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Obstructive airways disease is common in the UK. Asthma and chronic obstructive pulmonary disease share many features but have different treatment aims and outcomes. Rachel Booker explains why reversibility testing with bronchodilators and corticosteroids is fundamental to the diagnosis of these conditions. Accurate diagnosis is essential if patients are to receive appropriate treatment and management.

**KEY WORDS**
- Asthma
- Chronic obstructive pulmonary disease
- Reversibility

### Testing for reversibility in patients with obstructive airways disease

Asthma and chronic obstructive pulmonary disease (COPD) have many similarities and can occur together in the same patient. Both cause coughing, wheezing and shortness of breath. The major difference between the two is that airflow obstruction is largely reversible in asthma, but in COPD it is largely irreversible.

Although they have many similarities, the focus of treatment for these two diseases and the outcomes that can be expected are different.

In asthma the aims of treatment are:

- Minimal symptoms;
- No exacerbations of the disease;
- No limitation on physical activity;

COPD is a slowly progressive disease, and the aims of its treatment are different from those of asthma:

- Best control of symptoms;
- Prevention of deterioration;
- Prevention of complications;
- Improved quality of life (BTS, 1997).

#### Diagnosis
The best method for diagnosis of asthma and COPD is spirometry. The most important parameters of lung function measured with a spirometer are:

- Forced expired volume in one second (FEV₁) – the volume exhaled in the first second of a forced exhalation from a position of maximum inhalation;
- Forced vital capacity (FVC) – the total volume exhaled forcibly from maximum inhalation to maximum exhalation;
- Ratio of FEV₁ to FVC (FEV₁/FVC or FEV₁%) – the FEV₁ expressed as a percentage of FVC. This is an indicator of airflow obstruction.

In a healthy person, the volume of FEV₁ and FVC should be more than 80 per cent of the predicted value for a person of that age, sex, height and ethnicity.

A healthy person should be able to exhale about 75 per cent of his or her FVC in the first second of a forced exhalation – in other words, the FEV₁/FVC ratio should be about 75 per cent. An FEV₁/FVC ratio which is less than 70 per cent is an indication of airflow obstruction.

FVC should be reached in less than six seconds. In patients who have airflow obstruction, it takes longer to empty the lungs. Some patients with severe airflow obstruction may take more than 12 seconds to reach FVC (Table 1).

When spirometry shows an obstructive pattern, it is important to establish whether the obstruction is reversible. Asthma is defined as ‘a chronic inflammatory disorder of the airways in susceptible individuals.

Inflammatory symptoms are usually associated with widespread but variable airflow obstruction and an increase in airway response to a variety of stimuli. Obstruction is often reversible, either spontaneously or with treatment’ (National Heart, Lung and Blood Institute, and National Institutes of Health, 1992).

In contrast, COPD is defined as ‘a disease state characterised by airflow limitation that is not fully reversible. The airflow obstruction is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases’ (Global Initiative for Chronic Obstructive Lung Disease (GOLD), 2001).

In order to establish the diagnosis, reversibility should be tested with both short-acting bronchodilators and, when the FEV₁ is less than 60 per cent of the predicted value, with corticosteroids.

Response to bronchodilators and corticosteroids in both asthma and COPD is altered during and immediately after an exacerbation of the disease. It is therefore vital that diagnostic reversibility tests are carried out when the patient is clinically stable.

#### Bronchodilator reversibility
Short-acting β₂ agonist bronchodilators, such as salbutamol and terbutaline, are often used to test reversibility (Table 2). If COPD is suspected from the patient’s history, it may also be helpful to assess reversibility to a short-acting anticholinergic bronchodilator, such as ipratropium.

Increased cholinergic tone is thought to be an important component of airflow obstruction in COPD, and some patients may respond better to an anticholinergic than to a β₂ agonist bronchodilator.

