Welcome
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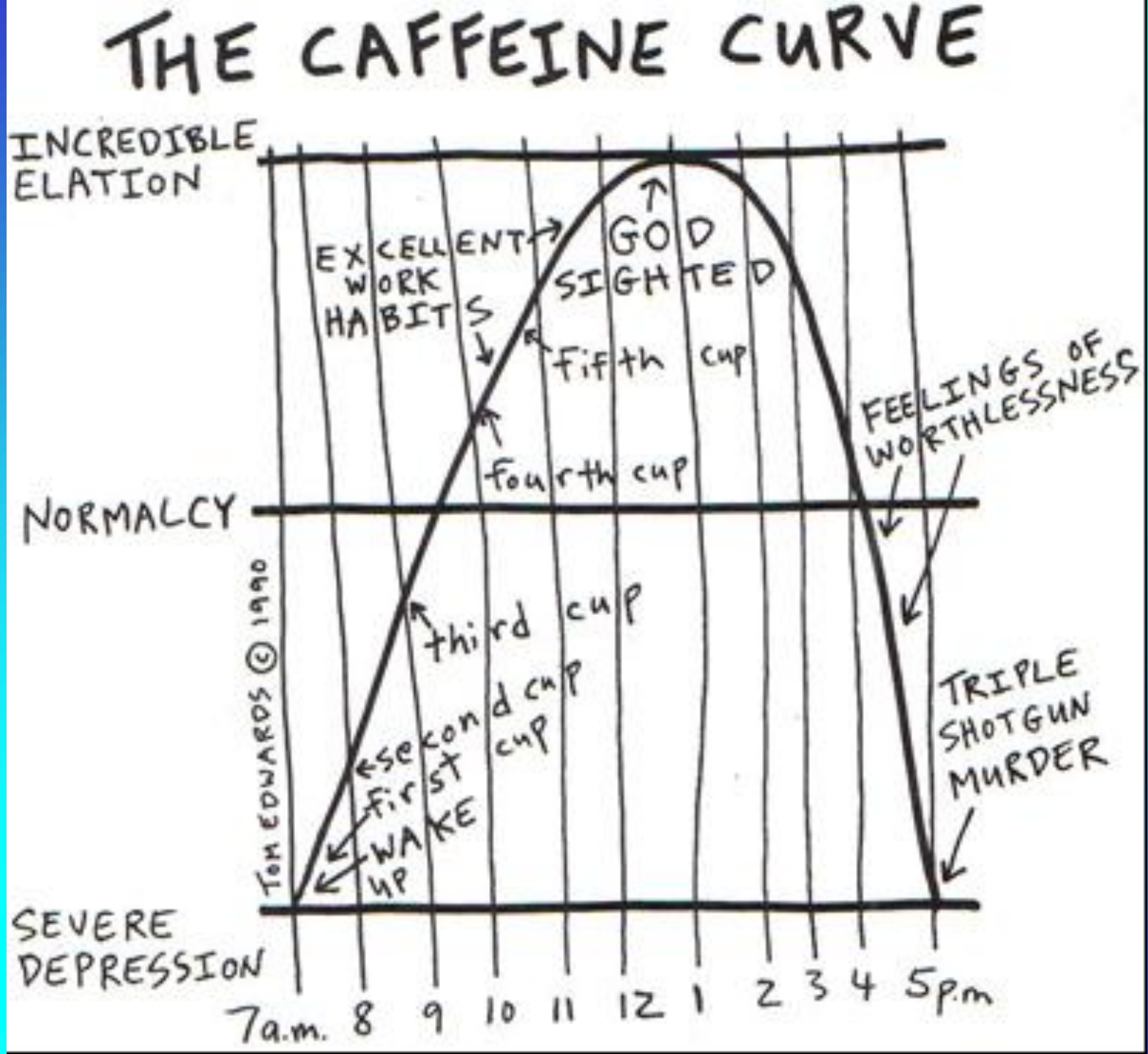
Before we start !?

Respiratory Medicine book Suggestion!

- ERS handbook
- Respiratory medicine
  - Editors Paolo Palange and Anita Simond
  - ISBN 978-1-904097-99-0
- Can be brought online: www.ersnet.org/handbook
- Not all chapters are important

- ONCE A COPI OF THE BOOK EACH HANDBOOK ARTICLE IS AVAILABLE TO DOWNLOAD AS A PDF !


THE CAFFEINE CURVE
INCREDIBLE ELATION
NORMALCY
SEVERE DEPRESSION
EXCELLENT WORK HABITS
GOD SIGHTED
Fifth cup
fourth cup
third cup
second cup
first cup
WAKE UP
FEELINGS OF WORTHLESSNESS
TRIPLE SHOTGUN MURDER
TOM EDWARDS © 1990
7a.m. 8 9 10 11 12 1 2 3 4 5p.m

Human Respiratory System

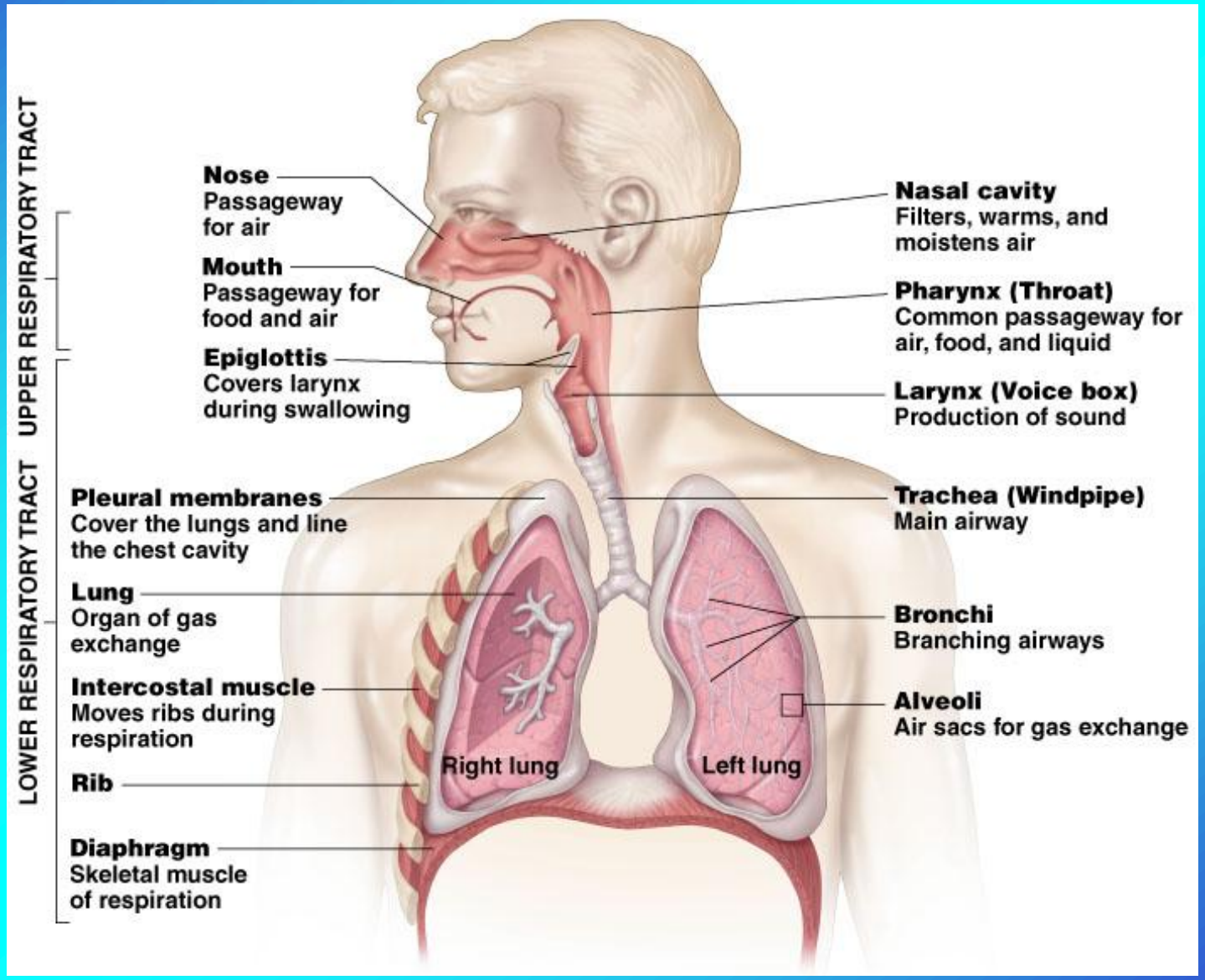
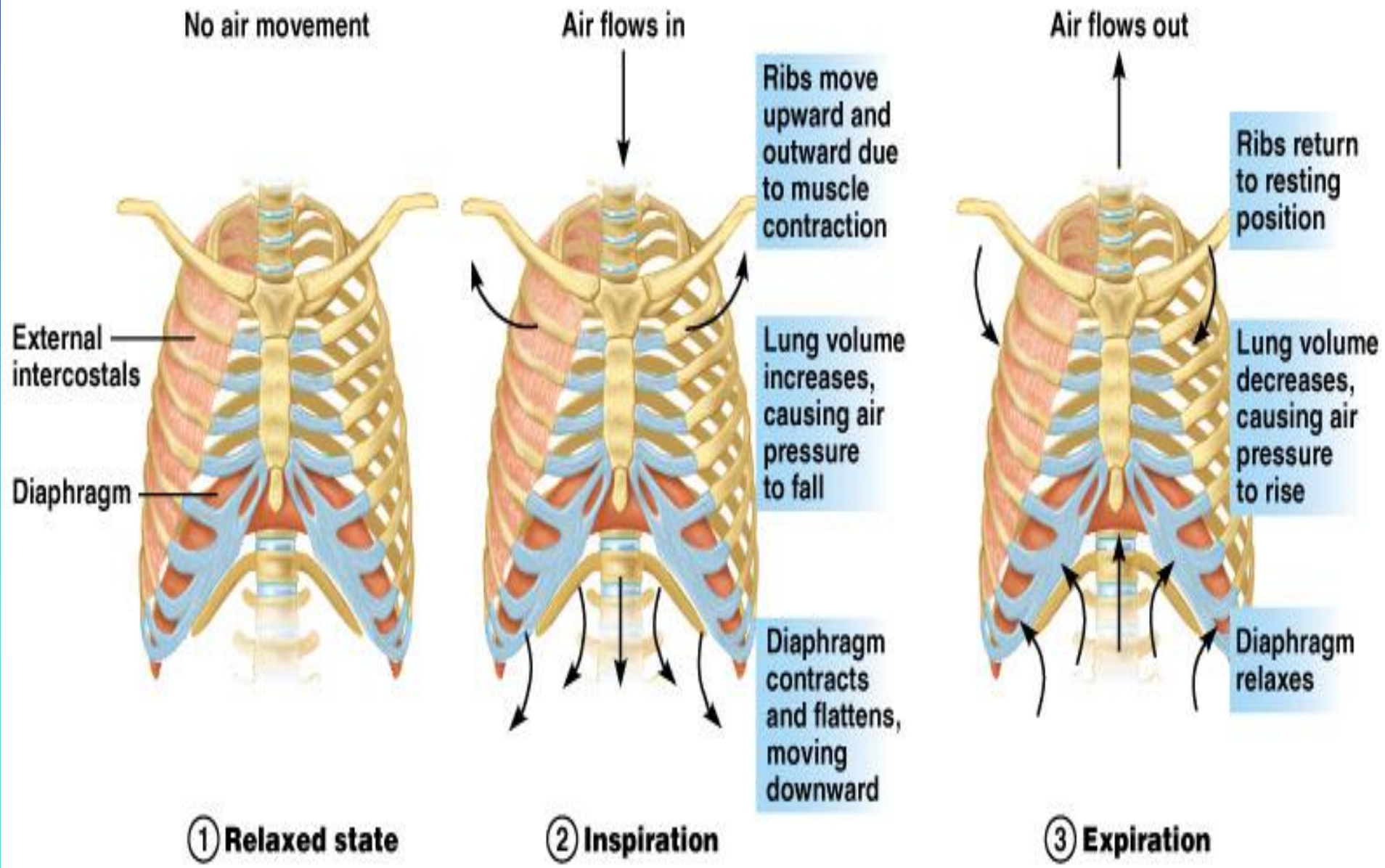


