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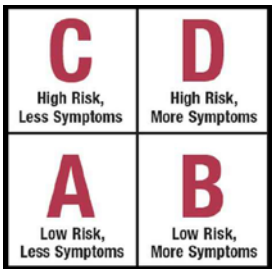
White Paper

Bernard Garbe, Vitalograph

Work Related Respiratory Disease: Tools for Differentiating Asthma from COPD



Introduction

With the 2016 update of GOLD adding an Appendix on Asthma COPD Overlap Syndrome, prepared jointly by the GOLD and GINA Science Committees, it is timely to discuss this topic.

In workers with asthma or chronic obstructive pulmonary disease (COPD) it is often difficult to establish whether the cause is related to their workplace or not, however it is known that the commonest cause of COPD is smoking, followed by workplace exposure. Similarly, asthma is the commonest occupational lung disease in developed countries and tends to occur in groups of workers associated with a particular trade or profession. Coal miners, bakers, nurses, animal handlers, garage workers and timber processors are amongst those at highest risk. The most common causes are dusts, chemical fumes, flour, grain, colophony, fluxes, latex, animal dander and aldehydes, although cases can occur almost anywhere.

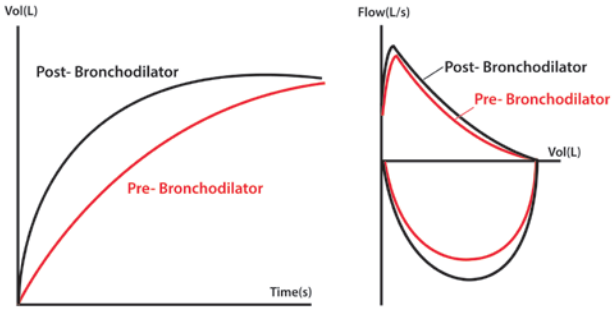
Many features of COPD and asthma overlap often making the differentiation between them difficult. A test subject survey by the British Lung Foundation (BLF) showed that nearly 39% of COPD test subjects had been told they also have asthma, highlighting the difficulty of correct diagnosis.

Detection and Diagnostic Tools

The primary tool for differentiating COPD from asthma is reversibility of airways obstruction. Asthma and COPD are both common obstructive lung diseases and, despite sharing some key symptoms, are distinct in pathogenesis. Asthma is characterized by reversible airway obstruction on bronchial challenge or more commonly by measuring the effect of a short-acting bronchodilator, when the subject is suffering with shortness of breath.

Measuring forced expiratory volume in one second (FEV1) compared to the vital capacity (VC) post-bronchodilator is one of the first elements in diagnosing COPD, on the basis of measuring a post-bronchodilator FEV1/VC of less than 0.7 (a ratio is unitless). VC measurement is often taken as the forced VC (FVC) or FEV in 6s (FEV6), both are useful surrogates depending on the available equipment and time to the occupational health professional.

Measuring and comparing the FEV1 before and after a bronchodilator has been administered and allowed time to take full effect (typically 20 minutes) will clearly show the degree of reversibility. This is usually taken as significant at 12% or more, which indicates that bronchoconstriction has been demonstrably alleviated. However, persistent asthma in some cases can be associated with partially reversible airway obstruction, less than 15%, which can make differential diagnosis difficult.



When partially reversible airway obstruction is present a rigorous medical history, physical examination, questionnaire-based tools and the use of supplementary techniques, such as the analysis of spirometry curves or the diffusing capacity of the lungs can help to distinguish between asthma and COPD.

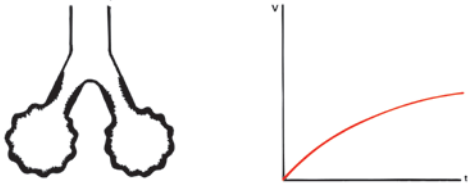
The measurement of forced expiratory volume in 1 second (FEV1) with a handheld respiratory monitor is an alternative to conventional spirometry for the routine monitoring of lung function. These devices have acceptable accuracy, and are portable and easy to use. Additionally, emerging tools, such as forced exhaled nitric oxide (FENO) are available and can be used in the diagnosis of asthma and differentiation between asthma and COPD.

