*"He who studies medicine without books sails an uncharted sea, but he who studies medicine without patients does not go to sea at all."*
William Osler

# Medicine

# 430

## COPD

**(Chronic Obstructive Pulmonary Disease)**

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## What is COPD? "Chronic Obstructive Pulmonary Disease"

Gold Definition (2010): "Is a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal ***inflammatory*** response of the lungs to ***noxious*** particles or gases".

- There are two types of COPD and they usually **coexist**: (Pure Emphysema or pure Bronchitis is rare)
  - Chronic Bronchitis
  - Emphysema

## What is Chronic Bronchitis? (A Clinical Diagnosis)

- Chronic or recurrent expectoration, which is present on most days for a minimum of 3 months a year for at least 2 successive years.

## What is Emphysema? (A Pathological Diagnosis)

- Permanent destructive enlargement of airspaces distal to the terminal bronchioles without obvious fibrosis.
- Loss of the elastic recoil of the lung with collapse of small airways during expiration

## Epidemiology and etiology:

- COPD is caused by long-term exposure to toxic particles and gases.
- In developed countries, cigarette smoking accounts for over 90% of cases.
- In developing countries other factors, such as the inhalation of smoke from biomass fuels used in heating and cooking in poorly ventilated areas, are also implicated.
- However, only 10–20% of heavy smokers develop COPD, indicating individual susceptibility.
- The development of COPD is proportional to the number of cigarettes smoked per day; the risk of death from COPD in patients smoking 30 cigarettes daily is 20 times that of a non-smoker.
- Climate and air pollution play a smaller role, but the mortality from COPD increases dramatically during periods of heavy atmospheric pollution.

COPD is predicted to become the third most common cause of death and fifth most common cause of disability worldwide by 2020.

## Pathophysiology:

Three mechanisms have been suggested for this limitation of airflow in small airways (< 2 mm in diameter).

- Loss of elasticity and alveolar attachments of airways due to emphysema. This reduces the elastic recoil and the airways collapse during expiration.
- Inflammation and scarring cause the small airways to narrow.
- Mucus secretion which blocks the airways.

Each mechanism narrows the small airways and causes air trapping leading to hyperinflation of the lungs and breathlessness.

Elaboration:

The most consistent pathological finding is increased number of mucus-secreting goblet cells in the bronchial mucosa.
There is infiltration of the walls of the bronchi and bronchioles with acute and chronic inflammatory cells (predominantly CD8) → squamous epithelium replaces the columnar cells. (Due to the healing of epithelial layer ulcerations) → Scarring and thinking of the wall leads to narrowing of the airways.
In early stages inflammation is reversible if the patient stops smoking but in late stages, it is not.
Further progression of the airways disease leads to progressive squamous cell metaplasia, and fibrosis of the bronchial walls → the physiological consequence of these changes is the development of airflow limitation → if the airway narrowing is combined with emphysema the resulting airflow limitation is even more severe.

