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Study of Spirometric Parameters and Diffusing Lung Capacity for Carbon Monoxide (DLCO) in Patients of Obstructive Airway Diseases in Accordance with Clinical Correlation

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ABSTRACT
For diagnosis and management of obstructive lung diseases a number of investigations are available, such as chest X- ray, blood investigations, Spirometry, sputum examination, peak flow measurements, exercise testing and DLCO. Present study was aimed to study spirometric parameters and Diffusing Lung Capacity for Carbon Monoxide (DLCO) in patients of Obstructive Airway Diseases in accordance with clinical correlation. Present study was single-center, prospective, observational study, conducted in patients presenting first time with complaints of cough, breathlessness, chest tightness, wheezing and paroxysmal nocturnal dyspnea OR already diagnosed cases of Bronchial Asthma and COPD. All patients underwent spirometry, DLCO and Arterial blood gas analysis. Amongst overall 112 patients, 63 (56.25%) were of COPD & 49 (43.75%) were of Asthma. Mean age of the patients with COPD was 52.93 and that of Asthma patients was 36.48. Amongst 112 overall patients, 93 patients were able to perform DLCO maneuver that is 51 amongst 63 patients with COPD and 42 amongst 49 patients with Asthma. The remaining patients were, not able to hold their breath for 10 seconds and thus were not able to perform the DLCO maneuver. Amongst 42 Asthma patients26hadincreased DLCO and 16 had normal DLCO. All 51 patients with COPD had decreased DLCO. DLCO in patients with COPD decreased progressively with decrease in FEV_1. DLCO is decreased in the patients with Chronic Obstructive Pulmonary Disease and may be normal or increased in the patients with Asthma. FEV_1 % predicted correlates positively with DLCO% predicted in patients with COPD.

INTRODUCTION

The working definition of COPD, as noted in the Global Initiative for Obstructive Lung Disease (GOLD) guidelines, is that COPD is "a preventable and treatable disease with some significant extrapulmonary effect that may contribute to the severity in individual patient[1]. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases. For diagnosis and management of obstructive lung diseases a number of investigations are available, some of these include; chest X-ray, blood investigations, Spirometry, sputum examination, peak flow measurements, bronchial provocation test, skin tests, blood gases, exercise testing and Diffusing Lung Capacity for Carbon Monoxide (DLCO)[2]. In Bronchial Asthma the standard test for evaluating airway narrowing is Spirometry. The test is based on the fact that, during exhalation increasing effort does not increase expiratory airflow; maximal flow occurs without great effort airway narrowing due to disease can be detected as a decrease in expiratory airflow[3].

A reduction in transfer factor (DLCO) and transfer coefficient (KCO) is the best functional indicator of the presence and severity of pulmonary Emphysema[4]. Diffusing Lung Capacity for Carbon Monoxide (DLCO) is usually normal or increased in patients with Asthma and decreased in patients of COPD. Present study was aimed to study spirometric parameters and Diffusing Lung Capacity for Carbon Monoxide (DLCO) in patients of Obstructive Airway Diseases in accordance with clinical correlation.

MATERIAL AND METHODS

Present study was single-center, prospective, observational study, conducted in department of pulmonary medicine, at Government hospital, Nanded, Maharashtra, India. Study duration was of 20 months (January 2009 to August 2010). Study approval was obtained from institutional ethical committee.

Inclusion Criteria:

- All patients presenting first time with complaints of cough, breathlessness, chest tightness, wheezing and paroxysmal nocturnal dyspnea OR already diagnosed cases of Bronchial Asthma and COPD, willing to participate in present study

Exclusion Criteria:

- Patients of age group <13 years
- Patients with active pulmonary tuberculosis
- Recent myocardial infarction (<1month)

Study was explained to patients in local language and written consent was taken for participation and study. Age, Gender, Height (in meter), weight (in kg), systolic and diastolic blood pressure (in mm Hg) were noted along with detail history, including detail smoking history like type of active smoking whether Bidi or Cigarette and smoking index was noted. Detail clinical examination for all the patients. Investigations carried out were X-ray chest PA view, Sputum for AFB-three samples (Acid fast bacilli), Complete hemogram including hemoglobin%, complete blood count, Spirometry, DLCO and Arterial blood gas analysis.

