

Guide to Chronic Obstructive Pulmonary Disease (COPD) assessments

What is COPD?

Chronic obstructive pulmonary disease (COPD) is an umbrella term for a group of disorders, which are progressive, long term and characterised by difficulty in breathing. This is due to airflow obstruction, which is progressive, not fully reversible and does not change markedly over several months.

COPD is the term encompassing chronic bronchitis and emphysema. In most people, there is considerable overlap in the two conditions although each condition may exist by itself. COPD does not include other obstructive lung diseases such as asthma.

COPD develops gradually over many years and usually is symptomatic, from middle age, (commonly the 5th decade) onwards, when the diagnosis is usually made. While it is present in 18% of male smokers in the UK, it is present in 14% of female smokers and is a significant reason for hospital admissions and lost working days.

It is one of the greatest causes of death in the world, being the 4th leading cause of death in the USA, was 4th in the year 2000 global mortality table and is currently rated 6th leading cause of death in the UK.

"Fifty percent of patients with severe breathlessness due to COPD die within 5 years."

"At least 25,000 people die each year in the UK from the end stages of COPD."

"A recent American Lung Association survey revealed that 51% of all COPD patients say that their condition limits their ability to work. 70% are limited in normal physical exertion, 56% in household chores, 53% in social activities, 50% in sleeping and 46% in family activities."

The statistics are gradually changing as smoking is decreasing in wealthy countries and increasing in poorer countries and as more women are smoking and at an early age.

There are two separate processes occurring; the process involved in chronic bronchitis and that involved in emphysema.

What is Chronic Bronchitis?

Chronic bronchitis is defined clinically as "a cough productive of sputum on most days, for at least three months of each year, in more than one consecutive year".

It is characterised by a persistent inflammation of the bronchial walls with oedema of the lining and an increased production of mucus, causing cough and sputum most of the time. This tends to "clog up" the airways, and the process can lead to the eventual scarring of the lining of the bronchial tubes, and resultant airways narrowing. In advanced disease, the bronchi and bronchioles are infected with pus and inflammation leading to narrowing of both sets of airways. Early in the disease, the inflammation of the small airways is reversible if smoking is stopped early.

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What is Emphysema?

Emphysema is a lung condition in which the small air sacs (or air spaces) in the lungs are affected.

The primary function of the lungs is to exchange gas, between air and the bloodstream, and this is done in the 300 million thin-walled, distensible sacs (alveoli) in the lungs. From the trachea to the alveoli are many divisions of air passages that get smaller and smaller, (the bronchi and bronchioles) and it is only the final centimetre (in the respiratory bronchioles, alveolar ducts and alveoli) that oxygen is passed into the blood, and carbon dioxide is passed out.

Emphysema is defined (histo-pathologically), as the irreversible dilatation of air spaces, caused by destruction of their walls.

It is caused by loss of elasticity of the lung tissue, both of the airways and the alveoli and the walls between many of the air sacs are gradually destroyed. This results in permanent "holes" in the lung tissue. Because the structure of the tiny airways is lost, the ability of the lungs to get rid of CO₂ and absorb O₂ efficiently is lost. Thus, less O₂ is able to get into the blood, and to vital organs, and less CO₂ can be got rid of, causing a rise in blood levels of the latter.

Also, the small airways collapse, during expiration instead of remaining open, thus causing air to be trapped in the lungs. This is because the natural elasticity of the lungs [which enables the airways to stay open] is reduced, and because there is destruction of the alveolar wall attachments, which normally hold the walls of the small airways open.

The lungs become over inflated because of this difficulty in breathing out, and this is obvious in emphysema sufferers, in an increased diameter of the chest antero-posteriorly relative to the lateral diameter.

A bulla is a locally over-distended area of emphysema. It is a thin-walled airspace caused by alveolar wall rupture. They may be any size, and may exist alone or in a collection. Rupture of a bulla may cause a pneumothorax.