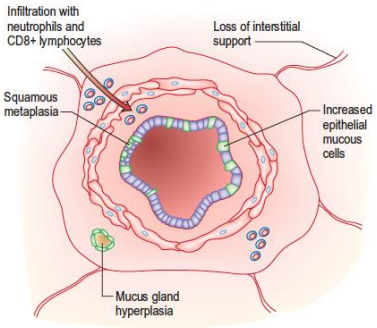


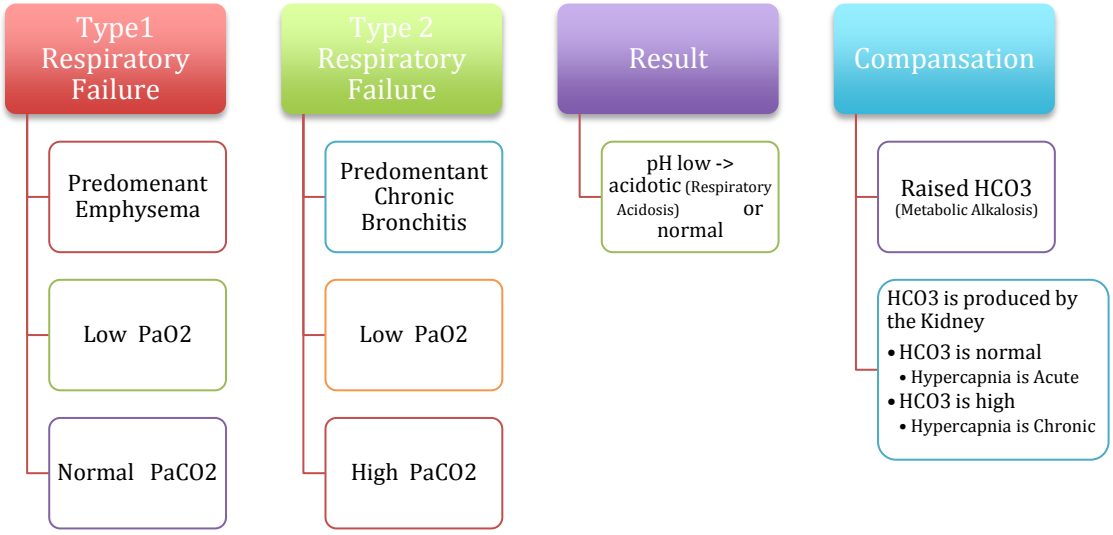

*Fig. 14.22* **Pathological changes in the airways in chronic bronchitis and emphysema.**

Centri lobular emphysema:

- Most common type, seen in smokers (rarely in nonsmokers)
- Destruction limited to respiratory bronchioles (proximal acini) with little change in distal acini
- Predilection for upper lung zones

Panlobular emphysema:

- Seen in patients with α1 -antitrypsin deficiency
- Destruction involves both proximal and distal acini
- Predilection for lung bases




## Pathogenesis:

- Cigarette Smoking
  - Bronchoalveolar lavage and biopsies of the airways of smokers show increased numbers of neutrophil granulocytes.
  - These granulocytes can release elastases and proteases, which may help to produce emphysema.
  - Mucous gland hypertrophy in the larger airways is thought to be a direct response to persistent irritation resulting from the inhalation of cigarette smoke.
- Infections
  - Patients with COPD cope badly with respiratory infections, which are often the precipitating cause of acute exacerbations of the disease.
- a1-Antitrypsin deficiency
  - α1-Antitrypsin is a proteinase inhibitor which is produced in the liver, secreted into the blood and diffuses into the lung.
  - Here it inhibits proteolytic enzymes such as neutrophil elastase, which are capable of destroying alveolar wall connectivetissue.

## Signs and Symptoms

The characteristic symptoms of COPD are:

- Productive cough with white or clear sputum.
- Wheeze
- Breathlessness-usually following many years of a smoker's cough.
- Colds seem to 'settle on the chest'
- Frequent infective exacerbations occur, giving purulent sputum.
- Tachypnea, Tachycardia
- Cyanosis
- Use of accessory respiratory muscles
- Hyper-resonance on percussion
- Prolonged forced expiratory time

First change in the ABG of a COPD patient is <u>Hypoxia</u>

Symptoms can be worsened by factors such as cold, foggy weather and atmospheric pollution. With advanced disease, breathlessness becomes severe even after mild exercise such as getting dressed. Apart from the pulmonary features, there are systemic effects on cardiovascular function e.g. hypertension, as well as osteoporosis, depression, metabolic problems leading to weight loss and loss of muscle mass with weakness

**Risk factors and causes**

- Tobacco smoke (indicated in almost 90% of COPD cases).
- $\alpha$1-Antitrypsin deficiency—risk, and it's worse if combined with smoking.
- Environmental factors (e.g., Passive **smoking** -the inhalation of **smoke-**).
- Chronic asthma—speculated by some to be an independent risk factor.

## Complications:

- Respiratory failure (In later stages of COPD)
- Cor pulmonale (Right sided heart disease secondary to disease of the lung)
- Bacterial colonisation
- Hemoptysis
- Pneumothorax
- Extrapulmonary
- Secondary polycythemia (Hct >55% in men or >47% in women)—compensatory response to chronic hypoxemia

## Extra-pulmonary manifestations

- Muscle wasting
- Cachexia (Because of the catabolic inflammatory marker production due to disease manifestation)
- Cardiac deconditioning
- Osteoporosis
- Depression
- Social isolation

## Diagnosis

- This is usually clinical (GOLD criteria, Table 14.9).
- There is a history of breathlessness and sputum production in a lifetime smoker.
- In the absence of a history of cigarette smoking an initial working diagnosis of asthma is usual unless there is a family history of COPD suggesting **α**1-antitrypsin deficiency.
- The patient may have signs of hyperinflation and typical pursed lip respiration.
- No individual clinical feature is diagnostic.
- Emphysema is often incorrectly diagnosed on signs of overinflation of the lungs (e.g. loss of liver dullness on percussion), but this may occur with other diseases such as asthma.
- Centri-acinar emphysema may be present without signs of overinflation. Some elderly men (without emphysema) develop a barrel-shaped chest as a result of osteoporosis of the spine, and a consequent decrease in height.