After physical examination and investigations, an informed consent was obtained from all the patients for spirometry. Patients were informed regarding withholding bronchodilator medications and abstinence from smoking. Patients were also instructed about the maneuver thoroughly prior to testing and were also positioned in a proper way. In all patients baseline Spirometry was done with computerized Medgraphics Spirometer. This Spirometer met American thoracic society criteria and was volume calibrated daily. Measurement accuracy of Spirometer was+2%. The patient was subjected to Spirometric study in PFT lab. Bronchodilator response was assessed by giving nebulized salbutamol in a dosage of 2.5 mg (0.5 ml) diluted with 2ml. 0.9% normal saline. Available as 5 mg/ml. 15 min after nebulization with salbutamol, Spirometry was performed. The best of three consecutive measurements were taken. After Spirometry patients were differentiated as those with good bronchodilator response, those with poor bronchodilator response, mixed ventilator disorder and normal Spirometry. Patients who could hold their breath for 10 sec were posted for DLCO. DLCO was done by OGILIVE technique. Detail maneuver explained to the patient. After taking pneumotach in mouth patient should be asked to take normal tidal breaths. At the end of inspiration during fourth breath patient is asked to inspire fully and fast. Now patient hold breath for 10 seconds. After 10 seconds patient expires fully and fast. At the end of breath-hold, the subject exhales a fixed washout volume(750ml) and a sample of alveolar gas (500ml) is taken for analysis with a multiple-gas chromatographic analyzer. Normal values for DLCO% predicted were considered as per Jeong Park: The high DLCO group included patients who had a DLCO> 140% of predicted value as per Ghulam Saydain study, of patients with clinical significance of increased DLCO[5]. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between

qualitative variables were tested using chi- square test or Fisher exact test as applicable. p<0.5 was considered as statistically significant.

RESULTS AND DISCUSSION

Patients in present study, were distributed as per post bronchodilator FEV_1 reversibility, as those with Asthma (>12% or200 ml reversibility in FEV_1) and those with COPD (< 12% reversibility or 200 ml in FEV_1). Amongst overall 112 patients, 63 (56.25%) were of COPD and 49 (43.75%) were of Asthma Most patients (93.26 %) with COPD were between 35-84 yrs of age and most patients (87.73%) with Asthma were < 45 yrs of age. Mean age of the patients with COPD was 52.93 and that of Asthma patients was 36.48. Amongst COPD Patients 47 (74.60) were males and 16 (25.39 %) were females, male: female ratio in COPD was 2.93:1. Amongst patients with Asthma 27 (55.10%) were males and 22 (44.89%) were females, with male to female ratio of 1.22:1. 51 (80.95%) amongst 63 patients with COPD were smokers and 12 (19.04%) were non-smokers, smokers non-smokers ratio was 4.2:1. In Asthma 21 (42.85%) patients were smokers and 28 (57.14%) patients were nonsmokers. Bidi smoking seen in 49 (96.07%) patients was common than cigarette smoking seen in 2 (3.92 %) patients with COPD.

Amongst patients with COPD Breathlessness seen in 53 (84.12 %) patients, was the commonest symptom followed by Cough in 43(68.25%) patients, Chest Tightness in 31 (49.20%) patients and Wheeze in 28 (44.44 %) patients. In Asthma, Breathlessness seen in 45 (91.83%) patients, was the commonest symptom followed by Wheeze in 42 (85.71%) patients, Cough in 40 (81.63 %) patients and Chest Tightness in 25 (51.02%) patients. Cyanosis was seen in 21(33.33%) of the patients with COPD and 17 (34.69%) of the patients with Asthma Signs of Co2 retention like Bounding Pulse and Hypertension and Altered Sensorium were seen in 25 (39.68%), 09 (14.28%) and 3 (4.76%) respectively in COPD patients. In Asthma signs of Co2 Retention like Bounding Pulse, Hypertension and Altered Sensorium were seen in 08 (16.32%), 01(2.04%) and 01(2.04%) patients respectively.