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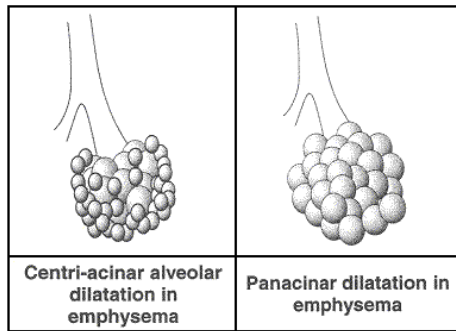
Types of Emphysema

There are two main types of emphysema:

- Centriacinar (centrilobular) where the damage mainly occurs around the respiratory bronchioles; affecting the upper parts of the lungs occurring in coal-miners and smokers.
- Panacinar (panlobular) where tissue loss and damage occurs throughout the acinus particularly affecting the lower half of the lungs. It may occur with ageing to a mild degree and the severe form is associated with alpha1- antitrypsin deficiency.

Other types of Emphysema:

- Paraseptal, where bullae occur on the lung edges, rupture of these could cause a pneumothorax.
- Irregular e.g. related to scarring, such as with tuberculosis.



What is the difference between Asthma and COPD?

Asthma is reversible

The mechanism, which causes asthma, is inflammation and constriction of the muscles around the airways. The symptoms "come and go" and treatment usually works well, reversing the effects of the irritation. However, asthma often progresses into COPD. There are usually daily variations in peak flow readings and a good response to bronchodilators. However, chronic asthma may progress to COPD.

COPD is poorly reversible or irreversible

COPD sufferers have a chronic cough with sputum, and the disease is slowly progressive. They are usually diagnosed in middle age and have a smoking history. Many patients with COPD show some response to bronchodilators but not to the extent that asthmatics do. However, bronchodilators in the form of inhalers or through a nebulizer may help with symptoms to some degree. This is because the narrowing of the airways in COPD is "fixed", and the symptoms are persistent (chronic). Also, because the condition is chronic and not very variable, peak flow testing over the course of a week will show little variation.

Table 3 Clinical features differentiating COPD and asthma

	COPD	Asthma
Smoker or ex-smoker	Nearly all	Possibly
Symptoms under age 35	Rare	Often
Chronic productive cough	Common	Uncommon
Breathlessness	Persistent and progressive	Variable
Night time waking with breathlessness and/or wheeze	Uncommon	Common
Significant diurnal or day-to-day variability of symptoms	Uncommon	Common

Clinical features in COPD

Symptoms

Initially, there may be few symptoms except for a "smoker's cough" with sputum (productive cough). The frequency of the cough and the amount of sputum steadily increases as the disease progresses. At first, the attacks of productive cough occur in the winter after colds, but eventually, with increasing severity of the disease the cough is ever-present.

With progression of the disease, breathlessness on exertion occurs with morning cough, recurrent respiratory infections and a now constant "smoker's cough". The person becomes increasingly disabled by exertional breathlessness, and eventually in severe cases may become breathless at rest. People with COPD are more susceptible to bacterial infections and breathlessness may be exacerbated by smoke, atmospheric pollutants and respiratory tract infections.

In severe cases the heart failure occurs.

Signs

In the early stages there may be no abnormal signs, but rhonchi on breathing in and breathing out may be heard, as well as crackles in the lower zones of the lungs.

In a person with severe disease, there will be the signs of breathlessness at rest, leaning forward, using extra muscles in the neck, abdomen and chest to breathe, reduced chest expansion and a hyper-inflated chest. Loss of weight is common and there may be cyanosis (blueness) and oedema (swelling) suggesting right heart failure.

The "Blue bloater" is often representative of a person with COPD

Poor respiratory drive with the following features evident:

- Relatively mild breathlessness (dyspnoea)
- Obese and plethoric (high colour)
- Oedema (swelling) and congestive heart failure
- Large volume sputum (productive cough)
- Hypoxia (low O₂) and hypercapnia (raised CO₂)
- Polycythaemia
- Sleep apnoea
- Unexpectedly well-preserved lung function
- No emphysema on X-Ray
- Poor prognosis with 70% 5-year mortality.

