COPD and Bronchiectasis

No.8

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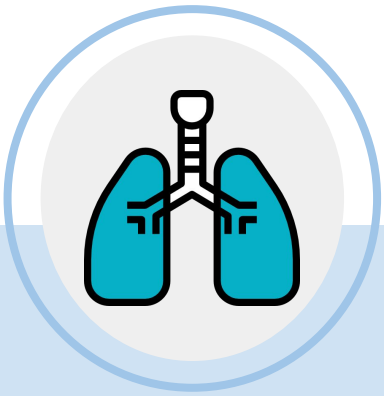

Objectives :

From 439, No objectives To be found slides 442

- ★ What's COPD
- ★ The definition of airway obstruction
- ★ Causes of COPD
- ★ Clinical presentation and diagnosis
- ★ Management of COPD
- ★ To know the definition of bronchiectasis
- ★ Discuss the radiological features and etiology
- ★ To know the principles of management

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COPD مرض الرئة الانسدادي المزمن

Definition

Chronic Obstructive Pulmonary Disease (COPD) is a common, **preventable** and **treatable** but not fully reversible disease that is characterized by **persistent respiratory symptoms** and **airflow limitation** that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases. COPD is a combination of emphysema and bronchitis which by prolonged exhalation.

Epidemiology

- higher in **smokers** and ex-smokers compared to non-smokers, cigarette smoking accounts for 90% of cases in developed countries. However, only 10-20% of smokers develop COPD, indicating individual susceptibility (host factors).
- **Higher ≥ 40 year group** compared to those < 40[1], Higher in men than women[2]
- Estimated 384 million COPD cases in 2010.
- The prevalence of smoking is increasing all over the world[3]
- Three million deaths annually by COPD, predicted to increase to 4.5 million by 2030.
- **Biomass Fuel** is The Most Common Cause of COPD in Some Parts of The World But **Smoking** Is The Most Common In Saudi Arabia

Risk factors

01 **Tobacco Smoking**[4] the main risk factor for COPD

02 **α_1-Antitrypsin deficiency**

03 **environmental factors** biomass fuel exposure, air pollution[5].

04 **Host factors**[6] Family history of COPD or AATD

05 **chronic Asthma** Asthma-COPD overlap syndrome

06 **Others** low birth weight,infections, low socioeconomic status

α_1-Antitrypsin deficiency (AATD)

"the most likely cause for young and non-smoker"

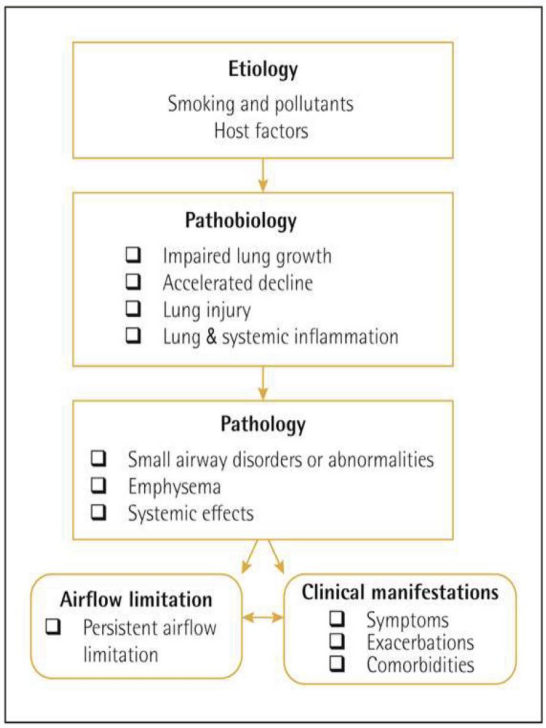
- Alpha-1-antitrypsin is a protease inhibitor that is synthesized in the liver and protects elastin from breakdown by neutrophil elastase.(Elastin is essential for the lung elasticity and recoiling).
- AATD patients are typically < 45 years with **panlobular basal emphysema** (destruction or airways due to relative excess in protease (elastase) activity that is released by PMNs, or relative deficiency of antiprotease (AATD) activity in the lung.)
- There are 2 types of A1AD:
  - Functional A1AD: occurs due to **tobacco smoking**. Smoking induces the release of ROS which may eventually inactivate alpha1-antitrypsin leading to increased elastase (Protease -antiprotease imbalance) which will lead to destruction of lung parenchyma.
  - Congenital A1AD: Autosomal co-dominant disorder due to a mutation in SERPINA1 gene, patients usually present with hepatitis and liver cirrhosis. People with congenital AATD will have COPD even if they aren't smoking.
- WHO recommends that all patients with a diagnosis of COPD should be screened once especially in areas with high AATD prevalence.
- Delay in diagnosis in older AATD patients presents as more typical distribution of emphysema (centrilobular apical).
- A low concentration (< 20% normal) is highly suggestive of homozygous deficiency. Advise the family to check since it is genetic .

1- If you see a 10 YO child who is breathless , it is more likely to be asthma or another disease rather than COPD .
2- Because of incidence of smoking that is higher among men. However this might have changed, as the prevalence of smoking is increasing among women
3- Is using E-cigarettes to quit tobacco smoking effective? Studies have shown that those who try to use E-cigarettes to stop tobacco smoking usually end up smoking both (Tobacco and E-cigarettes), so...no. E-cigarettes (vaping) : most people use them as a nicotine replacement to stop smoking but it causes significant disease where they have inflammation in their airways (alveoli) . Patients become very sick and unwell so they die or end up with lung transplant. So although vaping does not contain the noxious gases that cause COPD , it does cause acute lung injury .
4- Smoking is the most common cause of COPD. Tobacco smoking increases number of activated PMNs and macrophages and digests human lungs, this is inhibited by a_1-antitrypsin.
5- climate and air pollution are lesser causes of COPD, but mortality from COPD increases dramatically during periods of heavy atmospheric pollution.
6- Host Factor Means That Not everyone Who Smoke Gonna Develop COPD

COPD *(cont.)*

Pathology & pathophysiology

- Pathology: Damage to the airways. Pathogenesis: the inflammatory process. Pathophysiology: the outcomes of the disease
- COPD is characterized by: **structural changes** (emphysema) and **chronic inflammation** (chronic bronchitis) leading to:



1 Airflow limitation and gas trapping

Because the airways are narrowed, so even when you breathe out , you can't empty your lungs .

2 Gas exchange abnormalities

3 Mucus hypersecretion

due to increased numbers of goblet cells, especially in larger bronchi, narrows the airway and causes productive cough.

4 Pulmonary hypertension

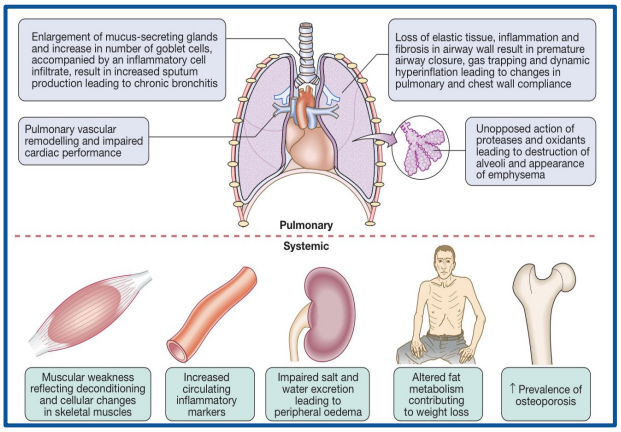
due to hypoxia → pulmonary vascular remodeling and PH occurs → Flattens the diaphragm and leads to increasingly horizontal alignment of intercostal spaces resulting in right sided HF (**cor pulmonale**).

Cor Pulmonale

- **Definition:** symptoms and signs of fluid overload secondary to lung disease. The fluid retention and peripheral oedema is due to failure of excretion of sodium and water by the hypoxic kidney rather than heart failure.
- **Characteristics**:
  - Pulmonary hypertension
  - Right ventricular hypertrophy.
- **Signs and Symptoms:**
  - Initially there may be a prominent parasternal heave[1] (due to right ventricular hypertrophy) and a loud pulmonary second sound.
  - central cyanosis (owing to the lung disease) → patient later becomes more breathless
  - ankle oedema.
- In case of very severe pulmonary hypertension → the pulmonary valve becomes incompetent.
- In case of severe fluid overload → tricuspid incompetence may develop → elevated jugular venous pressure (JVP), ascites and upper abdominal discomfort due to liver swelling.

Pathogenesis

COPD isn't just limited to the lungs, you could have inflammation elsewhere in the body (as seen in the pic). What are the most common causes of death in COPD patients? Lung cancer, Cardiovascular diseases and respiratory failure.



- Oxidative stress.
- Protease-Antiprotease imbalance.
- Inflammatory cells.
- Inflammatory mediators.
- Peribronchiolar fibrosis.
- interstitial fibrosis.

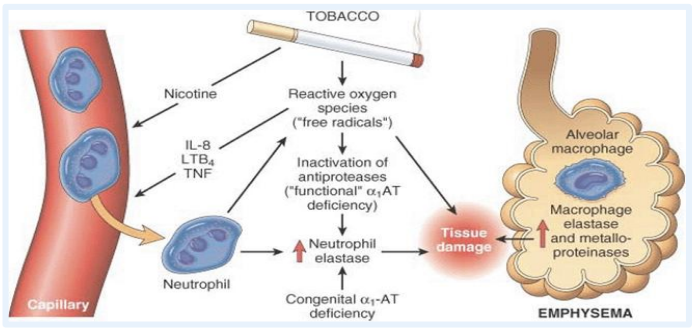
1- a heaving motion felt over the left parasternal area while palpating with the heel of the right hand, suggests RVH

Emphysema النفاخ الرئوي

Definition

Permanent enlargement of the airspaces distal to the terminal bronchioles accompanied by destruction of their walls, without obvious fibrosis. (Associated with loss of recoil and support of small airways —> tendency to collapse with obstruction)

Pathogenesis



smoking

Inflammatory Reaction
with increased chemotactic factors
e.g: LTB4, IL-8, TNF.

