Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Correlation of Clinical Parameters with Spirometry Findings in Patients of Chronic Obstructive Pulmonary Disease (COPD)

Ankit Agrawal[1], G. Ramakrishna Vishnu Panth[2], Mazher Maqusood[3], Sanjay Sahay[3], Mazhar Alam[4], Abhishek Kumar[5]

[1]PG Resident, Department of Pulmonary Medicine, TMMC & RC, TMU Moradabad.
[2]Professor & Head, Department of Pulmonary Medicine, TMMC & RC, TMU Moradabad.
[3]Associate Professor, Department of Pulmonary Medicine, TMMC & RC, TMU Moradabad.
[4]Assistant Professor, Department of Pulmonary Medicine, TMMC & RC, TMU Moradabad.
[5]Senior Resident, Department of Pulmonary Medicine, TMMC & RC, TMU Moradabad.

Received: January 2019
Accepted: January 2019

ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is major cause of mortality & morbidity all over the world significantly affecting Quality of life of all the affected individuals and it also causes economic as well as social burden on society. COPD at present is the 4th leading cause of death worldwide, and is suspected to become 3rd leading cause of death worldwide by 2020. COPD diagnosis is confirmed by post bronchodilator FEV1 / FVC ratio < 0.70. In the present study, we wanted to examine the relationship between the history, clinical indices and spirometry in patients of COPD. **Methods:** Study was done in the department of pulmonary medicine on 50 patients of COPD, randomly selected after taking inclusion and exclusion criteria under consideration. **Results:** >80% of the patients were in age group of 40-70 years and mean age of presentation was 57.6 years. Smoking was present as risk factor in 62%. Most of the patients (42%) were under GOLD stage 3 followed by stage 4 (36%), stage 2 (22%) and no patients in stage 1. Duration of illness among patients ranged from 1 month to 40 years, with a mean of 7.4 years. As per new GOLD 2019 grouping criteria, maximum participants were in group B (78%), followed by group D (20%) and group A (2%). 24 out of 50 patients were in 19-25 BMI (normal) group, followed by 20 patients under <19 (low BMI) group and then 6 in >25 BMI group. We found statistically significant correlations between: FEV1/FVC ratio, MEF 25-75 and Age; between FVC and sexual difference;FEV1, FVC and MMRC Grading. **Conclusion:** PFT is an important tool for measuring degree of involvement of lung parenchyma in cases of COPD. It is affected by various factors, therefore a thorough history is important for assessment of level of involvement as well as for planning further management of patients.

Keywords: COPD, Spirometry

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is major cause of mortality & morbidity all over the world significantly affecting quality of life of all the affected individuals and it also causes economic as well as social burden on society. As per Global Initiative for Obstructive Lung Diseases (GOLD) guidelines 2019 "Chronic Obstructive Pulmonary Disease is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases."[1]

COPD at present is the 4th leading cause of death worldwide, and is suspected to become 3rd leading cause of death worldwide by 2020.[2]

According to a recent study conducted by Vinod Sharma et al. "the prevalence found for chronic bronchitis was 3.36 %, for bronchial asthma was 1.18 % and for COPD it was 4.21%."[3]

Smoking is a major causative as well as a known risk factor for COPD. COPD is more common in males because of increased use of tobacco and its products, but prevalence of COPD is increasing day by day among females with increase in tobacco abuse and biomass smoke exposure mainly in developing countries.[4]

Clinically COPD is suspected in a patient who has dyspnea, chronic cough and/or sputum production with or without a history of exposure to the risk factors. Spirometry is required with this clinical background to make a confirm diagnosis. For confirmation persistent airflow limitation, post bronchodilator FEV1 / FVC [Forced Expiratory

Name & Address of Corresponding Author
Dr. G. Ramakrishna Vishnu Panth,
Professor & Head,
Department of Pulmonary Medicine,
TMMC & RC,
TMU Moradabad.