Figure 10.1

Respiratory Cycle



The respiratory system

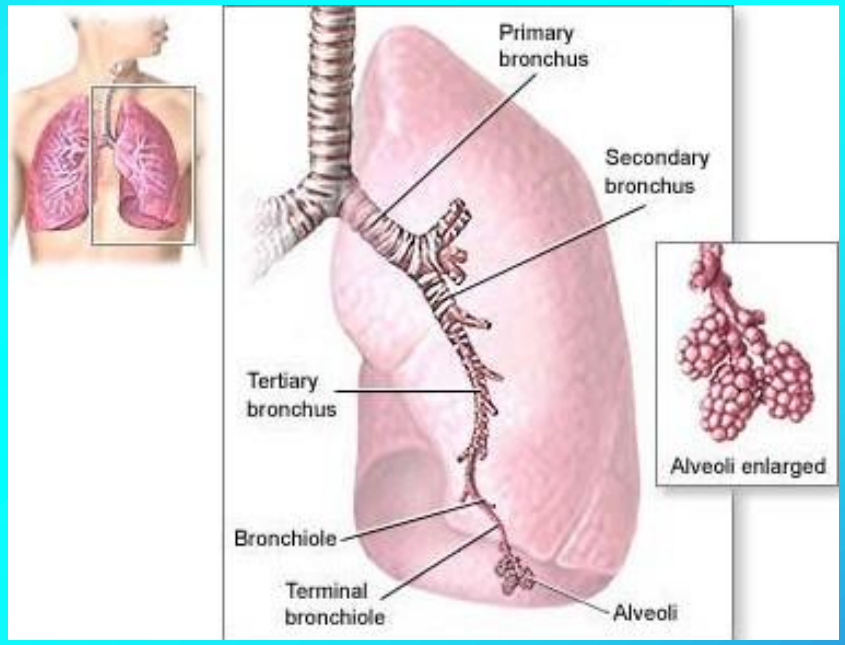
You most know the normal to recognize the abnormal

Rest	Breathe 6 liters air/minute
Heavy exercise	Breathe over 75 liters /minute
8 hr day of moderate activity	Up to 8.5m^3
Skin surface area	1.9m^2
Lungs surface area	28m^2 rest $\rightarrow$ 93 m^2 deep breath

Susceptible to damage from inhaled pathogens as bacteria virus or toxic materials & irritants

THE RESPIRATORY SYSTEM

- **Natural mechanism against airborne hazards**
- Fine hairs in nose
  -front-line barrier
  -filter
  -exercise/hard work
- Cough reflex –clears trachea & main bronchi
- Special cells-destroy bacteria & viruses



•Ciliary cells-few hrs to expect foreign material
•Innermost areas of lungs- much longer to clear out

Sign and symptoms

- Very rarely a sign or symptoms is 100 % specifik

How Should/does a doctor think ?