Attraction Of Inflammatory Cells e.g: neutrophils, macrophages, CD4, CD8.

Release Of Reactive Oxygen species

Protease-antiprotease imbalance.
Increase protease & Decrease anti-protease.

Alveolar Wall Destruction

Two main causes of protease-antiprotease imbalance: smoking & congenital deficiency (AATD)

Extra

Pink Puffer

Increase RBCs: Pink

Stimulate The Respiratory Center: Puffer

And It's Partial Obstruction

Types of emphysema

	Centriacinar[1] (centrilobular) **"Most common"**	**Panacinar** (panlobular)	**Distal acinar** (paraseptal)	**Irregular**
Location	Central or Proximal alveoli of the acini.	Uniform injury, total damage of the alveoli.	The distal alveoli of the acinus.	Can affect any part of the respiratory tract.
Cause	Smoking	Genetic condition: Alpha-1 antitrypsin deficiency	Unknown	Invariably associated with scarring such as that resulting from healed inflammatory diseases.
Features	Common in upper Lobes.	- Common in lower lobes. - leads to **V_A / Q mismatch**	- adjacent to areas of fibrosis or atelectasis. - More severe in the upper half of the lungs	Asymptomatic.

- Emphysema leads to **expiratory airflow limitation** and **air trapping**. The loss of lung elastic recoil results in an **increase in TLC**. Premature closure of airways limits expiratory flow while the loss of alveoli decreases capacity for gas transfer.
- **V_A / Q mismatch**: due to damage and mucus plugging of smaller airways from chronic inflammation, and partly due to rapid closure of smaller airways in expiration owing to loss of elastic support. The mismatch leads to a fall in PaO_2 and increased work of respiration.

1- To remember centriacinar emphysema is associated with smoking and involves upper lobes, remember that smoke always rise up

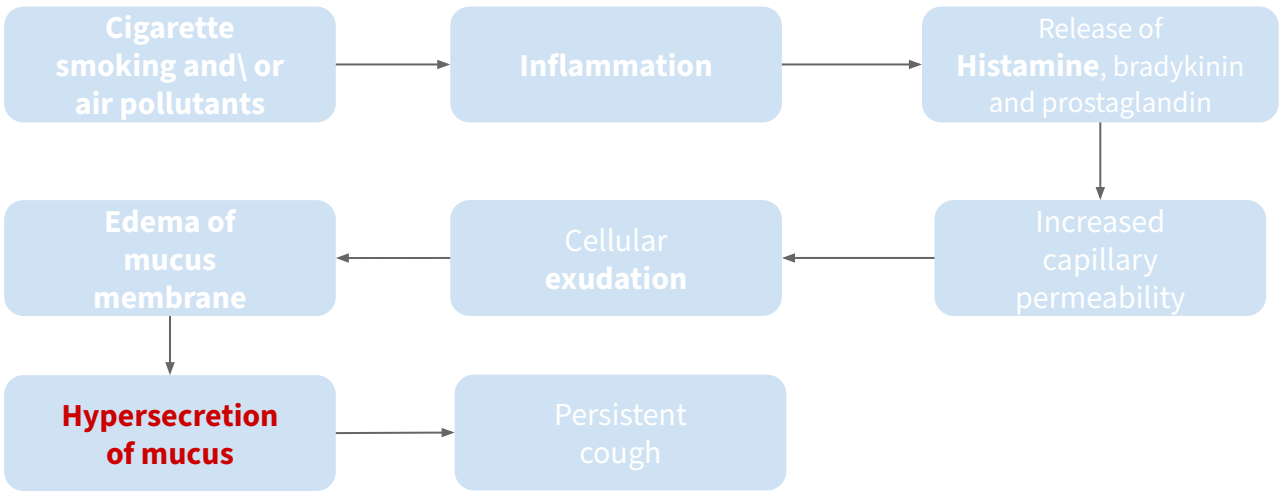
Chronic bronchitis التهاب القصبات

Definition

A chronic obstructive airway disease characterized by the presence of chronic productive cough that Persists for at least 3 consecutive months in at least 2 consecutive years.

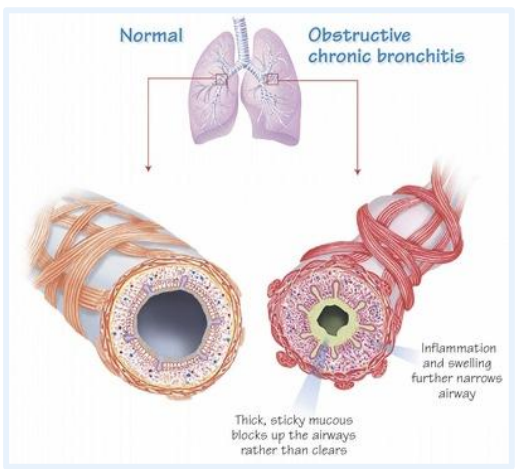
Pathogenesis

The distinctive feature of chronic bronchitis is hypersecretion of mucus, beginning in the large airways.



Etiology

- Cigarette smoking "disturbs the cilia so the cilia can't clear the airway"
- Atmospheric pollution



Extra

Blue Bloated

Right To left Shunt: Blue

Right Ventricular Failure(Oedema): Bloated

And It's Complete Obstruction

COPD *(cont.)*

Clinical features

- Signs & Symptoms

- Chronic and progressive dyspnea*.
- Cough.
- Sputum production.
- Wheezing and chest tightness.
- Syncope. This may occur due to severe bouts of coughing which may generate intrathoracic pressure and induce valsalva maneuver leading to syncope.
- Rib fractures. The cough in COPD will be so bad that the amount of pressure generated in the chest is very high (up to 300 mmHg) leading to rib fracture.
- Fatigue.
- Weight loss.
- Anorexia.

Because they got systemic effect

- Ankle swelling.
- Depression and anxiety. So we need to check the patient's mental status.
- Tachypnea.
- Prolonged expiration.
- Pursing of the lips on expiration.
- Loss of the normal cardiac and liver dullness.

*Other causes of chronic cough "DDx"	
Intrathoracic	Extrathoracic
• Asthma • Tuberculosis • lung cancer. CT scan : mass in the lung • bronchiectasis • left heart failure • interstitial lung disease • cystic fibrosis • idiopathic cough	• Chronic allergic rhinitis • Post nasal drip syndrome (PNDS) • Upper airway cough syndrome (UACS) • Gastroesophageal reflux disease (GEGD) • Medication (eg: ACEI). It might be a side effect. However, if the pt was prescribed ACE inhibitor for HF that is not well controlled , he/she will be breathless and has cough .

Diagnosis and investigations

01

Pulmonary function tests / Spirometry

The only diagnostic investigation, It's the most **accurate** test.

- **Reduced FEV1: FVC ratio <70%.**
- **Reduced FEV1 <80 and reduced FVC.**
- Reduced PEFR.
- In many patients the airflow limitation is partly reversible (usually a change in FEV 1 of <15%), and it can be difficult to distinguish between COPD and asthma.
- Lung volumes may be normal or increased.
- Carbon monoxide gas transfer factor is low when significant emphysema is present.
- Recall that asthma is reversible,and to diagnose asthma we do a bronchodilator test, so to rule-out asthma and reversibility all your measures for COPD should be **post bronchodilator.** (While having a baseline PFT prior to bronchodilation test)

- The results should be:
  - → incomplete improvement with albuterol.
  - → little or no worsening with methacholine.

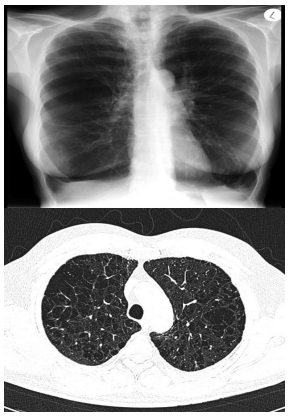
Classification of airflow limitation severity in COPD (Based on post Bronchodilator)		
In Patients with FEV1/FVC < 70%		
Gold 1:	mild	FEV1 ≥ 80% of predicted
Gold 2:	moderate	50% ≤ FEV1 < 80% of predicted
Gold 3:	severe	30% ≤ FEV1 < 50% of predicted
Gold 4:	very severe	FEV1 < 30% of predicted

COPD *(cont.)*

02

Radiological studies

it's the best **initial** test



- **CXR**
  - Often **normal**, even when the disease is advanced.
  - The classic features are **overinflation** of the lungs with low, flattened diaphragms, and sometimes the presence of large bullae.
  - Blood vessels may be 'pruned' with large proximal vessels and relatively little blood visible in the peripheral lung fields.
  - Hyperlucency of lung tissue: Less lung markings
  - If you count the ribs you'll find 11 posterior ribs at the midclavicular line above diaphragm : flattened (Sign of hyperinflation or overinflation). and widened intercostal spaces.
- **CT**
  - Might be helpful when CXR is normal.
  - Tissue destruction: if you compare the trachea and the lung tissue, it's almost the same (no gas exchange occurs)

Choices of threshold

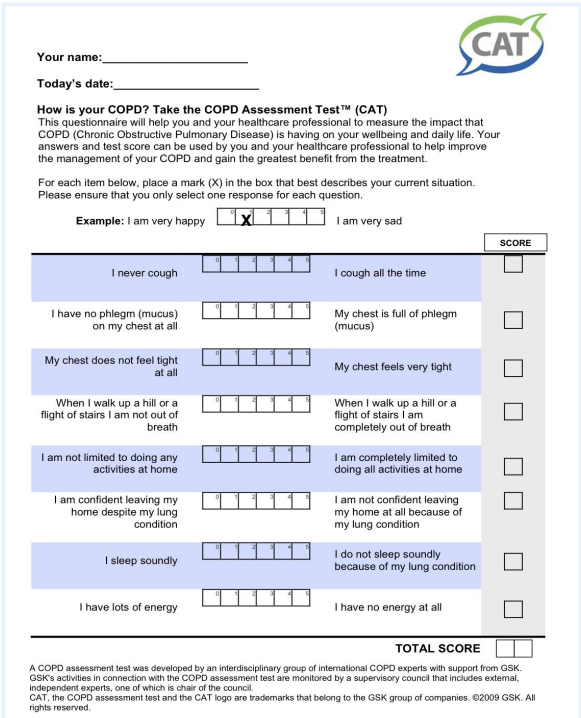
To know the degree of their symptoms (how impaired are they ?)

