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Original Research Article

Importance of spirometry, pulse oximetry and hematocrit in chronic obstructive pulmonary disease

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ABSTRACT

Background: To study the correlation of clinical features, spirometry, pulse oximetry assessment and haematocrit abnormalities in chronic obstructive pulmonary disease and to assess the severity of chronic obstructive pulmonary disease by spirometry.
Methods: In the present study total 50 cases were selected on the basis of simple random sampling method from the Department of Pulmonary Medicine, Chalmeda Anand Rao Institute of Medical Sciences, Bommakal, Karimnagar, Telangana, India. During study period from June 2017 to December 2018.
Results: About 50 patients of chronic obstructive pulmonary disease were studied. Majority of the patients were in the age group of 50-70 years. COPD was seen predominantly in male patients and majorities were smoker. In the majority of patients, the duration of illness was 6-10 years, cough with expectoration was present in all patients. As the number of cigarettes/day and duration increases the severity of the disease also increases in the studied population. In the study, about 40 % of cases were in stage III disease. Computerised spirometry was found to be most sensitive investigation in diagnosing and assessing the severity of the disease in all these cases. As the severity and duration of the disease increases, they are more prone to develop hypoxia and polycythaemia as a complication. In present study 8 patients had hypoxia, as assessed by pulse oximeter.
Conclusions: Computerized spirometry is a very useful investigation in the management of chronic obstructive pulmonary disease. Pulse oximetry is a useful tool in diagnosing periods of oxygen desaturation. Pulse oximetry also useful in monitoring the oxygen therapy during management. Haematocrit analysis is a useful adjunct in assessing the severity of the disease. Polycythaemia, even though uncommon in chronic obstructive pulmonary disease patients is one of the rare but preventable complication with early cessation of smoking and with oxygen therapy.

Keywords: Chronic obstructive pulmonary disease, Electrocardiogram, Forced vital capacity, Forced expiratory volume in first second

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the name of a group of chronic and slowly progressive respiratory disorders characterized by reduced maximal expiratory flow during forced expiration.[1] COPD is a common and preventable disease that has great implications on global health. It is the fourth leading cause of death world over, exceeded only by myocardial infarction, malignancy and stroke.[2] COPD is known to cause airflow limitation, impaired gas exchange and it also has effects on the pulmonary circulation. Pulmonary hemodynamics in patients with COPD depends on the stage of the disease. In patients with mild obstruction and

without severe hypoxemia pulmonary arterial pressure is normal at rest. As air flow limitation worsens, along with development of chronic severe hypoxemia and hypercapnia the pulmonary artery pressure is increased at rest.

Spirometers provide quick assessment of expiratory function that correlates with FEV1 and also enables us to differentiate between restrictive, obstructive and proximal air way disease.[3]

The combination of pulse oximetry and spirometry give valuable Information about patient's status. Long standing COPD disease can lead to exertional and nocturnal hypoxemia. Frequent hypoxic episodes and nocturnal hypoxemia leads to the development of secondary polycythemia and its consequences. When present in COPD, polycythemia can contribute to the development of pulmonary hypertension, and leads to pulmonary endothelial dysfunction, reduced cerebral blood flow, hyperuricemia and gout, and increased risk of venous thromboembolic disease.[4]

So, the aim was to study the correlation of clinical features, spirometry, pulse oximetry assessment and hematocrit abnormalities in chronic obstructive pulmonary disease, to assess the severity of chronic obstructive pulmonary disease by spirometry, To correlate the development of hypoxia and polycythemia with respect to severity and duration of the disease, To study about the Influence of smoking in the development and amp; progression of COPD.

METHODS

A prospective study of 50 cases were selected on the basis of simple random sampling method from the department of pulmonary medicine, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar. The duration of study was 18 months from June 2017 to December 2018.

Inclusion criteria

- Adult males and females admitted in the ward with symptoms suggestive of airway obstruction of more than 2 years duration and in whom clinical diagnosis of chronic obstructive pulmonary disease was made were included in the study.

All these patients were subjected to clinical examination, chest X-ray, pulmonary function testing, pulse oximetry and hematocrit analysis on spirometry the presence of COPD was diagnosed by post bronchodilator values of:

- (Forced expiratory volume in first second/forced vital capacity=FEV1/FVC less than 70%,
- Forced expiratory volume in first second (FEV1) less than 80%,
- All patients were clinically stable at the time of conducting pulmonary function test.

Exclusion criteria

- Cases which were excluded from the study were patients with primary diagnosis of bronchial asthma, pulmonary tuberculosis, bronchiectasis, cases of sleep apnea syndromes and patients with post infarction failure.

Statistical analysis

Descriptive data are presented as frequencies (percentages) for discrete variables and as means (SDs) for continuous variables. All statistical tests and factors were considered statistically significant at $p<0.05$. Microsoft office version 2010 was used for analysis.

A proforma was prepared after applying the above inclusion and exclusion criteria, meeting the objectives of study for the present study 50 patients were selected, 42 males and 8 females and they were subjected to the following examinations.