**Table 14.9 COPD – Global Initiative in Obstructive Lung Disease (GOLD) criteria**

| Stage of COPD | | Function | Symptoms of breathlessness |
|---|---|---|---|
| I | Mild | $FEV_1/FVC < 70\%$<br>$FEV_1 \geq 80\%$ predicted | None or mild |
| II | Moderate | $FEV_1/FVC < 70\%$<br>$50\% \text{ of predicted} \leq FEV_1 < 80\%$ of predicted | On exertion |
| III | Severe | $FEV_1/FVC < 70\%$<br>$30\% \text{ of predicted} \leq FEV_1 < 50\%$ of predicted | On minimal exertion, e.g. dressing |
| IV | Very severe | $FEV_1/FVC < 70\%$<br>$FEV_1 < 30\%$ predicted or $FEV_1 < 50\%$ predicted plus respiratory failure | At rest |

Modified from the Global Strategy for the Diagnosis, Management and Prevention of COPD, 2006. www.goldcopd.com.

### Key Points in Taking the History of COPD Patients

General

- History of cardiopulmonary diseases
- Smoking history (duration, intensity, current smoker)
- Family history—COPD, heart disease, asthma
- Occupation—industrial dusts, fumes
- Overall health
- History of respiratory infections—frequency, severity
- Pulmonary medications

Pulmonary Symptoms

- Dyspnea—quantitate severity
- Cough
- Sputum production—quantity, quality, duration, hemoptysis
- Wheezing

Adapted from Burton GG, Hodgkin JE, Ward JJ, Eds. Respiratory Care —A Guide

## More on Diagnosis:

Pulmonary function testing (spirometry)

- o This is the definitive diagnostic test.
- o Obstruction is evident based on the following:
  - ❖ **Decreased $FEV_1$** and decreased $FEV_1/FVC$ ratio—If $FEV_1$ is reduced to 70% of predicted value, mild disease is suggested. If $FEV_1$ is reduced to 50% or less of predicted value, severe disease is present. Values in between indicate moderate disease.
  - ❖ Increased total lung capacity (TLC), residual volume, and functional reserve capacity (FRC) (indicating air trapping)
  - ❖ Decreased vital capacity

Chest radiograph (CXR)

- o Low sensitivity for diagnosing COPD; only severe, advanced emphysema will show the typical changes, which include:
  - ❖ Hyperinflation, flattened diaphragm, enlarged retrosternal space
  - ❖ Diminished vascular markings
- o Useful in an acute exacerbation to rule out complications such as pneumonia or pneumothorax

Measure $\alpha_1$ -antitrypsin levels in patients with a personal or family history of premature **emphysema (≤50 years old).**

- $FEV_1$ is the amount of air that can be forced out of the lungs in 1 second. The lower the $FEV_1$, the more difficulty one has breathing.
- To diagnose airway obstruction, one must have a normal or increased TLC with a decreased
- $FEV_1$.
- One can measure the peak expiratory flow rate using a peak flow meter. If <350 L/min, one should perform pulmonary function testing, because this is a good screening test for obstruction.

## Differential diagnosis between COPD and Asthma:

- ❖ Age of onset
  - ○ Early → Asthma (Usually)
  - ○ Late → COPD
- ❖ History of atopy (Asthma)
- ❖ Eosinophilia and IgE (Asthma)
- ❖ Bullae (COPD)
- ❖ Chronic respiratory failure (COPD)
- ❖ Diffusing capacity (COPD)
- ❖ Trial of inhaled corticosteroids (Works from the first time on Asthma) (Needs to be administered more than once to work on COPD)