In reality he/she should be aware that he uses probabilities in decision making

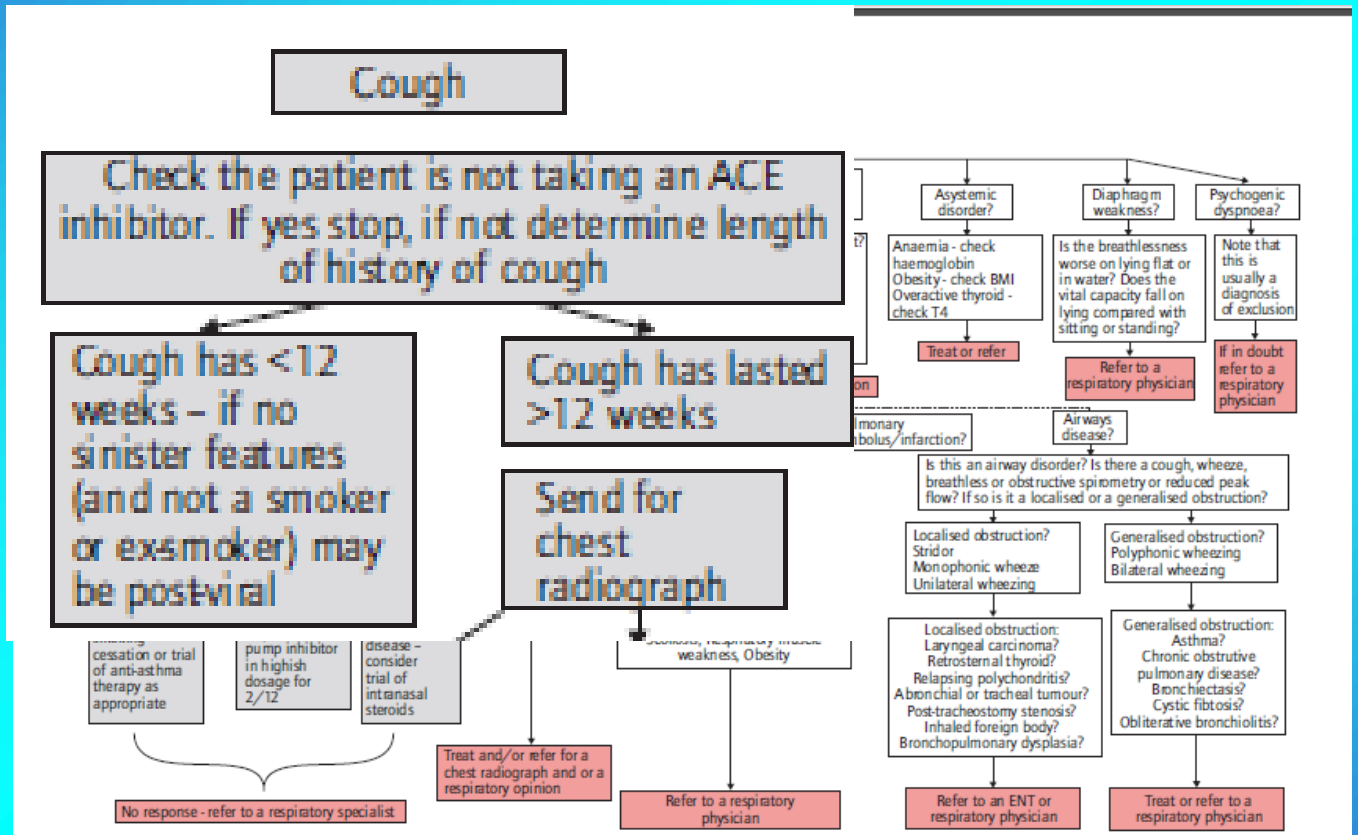


Figure 1. Diagnosis and management of respiratory disease. ACE: angiotensin-converting enzyme; DVT: deep vein thrombosis; FH: family history; VTE: venous thromboembolism; BMI: body mass index; COPD: chronic obstructive pulmonary disease; ENT: ear–nose–throat.

Nobody is god !!

Symptoms and sign

Respiratory system

Most common symptoms!

- Cough
- Sputum
- Dyspnoea
- Chest pain
- Haemoptysis
- And some others !?

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Respiratory system

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- Chest pain
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Test

What is the most common cause to acute cough in the community?

1. Bacterial infection
2. Fungal infection
3. Asthma
4. Virus infection
5. Rhinitis

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Test

- In a heavy smoker with cough and progressive hoarness which of the following tests will you suggest as the most relevant.

1. EKG
2. Ventilation/perfusion skintigrafi
3. Bronkoskopy
4. X-Ray Thorax
5. UL abdomen

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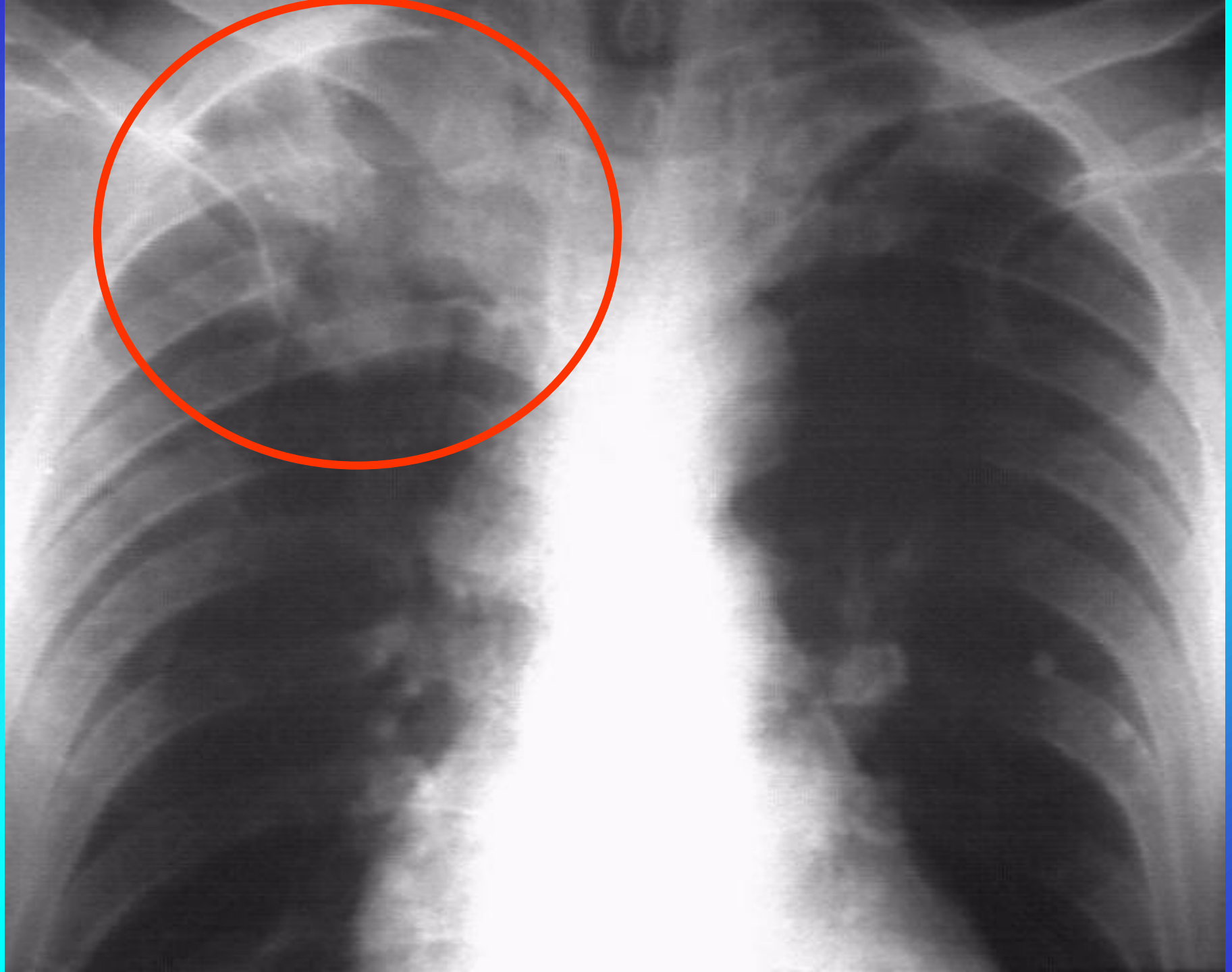
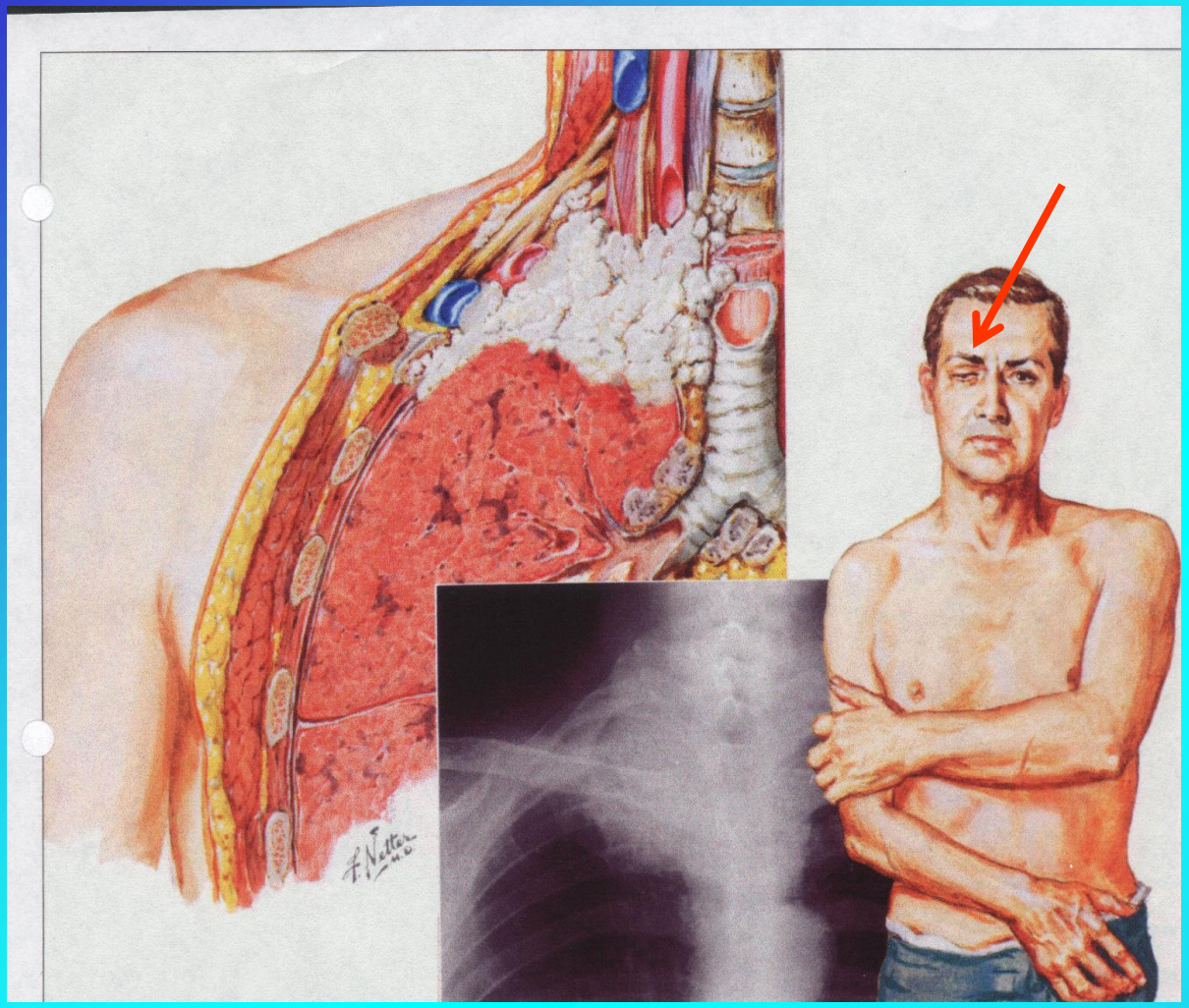