History and physical examination

In every case a detailed history was elicited, and thorough clinical examination was done as indicated in the proforma.

Radiographic examination

Chest X-ray postero-anterior view and left lateral view were obtained to detect signs of chronic bronchitis and emphysema

Spirometry

Spirometry was performed when the patients were clinically stable. Test was performed with the patient comfortably seated, with clothes loosened. The patient was instructed to take a deep inspiration then close the lips around the mouthpiece and blow out as hard and fast as possible, followed by deep inspiration

Volume was obtained on the vertical axis of recording paper and time on the horizontal axis. The curve which was obtained is referred to as forced vital capacity curve. Forced vital capacity (FVC) is the volume of air that can be forcibly exhaled (as fast as possible) after a maximal inspiration. It is expressed in liters.

Forced expiratory volume in one second (FEV1)

It is defined as the volume of air expelled in the first second, from the start of maximum expiratory effort of the forced vital capacity. It is expressed in liters or percentage of predicted value.

RESULTS

About 50 cases of COPD were studied; the results are tabulated as follows:

(Table 1) shows maximum cases among males were between 61-70 years of age constituting 42.9% and the Minimum number cases were in the age group of 81-90 years being 2.4%.

Table 1: Age distribution.

Age in years	Male	Percentage	Female	Percentage	Total	Percentage
41-50	3	7.1	1	12.5	4	8
51-60	8	19.0	2	25.0	10	20
61-70	18	42.9	3	37.5	21	42
71-80	12	28.6	1	12.5	13	26
81-90	1	2.4	1	12.5	2	4
Total	42	100	8	100	50	100

Among females, maximum number of cases were in the age group of 61-70 years constituting 37.5% and the minimum were in the age group of 41-50, 71-80 and 81-90 made up of 12.5% each respectively Both sexes put together the maximum cases were in age group of 61-70 years constituting 42% and minimum in the age group of 81-90 years constituting only 4%.

Table 2: Sex distribution.

Sex	No. of cases	Percentage
Male	42	84
Female	8	16
Total	50	100

(Table 2) shows majority of the patients in the present study were males 42 out of 50 patients with percentage of 84. Females were only 8 out of 50 with percentage of 16. The male female ratio was 5.25:1.

Table 3: Duration of illness.

Duration of illness(years)	Males	Females	Total	Percentage
2-5 years	8	0	8	16
6-10 years	19	2	21	42
11-15 years	13	6	19	38
16-20 years	2	0	2	4
Total	42	8	50	100

(Table 3) shows majority of people in the present study group belonged 6-10 years of duration of illness with percentage of 42 followed by 11-15 years duration with 38 percentage. In the study only 2 cases out of 50 were with 16 -20 years duration of illness.

Table 4: Risk factor exposure.

	Males	Females	Total	Total (%)
History of smoking	42	0	42	84
Exposure to smoke or burnt fuels	0	8	8	16
Total	42	8	50	100

Table 5: Presenting symptoms.

Symptoms	No. of patients n=50	Percentage
Cough	50	100
Expectoration	50	100
Breathlessness	46	92
Wheezing	40	80
Fever	10	20

Table 4 shows all the male patients were smokers; in female history of exposure to smoke of burnt fuels was present in all case. $P<0.05$ which is statistically significant. Out of 50, 42 males are all smokers and 8 females are non-smokers but had a history of exposure to smoke.

Table 5 shows all the patients presented with cough and expectoration. Breathlessness and wheezing were present in majority of the patients and fever was present among a small percentage (20%) of patients.

Spirometric values

Though there are many spirometric values FEV1 and FEV1,/FVC are often considered as indices of pulmonary function in chronic obstructive pulmonary disease.

- FEV1: Reflects the degree of airway obstruction. The mean expected FEV1, among the subjects studied was 2.44 + 0.5 Lt, however the actual mean FEV1 was 1.11 +0.38 liters. The mean FEV1 % of expected value in this study was 44.92 + 14.01%.
- FVC: Reflect the change in vital capacity. The mean expected FVC was 3.03+0.42 lt. The actual mean FVC was 2.01+0.60 lt.
- The mean FEV1 /FVC-was 54.26+10.12% in the present study.

Table 6 shows maximum number of patients in present study were in stage III with 40% of the patients showing severe airflow obstruction with a mean FEV1 of 45.34+ 4.6%, 24% of patients had very severe obstruction with a mean FEV1 of 28.4+1.5% and 36% of patients had moderate obstruction of FEV1 66.9+6.9%. None of the patient's study had mild obstruction.

Table 6: Range and mean value of pft findings.

Test	Range	Mean	SD
FVC (It)	1.03-3.76	2.01	0.60
FEV1 (It)	0.60-1.98	1.11	0.38
FEV1%	26-78	44.92	14.01
FEV1 /FVC%	34-73	54.26	10.12

Table 7: Patients in different stages as per gold staging criteria.