Amongst patients with COPD 9 (14.28%) were with Mild COPD, 26 (41.26%) were with Moderate COPD, 20 (31.74 %) were with Severe COPD and 8 (12.69%) were with Very Severe COPD. Amongst patients with Asthma 8 (16.32%) were of Intermittent Asthma, 8 (16.32%) were of Mild Persistent Asthma,17(34.69 %) were of Moderate Asthma and 16 (32.65%) were with severe Asthma. Amongst 112 overall patients, 93 patients were able to perform DLCO maneuver that is 51 amongst 63 patients with COPD and 42 amongst 49 patients with Asthma. The remaining patients were, not able to hold their breath for 10 seconds and thus were not able to perform the DLCO maneuver. Amongst 42 Asthma patients26hadincreased DLCO and 16 had normal DLCO. All 51 patients with COPD had decreased DLCO.

DLCO in patients with COPD decreased progressively with decrease in FEV_1. In present study 112 patients with symptoms suggestive of obstructive lung disease and with age range of 14-84 years, 74(66.07%) males and 38 (33.92%) females were included. Spirometry was performed with Medgraphics Spirometer. Also detail clinical evaluation of all patients was done. Asthma was diagnosed on the basis of Global Initiative for Asthma guidelines[1] i.e. history of paroxysmal dyspnea, seasonal variation, wheeze, hypersensitivity to allergens, family history of Asthma and Spirometry showing forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) ratio less than 70 % and FEV_1 less than 80% predicted with good bronchodilator reversibility i.e. as improvement FEV_1 by 12% and 200 ml. Diagnosis of COPD was based on Global Initiative for obstructive lung Disease guidelines i.e. cough with sputum production for most of the days in a year at least 3 months for 2 consecutive years or dyspnea with history of exposure for risk factors (e.g. tobacco smoking), progressive breathlessness and Spirometry showing FEV_1/ FVC less than 70 % and FEV_1 less than 80 % predicted with poor bronchodilator reversibility[1].

In present study 51(80.95%) amongst 63 patients of COPD are smokers and 12 (19.04 %) were nonsmokers, with smokers: nonsmokers ratio of 4.2:1. This coincides with study By D. Gothi *et al*[6]., where 98% OF COPD patients were smokers. Also present study correlates with study by Li Yuan-Yuan ,Liu Xian Sheng[7] where most of the patients (61.4%) with COPD were smokers. Present study findings also coincides with study by S.K Jindal[8] where most of the patients with COPD were smokers and smokers: nonsmokers ratio was 2.65:1. Crofton and Douglas textbook of Respiratory Diseases[9], mentions that Active smoking

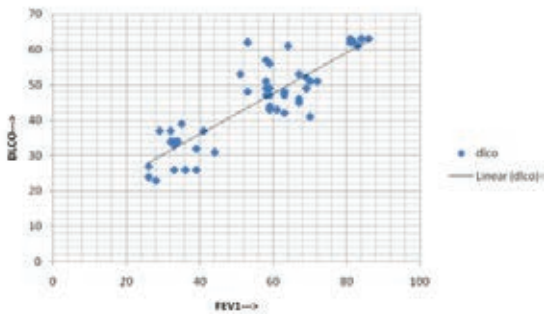

Fig. 1: In present study DLCO in patients with COPD decreased progressively with decrease in FEV_1 and this the graph showing the same. Correlation Coefficient r = 0.87).