Other tools can also help facilitate the monitoring of disease progression such as blood gas tensions (SpO2), airway challenge testing, shuttle walking tests, exercise tolerance, sputum or condensate analysis, questionnaires such as the St George's Respiratory Questionnaire (SGRQ), Chronic Respiratory Questionnaire (CRQ), Asthma Control Test (ACT), and the Clinical COPD Questionnaire, and Medical Research Council (MRC) dyspnoea scale, perceived breathlessness (BORG) scores and health status measurements.

Defining Asthma and COPD

Differentiating between COPD and asthma requires a history of both symptoms and spirometry. The spirometry history should include post bronchodilator measurements, the degree of reversibility and, for advanced home and workplace study methods, home monitoring which can give a detailed history of diurnal variation.

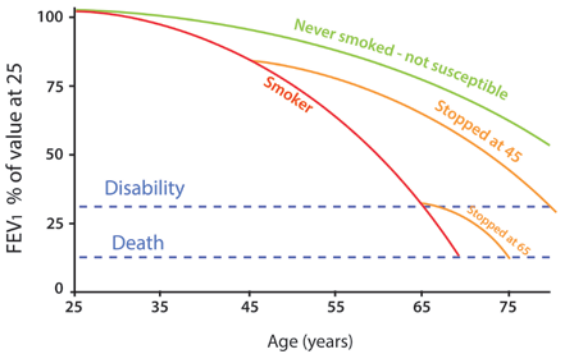
Airflow Obstruction: Both asthma and COPD are characterised by airflow obstruction. Airflow obstruction is defined as a FEV1/VC ratio less than 0.7 and FEV1 less than lower limit of normality (LLN). Previously 80% of the predicted FEV1 was used, which may be comparable in workers under 40 years but gives false positive errors over that age.



Asthma: Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation is associated with airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment.

Spirometry, in combination with medical history and physical examination, is essential to establish the diagnosis of asthma. Spirometry must establish reversible obstructive airflow defined as an increase in FEV1 of ≥12% and ≥200 mL after the administration of a bronchodilator. The Global Initiative for Asthma (GINA) guidelines advises that most asthma test subjects will not demonstrate reversibility at every assessment, repeat tests, therefore, are recommended. Importantly for the differential diagnosis of asthma and COPD it should be noted that persistent non-fully reversible airway obstruction, the classic hallmark of COPD, can also occur in test subjects with long-standing asthma.

COPD: COPD is a chronic, slowly progressive disorder characterised by airflow obstruction (reduced FEV1 and FEV1/VC ratio) that does not change markedly over several months. The airflow obstruction is not fully reversible. Diagnosis of COPD relies on the clinical presentation of the test subject, a detailed review of the test subject's medical history, and spirometry. Key indicators include progressive dyspnoea, chronic cough, chronic sputum production, and exposure to risk factors for the disease, smoking in particular. Diagnosing COPD can be complicated by the presence of comorbidities, especially age-related conditions such as congestive heart failure and cardiac arrhythmia that can mimic COPD exacerbations.



Accurate Spirometry is Essential

An accurate diagnosis requires accurate spirometry. All spirometry guidelines emphasise the importance of coaching the test subject during a forced expiratory test measuring FVC. This includes aspects such as ensuring a complete inhalation before beginning the test, enthusiastically and energetically encouraging the subject to "blast," not just "blow," the air from their lungs and encouraging them to fully exhale by squeezing all the air from their lungs. A summary of the acceptability of each blow and repeatability criteria for the session is provided below.

Acceptable FVC test criteria

Individual blows are "acceptable" if:

- They are free from artefacts, i.e.
  - No cough during the first second of exhalation
  - No glottis closure that influences the measurement
- There is no early termination or cut off from a smooth volume/time curve

- Show effort that is not maximal throughout
- Have no obstructed mouthpiece (tongue obstruction is common if the subject does not bite the mouthpiece)
- The blows have good starts, i.e.
    - Extrapolated volume (Vext) is less than 5% of VC
    - Vext is less than 0.15 L
- They show satisfactory exhalation
    - Duration of ≥6 s (3 s for children) or
    - a plateau (<0.25L in a second) in the volume–time curve or
    - if the subject cannot or should not continue to exhale

A spirometry session is completed when:

- 3 acceptable spirograms have been obtained
- The 2 largest values of FVC are within 0.15 L of each other
- The 2 largest values of FEV1 are within 0.15 L of each other

If these criteria are not met, continue testing until both of the criteria are met or the subject cannot or should not continue, a guideline of max. 8 blows is suggested.