Stage	No.	Percentage	Mean FEV in % with SD
I- Mild COPD FEV1>80%	-	-	-
II-Moderate COPD FEV1 50-80%	18	36	66.9±6.9
III-Severe FEV1 30-50%	20	40	45.34±4.6
IV-Very severe FEV1< 30%	12	24	28.4±1.5

Table 7 shows majority of patients were in stage III with FEV1 30-50%. Out of 50, 20 were in stage III, 18 were in stage II and 12 were in stage IV. 12 patients had FEV1<30%. Mean FEV1 in stage IV patients is 28.4+1.5.

Pulse oximetry assessment

Serum arterial oxygen saturation values are assessed by pulse oximeter in all the patients.

Table 8: Distribution of pulse oximetry values in studied population.

SaO_2 %	No. of patients	Percentage
<89	8	16
89-92	22	44
92-95	16	32
>95	4	8

Table 8 shows patients with H/O chronic smoking (pack years>45) are commonly presented with oxygen saturation of 89%-92%. 8 patients had SaO_2% of <89%. Only 4 patients had SaO2% of >95%. 22 patients had SaO_2% in the range 89-92. 16 patients had SaO_2% in the range of 92-95%.

Table 9 shows among the studied population about 3 patients had the values in polycythemia range. All females had normal hematocrit levels. 13 males had hematocrit <40%. 22 males had hematocrit in the range of 40-46%. 4 males had hematocrit in the range of 46-53%. Only 3 males had hematocrit >53%.

Table 9: Distribution of hematocrit values among studied population.

Haematocrit(%)	Male	Female	Total	%
<40	13	6	19	38
40-46	22	2	24	48
46-53	4	-	4	8
>53	3	-	3	6
Total	42	8	100	100

DISCUSSION

In India COPD is the second most common lung disorder after pulmonary tuberculosis.[5] Overall the prevalence is higher in males due to greater prevalence of smoking. The disease is most often seen in middle aged or elderly people.

Chronic hypoxia causes stimulation of erythropoietin production leading to compensatory erythrocytosis.[6] However polycythemia is uncommon in COPD various studies show that it occurs in 5-8% of cases cigarette smoking may determine the severity of secondary polycythemia in patients with hypoxic COPD and prevent its correction by long-term oxygen therapy.

Pulse oximeters are invaluable, non-invasive tools for the assessment of hypoxemia in patients with COPD.[7] Pulse oximetry can determine rapidly whether impairment is mild, moderate, or severe. Arterial oxygen saturations of less than 92% may be associated with the development of a secondary polycythemia. Oximetry is useful in checking that the selected oxygen flow will ensure

nighttime SpO_2 of over 90%. The goal of management is to improve daily living and the quality of life by preventing symptoms and the recurrence of exacerbations by preserving optimal lung function.

About 50 cases of chronic obstructive pulmonary disease were studied mean age in present study was 64.37±9.7 years whereas compared to study from Trivedi HS et al, mean age was 59.5±4.92, Higham MA et al, mean age 66.7±8.1.[8,9]

In present study showed that males accounted for 84% with a male female ratio of 5.25:1. Patients had more than 20 pack years and majority of patients were in 30-50 pack year exposure duration. The mean pack year was 39.75±18 years, reinforcing the fact that at least 20 pack year's exposure is necessary for development of COPD. whereas Migueres M et al, study has mean pack year 49.0.[10]

In present study, cough with expectoration was present in all the cases and breathlessness was present in 92% of cases, wheezing was present in 80%, fever was present in 20% cases ,cyanosis was present in 7 cases; pursed lip breathing and intercostals in drawing was present in 6 cases each, flapping tremor was present in 2 cases.

In the study conducted by Higham MA et al, majority of patients were in stage IV and constituted about 57.58%, whereas in present study majority of patients were in group III.[9]

In present study majority of patients had oxygen saturation values in the range of 89-95 %. About 8 patients had hypoxia (<89% saturation) after oxygen administration, treatment with bronchodilators, and intensive care management they recovered and maintained normal oxygen saturation levels. Polycythemia was a feature in 6% of cases. In the study Cote C et al, Zilberberg, MD et al, polycythemia was present in 5% of patients.[11] About 3 patients had polycythemia range of hematocrit values. In these patient's phlebotomy was done. Reduction in the hematocrit was observed. Symptomatic improvement was also observed in these patients.

CONCLUSION

Computerized spirometry is a very useful investigation in the management of chronic obstructive pulmonary disease. Forced expiratory volume in first second (FEV1) values can be used to diagnose as well as to assess the severity of the disease. Pulse oximetry is a useful tool in diagnosing periods of oxygen desaturation. Pulse oximetry also useful in monitoring the oxygen therapy during management. Hematocrit analysis is a useful adjunct in assessing the severity of the disease. Polycythemia, even though uncommon in chronic obstructive pulmonary disease patients is one of the rare but preventable complication with early cessation of smoking and with oxygen therapy.

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