Age (Years)	20-29	30-39	40-49	50-59	60-69	Total
Men						
DLCO	72.11	72.27	70.46	76.23	79.66	64.76
DLCO/VA	72.40	83.95	78.97	85.25	36.53	70.23
Women						
DLCO	69.04	65.69	75.21	58.08	73.43	62.01
DLCO/VA	68.81	80.64	76.29	53.12	66.08	68.98

Severity Assessment of a Reduced DLCO was done in following way14:

Degree of Severity	DLCO % Predicted
Mild	>60 and less than lower limit of normal
Moderate	40-60
Severe	<40

Table 1: General characteristics

	COPD (n = 63)	Asthma (n = 49)	Total (n = 112)
Age			
14-24	0	9 (18.36%)	9 (8.03%)
25-34	4 (6.34%)	11 (22.44%)	15 (13.39%)
35-44	8 (12.69%)	23 (46.93%)	31 (27.67%)
45-54	27 (42.85%)	4 (8.16%)	31 (27.67%)
55-64	16 (25.39%)	2 (4.08%)	18 (16.07%)
65-74	4 (6.34%)	0	4 (3.57%)
75-84	4 (6.34%)	0	4 (3.5%)
Gender			
Male	47 (74.60%)	27 (55.10%)	74 (66.07%)
Female	16 (25.39%)	22 (44.89%)	38 (33.92%)
Active smoking			
Smokers	51 (80.95%)	21 (42.85%)	
Nonsmokers	12 (19.04%)	28 (57.14%)	

Table 2: Clinical features

Clinical features	COPD (n = 63)	Asthma (n = 49)
Symptoms		
Breathlessness	53(84.12%)	45(91.83%)
Cough	43(68.25%)	40(81.63%)
Chest tightness	31(49.20%)	25(51.02%)
Wheeze	28(44.44%)	42(85.71%)
Signs of respiratory failure		
Cyanosis	21(33.33%)	17(34.69%)
Bounding pulse	25(39.68%)	08(16.32%)
Hypertension	09(14.28%)	01(2.04%)
Altered sensorium	03(4.76%)	01(2.04%)

Table 3:COPD as per stages of severity

Severity	No. of patients (n = 63)	Percentage
Mild	09	14.28
Moderate	26	41.26
Severe	20	31.74
Very severe	08	12.69

Table 4:Asthma as per stage of severity

Severity	No. of patients (n = 49)	Percentage
Intermittent	08	16.32
Mild persistent	08	16.32
Moderate	17	34.69
Severe	16	32.65

Table 5:DLCO in asthma and COPD patients (n = 93)

	DLCO		
Disease	**Increased**	**Decreased**	**Normal**
Asthma	26	-	16
COPD	-	51	-
Total(93)	26	51	16

Table 6:Relation of DLCO with severity (FEV_1 % predicted) in COPD patients Severity (FEV_1 % PREDICTED)

	DLCO			
	Mild	**Moderate**	**Severe**	**Total**
Mild	09	-	-	09
Moderate	-	26	-	26
Severe	-	-	12	12
Very severe	-	-	04	04
Total				51

is clearly the single most important etiological factor in COPD. However 10-20% of smokers develop clinically significant COPD. In present study amongst COPD patients, Bidi smoking was common seen in 49 (96.07

%) patients, than cigarette smoking seen in 2 (3.92%) patients. This correlates with the study By Gothi *et al*[6]., where 83% of the smokers with COPD were Bidi smokers. Also S.K Jindal[8] mentions that Bidi smoking is common than Cigarette smoking in patients with April 1, 2024COPD in India mostly due to Rural based population. Amongst patients of Asthma 21 (42.85%) were smokers and 28 (57.14%) were nonsmokers. Gilliland *et al*[10]., has mentioned active smoking as a risk factor for new onset bronchial asthma . Also Fishmans Textbook Of Pulmonary Diseases and Disorders mentions that smoking is associated with development of airway hyperreactivity. This hyperreactivity can represents with Asthma or COPD[11].