## Management:

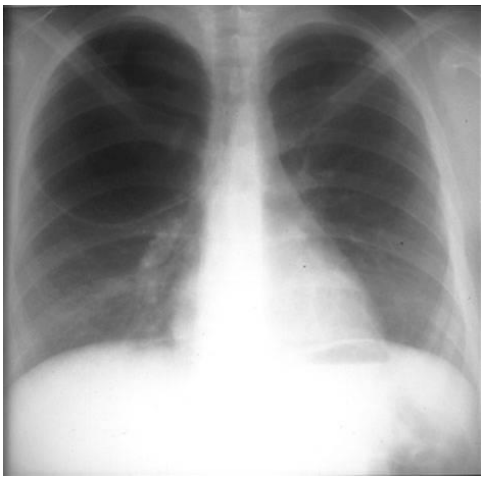
- ❖ Bronchodilation:
  - Ipratropium 40 to 80 µcg q 6 hourly or Combivent
  - Tiotropium 18 µcg q 24 hrs
  - Salmetrol 50 µcg q 12 hrs
  - Formoterol 9 µcg q 12 hrs
- ❖ Influenzae vaccine yearly
- ❖ Rehabilitation: Grade 3-5 S.O.B.
- ❖ Nebulise higher doses of Salbutamol + Ipratropium Spacer as effective
- ❖ Inhaled corticosteroids for "frequent exacerbations"
  - 500 µcg fluticasone HFA (Seretide)
  - 800 µcg busesonide (Symbicort)
- ❖ Rinse throat Spacer
- ❖ Mucolytics every winter

Management outline:

- ❖ **Smoke cessation (Most important intervention)**
- ❖ Drug therapy:
  - Bronchodilators
    - ○ Mild COPD → Salbutamol
    - ○ Moderate/Sever COPD → Formoterol
    - ○ Tiotropium & Ipratropium (Long acting)
  - Corticosteroids
    - ○ Start with Prednisolone for 2 weeks → If it works replace with Inhaler (Beclomethsone)
  - Antibiotics
  - Antimucolytic Agents
  - Diuretic therapy (For all edematous patients)
  - Oxygen therapy

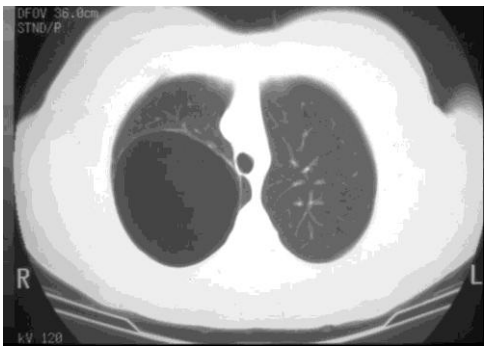
## Long-term rehabilitation:

- Benefit independent of age, $FEV_1$, exercise capacity, $PaO_2$
- Walk test 25-40%
- 6 minutes walk + 60 metres
- Only modest rise $VO_2$ peak
- Well being +
- 2 supervised + 1 unsupervised session
- As little as 6 weeks (Max. 12 weeks)
- 20-30 min
- Anaerobic (cycle, brisk walking) Strength exercises
- Lower limbs > upper limbs
- Respiratory muscles: no effect
- 60 – 85% peak performance
- Benefit maintained 12-18 months without formal maintenance regimen



## WHO Predictions (1990-2020)

- COPD as cause of disability 12th → 5th position
- COPD as cause of deaths 5th → 3rd position




Bullae in the left lung
Advanced Emphysema
Loss of blood vessels
Destruction of alveoli

## Bullectomy

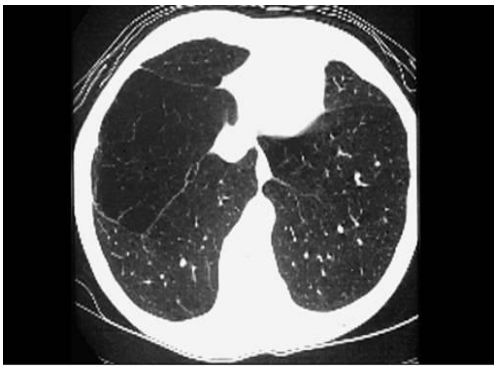
- FEV1 > 40%
- PaO2, PaCO2 near normal
- Normal V/Q scan in the surrounding lung

## Lung volume reduction surgery LVRS

- FEV1 and DLCO above 20%
- Predominantly upper lobe emphysema

## Exacerbations:

- Viral infection followed by bacterial activity one third associated with virus (rhinovirus or influenza)
- Bacterial colonisation
  - (20 to 30% during remissions)
  - (30 to 50% during exacerb.)
  - Haemophilus influenzae & parainfluenzae
  - Streptococcus pneumoniae
  - Branhamella catarrhalis
- Bronchospasm
  - Pollution or occupational
- Minor Causes
  - Pneumonia
  - Lt or Rt cardiac failure
  - pneumothorax



Bullae in the left lung (Middle lobe)

## Life Threatening Exacerbations:

- Deterioration of consciousness
- Marked distress
- Paradoxical thoracoabdominal movement
- Worsening ABGs in spite of oxygen and bronchodilators ( 50 – 70 – 7.3 )
- Other comorbidities
- Social support

## Management of Exacerbations:

- Nebulize Ipratropium 250 ucg
- Salbutamol 5 mg O2 24% or 2 l / min
- Prednisolone 40 mg daily ?
- Antibiotics ?
- Non-invasive ventilatory support ?