Horners syndrome:
Ptosis
Anhidrosis (decreased sweat)
Miosis(small)

Pancoast tumor (tumor in the apex of the lungs)

NB many other causes to horners syndrome: goitre, thyroid cancer, aneurism etc

Cough

- Acute
  - Viral infection
- Chronic

Also important to consider the combination with other symptoms

Table 2. Areas of enquiry in chronic cough

Hoarseness or a problem with your voice
Clearing your throat
The feeling of something dripping down the back of your nose or throat
Retching or vomiting when you cough
Cough on first lying down or bending over
Chest tightness or wheeze when coughing
Heartburn, indigestion, stomach acid coming up or do you take medications for this?
A tickle in your throat, or a lump in your throat
Cough with eating (during or soon after meals)
Cough with certain foods
Cough when you get out of bed in the morning
Cough brought on by singing or speaking (for example, on the telephone)
Coughing more when awake rather than asleep
A strange taste in your mouth

Cough
-often reasons acute and chronic

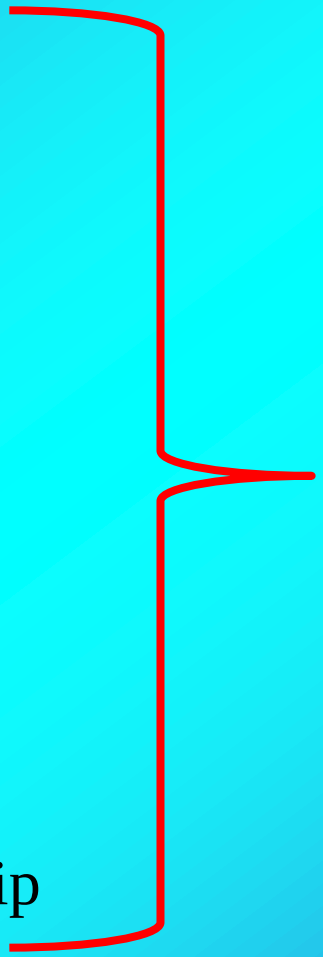
Table 1. Early reports from cough clinics illustrating the variety of cough diagnosis dependent on criteria used

First author, year	Mean age yrs	Patients n (female n)	Diagnosis (% of total)		
			Asthma syndrome	GOR	Rhinitis
Irwin 1981	50.3	49 (27)	25	10	29
Poe 1982	-	109 (68)	36	0	8
Poe 1989	44.8	139 (84)	35	5	26
Irwin 1990	51	102 (59)	24	21	41
Hoffstein 1994	47	228 (139)	25	24	26
O'Connell 1994	49	87 (63)	6	10	13
Smyrnios 1995	58	71 (32)	24	15	40
Mello 1996	53.1	88 (64)	14	40	38
Marchesani 1998	51	92 (72)	14	5	56
McGarvey 1998	47.5	43 (29)	23	19	21
Palombini 1999	57	78 (51)	59	41	58
Brightling 1999	-	91 (-)	31	8	24

The typical patient is a middle-aged female. These diagnoses are now thought to represent phenotypes of the cough hypersensitivity syndrome. GOR: gastro-oesophageal reflux. Studies can be found in Morice *et al.* (2004).

Cough

- Acute
  - virus
- Chronic
  - GOR
  - Asthma
  - Rhinitis
    - Post nasal drip



Some overlap exists and remember that a virus infection can trigger ex an asthma exacerbation

Symptoms and sign

Respiratory system

Most common symptoms!

- Cough
- Sputum
- Dyspnoea
- Chest pain
- Haemoptysis
- And others !!

Test

- In a 44 years old women with excess sputum amounts every day (more than 2 cups) what is the most likely a priory diagnosis ?

1. Angina pectoris
2. COPD
3. Bronchieectasies
4. Asthma
5. Empyema

Sputum, ask more?

- Amount
  - More than half a cup (think bronchieectasies)
- Color
  - Haemoptysis (always considerer further tests)
  - Green (often bacteria)
  - Yellow (can be bac. and virus)
  - White (often no problem !!)
    - However think ex asthma or COPD

3. Clinical findings

1. cough and mucopurulent sputum - months / years
2. dyspnea, wheezing, chest pain
3. recurrent “bronchitis” and frequent antibiotic courses

Cough	**98%**
Daily sputum	**78%**
Rhinosinusitis	**73%**
Dyspnea	**62%**
Hemoptysis	**27%**
Pleurisy	**20%**
Crackles	**75%**
Wheezing	**22%**
Digital clubbing	**2%**

*King PT et al. Respir Med 2006; 100: 2183.

