Interpreting Spirometry: The Basics

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KEYWORDS

- Spirometry • Airway • Asthma • Asthma diagnosis
- Objective monitoring of asthma therapy

KEY POINTS

- Spirometry is useful in detecting and monitoring airway disease in patients with symptoms, risk factors or suspicion of airway disease.
- Spirometry should accurately measure forced expiratory volume in 1 second, forced vital capacity, or forced expiratory volume in 6 seconds, and it should be reported both as the absolute measurement and as a percentage of normative data.
- Spirometry should be used to diagnose disease as well as monitor response to therapy and progression of disease over time.
- The contour of the flow-volume loop provides additional information with regard to the location of obstruction.
- Most patients with the suspicion of, or being treated for, asthma should have a baseline spirometry test.

INTRODUCTION

The classic signs and symptoms of asthma, which include intermittent dyspnea, cough, and wheezing, are often nonspecific, making it difficult to distinguish asthma from other respiratory diseases. The intermittent nature of the disease also makes it difficult for both patient and clinician to monitor the efficacy of therapy. Tests of airflow limitation are critical tools in the diagnosis and monitoring of asthma. Office spirometry is the most frequently used basic tool used to detect, confirm, and monitor obstructive airway disease (eg, asthma, chronic obstructive pulmonary disease [COPD]).[1,2] Spirometry plays an essential role in the management of patients with, or at risk for, respiratory dysfunction. Spirometry, in which a maximal inhalation is followed by a rapid and forceful complete exhalation into a spirometer, includes measurement of forced expiratory volume in the first second of expiration (FEV_1), forced vital capacity (FVC), and the relation of these two numbers (FEV_1/FVC) and the representation of the effort graphically as a flow-volume loop and volume-time graph. These measurements provide information that is essential to the diagnosis and management of asthma.[3]

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This article discusses the use of spirometry in the office setting and discusses the primary measurements obtained and techniques used to obtain an accurate test. Issues related to equipment, performance of the forced expiratory maneuver, and interpretation of the data to obtain reliable and clinically useful information are discussed.[4–6] Examples of normal spirometric data as well as spirometric data from disease states are briefly reviewed.

INDICATIONS: WHO SHOULD BE TESTED?

Spirometry is an invaluable tool as a screening test of general respiratory health in the same way that blood pressure monitoring provides important information about the general health of the cardiovascular system.[7] Data from spirometry are also important to help convince patients with asthma to be more attentive to their disease, particularly those patients with mild intermittent asthma, who often have accommodated to their disease by modifying their lifestyles and avoiding situations that might provoke symptoms. Spirometry lends objectivity to subjective symptoms, is used to determine control in treated patients, and can be a tool to convince patients to be more compliant. It is a simple validated tool, with the ability to be used in nearly any setting.

SPIROMETRY MEASUREMENTS

Spirometry records the forced airflow from fully inflated lungs. Spirometry includes measurement of the FVC, the amount of air exhaled from the lungs from a maximal inhalation to a maximal exhalation, and the FEV_1. Both FEV_1 (airflow) and FVC (air volume) can be compromised by airway narrowing, inflammatory and bronchospastic factors, and mucus plugging, which can obstruct or occlude some of the small (or even larger) airways. These values are typically reported in 2 ways: as a volume measurement (milliliters or liters of air), or as a percentage of the predicted normative or expected value for that patient's age, height, gender, and race from data obtained in the National Health and Nutrition Examination Survey III (NHANES III).[8]

The FEV_1 is the most important spirometric measurement for assessment of the severity of airflow obstruction. The highest FEV_1 from the 3 acceptable forced expiratory maneuvers is used for interpretation, even if it does not come from the maneuver with the highest FVC.[7]

In patients with asthma, the FEV_1 declines are in direct and linear proportion with clinical worsening of airway obstruction. FEV_1 has been shown to increase with successful treatment of airway obstruction. The FEV_1 should be used to determine the degree of obstruction (mild, moderate, or severe) and for serial comparisons when following patients with asthma.[3] The measured FEV_1 is usually expressed as a percentage of the predicted value for determination of normality. The reference values from the NHANES III study (recently expanded to preschool children) are recommended for use throughout North America.[9,10] The lower limit of normal FEV_1 is more accurately defined by the fifth percentile of healthy never-smokers, instead of the traditional 80% of predicted.[11]

The FVC (also known as the forced expiratory volume) is the maximal volume of air exhaled with a maximally forced effort from a position of full inspiration and is expressed in liters. The highest FVC from the 3 acceptable forced expiratory maneuvers is used for interpretation.[8]

The FVC may be reduced by suboptimal patient effort, airflow limitation, restriction (eg, from lung parenchymal, pleural, or thoracic cage disease), or a combination of these. In general, a moderately or severely low FVC needs further evaluation with a more complete battery of pulmonary function tests.[12]