Volume in 1 second/Forced Vital Capacity] ratio should be < 0.70. Whereas post bronchodilator FEV1 is needed for assessment of severity and staging of COPD (GOLD staging of COPD)[1]
In the present study, we wanted to examine the relationship between the history, clinical indices and spirometry in patients of COPD.

MATERIALS AND METHODS

Study was conducted in the department of pulmonary medicine. 50 patients of COPD were randomly selected after taking inclusion and exclusion criteria under consideration.

Parameters to be studied:

Clinical parameters –

- History
- Physical examination

Investigations –

- Spirometry with bronchodilator reversibility testing
- Routine blood investigations

Inclusion Criteria

- Patients diagnosed with COPD according to GOLD criteria – post-bronchodilator FEV1/FVC < 70%
- Age – 35 to 80 years.
- Patients willing to participate in the study (by giving a written consent)

Exclusion Criteria

- Patients with acute exacerbation at the time of enrolment in study
- Any known cardiac illness
- Severe obesity
- Severe anemia
- Chronic renal failure
- Chronic liver disease
- Neuropsychiatric illness
- Any known malignancy
- Known case of musculoskeletal disease
- Patients who are unwilling to participate in study

Standardization of Spirometry

Spirometry was performed as per ATS/ERS guideline[5,6] using GANSHORN (Medizin Electronic) PowerCube Diffusion+

Data analysis

Data was entered in Microsoft Excel 2016 and analysis was done using SPSS version 21-software. Descriptive results for categorical variables are presented as frequency tables, and for continuous variable, results have been presented as means, standard deviation, median and confidence interval.

RESULTS

- Mean age of the participants was 57.6 years (SD 9.92 years). Youngest participant was of 35 years age and oldest was of 80 years.
- On MMRC grading, all participants graded average 3.24 with minimum value of 1 and with maximum value of 4.
- Mean (SD) of PFT observations of FVC %, FVC L, FEV1 %, FEV1 L, FEV1/FVC %, FEV1/FVC L, MEF (25-75) % and MEF (25-75) L all participants were 53.3 (16.14), 1.6676 (0.58), 38.9 (15.85), 0.9442 (0.39), 72.12 (11.22), 54.66 (9.04), 17.12 (9.55) and 0.5686 (0.30) respectively.
- Mean BMI of all participants was 20.39 Kg/m2 (SD 4.06 Kg/m2).
- On assessing Gold staging of all 50 participants, mean was 3.14 with SD of 0.75.

Table 1: Summary of various variables

Characteristic	Observations	Mean	SD	Min	Max
Age of the Participants	50	57.6	9.922146	35	80
Duration of Illness in years	50	7.438	7.942597	0.1	40
MMRC Grading	50	3.24	0.743955	1	4
FVC %	50	53.3	16.14381	29	87
FVC L	50	1.6676	0.580617	0.64	3.44
FEV1 %	50	38.9	15.85038	15	78
FEV1 L	50	0.9442	0.391408	0.35	2.13
FEV1/FVC %	50	72.12	11.22977	45	94
FEV1/FVC L	50	54.66	9.049997	36	70
MEF (25-75) %	50	17.12	9.556791	5	45
MEF (25-75) L	50	0.5686	0.30053	0.17	1.6
BMI	50	20.398	4.06571	14	33.3
Gold Staging	50	3.14	0.756199	2	4

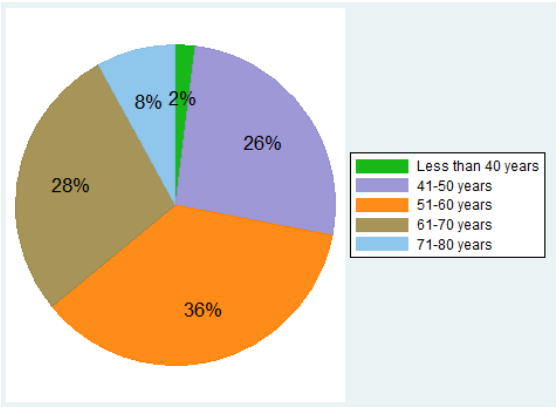

Figure 1: Age Distribution

- Maximum (36%) participants were belonging to 51-60 years of age group followed by 61-70 years (28%) and 41-50 years age group (26%). [Fig 1]
- On calculating Pearson correlation coefficient between age and various parameters of PFT, it was evident that most of the PFT parameters do not have any significant coefficient with age. Only FEV1/FVC % and MEF (25-75) % were found to be having correlation coefficient with statistical significance. [Table 2]