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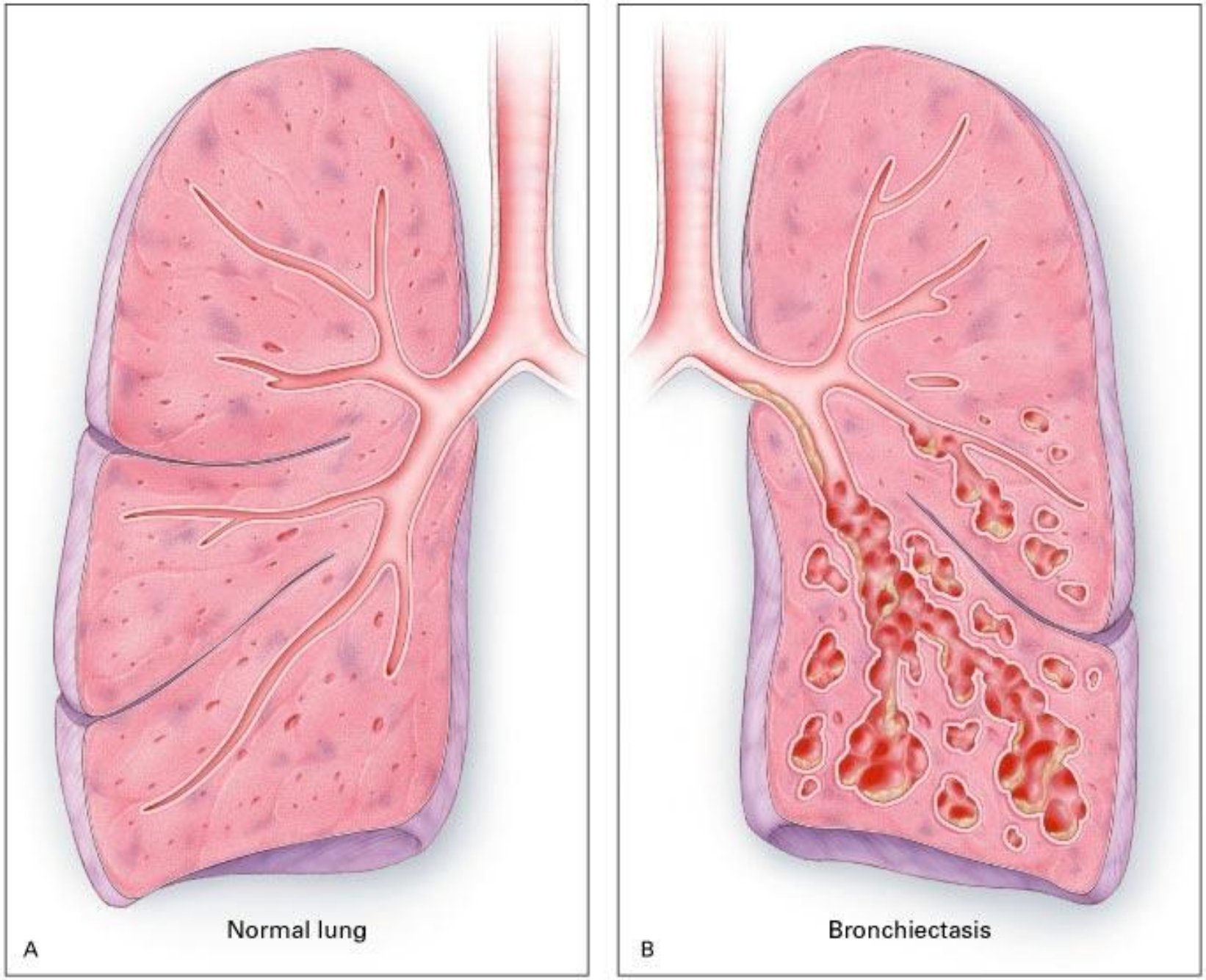
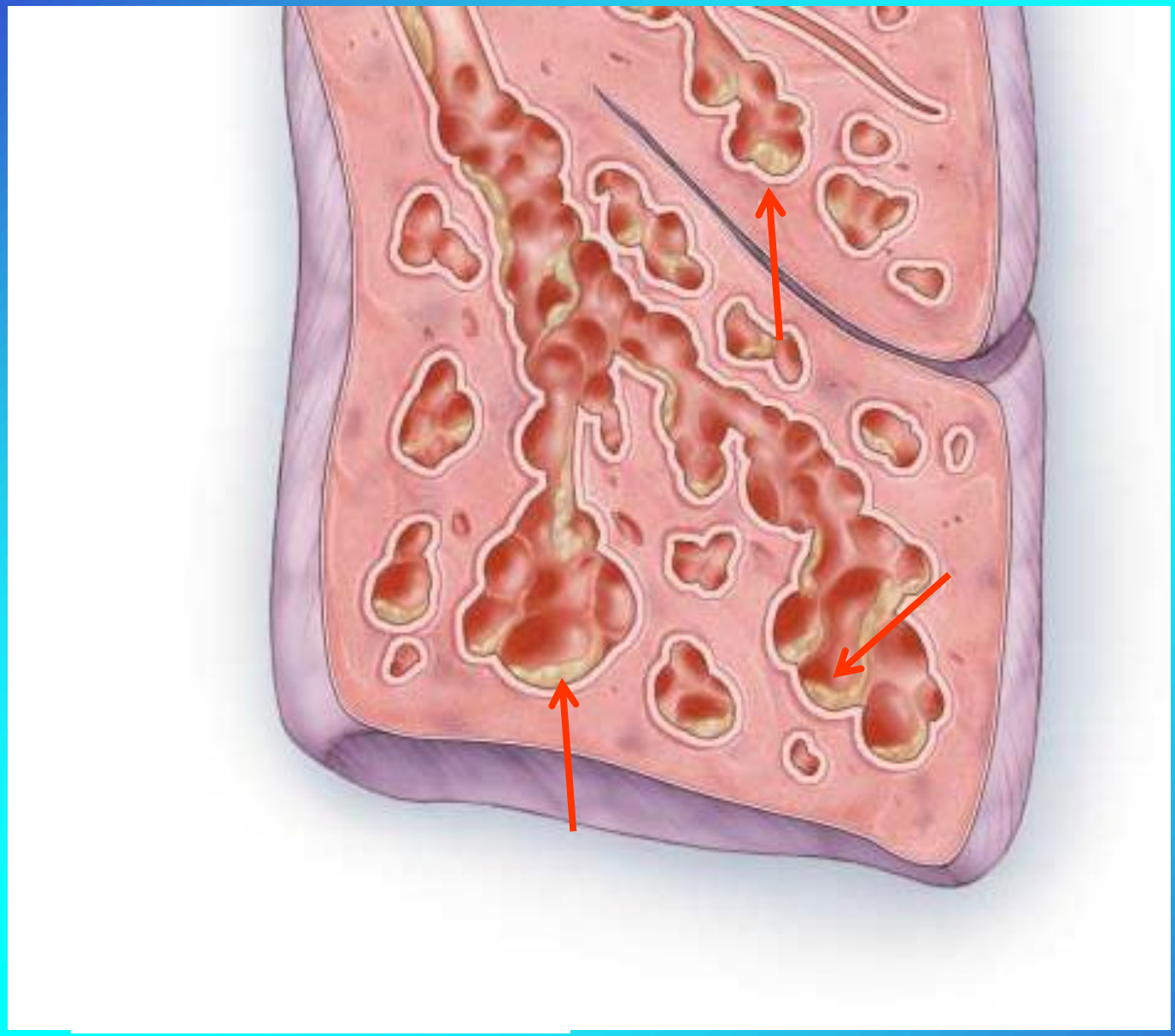

A
Normal lung
B
Bronchiectasis



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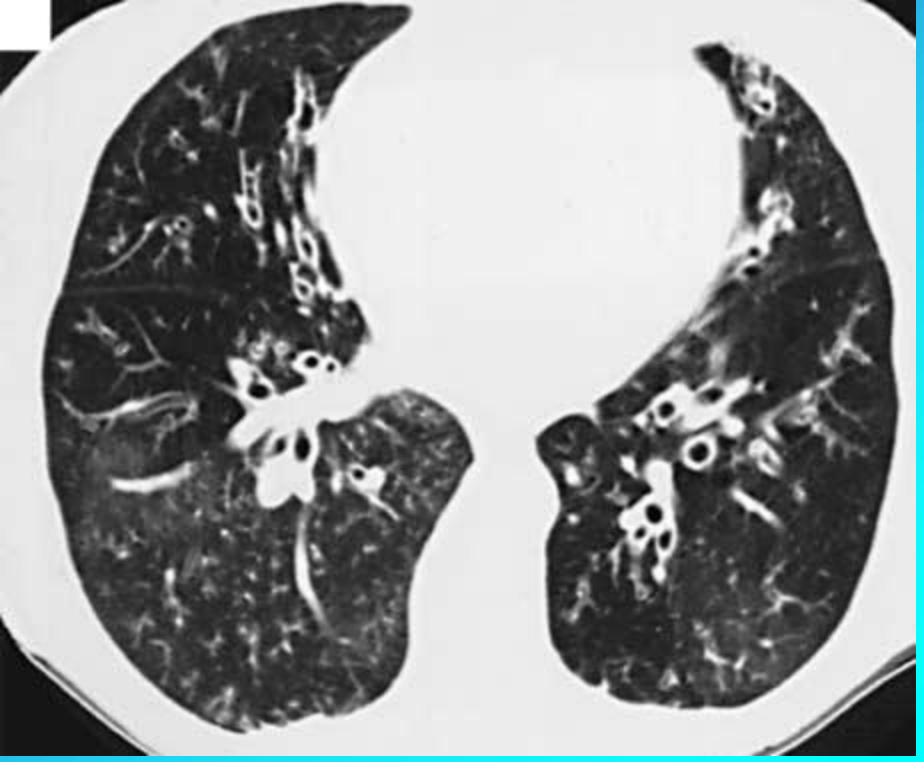