Testing should take place on separate occasions. However, when time is short or patients are unable to attend repeatedly, testing with a combination of both anticholinergic and β₂ agonist will ensure that any reversibility present is not missed.

Bronchodilator response in COPD is limited and it is recommended that higher doses of bronchodilators than those usually prescribed are administered. This will

### Table 1. Normal and abnormal parameters of lung function

<table>
<thead>
<tr>
<th></th>
<th>Normal lung function</th>
<th>Airflow obstruction</th>
<th>Airflow restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV₁</td>
<td>&gt; 80% of predicted</td>
<td>Reduced</td>
<td>Reduced</td>
</tr>
<tr>
<td>FVC</td>
<td>&gt; 80% of predicted</td>
<td>&gt; 80% of predicted</td>
<td>Reduced</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>About 75%</td>
<td>&lt; 70%</td>
<td>Normal or high</td>
</tr>
</tbody>
</table>

Note: In severe airflow obstruction the FVC may also be reduced due to air trapping.
ensure that any reversibility present is not missed (GOLD, 2001).

The easiest way to ensure that the maximum dose is delivered to the airways is to use a nebuliser. However, a more cost-effective option may be to take multiple puffs from a pressurised metered dose inhaler (taking one puff at a time) through a holding chamber (spacer).

A positive response to bronchodilators is an increase in FEV₁ from baseline that is more than 200ml and more than 15 per cent of the prebronchodilator value.

The FEV₁ can vary by as much as 178ml from day to day in the same individual (Sourk and Nugent, 1983) and many patients with COPD have very low starting values, so it is important to consider both the percentage improvement and the absolute improvement in FEV₁.

The percentage improvement in FEV₁ can be calculated as follows:

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\text{Percentage improvement in FEV}_1 = \frac{\text{Postbronchodilator FEV}_1 - \text{Prebronchodilator FEV}_1}{\text{Prebronchodilator FEV}_1} \times 100
\]

TABLE 2. BRONCHODILATOR REVERSIBILITY TESTING

<table>
<thead>
<tr>
<th>Beta₂ agonist bronchodilator</th>
<th>Anticholinergic bronchodilator</th>
<th>Combination of beta₂ agonist and anticholinergic bronchodilator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure FEV₁</td>
<td>Measure FEV₁</td>
<td>Measure FEV₁</td>
</tr>
<tr>
<td>Give: 2.5–5mg salbutamol (5–10mg terbutaline) via nebuliser</td>
<td>Give: 250–500µg ipratropium via nebuliser</td>
<td>Give: 2.5–5mg salbutamol and 250–500µg ipratropium via nebuliser</td>
</tr>
<tr>
<td>OR 4 puffs salbutamol via holding chamber</td>
<td>OR 4 puffs ipratropium via holding chamber</td>
<td>OR 4 puffs of salbutamol + 4 puffs ipratropium via holding chamber</td>
</tr>
<tr>
<td>Re-measure FEV₁ after 15–30 minutes</td>
<td>Re-measure FEV₁ after 30–45 minutes</td>
<td>Re-measure FEV₁ after 30–45 minutes</td>
</tr>
</tbody>
</table>

asthma. When the history is also suggestive of asthma (for example, variable symptoms, or positive family or personal history of atopy), a positive bronchodilator reversibility test may be enough to confirm the diagnosis and to justify the commencement of long-term inhaled corticosteroids.

However, in older patients, particularly those with a significant smoking history, the bronchodilator response may be marginal and the history less cut. In such cases, a corticosteroid reversibility test may help to clarify the diagnosis of asthma or COPD. The test may also indicate which patients with COPD have a significant asthma element to their disease and are likely to benefit from long-term inhaled corticosteroids.

The current guidelines on COPD (BTS, 1997) recommend testing corticosteroid response in all patients who present with an FEV₁ of less than 60 per cent of the predicted value (moderate disease), and in those with a positive bronchodilator reversibility test. Again, it is vital that the test is done during a period of clinical stability.