➔ Modified Medical Research Council (mMRC) questionnaire:

Modified Medical Research Council (MRC) dyspnoea scale	
Grade	**Degree of breathlessness related to activities**
0	No breathlessness, except with strenuous exercise.
1	Breathlessness when hurrying on the level or walking up a slight hill
2	Walks slower than contemporaries on level ground because of breathlessness or has to stop for breath when walking at own pace.
3	Stops for breath after walking about 100 m or after a few minutes on level ground.
4	Too breathless to leave the house, or breathless when dressing or undressing

- Other tests
  - ECG: RAD and poor QRS amplitude
  - CBC: increased hematocrit and erythrocytosis
  - A1-anti trypsin levels

➔ COPD Assessment Test (CAT ™):



Your name:_____

Today's date:_____

How is your COPD? Take the COPD Assessment Test™ (CAT)

This questionnaire will help you and your healthcare professional to measure the impact that COPD (Chronic Obstructive Pulmonary Disease) is having on your wellbeing and daily life. Your answers and test score can be used by you and your healthcare professional to help improve the management of your COPD and gain the greatest benefit from the treatment.

For each item below, place a mark (X) in the box that best describes your current situation. Please ensure that you only select one response for each question.

Example: I am very happy [X] I am very sad

		SCORE
I never cough	I cough all the time	
I have no phlegm (mucus) on my chest at all	My chest is full of phlegm (mucus)	
My chest does not feel tight at all	My chest feels very tight	
When I walk up a hill or a flight of stairs I am not out of breath	When I walk up a hill or a flight of stairs I am completely out of breath	
I am not limited to doing any activities at home	I am completely limited to doing all activities at home	
I am confident leaving my home despite my lung condition	I am not confident leaving my home at all because of my lung condition	
I sleep soundly	I do not sleep soundly because of my lung condition	
I have lots of energy	I have no energy at all	

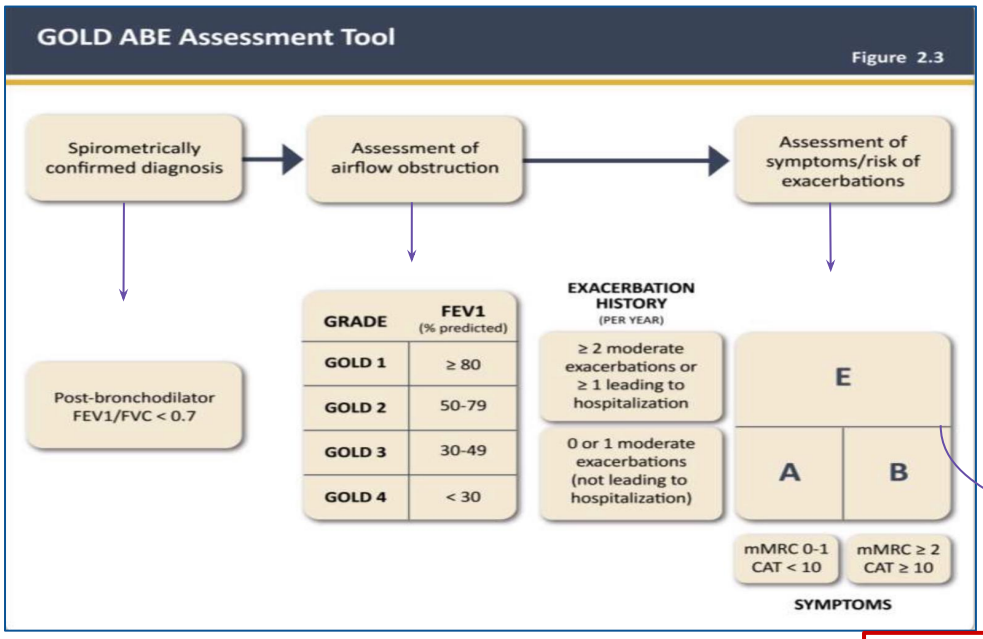
TOTAL SCORE

A COPD assessment test was developed by an interdisciplinary group of international COPD experts with support from GSK. GSK's activities in connection with the COPD assessment test are monitored by a supervisory council that includes external, independent experts, one of which is chair of the council.

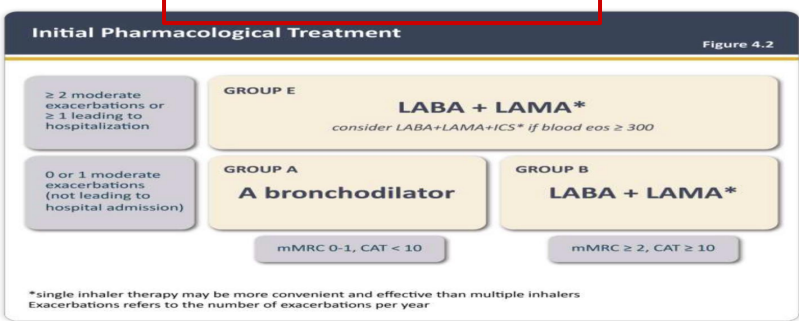
COPD *(cont.)*

ABE of COPD

- It's important to understand this, as it will guide you in management



ABE of COPD



LABA : long acting beta 2 agonist
LAMA : long acting antimuscarinic
ICS : inhaled Corticosteroids
No need to remember these, just have an idea .

Management of COPD

- Once COPD has been diagnosed, effective management should be based on an individualized assessment to reduce both **current symptoms** and **future risks of exacerbations.**

reduce symptomes
1. relieve symptoms
2. improve exercise tolerance.
3. improve health status (including mental status and comorbidities)

Goals for treatment of stable COPD

reduce risk
1. prevent progression (stop smoking)
2. prevent & treat exacerbations
3. reduce mortality

1- Exacerbation history is how many exacerbations they have had in the last 12 hours .
2- Somebody who does not have much symptoms , he can walk fairly, only gets breathless on strenuous activities which is normal for most people. He doesn't get exacerbation neither hospitalization.
3- Unique group, they have few symptoms but tend to exacerbate. Either 1 or 2 and need hospitalization .

Management of COPD

1- non-pharmacological treatment

Important As Pharmacological Drugs

Smoking cessation[1]

Smoking cessation Can Partially Reverse Harmful Effects of Smoking

- **Smoking cessation has the greatest capacity to influence the natural history of COPD.**
- If effective resources and time are dedicated to smoking cessation, long-term quit success rates of up to 25% can be achieved. Reduces mortality.
- May slow down the rate of deterioration and prolong time before disability and death even in advanced disease.

Long term oxygen therapy[2]

Long term oxygen therapy has proven to reduce mortality.

Indicated for stable patients who have:

- **$PaO_2 \leq 7.3$ kPa (55 mmHg)** or **$SaO_2 \leq 88\%$,** with or without hypercapnia confirmed twice over a three week period.

or

- **PaO_2 (7.3 kPa (55 mmHg) - 8.0 kPa (60 mmHg))** or **SaO_2 of 88%**, if there is evidence of :
  - pulmonary hypertension,
  - peripheral edema suggesting congestive cardiac failure,
  - or polycythemia (hematocrit > 55%).

Vaccination

(Evidence B)

- **Influenza vaccination:** reduces:
  - serious illness (such as lower respiratory tract infections requiring hospitalization)
  - death in COPD patients.
- **Pneumococcal vaccinations:** recommended for all patients ≥ 65 years of age.
  - PCV13: has demonstrated significant efficacy in reducing bacteremia and serious invasive pneumococcal disease in adults ≥ 65 years.
  - PPSV23: has been shown to reduce incidence of CAP in COPD patients aged < 65 yrs with FEV_1 < 40% predicted in those with comorbidities.

Pulmonary rehabilitation[3]

- Improves dyspnea, health status & exercise tolerance (evidence A)
- reduces hospitalization among patients who have recurrent exacerbations **(≤ 4 wks from prior hospitalization)** (evidence B)

other measures

- **education:** ineffective (evidence C)
- **self management:** intervention with communication with health care professional improves health status & decrease hospitalization and ER visits. (evidence B)
- **Exercise training:** 6-12 wks (longer program = larger effects). 20-30 min walking per session, no limits of symptoms.
- **Patient education about:**
  - Smoking cessation
  - COPD natural history and management
  - self-management
  - exacerbations
- Nutritional support

1- Normally if you don't smoke your lung functions will be maintained until the age of 40, after 40y/o there will be a slow down-hill regression (loss of 15-20ml of lung capacity/yr). If the person is a smoker, there will be a RAPID deterioration of his lungs functions (about 100ml of lung capacity/yr) and by the age of 75 his lungs will not be able to sustain his life, unless he quits smoking early (the earlier the better).

2- Normally air contains 21% of O_2 and 79% of N_2. If you reduce the nitrogen amount in the air , the PaO_2 will go up, and that what the machine does . So the percentage of O_2 the patient inhaling is increasing . The aim in COPD patients if to keep their PaO_2 88-92% .

3: Pulmonary rehabilitation has shown to be more effective in reducing dyspnea in patients with COPD than all other medications.