Clinical features of Emphysema

Symptoms

- Emphysema develops gradually over a period of years.
- People with emphysema have great difficulty in exhaling (breathing out). Symptoms such as shortness of breath (sometimes associated with wheeze) occur initially on exertion and then as the disease progresses, with little exertion and ultimately at rest. The person eventually may not be able to carry out basic activities in a normal fashion. At end-stage disease the person may be dependent on oxygen for several hours a day.
- Weight loss caused by reduced eating and interest in eating because of poor breathing ability
- Feeling of tiredness because of chronic lack of oxygen in the body. Other symptoms may be impaired memory and concentration, irritability and excessive daytime sleepiness.

Signs

A barrel-shaped chest, which is a sign of over-inflation of the lungs and trapped air in the lungs. Horizontal ribs with prominent sternal angle and increased diameter from front to back. The liver may be displaced downwards.

The "Pink Puffer" is often representative of a person with emphysema.

Respiratory drive is preserved, and the following features are evident:

- Severe breathlessness with pursed-lip breathing
- Thin, and often elderly
- Heart failure uncommon but is usually terminal
- Near normal blood gas (O₂ and CO₂) values
- Very severe airways obstruction
- Reduced gas transfer factor
- Increased total lung capacity
- Absence of cyanosis (blue lips)
- Tachypnoea (fast breathing)
- Over-inflated chest
- Reduced breath sounds especially over bullae

Investigations in COPD

Lung function tests which demonstrate:

- Increased total lung capacity
- FEV₁/ FVC Ratio usually less than 70%, an "obstructive" picture. This is demonstrated in Spirometry. The volume of air blown out in one second is divided by the total amount of air blown out, until all air is expired. This is expressed as a percentage value and a value of less than 70% indicates COPD.
- Reduced gas transfer at alveolar level

Chest x-rays/ CT Scans - These can be often normal, however an X-ray is useful in excluding other pathology (e.g. lung cancer). In moderate and severe disease there may be visible on x-ray over-inflated lungs and disorganisation of blood vessel markings with a narrow, long heart shadow and a low, flat diaphragm. There may be an abnormally increased chest diameter. Bullae (locally over-distended skin lesions usually to greater than 1 centimetre in size) may be visible.

Blood tests – There may be an increase in the count of red blood cells, which is known as "polycythaemia", as a result of low oxygenation.

Arterial blood Gases – which demonstrate mild reduction in blood oxygen levels, and normal carbon dioxide levels.

Heart Function Tests – Echocardiogram shows the function of the heart, and ECG will demonstrate changes of right heart strain or heart failure (cor pulmonale).

Additional investigations in Emphysema

Alpha- Antitrypsin levels – This is important in emphysema; though it accounts for only around 2% of emphysema it accounts for severe emphysema at a young age and early death, especially in cigarette smokers.

Forced Expiratory Volume and Forced Vital Capacity reading

Forced Expiratory Volume (FEV₁)

This is the volume of air expired into a spirometer in the first second.

In COPD, the following values are indicative of the severity of the disease:

Mild disease	Males – 2.5 litres or more
	Females – 2.0 litres or more
Moderate disease	Males – 1.5 litres to 2.49 litres
	Females – 1.0 litres to 1.99 litres
Severe disease	Males – less than 1.5 litres
	Females – less than 1.0 litre

Forced Vital Capacity (FVC)

This is the total volume of air breathed out by the person after a full inspiration (breath in) into a spirometer. This is not generally used as a diagnostic test in COPD.

The FEV1 / FVC Ratio

This is a useful diagnostic aid and is a measure of airflow limitation.

Normally, the FEV1 / FVC ratio is approximately 75%.

A value of below 70% is indicative of airflow obstruction (obstructive airways disease). This could be either asthma or COPD. The difference is that asthma is reversed when a short-acting beta agonist such as salbutamol or terbutaline are used (this is known as reversibility), whereas COPD is not reversible.

A value of between 70% and 75% is indicative of restrictive lung disease such as lung fibrosis, asbestosis etc.