Corticosteroid response can be tested using a two-week course of 30–40mg oral prednisolone a day, taken as a single dose in the morning. The dose does not need to be tapered at the end of the course – treatment can be stopped abruptly, except where repeated short courses have been prescribed recently or the patient is already taking maintenance oral steroids for another condition.

Insomnia, hyperactivity, mood changes and increased appetite can all occur during treatment but will generally subside once treatment is stopped. Short courses of oral corticosteroids are generally safe and free from long-term, serious side-effects, but in some patients, particularly older patients, caution may need to be exercised.
Such patients include those with diabetes, osteoporosis, unstable hypertension, active peptic ulceration or dormant tuberculosis.

An alternative method of testing corticosteroid response is to give inhaled corticosteroid (for example, 500µg beclometasone twice daily) for six to 12 weeks. This has the advantage of being safer and may also be a more reliable method. However, its disadvantages are that patients need to be taught how to use an inhaler, they will need to adhere to treatment over an extended period, and the treatment is far more expensive.

Whichever method is used, the FEV1 should be measured after giving an adequate dose of bronchodilator both at the beginning and at the end of the trial. That is, the postbronchodilator FEV1 at the start of the corticosteroid trial is compared with the postbronchodilator FEV1 at the end of the trial. This enables corticosteroid response to be measured in addition to the bronchodilator response (GOLD, 2001).

A positive response is an increase in the postbronchodilator FEV1 that is more than 15 per cent of the pretrial value and more than 200ml. Again, an FEV1 that improves to more than 80 per cent of predicted value with a corticosteroid trial is incompatible with a diagnosis of COPD.

Peak expiratory flow (PEF) Spirometry is the method of choice for assessing reversibility, but spirometers are not universally available – particularly in primary care – and accurate spirometry depends on the operator being trained and proficient in their use.

Peak expiratory flow is cheaper and easier, but is less reliable than spirometry for diagnosing COPD. Its main use is for monitoring and diagnosing asthma. An improvement in PEF of more than 20 per cent and 60ml from baseline is considered a positive response to both bronchodilators and corticosteroids (BTS and SIGN, 2003). However, where COPD is suspected, the patient should be referred for spirometry if it is not available locally.

Conclusion The first step in getting disease management right is to make an accurate diagnosis. Testing for reversibility of airflow obstruction is a vital part of the diagnostic process. It enables the correct diagnostic label to be applied, and should lead to appropriate treatment and management of the patient’s condition.


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For more information, see the National Respiratory Training Centre website at www.nrtc.org.uk

Nutrition information leaflet for respiratory patients A nutrition information leaflet specifically for patients with respiratory illness has been devised by the respiratory team at James Paget Hospital NHS Trust, Norfolk. The leaflet aims to help people to establish healthy eating habits, and deals with the issues facing people who are under or overweight.

Spirometry workshops The National Respiratory Training Centre is offering a regular one-day spirometry workshop. This provides basic, up-to-date information on the equipment available, and helps participants to develop the practical skills necessary to ensure that quality results are obtained. The workshop includes informal lectures and interactive practical sessions in spirometry use, and basic interpretation of results. It is suitable for any health care professional who is involved in taking spirometry measurements.

Launch of allergen control guidelines A flow chart, ‘Guidelines for the Effective Management of House Dust Mites’, has been produced for use in patient consultations. The guidelines are sponsored by Omni Nutraceuticals. For a copy, tel: 01923 777277 or e-mail: emma@hsdcommunications.com

For more information, see the National Respiratory Training Centre website at www.nrtc.org.uk

also says that maintaining an ideal weight has a beneficial effect on the respiratory and immune systems. Osteoporosis is common in patients with advanced COPD, so calcium supplements should be offered to all patients with COPD who have proven osteoporosis. The authors suggest that hypophosphataemia, also common in COPD, should be corrected as this improves contractility of respiratory muscles and the diaphragm.