Management of COPD *(cont.)*

2- Pharmacological treatment

Bronchodilators	1. **Short acting bronchodilators for mild disease:** ○ Inhaled Beta 2 agonists: Salbutamol, Terbutaline 2. **Long acting bronchodilators for moderate to severe disease:** ○ formoterol, salmeterol 3. **Inhaled Anticholinergics (muscarinic antagonists) are more appropriate and effective for patients with moderate to severe disease:** ○ Tiotropium bromide (LAMA), Ipratropium bromide (SAMA). 4. **Oral Bronchodilators can be given to patients who cannot inhale efficiently:** Theophylline ○ not commonly used due to its side effects, drug interactions and Narrow therapeutic index. ○ Improves mucociliary clearance and central respiratory drive. **Combinations are commonly used:** • short acting beta 2 agonist (Salbutamol) with anticholinergic (ipratropium bromide) more efficacious than either agent alone • long acting beta 2 agonist (formoterol) with anticholinergic (aclidinium) • long acting beta 2 agonist (formoterol) with corticosteroids (budesonide)
Corticosteroids	1. **Inhaled corticosteroids:** usually given in combination with LABA[1] 2. **Oral corticosteroids:** used in management of acute exacerbations.
Other drugs	1. **Methylxanthines:** aminophylline, theophylline 2. **Phosphodiesterase-4 inhibitors:** Roflumilast: work by: a. inhibiting PDE4 → increase cAMP → open the airway b. Reducing inflammation
Surgery	**May be beneficial in selected patients (with damaged lungs)**; carefully weigh potential benefits with risks: • Surgical or endoscopic Lung resection (LVRS)[2] • Bullectomy[3] • Lung transplantation[4]

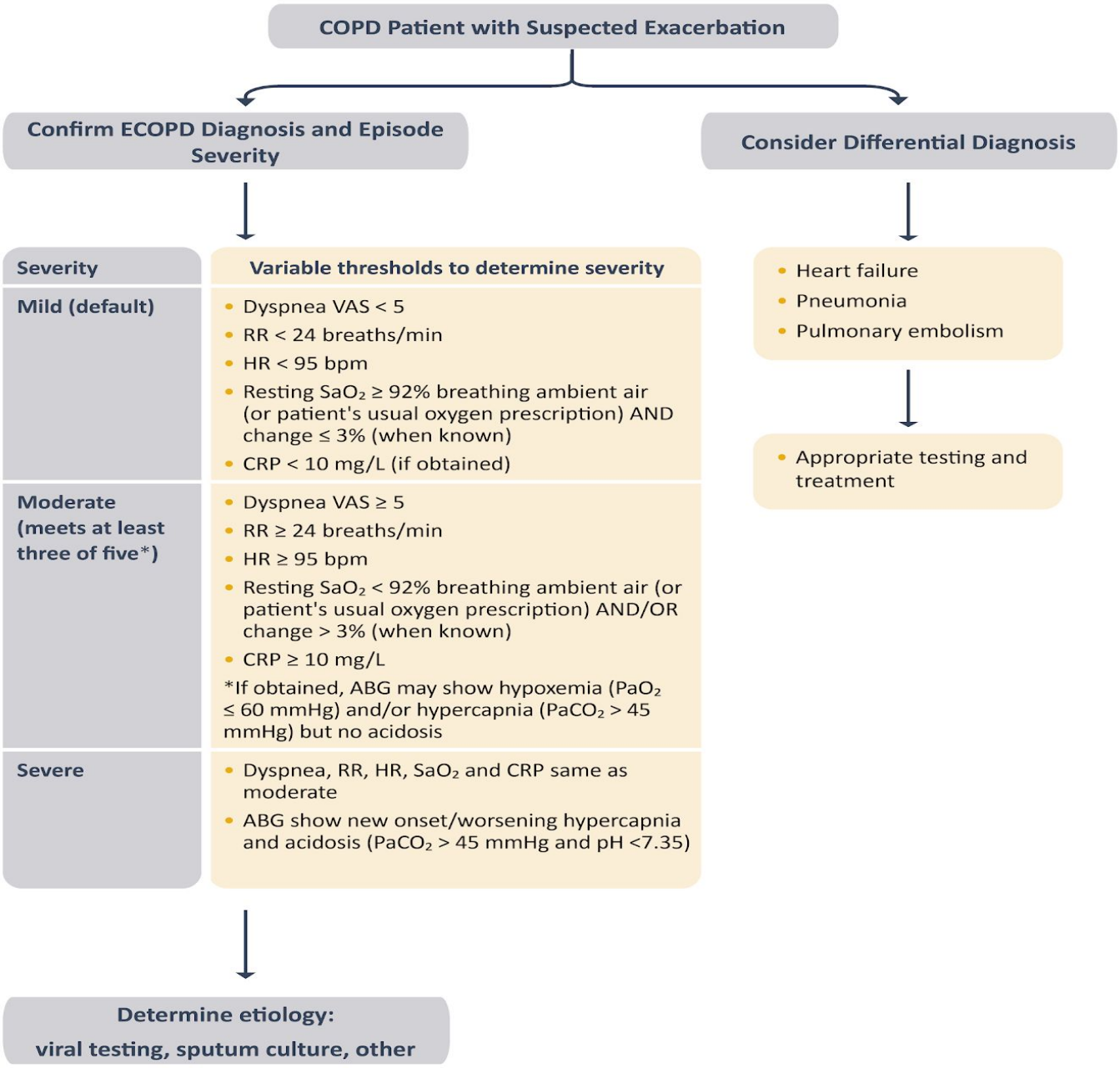
1- LVRS : lung volume reduction surgery . Benefits: 1- Improve lung functions 2- Reduce inflammation 3- Prevents exacerbation
2- If the patient has severe emphysema affecting top of the lung, then you can use this to remove the emphysematous tissue.
3- To get rid of a big bullae (Big, useless, air filled sac) in the lung.
4- Last option, when the lung are unfixable. Because the median survival is 5-10 years only, then the patient dies. The risk of dying after 1 month of transplant is 10% . So it is not a cure, it is another disease!

COPD exacerbations

you have to have definition otherwise everybody will have it's own diagnosis

Definition

COPD exacerbations are defined as: an acute worsening of respiratory symptoms that result in additional therapy.



Extra 39 slides

Mild[1]

short acting bronchodilators only (SABDs) e.g. inhaled salbutamol

Moderate

SABDs
+ antibiotics and/or oral corticosteroids

Severe

hospitalization or ER. may also be associated with **acute respiratory failure**[2].

-Depend on the level of exacerbation give the treatment
1- No need to be hospitalized.
2- Do ABCDs first

Extra 39 slides

classification of hospitalized patients

No respiratory failure

01

- Respiratory rate: 20-30 breaths per minute
- No use of accessory respiratory muscles
- No changes in mental status
- Hypoxemia improved with supplemental oxygen given via Venturi mask 28-35% inspired oxygen (FiO_2);
- No increase in $PaCO_2$.

Acute respiratory failure (non- life threatening)[3]

02

- **Respiratory rate: >30 breaths per minute**
- **Using accessory respiratory muscles**
- **No changes in mental status** (not confused)
- Hypoxemia improved with supplemental oxygen given via Venturi mask 25-30% inspired oxygen (FiO_2)
- hypercarbia (i.e. $PaCO_2$ increased compared with baseline or elevated 50-60 mmHg)

Acute respiratory failure (life threatening)

03

- Respiratory rate: >30 breaths per minute
- Using accessory respiratory muscles
- **Acute changes in mental status** (confused)
- **Hypoxemia not improved** with supplemental oxygen given via Venturi mask or requiring >40% inspired oxygen (FiO_2)
- hypercarbia (i.e. $PaCO_2$ increased compared with baseline or elevated >60 mmHg) or presence of acidosis (pH≤7.25).

.

3- Treated with steroids , regular bronchodilators and antibiotics . Usually they recover after few days and sent home .

COPD exacerbations *(cont.)*

Management of exacerbations

→ Bronchodilators
- Inhaled or nebulizer.
- Salbutamol and ipratropium bromide are given 4–6 hourly together

→ Antibiotics
- Given if there's evidence of infection (confirm by CXR or sputum).
- cefaclor or co-amoxiclav, are given if there is a history of more purulent sputum production or with chest X-ray changes. Antibiotic treatment is modified depending on sputum culture results.

→ Corticosteroids
- OCS e.g.30-40 mg Prednisolone for 5-7 days
- short course Prednisolone

→ Controlled O_2 therapy
- Why don't we give them as much O_2 as they need ? [1]

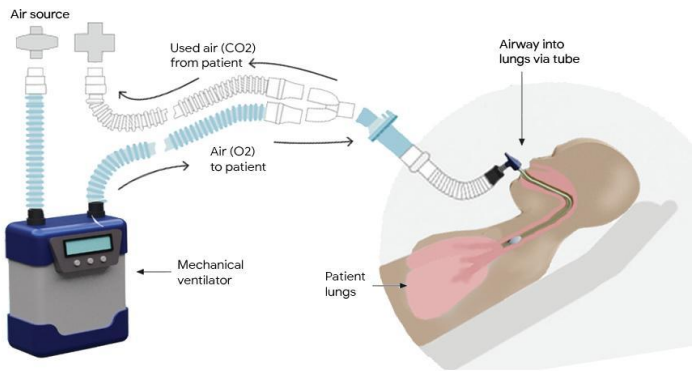
→ Ventilatory support;non invasive/invasive

➔ *indications for noninvasive mechanical ventilation (NIV):*

NIV: delivery of oxygen via a face or nasal mask and therefore eliminating the need of an endotracheal airway. The patient wears a tight-fitting nasal (Mouth have to be kept close if you're using a nasal mask) or face mask, which is connected to a CPAP unit. The treatment provides a larger tidal volume with the same inspiratory effort, thus improving alveolar ventilation and decreasing the work of breathing.