In present study amongst patients with COPD Breathlessness seen in 53 (84.12%) patients, was the commonest symptom followed by Cough in 43 (68.25%) patients, Chest Tightness in 31(49.20%) patients and Wheeze in 28 (44.44%) patients. This correlates with the study by Martyn R.Partridge *et al*[12]., in which Breathlessness (72.8%) was the commonest symptom in COPD followed by Cough (58.7%). It also coincides with the study by Steven Kesten *et al*[13]., in which Dyspnea was the commonest symptom (71%) in COPD followed by cough (19%). In Asthma, Breathlessness seen in 45 (91.83%) patients, was the commonest symptom followed by Wheeze in 42 (85.71%) patients, Cough in 40 (81.63%) patients and Chest Tightness in 25 (51.02%) patients. This correlates with the text mentioned in Crofton and Douglas that Breathlessness is the most common symptom in Asthma[9]. D. Sistek, *et al*[14]., found Wheezing (94.4%) as the commonest symptom in Asthma followed by Exertional Dyspnea(82%). In present study amongst patients with COPD 9 (14.28%) were with Mild COPD, 26 (41.26%) were with Moderate COPD, 20 (31.74%) were with Severe COPD and 8 (12.69%) were with Very Severe COPD. Present study findings correlates With T Seemungal and R Harrinarine[15] study where most of the patients are with moderate to severe disease.

In present study amongst patients with Asthma 8(16.32%)were of Intermittent Asthma, 8 (16.32%) were of Mild Persistent Asthma, 17 (34.69%) were of Moderate Asthma and 16 (32.65 %) were with severe Asthma. Similar findings were noted by Aimee Liou *et al*[16]., and D.Gothi *et al*[2]., In overall study amongst 112 PATIENTS, 93 patients were able to perform DLCO maneuver that is 51 amongst 63 patients with COPD and 42 amongst 49 patients with Asthma. Amongst 42 Asthma patients26hadincreased DLCO and 16 had normal DLCO. All 51 patients with COPD had decreased DLCO. Ruppel textbook[17] of pulmonary function test mentions that DLCO is decreased in patients with Chronic Obstructive Lung Disease. Also Alan L. Plummer[18] mentions that DLCO may be normal or increased in patients with Asthma. Ghulam Saydain *et al*[5]., also mentions that high values of DLCO is frequently associated with Asthma, Obesity. This findings correlate with study by Tarek Safwat *et al*[19]., who mentioned that FEV_1 % predicted correlates positively with DLCO % predicted in patients with COPD. It also coincides with the study by Yaling Zhu *et al*[20]., who stated that Diffusion progressively impaired with severity of COPD. Also Brashier *et al*[21]., mentions that FVE1 Values correlate positively with DLCO in patients with COPD.

CONCLUSION

Most of the patients with both COPD as well as Asthma who presented to us for the first time, had moderate to severe disease. It can be concluded from this, that Spirometry although very useful test in the diagnosis of obstructive airway diseases, is neglected by the physicians in the early diagnosis of the same. DLCO is decreased in the patients with Chronic Obstructive Pulmonary Disease and may be normal or increased in the patients with Asthma. FEV_1% predicted correlates positively with DLCO% predicted in patients with COPD.

REFERENCES

1. Mauad, T. and M. Dolhnikoff, 2008. Pathologic similarities and differences between asthma and chronic obstructive pulmonary disease. Curr. Opin. Pulm. Med., 14: 31-38.
2. Reich, S., A. Weinshelbaum and J. Yee, 1985. Correlation of radiographic measurements and pulmonary function tests in chronic obstructive pulmonary disease.
3. Murray, J.F. and J.A. Nadel, 2005. Murray and Nadel Textbook of Respiratory Medicin. 3rd Edn., Elsevier, Amsterdam, Netherlands, Pages: 1181.
4. Sekulic, S., M. Vukcevic, P. Rebic, M. Mitic-Milikic and L. Nagroni-Obradovic, 1999. Lung function tests in clinical diagnosis of pulmonary emphysema. Sci. J. Facta Uni. Ser. Med. Biol., 6: 78-81.
5. Saydain, G., K.C. Beck, P.A. Decker, C.T. Cowl and P.D. Scanlon, 2004. Clinical significance of elevated diffusing capacity. Chest, 125: 446-452.
6. Gothi, D., D.V. Shah and J.M. Joshi, 2007. Clinical profile of diseases causing chronic airflow limitation in a tertiary care centre in India. J. Assoc. Physic. India, 55: 551-555.
7. Yuan-Yuan, L.I., L.I.U. Xian-Sheng and X.U. Yong-Jian, 2010. Basic and clinical research into chronic obstructive pulmonary disease in China. Chinese Med. J., 123: 491-497.
8. Jindal, S.K., 2006. Emergence of chronic obstructive pulmonary disease as an epidemic in