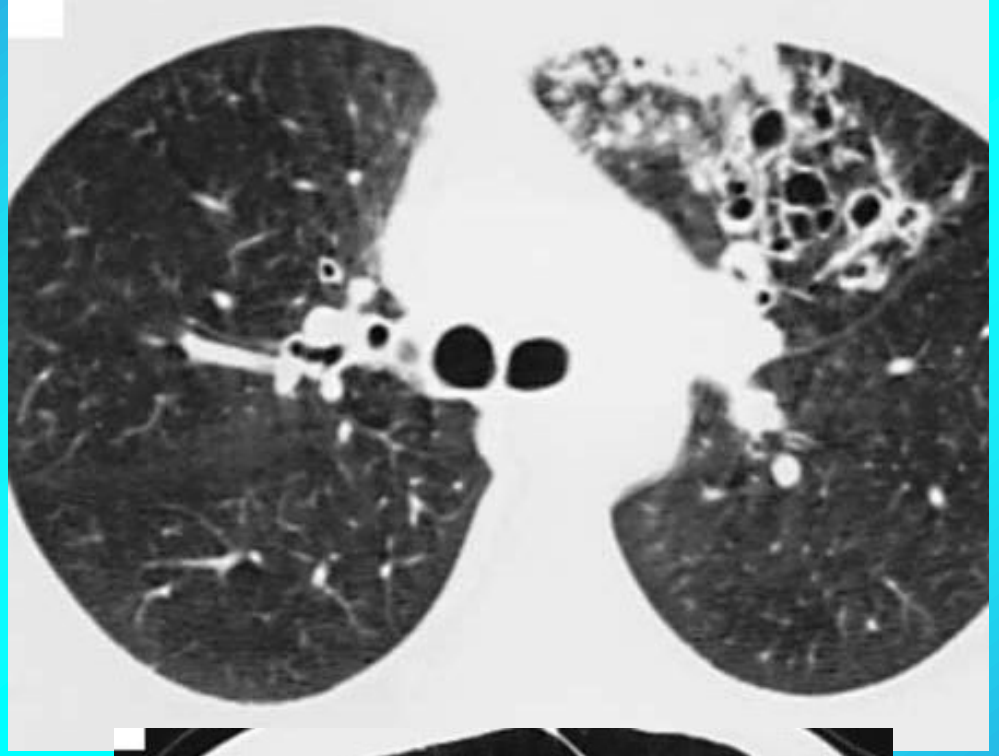

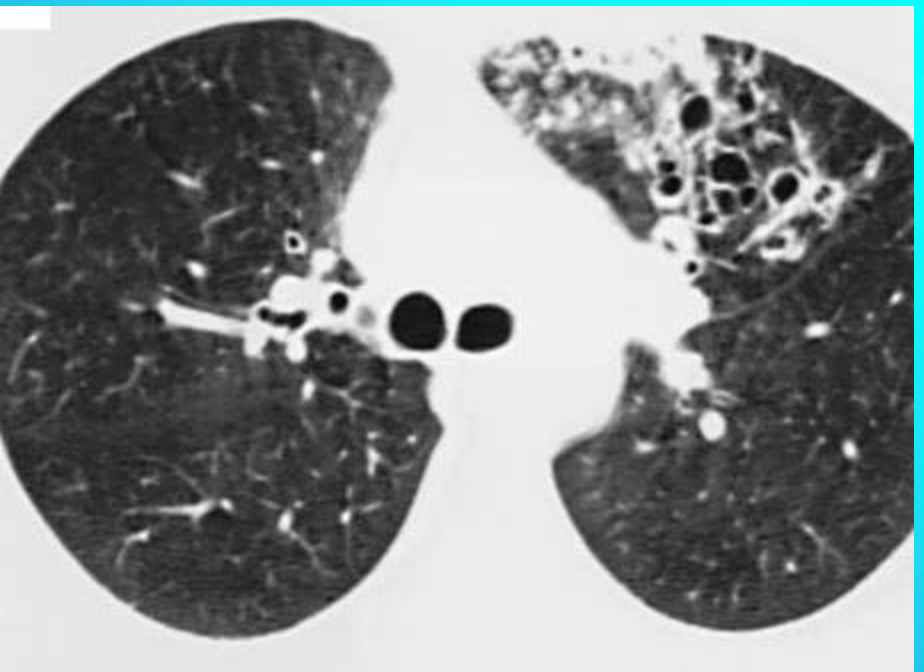

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4. Diagnosis – **Chest CT**

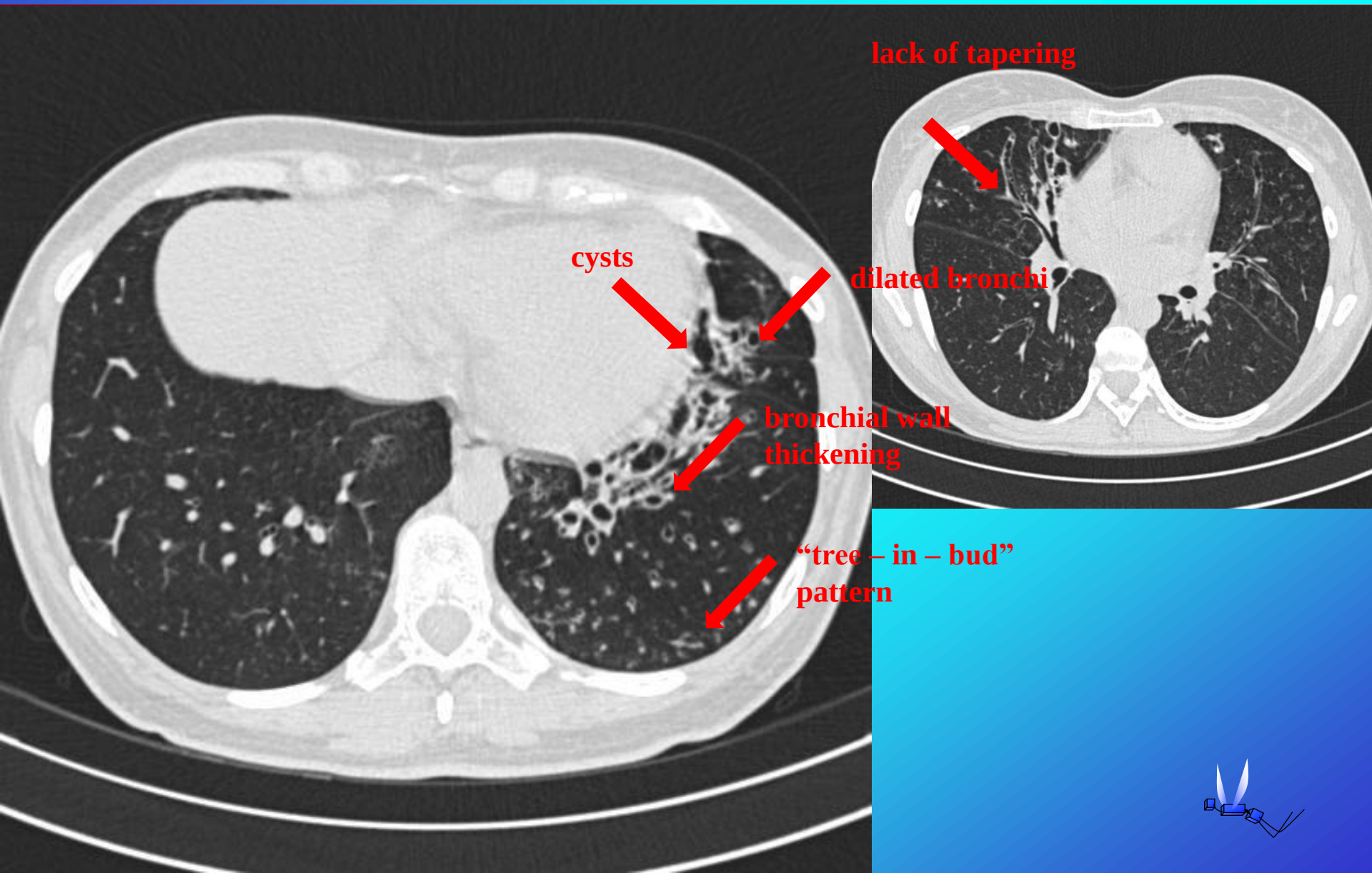


TABLE 1. CONDITIONS ASSOCIATED WITH BRONCHIECTASIS.

- Postinfectious conditions
  - Bacteria (pseudomonas, haemophilus)
  - Mycobacterium tuberculosis
  - Aspergillus species
  - Virus (adenovirus, measles virus, influenzavirus, human immunodeficiency virus)
- Congenital conditions
  - Primary ciliary dyskinesia
  - Alpha$_1$-antitrypsin deficiency
  - Cystic fibrosis
  - Tracheobronchomegaly (Mounier–Kuhn syndrome)
  - Cartilage deficiency (Williams–Campbell syndrome)
  - Pulmonary sequestration
  - Marfan's syndrome
- Immunodeficiency
  - Primary
    - Hypogammaglobulinemia
  - Secondary
    - Caused by cancer (chronic lymphatic leukemia), chemotherapy, or immune modulation (after transplantation)
- Sequelae of toxic inhalation or aspiration
  - Chlorine
  - Overdose (heroin)
  - Foreign body
- Rheumatic conditions
  - Rheumatoid arthritis
  - Systemic lupus erythematosus
  - Sjögren's syndrome
  - Relapsing polychondritis
- Other
  - Inflammatory bowel disease (chronic ulcerative colitis or Crohn's disease)
  - Young's syndrome (secondary ciliary dyskinesia)
  - Yellow nail syndrome (yellow nails and lymphedema)

- Many different aetiologies associated with presence of bronchie ectasies

N Engl J Med, Vol. 346, No. 18May 2, 2002

Exacerbation

Symptoms of Acute Exacerbation of Bronchiectasis*†

- Change in sputum production
- Increased dyspnea
- Increased cough
- Fever (temperature, >38° C)
- Increased, wheezing
- Malaise, fatigue, lethargy, or decreased exercise tolerance
- Reduced pulmonary function
- Radiographic changes consistent with a new pulmonary process
- Changes in chest sounds

* In the study by O'Donnell et al, a patient with four of these symptoms was defined as having an acute exacerbation.

† Reproduced with permission from: Barker, AF. Bronchiectasis. N Engl J Med 2002; 346:1383. Copyright © 2002 Massachusetts Medical Society.

Exacerbation: Etiology +Rx

Colonization/infection:

- Hemophilus
- Pseudomonas
- MAI
- Aspergillus

Very difficult to distinguish colonization from acute infection with these bugs.