At least one of the following:
- Respiratory acidosis (PaCO2 ≥ 6.0 kPa or 45 mmHg and arterial PH ≤ 7.35)
- Severe dyspnea with clinical signs suggestive of respiratory muscle fatigue, increased work of breathing or both such a respiratory accessory muscles, paradoxical motion of the abdomen or retraction of the intercostal spaces
- persistent hypoxemia despite supplemental oxygen therapy

➔ *invasive mechanical ventilation*
- Unable to tolerate NIV or NIV failure
- Status post-respiratory or cardiac arrest
- Diminished consciousness,psychomotor agitation inadequately controlled by sedation
- Massive aspiration or persistent vomiting
- Persistent inability to remove respiratory secretions
- Severe hemodynamic instability without response to fluids and vasoactive drug
- Severe ventricular or supraventricular arrhythmias
- Life-threatening hypoxemia in patients unable to tolerate NIV



Extra 39 slides

➔ *indications for respiratory or medical intensive care unit admission:*

1. **Dyspnea:** Severe dyspnea that responds inadequately to initial emergency therapy.
2. **Mental status:** Confusion, lethargy and coma.
3. **Blood chemistry:** Persistent/worsening hypoxemia (PaO2 < 5.3 kPa or 40 mmHg). severe/worsening respiratory acidosis (PH < 7.25) despite supplemental oxygen and noninvasive ventilation.
4. **Ventilation:** need for invasive mechanical ventilation.
5. **Hemodynamic instability:** need for vasopressors.

1- Risk do decompansated type 2 respiratory failure (maintain the saturation between 88-92%
Because hypoxia is the driving force in these pts. First, you should tell the nurse that the saturation shouldn't be above 92% and not below 88% (88-92%) otherwise they'll increase it up to 99%. And if that happens, you blunt the hypoxic drive, the patient will have high CO_2 → acidosis occurs and the patient becomes unconscious. For better understanding, read this amazing explanation Here.

Bronchiectasis توسّع القصبات

Definition

This term describes abnormal and permanently dilated airways. Bronchial walls become inflamed, thickened and irreversibly damaged. The mucociliary transport mechanism is impaired and **frequent bacterial infections ensue.** originally described by Laennec in 1819 as **chronic debilitating disease.**

Characteristics

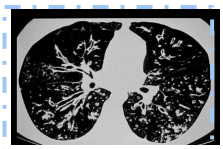
1. **Persistent cough**
2. **Excessive sputum secretions**[1] Mostly in the morning
3. **Recurrent airway infection**[1]

Etiology

Congenital	Acquired
• **Kartagener's syndrome** (primary ciliary dyskinesia or immotile cilia syndrome) • **Hypogammaglobulinemia** corrected by globulin infusions. • **Cystic fibrosis** they have a problem in hydrating their airways , NaCl channel is abnormal, mucous within airways is very thick and block the airway. • Abnormal cartilage formation[2] • Pulmonary sequestration.	• **Recurrent pulmonary infection** (eg: bacterial and viral pneumonia) • **Bronchial obstruction**[3] • **Childhood infection** e.g measles, pertussis • Aspiration (eg: GERD) • Granulomas (eg: TB & sarcoidosis)

Pathophysiology

- Permanent abnormal dilatation
- impaired mucociliary clearance
- bacterial colonisation
- excessive airways inflammation

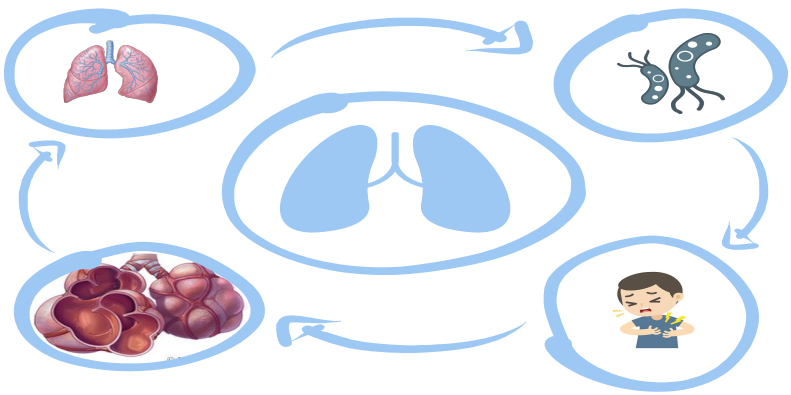


Airway dilated and thickened and some fill with secretion

Pathogenesis[4]

Impaired lung defences[5]

mucus accumulation & stasis



Microbial infection

bacterial infection → further remodeling and damage
E.x: TB , child measles

inflammation

E.x : Ulcerative colitis and crohn's disease. Bronchiectasis is the most common pulmonary manifestation of IBD. Inhaled corticosteroids are used in these pts.

Tissue damage

Airway obstruction & dilation

1: Bronchiectasis is similar to COPD except for these two feature.
2: If the cartilage is very floppy, airways won't be able to contract and clear secretions.
3: Can be intrinsic (e.g.: foreign body, post TB stenosis, tumor) or extrinsic (e.g.: lymph node, tumor), this will lead to accumulation of secretions distal to the obstruction leading to inflammation and infection
4: The onset of bronchiectasis could be anywhere in this circle e.g. Severe infection will lead to inflammation and tissue damage and eventually bronchiectasis. The principle of management is to interfere with this vicious cycle.
5: e.g. If cilia are non-motile (Unable to clear secretions, bacteria) or Immunodeficiency. What are the lung defences ? 1- Mucociliary clearance (when impaired becomes unable to clear secretions naturally) 2- Immunoglobulins (congenital hypogammaglobulinemia results in getting infections easily) .

Cystic Fibrosis التليف الكيسي

Impaired Lung Defences

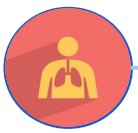
Definition

CF is a hereditary autosomal recessive disorder caused by defective **CFTR** (cystic fibrosis transmembrane conductance regulator) protein due to mutation in the *CFTR* gene located on the long arm of **chromosome 7**.

Pathophysiology

In general

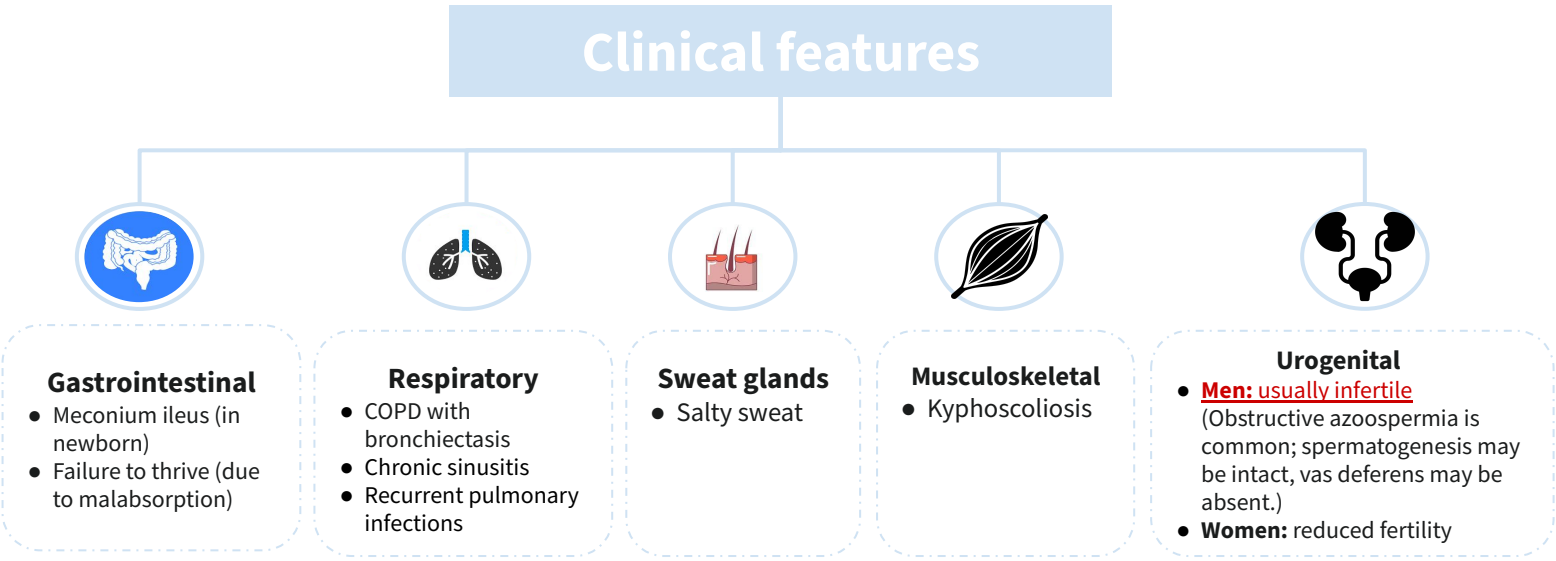
Mutated *CFTR* gene → **misfolded protein** → retention for degradation of the defective protein in the rough endoplasmic reticulum (rER) → **absence of ATP-gated chloride channel** on the cell surface of epithelial cells throughout the body (e.g., intestinal and respiratory epithelia, sweat glands, exocrine pancreas, exocrine glands of reproductive organs)



In GIT and lungs

Defective ATP-gated chloride channel → inability to transport intracellular Cl- across the cell membrane → reduced secretion of Cl-and H2O → accumulation of intracellular Cl- → ↑ Na+ reabsorption (via ENaC) → ↑ H2O reabsorption → formation of hyperviscous mucus → accumulation of secretions and blockage of small passages of affected organs → chronic inflammation and remodeling →organ damage

Clinical features



Diagnosis

What's the best initial test? Sweat chloride test (A chloride concentration **≥ 60 mmol/L** indicates a likely diagnosis of cystic fibrosis)

Primary ciliary dyskinesia (PCD)