## Antibiotics for Exacerbations:

Worsening of 2 out of 3 of the following:

1. Shortness of breath
2. Amount of sputum
3. Purulency of sputum

- Amoxycillin / clavunate
- Cephalosporin (eg. Cefuroxime)
- Quinolone
  - Ciprofloxacin
  - Levofloxacin
- Moxifloxacin (Avalox)

**More on the Management of exacerbations:**

 Systemic corticosteroids are used for patients requiring hospitalization (IV methylprednisolone is a common choice). Taper with oral prednisone on clinical improvement. Do not use inhaled corticosteroids in acute exacerbations.

 Antibiotics (azithromycin or levofloxacin): Studies have shown that patients who receive broad-spectrum antibiotics do slightly better than a placebo group.

 Supplemental oxygen is used to keep O2 saturation above 90%. Start with a nasal cannula; a face mask may need to be used.

 β-Blockers are generally contraindicated in acute COPD or asthma exacerbations.

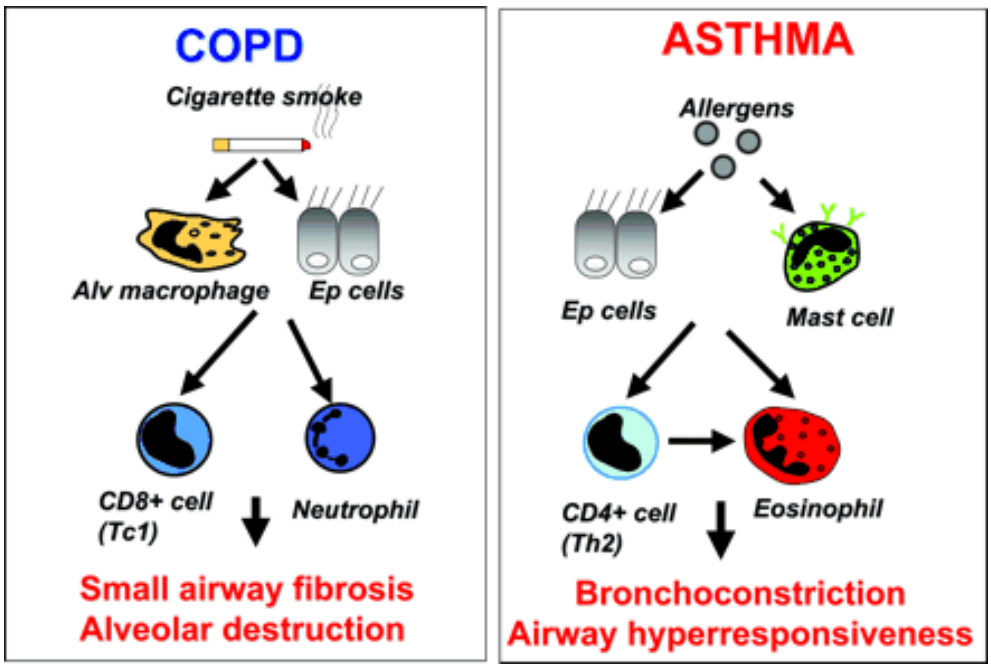
 Pulmonary infection (Streptococcus pneumoniae, Haemophilus influenzae, Mycoplasma pneumoniae, Moraxella catarrhalis, and viruses are the most common organisms.) is one of the main precipitants of a COPD exacerbation.

 If a patient presents with COPD exacerbation, the following steps are appropriate:

- CXR
- β2-agonist and anticholinergic inhalers
- Systemic corticosteroids
- Antibiotics
- Supplemental oxygen
- Noninvasive positive-pressure ventilation (NPPV) if needed

| | Asthma | COPD |
|---|---|---|
| Definition | A chronic inflammatory disorder of the airways | Disease state characterized by airflow limitation that is not fully reversible |
| Onset (typical) | Early in life | Midlife |
| Airflow limitation | Widespread though variable; often reversible spontaneously or with treatment | Usually progressive and associated with abnormal inflammatory response to particles or gases |

Medscape

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