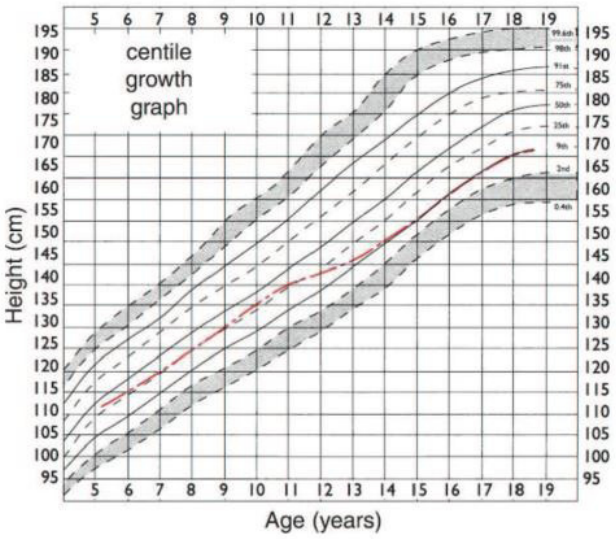
Performing Spirometry

Confirm or Preclude COPD or Asthma using Spirometry

Spirometry	COPD	Asthma
VC	Reduced	Nearly Normal
FEV1	Reduced	Reduced in attack
FVC (or FEV6)	Reduced	Nearly Normal
FEV1 Ratio (of VC/FVC/FEV6)	Reduced anytime	Reduced in attack
FEV1 compared to 'predicted'	< LLN	Reduced in attack
Bronchodilator reversibility	A little	Marked if in attack
Serial spirometry	Progressive deterioration	Constant or erratic
Home monitoring	Use for alerts	Use for variability
Peak Flow measurement	Not useful	As above
Peak Inspiratory Flow measurement	Not useful	Not useful
DLCO	Normal	Reduced
SpO2	Normal between exacerbations	Permanently reduced
Airway challenge testing	Normal	May be significant
FENO	Normal or low	Elevated if eosino-philic inflammation
Sputum or condensate analysis	Not useful	Not useful

Serial Spirometry

The most important objective measurement of all in lung disease management is serial spirometry. Taking a single lung function measurement may or may not yield useful information, however, comparing that spirometry test data, particularly the FEV1, with data from the previous few years yields invaluable information. But comparing that spirometry test data, particularly the FEV1, with data from the previous few years yields invaluable, yet simple, information.



As a normal growing child it is fairly obvious that the lung function values will rise according to the individual's growth centiles. After achieving adulthood, and a period of a few years without change in values, every normal person will have a gradual decline lung function. In disease this pattern may radically change. In older people, the rate of decline of a COPD sufferer can be two or three times the FEV1 decline in normal people. Medical intervention can bring this back to a normal rate of decline but not back to the level of a normal person. For this reason early detection is crucial. It is very possible to detect this accelerated rate of decline, even when the test subject is in 'normal range'. An accelerated rate of decline detected by serial spirometry is definitely abnormal, no matter if the test subject still has 'good' lung function values.

Serial spirometry is impossible without spirometry quality control. Without consistently accurate measurements the serial data will be useless, or worse, misleading. Although serial spirometry can help identify device or procedural problems this is shutting the door after the horse has bolted, the real answer is training and quality control.

Spirometry Quality Control

An accuracy check is a two minute check that you do just before starting your asthma or COPD clinic and is as simple as setting the device to 'accuracy check' mode (for ATPS measurement) then pumping the 3-L syringe. If all is well the device will measure 3L ±3%. It is important not to confuse 'calibration' with an accuracy check. Calibration is an annual certification of traceability to international measurement standards which may or may not involve adjustment prior to certification.

Training

None of the above can be achieved without proper training. There are a number of excellent professional training facilities in the UK, and Vitalograph also run one-day spirometry training courses.

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The Medical Research Council (MRC) dyspnoea Scale has been in use for many years for grading the effect of breathlessness on daily activities. This scale actually measures perceived respiratory disability, the WHO definition of disability being "any restriction or lack of ability to perform an activity in the manner or within the range considered normal for a human being". Fletcher CM (Chairman).