Table 2: Correlation Coefficient between Age and various parameter of PFT

Parameter of PFT	Correlation Coefficient with Age	p-value
FVC %	0.1487	0.3028
FVC L	-0.2304	0.1074
FEV1 %	0.2651	0.0628
FEV1 L	-0.1113	0.4417
FEV1/FVC %	0.3345	0.0176*
FEV1/FVC L	0.1585	0.2717
MEF (25-75) %	0.3137	0.0265*
MEF (25-75) L	0.0005	0.9973

* Statistically significant

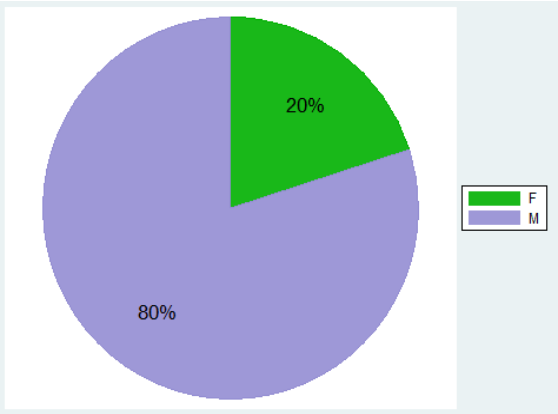

Figure 2: Sex of the participants

- Among all COPD patients included in the study, most 80% of them were males and only 20% participants were females. [Figure 2]

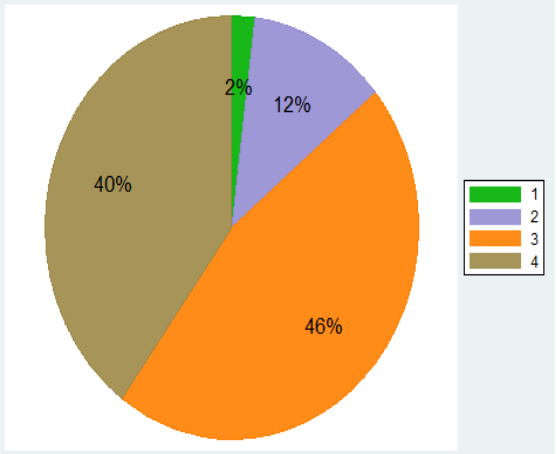

Figure 3: MMRC grading of the participants

- On the assessment of MMRC grading, most of the participants belong to grade III (46%) or IV (40%). [Figure 3]
- Higher lever MMRC grading have lower mean FVC %, FVC L and FEV1 L. This difference is statistically significant. [Table 3]

Table 3: Comparison of Means of various parameters of PFT with MMRC Grading (Results presented as Means with Standard Deviation in Parenthesis)

various parameters of PFT	Grade I or II (n=27)	Grade III or IV(n=43)	T-Test	P value
FVC %	67.42 (12.12)	51 (15.63)	2.6452	0.0110*
FVC L	2.15(.64)	1.58 (.53)	2.5436	0.014*
FEV1 %	48.42 (11.70)	37.34(15.99)	1.7509	0.0864
FEV1 L	1.28(.39)	0.88(.36)	2.6614	0.0106*
FEV1/FVC %	75.14(11.0)	71.62(11.31)	0.7647	0.4482
FEV1/FVC L	59.85(8.07)	53.81 (9.00)	1.6679	0.1018
MEF (25-75) %	20.28(6.36)	16.60(9.94)	0.9440	0.3499
MEF (25-75) L	.75(.22)	.53(.30)	1.8176	0.0754

