

Role of DLCO in differentiation or subtyping of obstructive lung disease beyond spirometry and CT scan.

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Abstract

Introduction: Spirometry helps us to differentiate between obstructive and restrictive disease, body plethysmography tells about lung volumes and DLCO about diffusion defect. Determining which tests to do depends on the clinical question to be answered i.e. whether test is being done to diagnose a disease or for evaluation for lung surgery or some other reason.

Material & Methods: 46 patients coming to department of respiratory medicine, who were diagnosed with obstructive lung disease by PFT as per GOLD guidelines were considered for the study. Chest X-ray and CT chest were also done. Then DLCO was performed in every patient. Single breath hold method was used in the study. The report of the DLCO was interpreted according to the American Thoracic Society/European Respiratory Society statement on PFT interpretation.

Results: Male preponderance was seen in study cases with 65.2% males to 34.8% females. Mean age of the study group was 54.39 years with most cases (18) from 31-50 years of age group. Most common diagnosis was COPD emphysema (22) followed by chronic bronchitis (12), bronchial asthma (10) and bronchiectasis (2). Among obstructive lung diseases, B. asthma had the highest mean DLCO percentage predicted of 102.20 ± 14.36 followed by COPD-Bronchitis (76.33 ± 5.57), COPD-Emphysema (37.80 ± 13.41) and bronchiectasis (62 ± 4.48).

Conclusion: DLCO can be helpful beyond spirometry in classification of obstructive lung diseases. DLCO values in COPD Emphysema variant are decreased, COPD bronchitis variant remains normal or slightly reduced and asthma either normal or increased. So, DLCO can help in differentiation or sub categorization of obstructive disease more than spirometry.

Key Words: DLCO, Obstructive diseases, Lung function test, COPD, Emphysema, Bronchial Asthma.

Introduction

Carbon monoxide diffusing capacity is the least understood pulmonary function test in clinical practice worldwide, even among experienced pulmonologists. There are lot of different tests used for evaluation of lung functions. These tests may be performed individually or in combination with other tests. Pulmonary function test report includes spirometry, diffusing capacity, lung volumes and airway resistance (R_{aw}) measurements in a commonly used format. Spirometry help us to differentiate between obstructive and restrictive disease, body plethysmography tells about lung volumes and DLCO about diffusion defect. Determining which tests to do depends on the clinical question to be answered

i.e. whether test is being done to diagnose a disease or for evaluation for lung surgery or some other reason. Measuring the diffusing capacity of lungs for carbon monoxide is 2nd most important pulmonary function test that is done after spirometry.

The single breath test of carbon monoxide (CO) uptake has a long history, from its birth (Krogh and Krogh, 1909)¹ to the first publication by Ogilvie et al describing a standardized technique for the diffusing capacity measurement (DLCO) in 1957.² The DLCO was devised originally as a physiological tool to test the notion that the lung, like the swim bladder of some deep-sea fish, could secrete oxygen against the normal tension gradient provided by inspired air by Bohr in 1900 although this

notion is now long abandoned.

As a clinical test DLCO was introduced in 1915 by Marie Krogh, but the measurement never caught on because methods of measuring carbon monoxide were so cumbersome.³But now a day's single breath technique is in common use. DLCO measures the transfer of a diffusion-limited gas (CO) across the alveolocapillary membranes.

DLCO is increased in the circumstances when pulmonary capillaries are recruited, as occurs during exercise, during a Mueller (reverse Valsalva) manoeuvre, pulmonary hemorrhage, polycythemia, obesity, asthma etc. DLCO is decreased in cases of lung resection, pulmonary emphysema affects capillary or alveolar bed, pulmonary vascular disease including PAH and chronic venous thromboembolism, interstitial lung diseases, anemia, drugs induced fibrosis e.g. bleomycin, amiodarone, pulmonary lymphangitic carcinomatosis

Material and Method

23 patients coming to department of respiratory medicine of MMIMSR, who were diagnosed with obstructive lung disease by PFT, Chest X-ray or CT chest, were considered for the study. At baseline, patient's medical history was recorded and thorough physical examination was done. The medical history chiefly included history of symptoms related to respiratory system, namely shortness of breath, cough, weight loss, fatigue, expectoration and any other symptom related to other systems. Obstructive disease was categorized as post-bronchodilator FEV1/FVC <0.70 for COPD and post bronchodilator change in FEV1 by >12% and 200ml in case of Bronchial asthma. Chronic bronchitis

defined clinically as the presence of a chronic productive cough for 3 months during each of 2 consecutive years after excluding other causes of cough. Then DLCO was performed in every patient. Single breath hold method was used in the study. The report of the DLCO was interpreted according to the American Thoracic Society/European Respiratory Society statement on PFT interpretation and is as follows – normal - >80% predicted DLCO, mild reduction - 79% to 60% of predicted DLCO, moderate reduction - 59% to 40% of predicted DLCO, severe reduction - < 40% of predicted DLCO.