Treatment / management of COPD

The following principles of treatment apply to both COPD and Emphysema:

- Stopping smoking prevents progression of the disease.
- Bronchodilators maximise lung function, and short-acting bronchodilators are used for immediate reversal.
- Inhaled steroids and beta- agonists are used to reduce exacerbations (but inhaled steroids can increase osteoporosis and pneumonia).
- Oxygen therapy reduces the risk of pulmonary hypertension and nocturnal falls in oxygen concentration.
- Pulmonary Rehabilitation increases muscle fitness and improves (mental) outlook. It is not used just for improving lung function

Stopping Smoking

The acceleration of COPD & Emphysema can be reduced by stopping smoking.

The most important management factor is stopping smoking. This will help slow the rate of deterioration but will not reverse existing damage to the lungs.

However, it will extend life expectancy. The patient should try all strategies to stop and if they stop sufficiently early, this will prevent the continuing accelerated decline in lung function. Strategies include:

- Support and encouragement from the GP and Chest Clinic.
- Nicotine replacement in the form of chewing gum or patches absorbed through the skin.
- Bupropion tablets (to aid the cessation of smoking).

Bronchodilator Medication

"The effectiveness of bronchodilator therapy should not be assessed by lung function alone but should include a variety of other measures such as improvement in symptoms, activities of daily living, exercise capacity and rapidity of symptom relief."

Therefore, the continuing use of bronchodilators depends on both the subjective feedback from the patient (i.e. that the symptoms have eased) and objective assessment.

Types of bronchodilators used are:

- Beta agonist inhalers such as Salbutamol (Ventolin), Terbutaline (Bricanyl), which are short- acting, Salmeterol (Serevent), Formoterol (Oxis or Foradil) which are long- acting
- Anti-cholinergic or anti-muscarinic inhalers (such as Ipratropium (Atrovent or Respontin), which are short-acting) and Tiotropium (Spiriva), which is long- acting.

However, the two drugs may be taken in combination and this has been shown to be effective in some patients. Such combinations are combivent (salbutamol and ipratropium) and Duovent (fenoterol and ipratropium).

- For mild disease, short- acting bronchodilators should be the initial treatment for the relief of breathlessness and exercise limitation.
- Patients who remain symptomatic should have their inhaled treatment intensified to include long- acting bronchodilators or combined therapy with a short- acting beta2 – agonist, and a short- acting anticholinergic. (Long-acting bronchodilators should be used in patients who do not respond to short-acting bronchodilators, because they appear to have additional benefits over combinations of short-acting drugs).
- Long-acting bronchodilators should also be used in patients who have 2 or more exacerbations a year.

Theophylline (in slow- release formulations)

Theophylline should only be used after a trial of short-acting bronchodilators and long-acting bronchodilators or in persons who are unable to use inhaled therapy. There is a need to monitor plasma levels and interactions with this drug.

Corticosteroids

Inhaled corticosteroids are mainly used for reducing the frequency of exacerbations (relapses) and to slow the decline in health status - not to improve lung function.

Inhaled corticosteroids should be used in patients:

- Who have an FEV1 of less than, or equal to, 50% of predicted
- Who are having 2 or more exacerbations requiring treatment with antibiotics or oral corticosteroids in a 12- month period.

There is a potential risk of developing osteoporosis and increased susceptibility to pneumonia in patients treated with high dose inhaled steroids. Maintenance use of oral corticosteroid treatment in COPD is not normally recommended.

Combination Therapy

If a patient still has symptoms on monotherapy, combination therapy may be tried, and these may include:

- Beta2 agonist and anticholinergic (Salbutamol and Ipratropium known as Combivent).
- Beta2agonist and theophylline.
- Anticholinergic and theophylline.
- Long-acting beta2agonist and inhaled corticosteroid (Seretide).

Again, the clinical effectiveness of combined treatments is assessed by:

- Symptoms,
- Activities of daily living,
- Exercise capacity,
- Lung function.

Antibiotics

When a bacterial infection is suspected by the GP, antibiotics should be used. There are many antibiotics to choose from and newer antibiotics may be used for more severe or resistant infections.

Pulmonary Rehabilitation

Most patients are middle-aged to elderly with associated problems of increasing age. Pulmonary rehabilitation should be considered for those with moderate to severe disease.