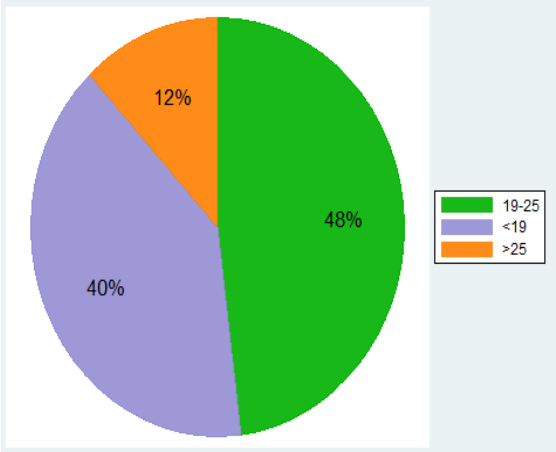

Figure 4: BMI Groups

- Almost half (48%) of the participants had BMI in between 19 to 25. In less than 19 and more than 25 BMI group, total number of participants were 40% and 12% respectively. [Figure 4]

Table 4: Correlation Coefficient between BMI and various parameter of PFT

Parameter of PFT	Correlation Coefficient with BMI	p-value
FVC %	-0.0275	0.8494
FVC L	-0.1101	0.4465
FEV1 %	0.0011	0.9937
FEV1 L	-0.0395	0.7851
FEV1/FVC %	0.1666	0.2475
FEV1/FVC L	0.1544	0.2844
MEF (25-75) %	-0.0527	0.7164
MEF (25-75) L	-0.0721	0.6190

- BMI also do not have any significant relationship with PFT parameters. [Table 4]

Table 5: Tobacco use in participants

Tobacco use	Frequency	Percentage
Ex-smoker	15	30
Non-smoker	19	38
Smoker	16	32
Total	50	100

- Out of total participants 30% were ex-smoker, 38% were non smoker and 32% were smoker. [Table 5]

Table 6: Comparison of Means of various parameters of PFT with Tobacco use (Results presented as Means with Standard Deviation in Parenthesis)

Various parameters of PFT	Non-Smoker or Ex-Smoker (n=34)	Smoker (n=16)	T-Test	P value
FVC %	55.55 (18.11)	48.5 (9.64)	1.4588	0.1511
FVC L	1.59 (.64)	1.82 (.38)	-1.2815	0.2062
FEV1 %	40.76 (17.93)	34.9 (9.38)	1.2186	0.2289
FEV1 L	.93(.45)	.96 (.21)	-0.1939	0.8471
FEV1/FVC %	72.14 (11.65)	72.06 (10.62)	0.0246	0.9805
FEV1/FVC L	54.91 (9.25)	54.1 (8.86)	0.2841	0.7776
MEF (25-75) %	18.05 (10.76)	15.12 (6.10)	1.0129	0.3162
MEF (25-75) L	.588 (.34)	.52 (.175)	0.6899	0.4936

- There is no significant effect of tobacco use on any PFT parameters. [Table 6]

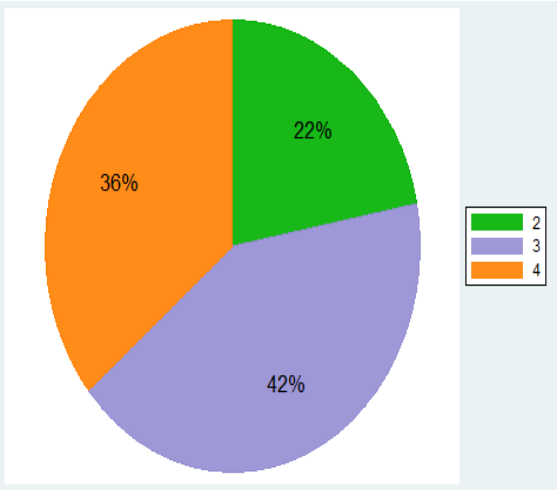

Figure 5: Gold staging of the participants

- There were no participants in gold staging 1. Gold staging 2, 3 and 4 had 11 (22%), 21 (42%) and 18 (36%) participants respectively. [Figure 5]

