the function of the lungs and any compromise of lung function will reduce the oxygen saturation which is easily measured by pulse oximetry[5].

The current study was aimed at studying the symptoms, pulse oximetric and spirometric parameters in smokers with respect to pack years. It was done to know the effects of smoking on lung function, in adults, by measuring the FEV1, FVC, FEV1/FVC, FEF_{25-75}.

2. Patients and Methods

The current study was an observational cross sectional study conducted in a tertiary care hospital over a period of one year, May 2014 to May 2015. The protocol of the study was approved by the institutional scientific and ethical committees. 100 subjects more than 21 years of age, smokers, who had been smoking for 2 years or more, whether symptomatic or asymptomatic were recruited. All those subjects who were less than 21 years of age or above 60 years of age with co-morbid conditions or smokers who have been smoking for less than 2 years and patients who are severely ill/ unable to perform spirometry were excluded from the study. Spirometry (RMS Helios digital spirometer) and pulse oximetry (BPL Ltd.) were done , relevant information was recorded in a set proforma and results were evaluated.

3. Observations and Results

Our study was done on 100 subjects out of which 97% were males and 3% were females. In this study 22 subjects were in the age group of 21-30 years, 17 in the 31-40 years age group, 18 in the 41-50 years group, 29 subjects in the 51-60 years age group and 14 were above 60 years of age.

Though 93% of our subjects had no physical findings, amongst the rest, 5% had clubbing and 1% had thyroid swelling and kyphoscoliosis each (Table 1).

Table 1: Physical Findings in 100 Subjects

Sr. No.	Physical Findings	No. of Subjects	Percentage (%)
1	Clubbing	5	5
2	Thyroid Swelling	1	1
3	Kyphoscoliosis	1	1
4	None	93	93
	Total	100	100

As per pack years, 43 subjects were in the 1-10 pack years group, 40 in the 11-20 pack years group, 11 in the 21-30 pack years group, 5 in the 31-40 pack years group and 1 in the >40 pack years group (Table 2)

Table 2: Distribution of 100 Subjects (In Pack Years)

Sr. No.	Pack Year	No. Of Subjects	Percentage (%)
1	1-10	43	43
2	11-20	40	40
3	21-30	11	11
4	31-40	5	5
5	>40	1	1
	Total	100	100

Table 3: Distribution of 100 Subjects In Pack Years With Respect To Average Pulse Oximetry Value At Room Air

Sr. No.	Pack Years	No. of Subjects	Average % SpO_2
1	1-10	43	95
2	11-20	40	95
3	21-30	11	96
4	31-40	5	97
5	> 40	1	97
	Total	100	-

Average pulse oximetry value was also recorded at room air. 43 subjects in the 1-10 pack years group had SpO2

of 95% , 40 in the 11-20 pack years group had 95% SpO2, 11 in the 21-30 pack years group had 96%, 5 in the 31-40 pack years group had 97% and 1 in the >40 pack years, group had 97%. (Table 3)

Table 4: Symptoms in No. Of Subjects with Average Pack Year

Sr. No.	Symptoms	No. of Subjects	Average Pack Years
1	Cough	22	15
2	Dyspnoea	8	15
3	Cough & Dyspnoea	19	18
4	Chest Pain	2	7
5	Hoarseness of voice	1	15
6	Dyspnoea & Chest Pain	1	12
7	Cough & Chest pain	2	22
8	Asymptomatic	45	< 10
	Total	100	-

In our study, 45 subjects were asymptomatic and all had a smoking history of <10 pack years, 22 subjects who complained of cough and 8 who complained of dyspnea all had a smoking history of 15 pack years, 19 subjects who complained of cough and dyspnea had a smoking history of 18 years, 2 patients complained of chest pain another 2 had cough along with chest pain, with a smoking history of 7 and 22 years respectively, one subject each had hoarseness of voice and dyspnea with chest pain with a history of smoking for 15 & 12 pack years respectively, as shown in table 4.

Table 5: FEV1<80(%) In Subjects According To Pack Years

Sr. No.	Pack Years	No. of Subjects	FEV1<80(%)	Percentage
1	1-10	43	9	21
2	11-20	40	26	65
3	21-30	11	8	73
4	31-40	5	4	80
5	> 40	1	-	-
	Total	100	47	

Fall of FEV1 came out to be significant in subjects with a history of >10 pack years of smoking (p<0.0001). FEV1 <80% was observed in 21% of 43 subjects with a <10 pack years of smoking, 65% of 40 subjects with a smoking history of 11-20 pack years, 73% of 11 subjects with a smoking history of 21-30 pack years and 80% of 5 subjects with a smoking history of 31-40 pack years (Table 5).

Table 6: Comparative Scatter Plot in 48 Subjects with FEV1 and FEF25-75% <80%

Sr. No.	PFT Variable	Measured Value(s) <80%
1	FEV1	48
2	FEF25-75%	48

The fall in FEV1 was always accompanied by fall in FEF25-75% (p>0.05), the fall in FEV1 and FEF 25-75% was observed in 48 subjects. The fall in FEV1 (obstructive pattern) was significantly more as compared to fall in FVC (restrictive pattern) (p>0.05) (Table 6).