In this present study we aimed to find out the importance of DLCO in differentiation of obstructive disease beyond spirometry and CT evidence as some of the COPD patients may also show post-bronchodilator reversibility.

Results

Male preponderance was seen in study cases with 65.2% males to 34.8% females. Mean age of the study group was 54.39 years with most cases (18) from 31-50 years of age group. Most common diagnosis was COPD emphysema (22) followed by chronic bronchitis (12), bronchial asthma (10) and bronchiectasis (2). 14 (30.4%) patients were smokers, 12 (26.1%) were non-smokers and 20 (43.5%) patients were ex-smokers. Among obstructive lung diseases, B. asthma had the highest mean DLCO percentage predicted of 102.20±14.36 followed by COPD-Bronchitis (76.33±5.57), COPD-Emphysema (37.80±13.41) and bronchiectasis (62±4.48).

Table 1. Distribution of study cases as per Diagnosis

Diagnosis	N	%
Chronic Obstructive Pulmonary Disease – Emphysema	22	47.82%
Chronic Obstructive Pulmonary Disease – Bronchitis	12	26.08%
Bronchial Asthma	10	21.73%
Bronchiectasis	2	04.34%
TOTAL	46	100%

Table 2– DLCO value in Obstructive lung disease

	N	Mean	SD
B. Asthma	10	102.2	14.32
COPD – E	22	37.80	13.41
COPD – B	12	76.33	5.57
Bronchiectasis	2	62	4.48
Total	46	62.39	29.44

Discussion

DL_{CO} measurement is very reliable and sensitive. DL_{CO} is determined by the amount of blood recruited in the alveolar capillary bed and the alveolo-capillary surface available for diffusion.

The decrease in DL_{CO} is probably more closely related to the loss of lung volume, alveolar surface area, or capillary bed than to the thickening of the alveolocapillary membranes. DLCO also decreases when there is loss of lung tissue or replacement of normal parenchyma by space-occupying lesions such as tumours. DLCO may also be decreased in pulmonary oedema as in congestive heart failure. Surgical lung resection for cancer or other reasons also reduce DLCO except in LVRS and bullectomy because the resected areas generally have little to no blood flow.

In acute and chronic obstructive lung disease also DLCO may be decreased. But other obstructive diseases (e.g., chronic bronchitis, asthma) may not reduce DLCO unless they result in markedly abnormal patterns. Some asthmatic patients may have an increased DLCO, but the cause is not completely understood.

Obstructive lung diseases in our study included B. Asthma, Chronic obstructive pulmonary disease- emphysema and bronchitis variants and bronchiectasis. The mean value of DLCO in obstructive lung diseases was 62.39 ± 29.44 . In specific diseases, B. asthma had the highest mean DLCO percentage predicted of 102.20 ± 14.36 . Saydain G⁴ et al did a study on clinical significance of elevated DLCO in 245 patients who had

elevated DLCO values. He found that most patients with elevated DLCO had the diagnosis of obesity, asthma or both. Our study also showed COPD- bronchitis patients had the mean DLCO of 76.33 ± 5.57 while COPD- emphysema patients had a mean predicted DLCO value of 37.80 ± 13.41 . There were only two bronchiectasis patients in the study and the mean DLCO value was 62 ± 4.48 .

To summarize, DLCO is a very good tool for early identification of lung diseases. It can be used to differentiate between COPD and asthma as percentage predicted DLCO is usually decreased in emphysematous patients while it may be normal or increased in asthmatic patients. Bronchitis patients may also show normal or slightly decreased DLCO values.

Conclusion

DLCO can be helpful beyond spirometry in classification of obstructive lung diseases. DLCO values in COPD Emphysema variant are decreased, COPD bronchitis variant remains normal or slightly reduced and asthma either normal or increased. So DLCO can help in differentiation or sub categorization of obstructive disease more than spirometry.

Conflict of Interest- None.

Source of Funding- Self.

Ethical Clearance: Ethical clearance was obtained from the Institutional Ethics Committee (IEC), Maharishi Markandeswar (deemed to be university) Mullana, Ambala.

References

1. Krogh A, Krogh M. 1909. Rate of diffusion into lungs of man. *Skand. Arch. Physiol.* 1909;23: 236-47.
2. Ogilvie CM, Forster RE, Blakemore WS, Morton JW. A standardized breath holding technique for the clinical measurement of the diffusing capacity of the lung for carbon monoxide. *The Journal of clinical investigation.* 1957;36(1):1-7.
3. Krogh M. 1915. The diffusion of gases through the lungs of man. *J. Physiol. Lond.* 1915; 49:271-96.
4. Saydain G, Beck KC, Decker PA, Cowl CT, Scanlon PD. Clinical significance of elevated diffusing capacity. *Chest.* 2004;125(2):446-52.