Contents lists available at ScienceDirect

Respiratory Investigation

journal homepage: www.elsevier.com/locate/resinv

Review

Office-based DLCO tests help pulmonologists to make important clinical decisions ☆

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ARTICLE INFO

Article history:
Received 5 November 2015
Received in revised form
31 January 2016
Accepted 18 March 2016
Available online 2 May 2016

Keywords:
DLCO
Pulmonary function
Quality control
Interpretation

ABSTRACT

Measurement of diffusing capacity of the lungs for carbon monoxide (DLCO), also known as transfer factor, is the second most important pulmonary function test (PFT), after spirometry. Previously available only in hospital-based PFT labs, DLCO testing is now available at outpatient clinics using a portable device. Compared to spirometry tests, assessments with these devices require very little effort. The patient breathes quietly, inhales the test gas, holds the breath for ten seconds, and then exhales. In adult smokers with post-bronchodilator airway obstruction, a low DLCO greatly increases the probability of the emphysema phenotype of COPD due to cigarette smoking, while a normal DLCO makes chronic asthma more likely. In patients with spirometric restriction (a low FVC with a normal FEV1/FVC), a low DLCO increases the pre-test probability of an interstitial lung disease (ILD), while a normal DLCO makes a chest wall type of restriction more likely. A normal TLC (VA from the single-breath helium dilution provided by a DLCO test) rules out restriction of lung volumes without the need for a body box measurement. In patients with dyspnea of unknown cause, the pattern of a low DLCO with normal spirometry increases the likelihood of pulmonary vascular disease, but this pattern also occurs with several other diseases such as a mild ILD. Once a diagnosis is made, the percent predicted DLCO provides an objective index of disease severity and prognosis. A DLCO below 40% predicted, or a decline in DLCO of more than 4 units, is associated with increased morbidity and mortality.

Contents

☆A mini-review invited by Toshihiro Nukiwa, Editor in Chief of Respiratory Investigation, based on evening seminar number 17 delivered at the Japanese Respiratory Society meeting on April 18, 2015 with the following title: Re-evaluation of the clinical value of enhanced DLCO testing, with innovation of methods, quality, and interpretation.

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http://dx.doi.org/10.1016/j.resinv.2016.03.006
2212-5345/

1. Introduction

This manuscript was written for pulmonary sub-specialists who order PFTs to be performed in a hospital-based PFT lab or in their outpatient office or clinic. PFT results should not be used in isolation to "make" a diagnosis. The results must be added to other information known about the patient, which determine the pre-test probability of each disease under consideration. For example, the PFT results may increase or decrease the pre-test probability of asthma or a COPD phenotype, and in some cases (such as borderline abnormalities), the PFT results may not change the pre-test probability at all.

Clinical indications for a DLCO test include the following: differential diagnosis of patients with dyspnea on exertion and post-BD obstruction seen by spirometry; spirometric restriction (low FVC but normal FEV1/FVC); screening to detect early ILD, pulmonary vascular disease (PVD), occupational lung disease, radiation therapy to the chest, or pulmonary side effects of drugs; determination of the severity of pulmonary diseases; disability evaluations and objective measurements of the treatment efficacy for ILD or PVD during follow-up examinations.

The results of DLCO tests can be used for the following three types of medical situations: (1) assisting in the detection and differential diagnosis of lung disease in patients who are at an increased risk or have respiratory symptoms, (2) helping to determine the severity of a lung disease (degree of impairment and risk of morbidity and mortality), and (3) during follow-up, helping to determine if the previously diagnosed disease has progressed or has responded to treatment.

DLCO tests require very little effort compared to spirometry tests. The patient breathes quietly for a minute, inhales the test gas, holds the breath for ten seconds, and then exhales (an unforced exhalation). After four minutes, the maneuver is repeated with the goal of matching DLCOs from two acceptable tests within 2 ml/min/mmHg (English DLCO units), otherwise a third test is done [1,2]. SI units for the uptake of carbon monoxide are one-third of English units. For easier reading throughout this paper, we use the term units instead of ml/min/mmHg.

Office-based DLCO instruments are new. See ⟨www.ndd.ch⟩ for an example (the EasyOne Pro from Switzerland). The major advantage of having a DLCO instrument available for testing in the outpatient office (compared to ordering the test from a hospital-based PFT laboratory) is that the results are available in less than 20 min. The differential diagnosis and treatment of patients with dyspnea on exertion may be initiated confidently and quickly instead of waiting weeks for results. For patients who have begun a treatment plan for an interstitial lung disease, decisions to modify expensive treatments (or those with potentially serious side-effects) can be made quickly.

We will now demonstrate the clinical value of adding a DLCO test to spirometry with several fictional cases (presented roughly in order of their clinical frequency).

2. DLCO differentiates asthma from COPD in adult smokers with dyspnea and airway obstruction

Barbara Black is a 65-year-old real estate agent referred to you by a primary care physician who plays golf with the patient. Barbara's physician found severe airway obstruction (FEV1 = 1.3 l) using an office spirometer. Her dyspnea began several years ago and also occurs when she climbs stairs. The patient is overweight and has a history of frequent respiratory problems as a child. She has been a smoker since age 25 and has tried to quit twice; she takes no medications. Her physical exam reveals obesity, yellow fingernails, frequent coughing, a prolonged expiratory time but no stridor, some rhonchi and wheezing, and 1+ankle edema. Her chest X-ray shows clear lung fields but a flat diaphragm. The repeat spirometry reveals the following: FEV1/FVC 0.52; FEV1 35% predicted, improved by 12% ten minutes after administration of salbutamol.

Both COPD and asthma are probable causes for her dyspnea and "fixed" airway obstruction, but since the initial treatment and prognosis differ, you ask your nurse to perform a DLCO test in your office using a new portable instrument. The results are available in 15 min, showing a DLCO of 96% predicted (quality grade A) and an alveolar volume (VA or TLC-SB) of 88% predicted. You are pleased to have found another "hidden asthmatic," and so you prescribe a high daily dose of an inhaled corticosteroid with a long-acting bronchodilator (ICS+LABA) and ten days of prednisone. You ask your nurse to teach the patient how to use the inhaler, give the patient advice about modern smoking cessation methods and how to minimize her exposure to indoor allergens, smoke, and fumes. You order a B-natriuretic protein (BNP) test to rule out heart failure and a HRCT of her lungs since she has an increased risk for lung cancer.

Two weeks later, you see Mr. Yonehiro, a 65-year-old banker with a nearly identical history, chest X-ray, physical exam, and spirometry results. However, his DLCO was 45% predicted and TLC-SB was 75% predicted, and he did not have anemia to explain the low DLCO. Since Mr. Yonehiro is an older cigarette smoker with severe airway obstruction and a low DLCO, you diagnosed his condition as the emphysema phenotype of COPD. Please see the right side of the