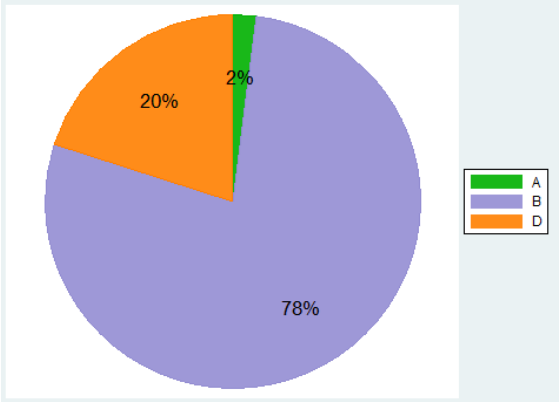

Figure 6: Gold group of the participants

- On Gold Grouping, no participant was grouped under category C. Most (78%) of the participants were in group B, followed by group D (20%) and group A (2%). [Figure 6]

Table 7: Comparison of Means of various parameters of PFT with Sex (Results presented as Means with Standard Deviation in Parenthesis)

Various parameters of PFT	Female (n=10)	Male (n=40)	T-Test	P value
FVC %	57.6 (18.45)	52.22 (15.58)	0.9406	0.3516
FVC L	1.209 (0.37)	1.78 (0.568)	-3.0141	0.0041*
FEV1 %	43.8 (17.02)	37.67 (15.52)	1.0952	0.2789
FEV1 L	0.74 (0.27)	0.99 (0.40)	-1.8329	0.0730
FEV1/FVC %	75 (12.15)	71.4 (11.03)	0.9051	0.3700
FEV1/FVC L	57.5 (8.87)	53.95 (9.06)	1.1122	0.2716
MEF (25-75) %	18.3 (9.05)	16.82 (9.76)	0.4329	0.6670
MEF (25-75) L	0.54 (0.30)	0.57 (0.30)	-0.3100	0.7579

*Significant

- On comparison of various PFT parameters in males and females, it was found that males have higher mean FVC L value and this difference is statistically significant. [Table 7]

DISCUSSION

In the present study, among 50 COPD patients, 80% were males and 20% were females (Male: Female ratio 4:1). This observation are congruence with the study done by Izqouiero, which resulted that the prevalence of COPD was 77.4% in males[7] and by Vinod Sharma et.al which stated that both COPD have a male preponderance, which could be best explained by different rates of smoking and occupational exposures between the two genders[3] and also with the WHO/World Bank Global Burden of Disease according to which the prevalence of COPD is higher among men than in women.[8] In a

review of population studies from India, done by Jindal et al. in 2001[9], observed median male: female ratio was 1.6:1. There is significant correlation of FVC between males and females, which signifies that total lung volume, (when calculated in liters) is more in males as compared to females.

Among 50 patients, mean age of presentation was 57.6 ± 9.92 years (maximum age found to be 80 years and minimum 35 years). This was also observed by P. P. Gupta et al.[10] where mean age of study population was 58.55 years (range 50-69 years). In our study >80% of the patients were in age group of 40-70 years. Same results were found by Nazia Mehfooz et al. who found maximum patients to be age group of 61-70 years of age.[11] In our study we found relation of FEV1/FVC% and MEF (25-75)% statistical significant with age of participants; this means increasing age has a direct impact and have an inverse relation with these PFT parameters. It means small airway obstruction (signified by MEF 25-75) increases with age.

In our study, smoking was present as risk factor either in current smokers or Ex-smokers (person who has left smoking for >one year) is 62% of the cases and non-smokers were 38%. In the review of population studies done by Jindal et al,[9] smoker to non smoker ratio in males was assessed 82.3%. But there was no significant relation found between smoking and various PFT parameters.