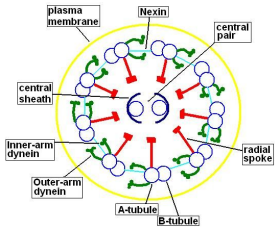
خلل الحركة الهدبية الأولي

Impaired Lung Defences

Definition

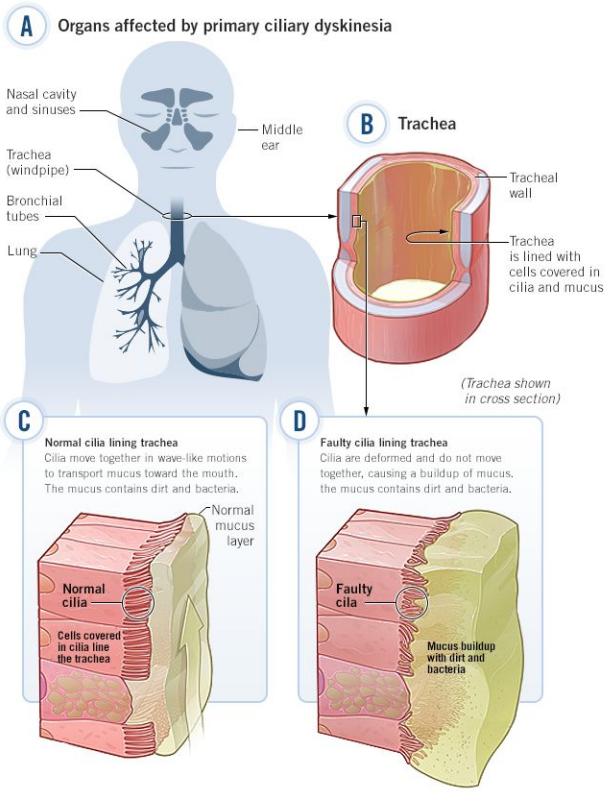
This is rare **autosomal recessive** disorder characterized by **absent or dysmotile cilia** caused by a defect in the **dynein arm** of microtubules

Clinical features



Clinical features

- **Chronic productive cough**
- **Recurrent otitis, sinusitis, and nasal polyps**
- **Bronchiectasis**
- **Conductive hearing loss**
- **Infertility in men due to decreased sperm motility as a result of defective flagella**
- **Reduced fertility in women (and rarely ectopic pregnancy) due to defective cilia in fallopian tubes**



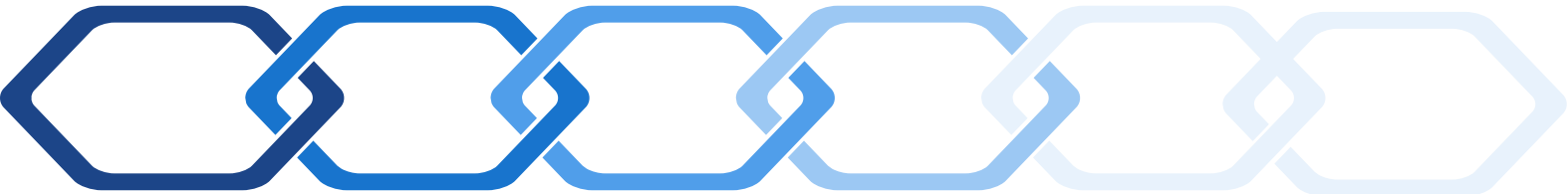
Kartagener syndrome:
Kartagener syndrome is a subtype of primary ciliary dyskinesia characterized by the **triad** of ***situs inversus***, ***chronic sinusitis***, and ***bronchiectasis***.
Tip: You can memorize the cause of Kartagener syndrome by thinking of **Kartagener**'s restaurant that only has 'take-out' service because there is no **dine-in (dynein)!**

Diagnosis

- **Nasal nitric oxide test:** reduced nasal nitric oxide (screening test)
- **Genetic tests** for dynein arm mutations
- **Chest x-ray: bronchiectasis**, dextrocardia, and **situs inversus** (suggests Kartagener syndrome)
- **Electron microscopy:** abnormal cilia

Bronchiectasis

Clinical features[1]



similar to COPD

with increased likelihood for infections commonly pneumonias

Chronic cough

with large amount of mucopurulent copious foul smelling sputum

Hemoptysis

due to rupture of blood vessels near bronchial wall surface

Clubbing of fingers

Others

Dyspnea, Weight loss and Fever.

Thought to have COPD:

COPD with bronchiectasis, No history of smoking, There is slow recovery from lower respiratory tract infections, Recurrent exacerbation and Sputum growth/colonised with Pseudomonas aeruginosa

When to suspect bronchiectasis?

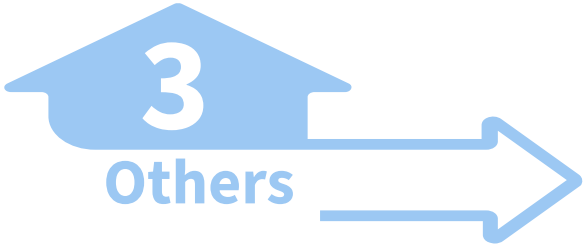
chronic productive cough[2]

especially if:

- young age at presentation .
- symptoms over many years.
- absence of smoking history.
- daily expectoration of large volumes of sputum.
- hemoptysis.

Past history of:

- Recurrent LRTI.
- Chronic productive cough.
- Breathlessness, wheeze.
- haemoptysis.
- Chest pain
- Tiredness
- (ENT,infertility,GI,ILD)[3]



consider:

only when other ddx are excluded, consider unexplained:

- hemoptysis.
- non-productive cough

1: As the condition worsens, patients suffer persistent halitosis, recurrent febrile episodes with malaise, and episodes of pneumonia. coarse crackles can be heard over the infected areas, usually the lung bases. When the condition is severe there is continuous production of foul-smelling, thick, khaki-coloured sputum. Haemoptysis can occur either as blood-stained sputum or as a massive haemorrhage. Breathlessness may result from airflow limitation.

2: Usually increased in the morning.

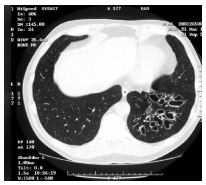
3: If ENT (e.g. deafness, recurrent sinusitis) or Infertility think of PCD and CF. For GI symptoms think of CF.

4:The first step in diagnosing bronchiectasis is to establish the cause mainly through history

Bronchiectasis

Investigations

Sputum Culture	• Sputum examination and culture are **essential for adequate treatment**.
	• The major pathogens are:
	  ○ Staph. aureus.
	  ○ Pseudomonas aeruginosa.
	  ○ H. influenzae
	  ○ anaerobes.
	• **Other pathogens**: Strep.pneumoniae, Klebsiella pneumoniae, Aspergillus fumigatus[1] & Mycobacterium avium-intracellulare complex (MAI).
	• Sputum microscopy culture sensitivities are done when patient is stable or at the onset of exacerbating[2].

High resolution-CT (HR-CT scan) (Gold standard)	• **thickened, dilated bronchi** • **cysts** at the end of the bronchioles. • Characteristically, the airways are larger than their associated blood vessels. • Gives an idea of the degree of bronchiectasis  Dilated airways at the bottom of the left lung (signet ring sign)
CXR	Can be **normal**, but sometimes shows: • dilated bronchi with thickened bronchial walls • sometimes multiple cysts containing fluid
Other investigations	Spirometry[3], Sinus x-ray, Serum immunoglobulins, Sweat electrolytes (when CF is suspected) & Mucociliary clearance

Management

- **Chest physiotherapy** — To keep the lungs clear
- **Postural drainage**
- **Antibiotics**
- **Inhaled bronchodilators & Anti inflammatory** — To open up the airways
- **Immunization** — To prevent infections
- **Nebulised saline** — To hydrate the airways and make the sputum easier to cough
- **Mucolytics** — To breakdown the mucus and get rid of sputum

1: Aspergillus fumigatus can be isolated from 10% of sputum specimens in cystic fibrosis, but the role of this organism in producing infection is uncertain. Treatment of Aspergillus is prednisolone 30 mg daily (± Antifungal agent (itraconazole, voriconazole) if high doses of steroids are used).
2: tells you what the patient is infected with at the onset of exacerbation
3: to establish the amount of damage the bronchiectasis has caused to the lung (the amount of damage is parallel to the abnormalities in PFTs)

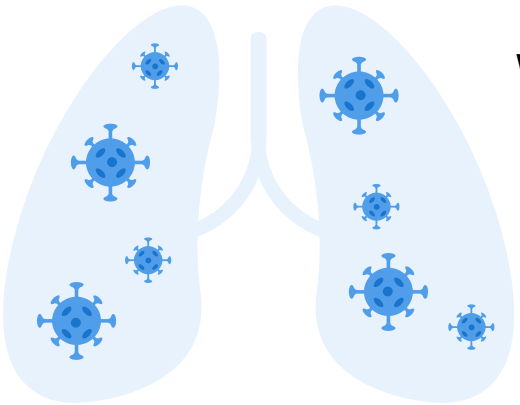
Exacerbations Of Bronchiectasis

How to spot a Bronchiectasis exacerbation?[1]

Deterioration over days

Increasing Cough

Increased sputum volume or change of viscosity



Non specific

Increased sputum purulence + increasing wheeze & breathlessness

Haemoptysis

Systemic upset
e.g. fever, hypoxia

Management of Bronchiectasis exacerbation

1 Antibiotics

➔ **1st: Empiric therapy** You don't have to know the doses.

Drug	dose		duration
Amoxycillin Severe bronchiectasis /colonized with H.influenza	500mg tds		14 days
	H.influenzae:	1g tds	
		3g bd	
clarithromycin	500 bd		
ciprofloxacin	Pseudomonas	500/750 bd	

➔ **2nd: Long term antibiotics**

- **Used in case of:**
  - 3 or more Exacerbations/yr.
  - Fewer Exacerbation in patients with significant morbidity.
- **Use:**
  - Nebulised antibiotics (Gentamicin/tobramycin/colistin)
  - Long term Macrolides[2]

1: **First Q:** Does the pt have an exacerbation? Check the features listed. If the answer is YES, your **Second Q** must be what's the antibiotic of choice? Usually in Bronchiectasis we give high doses for long duration (14 days).
2: Macrolides have both anti-microbial and anti-inflammatory activity.