Psuedomonas colonized →more bronchiectasis on CT; increased number of hospitalizations vs H. flu colonization

Effect of sputum bacteriology on the quality of life of patients with bronchiectasis. Wilson CB; Jones PW; O'Leary CJ; Hansell DM; Cole PJ; Wilson R

Eur Respir J 1997 Aug;10(8):1754-60.

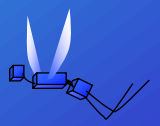
Treatment:

fluoroquinolone

Summary

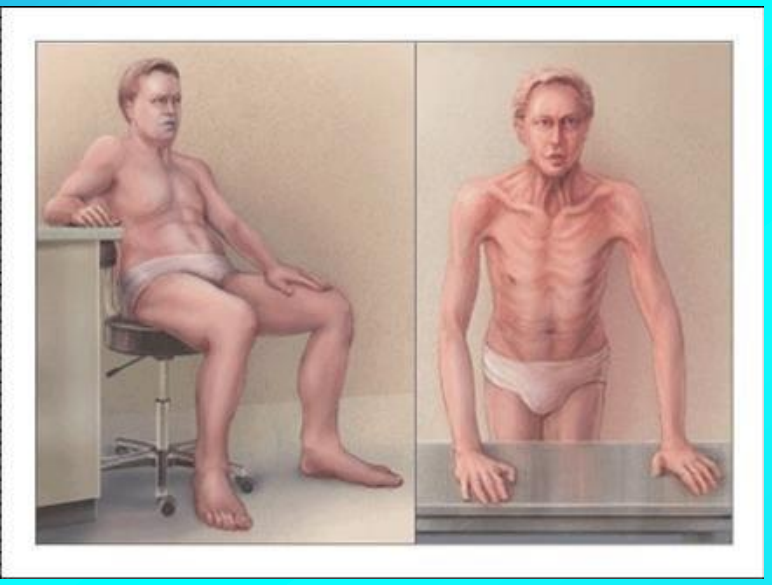
1. clinical findings (cough & sputum)
2. radiographic confirmation
3. identification of treatable causes
4. functional assessment

are important for proper treatment plan.

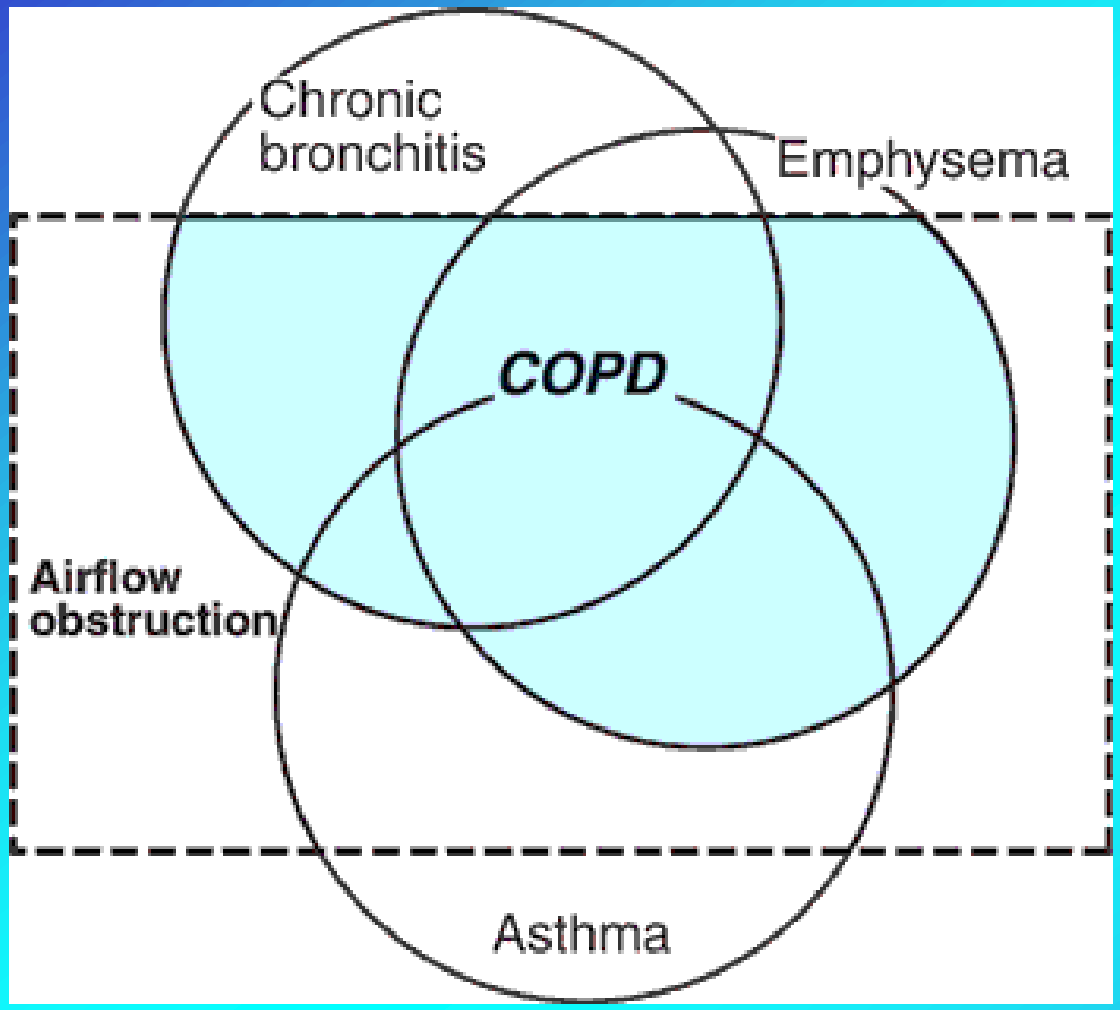


Test

- What is the medical definition of chronic bronchitis?



1. A forced expiratory volume in 1 second (FEV_1) lower that 70%.
2. A 3 month period of cough and sputum production.
3. Daily cough with sputum production for 3 month, 2 years in a row.
4. A $FEV_1/FVC < 70\%$
5. Infection of the bronchioles.



This is Why do doctors and patients uses the names wrong

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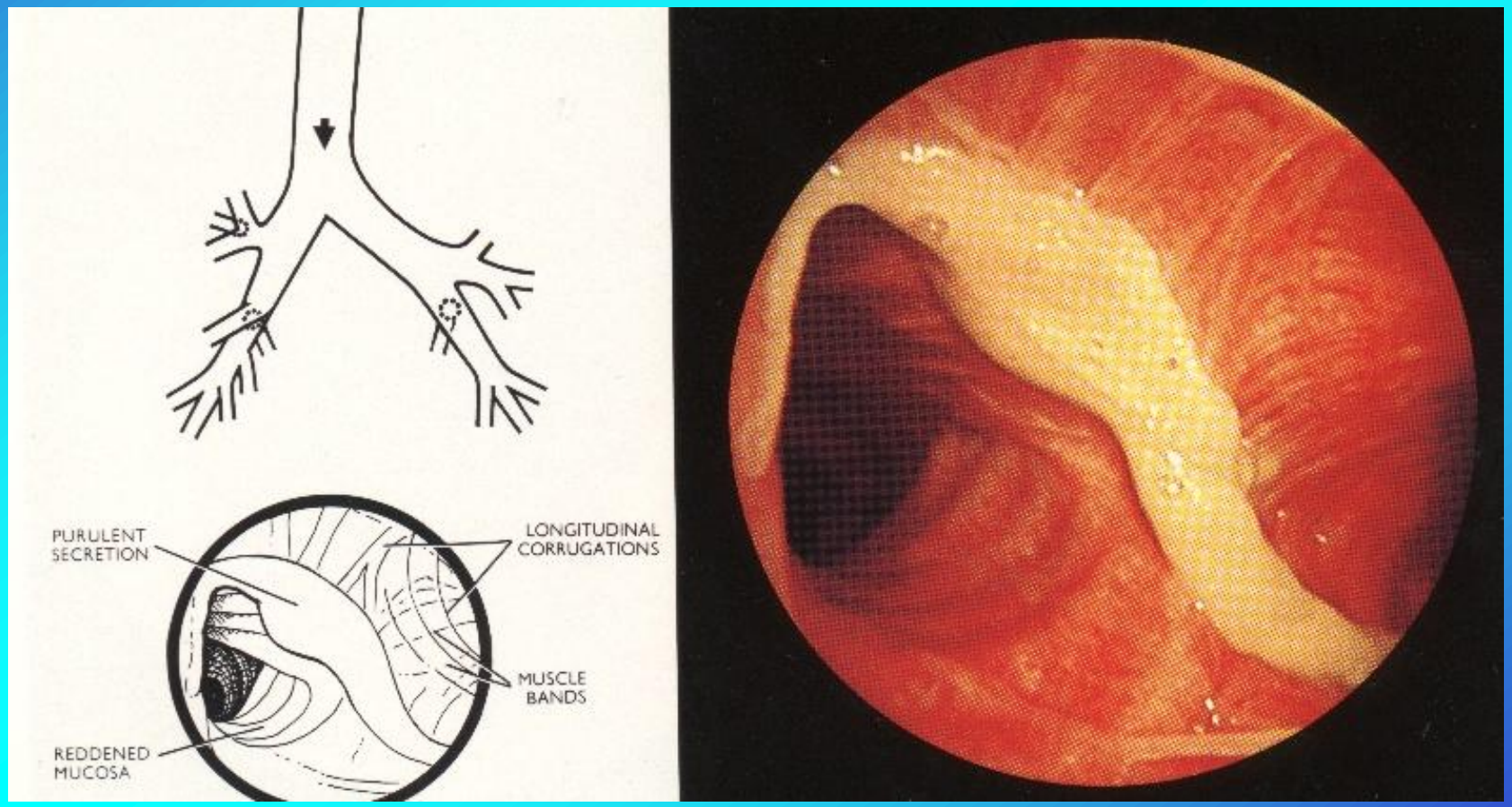
chronic bronchitis



symptoms
look for patterns

Finding a pattern
Clues to the diagnosis !