India. Indian J. Med. Res., 124: 619-360.
9. Seaton, A., A.G. Leitch and D. Seaton, 2008. Crofton and Douglas Respiratory Diseases. 5th Edn., Wiley-Blackwell,, Hoboken, New Jersey, USA., ISBN-17: 978-0-470-69524-1, Pages: 1696.
10. Gilliland, F.D., T. Islam, K. Berhane, W.J. Gauderman, R. McConnell, E. Avol and J.M. Peters, 2006. Regular smoking and asthma incidence in adolescents. Am. J. Respir. Crit. Care Med., 174: 1094-1100.
11. Fishman, A.P., J.A. Elias, J.A. Fishman, M.A. Grippi, R.M. Senior and A.I. Pack, 2008. Fishman's Pulmonary Diseases and Disorders. 4th Edn., McGraw Hill Professional,, New York, USA., ISBN-13: 9780071641098, Pages: 2948.
12. Partridge, M.R., M. Cazzola, R. Kessler, M. Miravitlles, C. Vogelmeier, D. Leynaud and J. Ostinelli, 2009. Diurnal variation of symptoms and impact on morning activities in severe COPD: a pan-European cross-sectional study. Proceedings of the 2009 Annual Congress on Risk factors for COPD,, September 13-13, 2009, Thematic Poster Session,, Vienna, Austria, pp: 1-1.
13. Kesten, S. and S. Menjoge, 2005. Patient-reported symptoms of chronic obstructive pulmonary disease (COPD) in clinical trials. Chest, 128: 249-250.
14. Sistek, D., J.M. Tschopp, C. Schindler, M. Brutsche, U. Ackermann-Liebrich, A-P. Perruchoud and P. Leuenberger, 2001. Clinical diagnosis of current asthma: predictive value of respiratory symptoms in the SAPALDIA study. Eur. Respir. J., 17: 214-219.
15. Seemungal, T., R. Harrinarine, M. Rios, V .Abiraj and A. Ali *et al.,* 2008. Obstructive lung disease in acute medical patients. West Indian Med. J., 57: 7-13.
16. Liou, A., J.R. Grubb, K.B. Schechtman and D.L. Hamilos, 2003. Causative and contributive factors to asthma severity and patterns of medication use in patients seeking specialized asthma care. Chest, 124: 1781-1788.
17. Ruppel, G.L., 2003. Manual of Pulmonary Function Testing. 8th Edn., Mosby,, London, UK., ISBN-18: ? 978-0323020060, Pages: 544.
18. Plummer, A.L., 2008. The carbon monoxide diffusing capacity: Clinical implications, coding and documentation. Chest, 134: 663-667.
19. Safwat, T., K. Wagih and D. Fathy, 2009. Correlation Between Forced Expiratory Volume in the first second (FEV_1) and diffusion capacity of the lung for carbon monoxide (DLCO) in chronic obstructive pulmonary disease. Egyp. J. Bronchol., 3: 119-123.
20. Zhu, Y., H. Wang and X. Chang, 2005. Changes of diffusion capacity in patients with chronic obstructive pulmonary diseases (COPD). Chest, Vol. 128. 10.1378/chest.128.4_meetingabstracts.248s-c
21. Brashier, B., S. Saoji, A. Raghupati, S. Mandrekar, S. Valsa, S. N. Gaikwad, S. V. Ghorpade and S. Salvi, 2007. Correlation between spirometric indices (FEV_1, FVC) and lung diffusion values (DLCO) in subjects with varying severity of chronic obstructive pulmonary disease (COPD). Eur. Respir. J., Vol. 30.