The aim is to counteract the effects of enforced immobility or reduced mobility, which occurs as a result of breathlessness due to the disease. Exercise programmes are devised, which are tailor-made for the person. These are multidisciplinary with the aim of increasing cardio-respiratory fitness and /or mobility so that general fitness, symptoms, quality of life, social performance and independence may be improved.

Rehabilitation should address the physical, psychological, nutritional, and educational needs of the patient.

Vaccination and Antiviral therapy

Annual influenza vaccination and vaccination against Pneumococcus should be offered to all patients. Antiviral medication is recommended for, and may be used in adults who are at risk and who present with a flu-like illness. They reduce the severity of the symptoms.

Oxygen therapy

Long-term oxygen therapy (LTOT) is used in patients who have been proved to have low oxygen levels in the blood. LTOT is delivered at a specific rate (4%) to increase O2 saturation most efficiently, while not causing the patient to drift into CO2 retention. This is called "Controlled O2 Therapy".

It is generally safe at this level. However, before this treatment is implemented, the patient is assessed to ensure that:

- They benefit sufficiently from this regime
- They do not drift into CO2 retention.

Therefore, anyone on LTOT should have been properly vetted first and so CO2 retention (excess levels of carbon dioxide in the blood tissues) is not relevant in people on controlled O2 Therapy.

LTOT is therefore beneficial to a selected patient group, normally those who no longer smoke and who have an FEV1 reading of less than 1.5 litres. It has beneficial effects on oxygen levels in the blood and on reducing the rise of the number of red blood cells, which occurs in response to low oxygen levels in the blood (known as hypoxia).

LTOT should be used for several hours a day (15 to 19). It is an indicator of severe disease. People on oxygen often have an oxygen concentrator in the home. This is a large, electronically operated machine, which is set up in the home for permanent use. It uses the oxygen present in the air, concentrating it and the person breathes it in through nasal cannulae (tubes which fit inside the nostrils) or a mask. It is fairly noisy and the tube may be very long, allowing the person to move about in the house. Cylinders of oxygen are sometimes used. They may be very large and heavy requiring special delivery and removal, set up by the bed or chair, or they may be small, for use while away from home even on aircraft.

Palliative Care

For those with end-stage disease, the full range of services available from Palliative Care Teams should be made available.

The patient should eat well or lose weight, if overweight. As the normal BMI (Body mass Index) is 25 to less than 20 there may be considerable variations from this norm. Advice from a dietician may be necessary. Nutritional supplements may be necessary if the person is very underweight.

Anxiety and depression, if present should be treated.

Air pollutants such as cigarette smoke should be avoided as much as possible.

Management / Treatment of Emphysema

The medical management of COPD and Emphysema is largely the same, but the following are specific to emphysema:

- Bullectomy (removal of emphysematous bullae)
- Lung volume reduction surgery
- Lung transplantation

Bullectomy and Lung Volume Reduction Surgery is used in persons with advanced emphysema.

Breathless people with a single large bulla, and an FEV1 of less than 50% should be considered for bullectomy.

Parts of affected (i.e. very expanded) lung are removed to reduce volume and improve efficiency of the remaining lung in persons in whom maximal medical therapy is not effective, as long as strict criteria are met.

Lung Transplantation should be considered in those with advanced emphysema, whose activities of daily living and quality of life are greatly restricted despite maximal medical therapy.

One source states that a very small group of persons are eligible for this and is mainly young people with severe disease suffering from Alpha1 Antitrypsin deficiency. Transplantation is usually of one lung.

Disablement	Treatment	Symptoms	Signs/Investigations (See guidance)
Virtually none	No regular treatment	Very mild shortness of breath made worse by a chest infection	No objective clinical findings most of the time
Minimal (1-4%)	Short-acting inhaled beta-2 agonist (eg: Salbutamol/ Terbutaline) or Short-acting inhaled antimuscarinic (anticholinergic) bronchodilators (eg: Ipratropium)	Shortness of breath on severe exertion e.g. running up a flight of steps stairs	Insignificant changes
Very mild (5-10%)	Short-acting inhaled beta-2 agonist (eg: Salbutamol/ Terbutaline) or Short-acting inhaled antimuscarinic (anticholinergic) bronchodilators (eg: Ipratropium)	Shortness of breath on moderate exertion e.g. Walking briskly. Able to climb a flight of stairs at normal pace	Early X Ray changes may be present Loss lung function 5-10%