Exacerbations Of Bronchiectasis *(cont.)*

2 When to admit the patient?

- Cyanosis
- Confusion
- Breathlessness (RR >25/minute)
- Circulatory & respiratory failure
- Temperature >38°C
- Patient unable to take oral therapy
- Patient unable to cope at home
- Haemoptysis >25mls/day

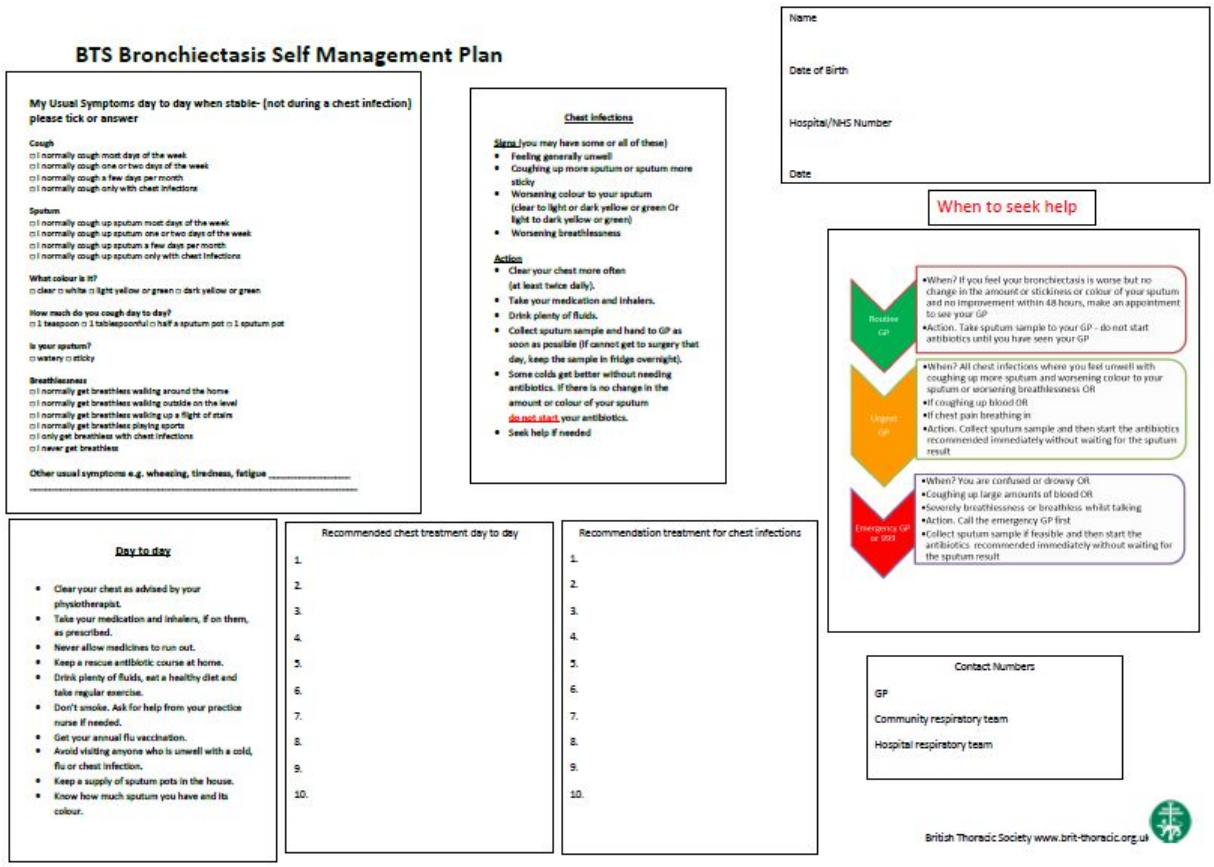
Use:

Intravenous therapy in patients with clinical failure after oral antibiotics

3 How to monitor a bronchiectasis patient ?

- Symptoms.
- Sputum Volume 24hrs/Purulence.
- Frequency of Exacerbations/yr.
- Frequency of Antibiotic use.
- FEV1/ FVC annually.
- CXR only if indicated.

Doctor slides



BTS Bronchiectasis Self Management Plan

My Usual Symptoms day to day when stable- (not during a chest infection) please tick or answer

Cough
□ I normally cough most days of the week
□ I normally cough one or two days of the week
□ I normally cough a few days per month
□ I normally cough only with chest infections

Sputum
□ I normally cough up sputum most days of the week
□ I normally cough up sputum one or two days of the week
□ I normally cough up sputum a few days per month
□ I normally cough up sputum only with chest infections

What colour is it?
□ clear □ white □ light yellow or green □ dark yellow or green

How much do you cough day to day?
□ 1 teaspoon □ 1 tablespoonful □ half a sputum pot □ 1 sputum pot

Is your sputum?
□ watery □ sticky

Breathlessness
□ I normally get breathless walking around the home
□ I normally get breathless walking outside on the level
□ I normally get breathless walking up a flight of stairs
□ I normally get breathless playing sports
□ I only get breathless with chest infections
□ I never get breathless

Other usual symptoms e.g. wheezing, tiredness, fatigue _____

Chest Infections

Signs (you may have some or all of these)
- Feeling generally unwell
- Coughing up more sputum or sputum more sticky
- Worsening colour to your sputum (clear to light or dark yellow or green Or light to dark yellow or green)
- Worsening breathlessness

Action
- Clear your chest more often (at least twice daily).
- Take your medication and inhalers.
- Drink plenty of fluids.
- Collect sputum sample and hand to GP as soon as possible (If cannot get to surgery that day, keep the sample in fridge overnight).
- Some colds get better without needing antibiotics. If there is no change in the amount or colour of your sputum do not start your antibiotics.
- Seek help if needed

Name

Date of Birth

Hospital/NHS Number

Date

When to seek help

Routine GP
- When? If you feel your bronchiectasis is worse but no change in the amount or stickiness or colour of your sputum and no improvement within 48 hours, make an appointment to see your GP
- Action. Take sputum sample to your GP - do not start antibiotics until you have seen your GP

Urgent GP
- When? All chest infections where you feel unwell with coughing up more sputum and worsening colour to your sputum or worsening breathlessness OR
- If coughing up blood OR
- If chest pain breathing in
- Action. Collect sputum sample and then start the antibiotics recommended immediately without waiting for the sputum result

Emergency GP or 999
- When? You are confused or drowsy OR
- Coughing up large amounts of blood OR
- Severely breathlessness or breathless whilst talking
- Action. Call the emergency GP first
- Collect sputum sample if feasible and then start the antibiotics recommended immediately without waiting for the sputum result

Day to day
- Clear your chest as advised by your physiotherapist.
- Take your medication and inhalers, if on them, as prescribed.
- Never allow medicines to run out.
- Keep a rescue antibiotic course at home.
- Drink plenty of fluids, eat a healthy diet and take regular exercise.
- Don't smoke. Ask for help from your practice nurse if needed.
- Get your annual flu vaccination.
- Avoid visiting anyone who is unwell with a cold, flu or chest infection.
- Keep a supply of sputum pots in the house.
- Know how much sputum you have and its colour.

Recommended chest treatment day to day
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

Recommendation treatment for chest infections
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

Contact Numbers
GP
Community respiratory team
Hospital respiratory team

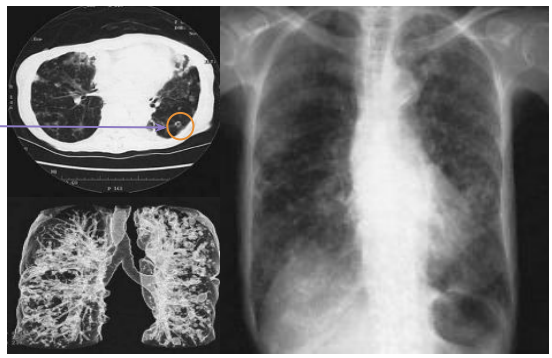
British Thoracic Society www.brit-thoracic.org.uk

Bronchiectasis cases

Case study 1

An 81-year-old woman was admitted with weight loss (18 kg in 27 months), hemoptysis, and tubular and diffuse granular shadows on her chest radiograph.

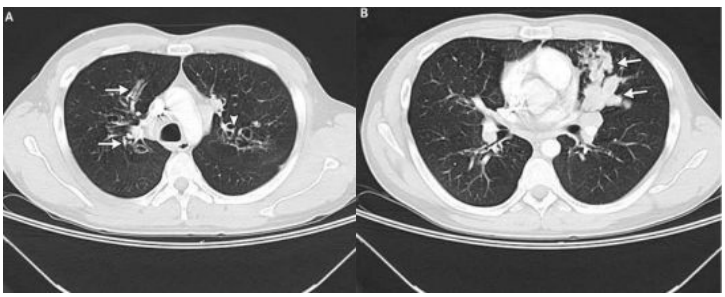
- **Features:**
  - CT: Dilated airways & Signet ring sign
- **What is your diagnosis?** Mycobacterium avium complex (MAC) infection of bronchiectasis



Case study 2

A 26-year-old man who smoked and had a long history of **poorly controlled asthma** and **severe environmental allergies** was admitted for an exacerbation of asthma Total **IgE 5000** Aspergillus IgE **raised Aspergillus antibody raised.**

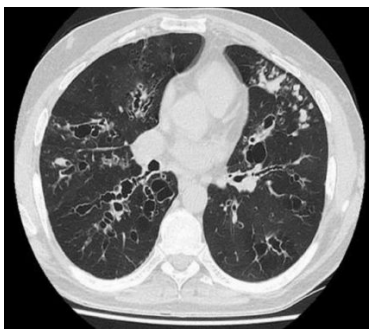
- **What is your diagnosis?** Allergic bronchopulmonary aspergillosis (ABPA)
- **Features:**
  - **Pic A:** Dilated airways
  - **Pic B:** Airways are plugged with mucus (Finger in glove appearance)



Case study 3

34-year-old man with recurrent respiratory infections and Chest problems since childhood. he told that he had asthma but inhalers are not effective. He struggled at school due to frequent absence due to "chest infections". He is married but no children[1]. His sister and Cousin have similar chest problems