4. Discussion

The effects of smoking are well known, but still a major chunk of the population is already addicted to smoking and a lot more of the youngsters start smoking each day. Various methods are used to study the effects of smoking on lung function of which spirometry is the simplest and most easily available. We aimed at studying the effects of smoking on 100 subjects, not only on the symptoms but also on the lung function by means of spirometry and pulse oximetry. We have measured the various lung functions like FEV1, FVC, FEV1/FVC, $FEF_{25-75\%}$.

In a study by O'Connor, G.T., Sparrow D. and Weiss S.T. there is such a large reserve of pulmonary function, that deterioration in airflow obstruction can proceed undetected for years if pulmonary function tests are not done. In fact, except in those individuals engaging in vigorous exercise, quite severe airflow obstruction is often present before any symptoms of COPD develop [6]. In fact, those 10% to 30% of cigarette smokers whose lung function is declining the most rapidly can be identified with simple spirometry, long before symptoms develop [7].

A study done at Kyoto University, Japan proved significant relation between the number of pack years smoked to the decline in lung function[8]. The Sapaldia 2 cohort study conducted in Switzerland concluded that the decline in lung function was largely related to the number of pack years of smoking.

Another study done by D. Satya Sri suggests that early changes in smokers are probably due to narrowing of the small airways [9]. FEF 25% to 75% incorporates flows over lower lung volumes than does FEV1 and is more likely to be abnormal in patients with small airway obstruction.

In our study, the fall of FEV1 increased with the rise in pack years of smoking (pack year is defined as one packet of cigarette smoked every day for one year). 21% of subjects with a history of smoking of 1-10 pack years showed a fall in FEV1 to less than 80% which increased to 65% with a rise in pack years to 11-20 years. As with an increase in pack years to 21-30, the fall in FEV1was seen in 73% of subjects and in upto 80% of smokers with a history of smoking of 31-40 pack years. As per our study, the fall in FEV1 is significant in subjects with a history of more than 10 pack years of smoking.

Our study also shows that fall in FEV1 was always accompanied by fall in FEF 25-75% and that the fall in FEV1 was significantly more as compared to fall in FVC.

Amongst numerous other studies done in smokers, one important aspect studied are the oxygen saturation (SPO_2) normally read by the pulse oximetric method. Pulse oximetry is a non invasive method to read SPO_2, which is known to give false readings in smokers as it does not differentiate between carboxyhaemoglobin, which is higher in smokers, and oxyhaemoglobin.

According to a study by Barker and Tremper, Carboxyhemoglobin levels in nonsmokers are less than 2%, while they may be as high as 10-20% in heavy smokers [10]. Carboxyhaemoglobin absorbs very little light at 940nm, while at 660nm its extinction coefficient is very similar to oxyhemoglobin. Thus the presence of significant COHb will resemble the curve of oxyhemoglobin in the red range, with no effect on the infrared, and "look like" oxyhemoglobin, causing the pulse oximeter to over read. For every 1% of circulating carboxyhemoglobin, the pulse oximeter over reads by 1%. Fifty percent of cigarette smokers have a carboxyhemoglobin concentration of 6%[11]. Another study done by Julie Miller concluded that pulse oximetry is a more accurate reflection of arterial oxygenation in non-smokers than in smokers [12]. In a study done by Glass *et al*, pulse oximetry oxygen saturation (SPO_2) does not distinguish carboxyhemoglobin (COHb) from oxyhemoglobin (O2Hb), giving a false impression of the apparent degree of oxyhemoglobin saturation in smokers who have elevated levels of COHb[13]. As per our study there was no significant difference in pulse oximetric values in observations of subjects with a history of less than 10 pack years of smoking, compared with observations of subjects with a history of more than 10 pack years of smoking.

Based on these, following are the conclusions of the current study:

- ✓ It can be concluded that the fall of FEV1 is significant in subjects with a history of >10 pack years of smoking (p<0.0001).
- ✓ FEV1 <80% was observed in 21% of 43 subjects with a <10pack years of smoking, 65% of 40 subjects with a smoking history of 11-20 pack years, 73% of 11 subjects with a smoking history of 21-30 pack years and 80% of 5 subjects with a smoking history of 31-40 pack years.
- ✓ The fall in FEV1 was always accompanied by fall in FEF25-75 % (p>0.05), the fall in FEV1 and FEF25-75% was observed in 48 subjects.
- ✓ Also it can be concluded that the fall in FEV1 (obstructive pattern) was significantly more as compared to fall in FVC (restrictive pattern) (p>0.05).
- ✓ Finally, it has been drawn from our study that there is no significant difference in pulse oximetric (SPO2) values in observations of subjects with a smoking history of<10 pack years, compared with observations of subjects with a smoking history of >10 pack years (p>0.05).

Thus, it is clear that smoking tobacco is extremely hazardous to one's health but there are still millions of people worldwide who smoke themselves to death every year. The best thing would be to devise an experiment powerful enough to scare people enough to start quitting worldwide.

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