<p>Mild (11-20%)</p>	<p>Regular antimuscarinic bronchodilator (short or long-acting) (eg Ipratropium (short acting) Tiotropium (Spiriva) (long acting) plus</p> <ul style="list-style-type: none"> • Long- acting Beta2 agonist • Salmeterol (Serevent) or • Formoterol Oxis (Foradil) <p>or In combination Combivent (Salbutamol and Ipratropium) and Duovent (Fenoterol and Ipratropium) or Inhaled Steroids (for those with frequent exacerbations and reversibility)</p>	<p>May have difficulty walking with peers. Can walk several hundred metres at own pace without stopping</p>	<p>Early X Ray changes present Loss lung function 10-20%</p>
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<p>Mild/Moderate (21-30%)</p>	<p>Regular antimuscarinic bronchodilator (short or long-acting) (eg Ipratropium (short acting) Tiotropium (Spiriva) (long acting) plus</p> <ul style="list-style-type: none"> • Long- acting Beta2 agonist • Salmeterol (Serevent) or • Formoterol Oxis (Foradil) <p>or In combination Combivent (Salbutamol and Ipratropium) and Duovent (Fenoterol and Ipratropium) or Inhaled Steroids (for those with frequent exacerbations and reversibility)</p>	<p>Can walk 500metres on the flat at own pace without stopping</p>	<p>Established X-Ray changes. Loss of lung function 25-40%</p>
<p>Moderate (31-50%)</p>	<p>This may include:</p> <ul style="list-style-type: none"> • Inhaled short-acting beta agonist, or antimuscarinic bronchodilator – Regular treatment (such as three times a day) • Inhaled steroids • Nebulized bronchodilator • Short course of oral steroids • Antibacterial treatment (antibiotics) • Combination of long-acting beta2 agonist, and inhaled corticosteroid (Seretide) • Theophylline (often used when other treatments have failed to adequately control symptoms) (Nuelin, Slophyllin, Uniphyllin) • Combinations of Salbutamol and Ipratropium (Combivent) 	<p>Manages 50 to 100 metres on the flat without stopping. Short of breath at the top of house stairs Likely to be under specialist care</p>	<p>Moderate X Ray changes Loss lung function 45-50%</p>

<p>Moderate/ Severe 51-80%</p>	<ul style="list-style-type: none"> • Inhaled short-acting beta agonist, or antimuscarinic bronchodilator – Regular treatment (such as three times a day) • Inhaled steroids • Occasional oxygen • Nebulized bronchodilator • Short course of oral steroids • Antibacterial treatment (antibiotics) • Combination of long-acting beta2 agonist, and inhaled corticosteroid (Seretide) • Theophylline (often used when other treatments have failed to adequately control symptoms) (Nuelin, Slophyllin, Uniphyllin) • Combinations of Salbutamol and Ipratropium (Combivent) 	<p>Able to walk 20-50 metres slowly on the flat.</p> <p>Stops on stairs due to breathlessness</p> <p>Under specialist care</p>	<p>Major X Ray changes</p> <p>Lung function 55 to 60%</p>
<p>Severe 81+%</p>	<ul style="list-style-type: none"> • Inhaled short-acting beta agonist, or antimuscarinic bronchodilator – Regular treatment (such as three times a day) • Inhaled steroids • Nebulized bronchodilator • Short course of oral steroids • Antibacterial treatment (antibiotics) • Combination of long-acting beta2 agonist, and inhaled corticosteroid (Seretide) • Oxygen therapy (may have concentrator) • Theophylline (often used when other treatments have failed to adequately control symptoms) (Nuelin, Slophyllin, Uniphyllin) • Combinations of Salbutamol and Ipratropium (Combivent) 	<p>Short of breath at rest</p> <p>Unable to manage stairs (stair lift or sleeps downstairs)</p>	<p>Severe X Ray changes</p> <p>Loss lung function 70+%</p>