In this study, patients were grouped according to GOLD stage on the basis of spirometry. Most of the patients (42%) were in GOLD stage 3 followed by stage 4 (36%), stage 2 (22%) and no patients stage 1. From the 2019 GOLD Guidelines, COPD is not only classified according to the (by spirometry) 1234 stages but also in ABCD groups. These ABCD groups of COPD are assessed on the basis of symptoms and the history of exacerbation in addition to lung function. In our study maximum patients were in group B (78%), followed by group D (20%) and group A (2%). There were no patients were in group C in our study. Not many studies have been done on this, as criteria for GOLD grouping has changed in 2017. As per studies done according to previous criteria, the distribution is somewhat different. A study published by Boland et al.[12] shows "out of 611 participants diagnosed with COPD, 55% were classified in GOLD-A, 18% in GOLD-B, 13% in GOLD-C, and 14% in GOLD-D". This is because previously GOLD grading 1234 were included in COPD assessment of ABCD grouping, now it has been removed and ABCD grouping is done on the basis of degree of symptoms (either mMRC or CAT scoring) and history of exacerbation.[1]

MMRC grading is the grading of symptoms of breathlessness of patient. In our study there was a significant correlation between FVC and MMRC grading, signifying an inverse relationship.

Though COPD is a respiratory disease mainly, it has many systemic effects as well. Weight loss and Nutritional depletion are the features of COPD. The exact mechanism for this is uncertain. In our study, we grouped 50 patients into 3 categories according to BMI: low (less than 19), normal (19 to 25) and high (more than 25).

The data showed that 48% patients were in 19-25 BMI group, followed by 40% patients under <19 group and then 12% in >25 BMI group. This signifies that severity of COPD was found to be associated with low BMI. It matched with many studies which showed that "low BMI is a good marker of systemic involvement of COPD and has been associated with greater mortality".[13,14]

But there are studies which found no correlation between BMI and GOLD staging. A study published by Ischaki et al.[15] demonstrated that there was no correlation between BMI and severity of obstruction in COPD patients. Ours was a cross-sectional study involving only 50 patients. A longitudinal study involving larger patient sample is further required to find out the correlation between BMI and severity of obstruction (GOLD) in COPD patients.

CONCLUSION

In this study, we took cases of COPD, diagnosed on the basis of GOLD criteria, attending the Department of Pulmonary Medicine during study period. We randomly selected 50 patients (40 male and 10 female) based on inclusion and exclusion criteria. >80% of the patients were in age group of 40-70 years and mean age of presentation was 57.6 years. Smoking was present as risk factor in 62%. Most of the patients (42%) were under GOLD stage 3 followed by stage 4 (36%), stage 2 (22%) and no patients in stage 1. Duration of illness among patients ranged from 1 month to 40 years, with a mean of 7.4 years. As per new GOLD 2019 grouping criteria, maximum participants were in group B (78%), followed by group D (20%) and group A (2%).

We found statistically significant correlations between:

1. FEV1/FVC ratio, MEF 25-75 and Age
2. Between FVC and sexual difference
3. FEV1, FVC and MMRC Grading

Therefore, the study showed

I. COPD is mainly present in age group of 40-70 years, with a male predominance.
II. In the Indian scenario most of the patients present with severe or very severe obstruction.
III. Low BMI is a good marker of systemic involvement of COPD and can be associated with greater mortality.
IV. Increase in MMRC grading is inversely proportional to lung function parameters.

Finally, we conclude that PFT is an important tool for measuring degree of involvement of lung parenchyma in cases of COPD. It is affected by various factors; therefore a through history is important for assessment of level of involvement as well as for planning further management of patient. There is a need of larger studies with more sample size in Indian scenarios to formulate Indian guidelines for management of COPD in the country.

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How to cite this article: Agrawal A, Panth GRV, Maqusood M, Sahay S, Alam M, Kumar A. Correlation of Clinical Parameters with Spirometry Findings in Patients of Chronic Obstructive Pulmonary Disease (COPD). Ann. Int. Med. Den. Res. 2019; 5(2):TB08-TB13.

Source of Support: Nil, **Conflict of Interest:** None declared