- **What is your diagnosis?** Cystic fibrosis (CF)
- **Features:**
  - **CT:**
    - Dilated airways
    - Airways full with secretion



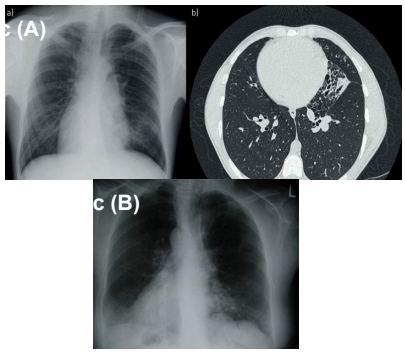
1: 100% of male patients with CF will be infertile

Bronchiectasis cases

Case study 4

A 17-Year-old with **Respiratory problems since childhood**. His grand parents describe him as a small child with **chronic cough from birth, Recurrent ear and sinus infections** which have led to partial deafness. **His brother and one of his cousins are similarly affected**

- **What is your diagnosis?** PCD (Katergener's)
- **X-ray: both pictures show dextrocardia**
  - **Pic (A):** Enlarged cardiac compartment
  - **Pic (B):** Heart is completely pushed to the right
- **CT:** Dilated airways

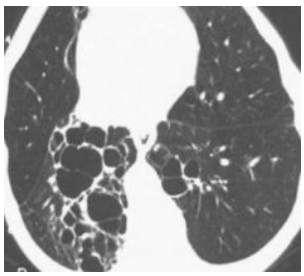


Case study 5

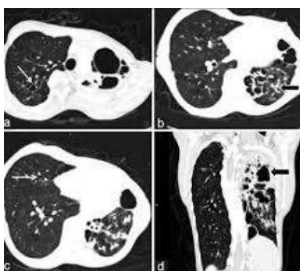
Patient A: 75 year old lady had TB 55 years ago, Chronic cough and SOB. Recurrent LRTI and Sputum production.
Patient B: 79 year old man presents Cough, sputum production and recurrent LRTI.

- **What is your diagnosis?** Post TB
- **CT:** Left lung is destroyed with thickened airways

Patient A



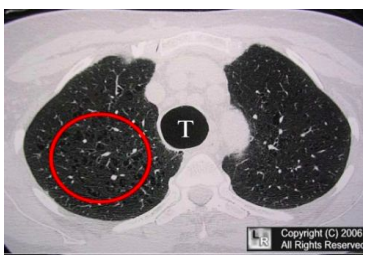
Patient B

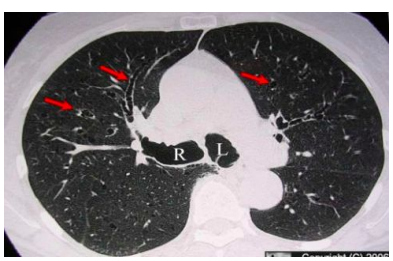


Case study 6

35-year-old man with chronic cough, increased sputum production, breathlessness with fever. Computed tomography of chest showed tracheal dilation (diameter, 31 mm) and emphysematous changes. Fiberoptic bronchoscopy revealed enlarged trachea and main bronchi. Pulmonary function testing showed combined ventilatory defect.

- **What is your diagnosis?** Mounier-kuhn syndrome
- These patients have very large non-functioning airways making them prone to some infections.
- **CT:** Tracheobronchomegaly

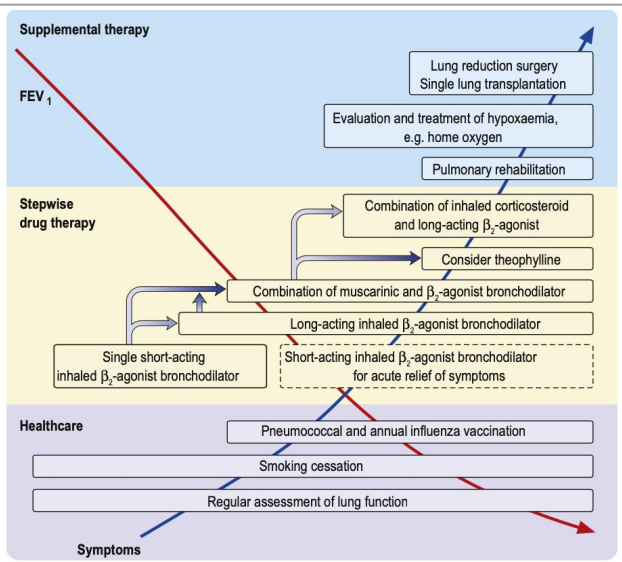




Summary

Chronic obstructive pulmonary disease	
Definition	• **Emphysema:** permanent enlargement of airspaces due to destruction of alveolar walls. • **Chronic Bronchitis:** inflammation and scarring in airways, and excess mucus production narrowing the airways.
Risk factor	• Smoking • α_1-antitrypsin deficiency • Environmental factors • Chronic Asthma

Clinical Features	• **Signs:**
	  ○ Prolonged expiratory time
	  ○ Wheezing
	  ○ Tachypnea, tachycardia
	  ○ Cyanosis
	  ○ Use of accessory respiratory muscles
	  ○ Hyperresonance on percussion
	  ○ Signs of Cor Pulmonale
	• **Symptoms:**
	  ○ Chronic and progressive dyspnea
	  ○ Cough
	  ○ Sputum production
	  ○ Wheezing and chest tightness

Diagnosis	• Pulmonary function testing (Spirometry): ↓ FEV1 and ↓ FEV1/FVC ratio. • CXR: overinflation of the lungs with low, flattened diaphragms. • α1-antitrypsin: in patients with a personal or family history of premature emphysema (≤50 years old). • Arterial blood gas (ABG): chronic PCO2 retention, decreased PO2.
Management	

Complications	• Acute exacerbations:
	  ○ Mild ⟶ short acting bronchodilators SABD
	  ○ Moderate ⟶ SABD plus antibiotics and/or oral corticosteroids
	  ○ Severe ⟶ patient requires hospitalization and may also be associated with acute respiratory failure.
	• Respiratory failure
	• Pulmonary hypertension/Cor pulmonale

Summary

Bronchiectasis	
Definition	Permanent dilation of bronchi and bronchioles caused by destruction of the muscle and supporting elastic tissue, resulting from or associated with chronic necrotizing infections.

Causes	• **Acquired bronchiectasis:**
	  ○ Recurrent pulmonary infection (e.g. pneumonia, and tuberculosis)
	  ○ Bronchial obstruction caused by (e.g. asthma, and chronic bronchitis)
	• **Congenital bronchiectasis:**
	  ○ Kartagener's syndrome (primary ciliary dyskinesia)
	  ○ Hypogammaglobulinemia·
	  ○ Cystic fibrosis

Clinical Features	• Persistent cough • Excessive sputum secretions • Recurrent airway infection • Clubbing of fingers • Hemoptysis • Dyspnea, Weight loss and Fever
Diagnosis	• Culture patient's sputum • HR-CT scan **(Gold Standard)** • CXR shows dilated bronchi with thickened bronchial walls • Spirometry reveals an obstructive pattern.
Management	• Empiric Antibiotic therapy (in acute exacerbations) • Chest physiotherapy (postural drainage,chest percussion) to help remove the mucus • Immunization • Inhaled bronchodilators • Mucolytics • Nebulised saline

Lecture Quiz

Q1: A 34-year-old man presents to the physician with progressive shortness of breath of several years' duration. Physical examination shows an increase in the anteroposterior diameter of the chest, hyperresonance to percussion, and diffuse wheezes. The patient is administered a combination nebulizer treatment of albuterol and ipratropium with only modest relief of symptoms. Laboratory studies are remarkable for elevated aspartate aminotransferase and alanine aminotransferase.A detailed history reveals that the patient has never smoked cigarettes or cigars, drinks one to two beers per week maximum, and has no history of illicit drug use. He has never traveled outside of the United States and works in billing. His mother is healthy, and his father died recently of liver failure. Which of the following parts of the respiratory pathway is most affected by his disease?

A- the central acinus
B- the distal acinus
C- the entire size of the mucous glands
D- the sub pleural region

Q2: A 30-year-old man presents to your clinic with a cough and finger clubbing. From the list below, which of these answers is not a respiratory cause of finger clubbing?

A- Empyema
B- Cystic fibrosis
C- Bronchogenic carcinoma
D- COPD

Q3:A 72-year-old man is brought to the emergency department after an episode of hemoptysis. He has a chronic cough that is productive of copious sputum. Six years ago, he had a stroke that left him with difficulty swallowing. He smoked one pack of cigarettes daily for 40 years, but quit 2 years ago. His respirations are 25/min and labored. Physical examination shows digital clubbing. An x-ray of the chest shows tram track opacities in the lower lung fields. Which of the following is the most likely diagnosis??

A- Pulmonary embolism
B- Chronic bronchitis
C- Bronchiectasis
D- asthma

Q4: A 14-year-old boy is brought to the physician because of increasing swelling of his legs and generalized fatigue for 1 month. During this period he has also had a productive cough and shortness of breath. He has been unable to carry out his daily activities. He has a history of recurrent respiratory tract infections and chronic nasal congestion since childhood. He has a 3-month history of foul-smelling and greasy stools. He is at the 4th percentile for height and weight. His temperature is 37.0°C (98.6°F), pulse is 112/min, respirations are 23/min, and blood pressure is 104/64 mm Hg. Examination shows clubbing of his fingers and scoliosis. There is 2+ pitting edema of the lower extremities. Jugular venous distention is present. Inspiratory crackles are heard in the thorax. Cardiac examination shows a loud S2. The abdomen is mildly distended and the liver is palpated 2 cm below the right costal margin. Hepatojugular reflux is present. Which of the following is the most likely diagnosis?

A- COPD
B- cystic fibrosis
C- empyema
D- pulmonary embolism

Answers: Q1:C | Q2:D | Q3:C | Q4:B |

Answers Explanation File!

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