TABLE 4
Physical Examination Findings in the Diagnosis of Acute Dyspnea

Findings	*Possible diagnosis*
Wheezing, pulsus paradoxus, accessory muscle use	Acute asthma, COPD exacerbation
Wheezing, clubbing, barrel chest, decreased breath sounds	COPD exacerbation
Fever, crackles, increased fremitus	Pneumonia
Edema, neck vein distension, S_3 or S_4 hepatojugular reflux, murmurs, rales, hypertension, wheezing	Congestive heart failure, pulmonary edema
Wheezing, friction rub, lower extremity swelling	Pulmonary embolism
Absent breath sounds, hyperresonance	Pneumothorax
Inspiratory stridor, rhonchi, retractions	Croup
Stridor, drooling, fever	Epiglottitis
Stridor, wheezing, persistent pneumonia	Foreign body aspiration
Wheezing, flaring, intercostal retractions, apnea	Bronchiolitis
Sighing	Hyperventilation

COPD = chronic obstructive pulmonary disease.

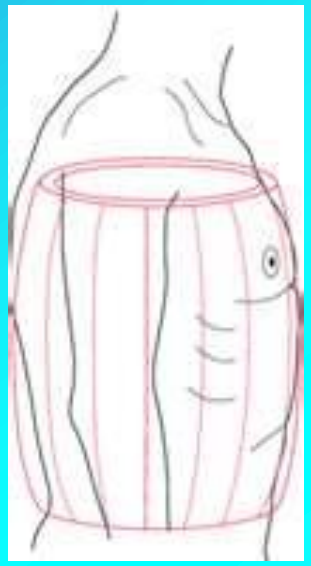
Sounds

Learning by hearing

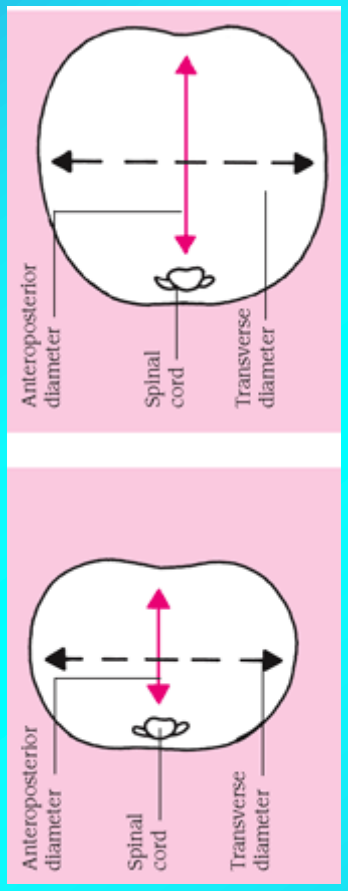
- Rales are small clicking, bubbling, or rattling sounds in the lung. They are believed to occur when air opens closed air spaces. Rales can be further described as moist, dry, fine, and coarse.
- Rhonchi are sounds that resemble snoring. They occur when air is blocked or becomes rough through the large airways.
- Wheezes are high-pitched sounds produced by narrowed airways. They can be heard when a person breathes out (exhales). Wheezing and other abnormal sounds can sometimes be heard without a stethoscope.
- Stridor is a wheeze-like sound heard when a person breathes. Usually it is due to a blockage of airflow in the windpipe (trachea) or in the back of the throat.

Medline Plus

Some further sign and their medical names before we proceed !!



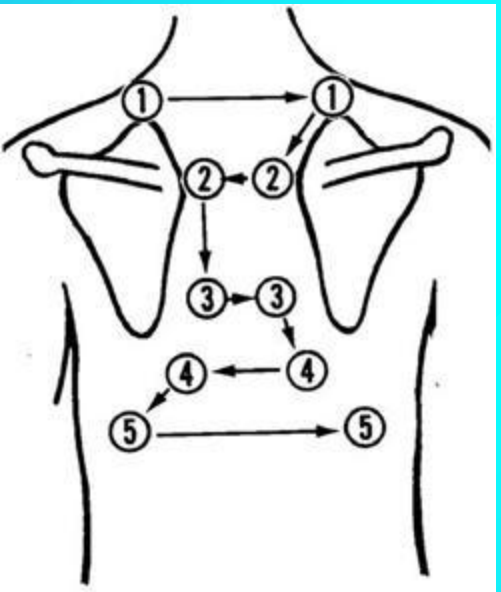
Barrel chest



Fremitus

Refers to the palpable vibrations transmitted through the lungs to the chest wall when the patient speaks. Have the patient say deep tones (low frequency) like "one-one-one" and you will feel vibrations. Vibrations are more difficult to feel over bone.

NOTE: Patients with a heavy layer of fat may need to speak more loudly for you to feel the vibrations.



Fremitus

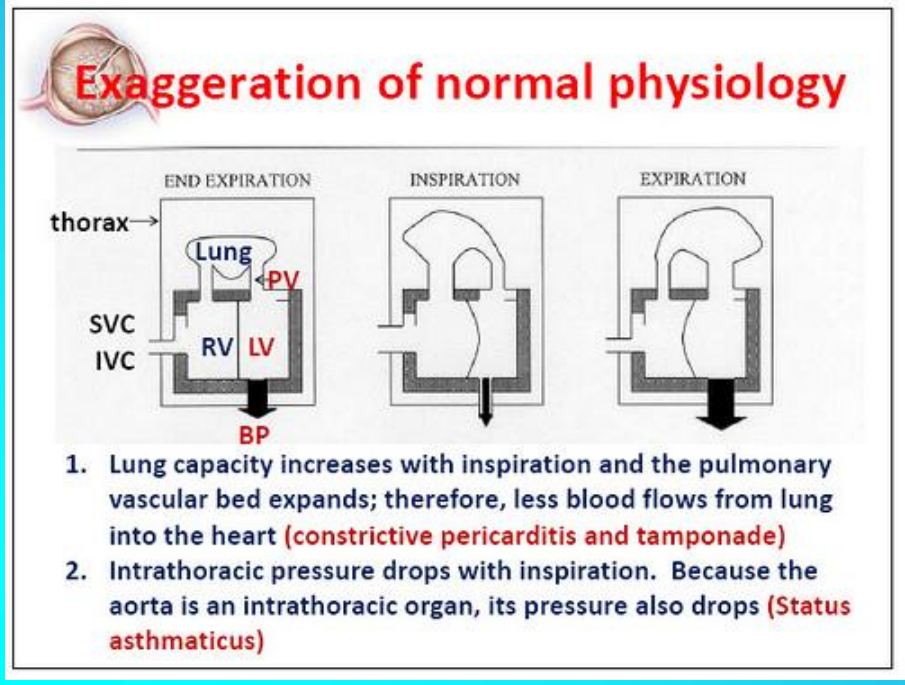
- Tactile fremitus is pathologically increased over areas of consolidation and decreased or absent over areas of pleural effusion or pneumonthorax (where there is liquid or air instead of usual lung). Rhonchal fremitus is increased in central bronchi's due to mucus and airway obstruction.

Clubbing

- Nail clubbing a deformity of the fingers and fingernails
  - A genetic form exists
- Normally a sign of chronic hypoxia

Pulsus paradoxus

The simplest definition of pulsus paradoxus is an exaggeration of the normal inspiratory decrease in systolic blood pressure.



There is no consensus on the underlying mechanism of pulsus paradoxus.

The *paradox* in *pulsus paradoxus* is that, on clinical examination, one can detect beats on cardiac aucultation during inspiration that cannot be palpated at the radial pulse!

It is a sign that is indicative of several conditions including cardiac tamponade, pericarditis, sleep apnea, severe obstructive lung Disease (asthma, COPD)

Wikipedia 2011

Chest pain

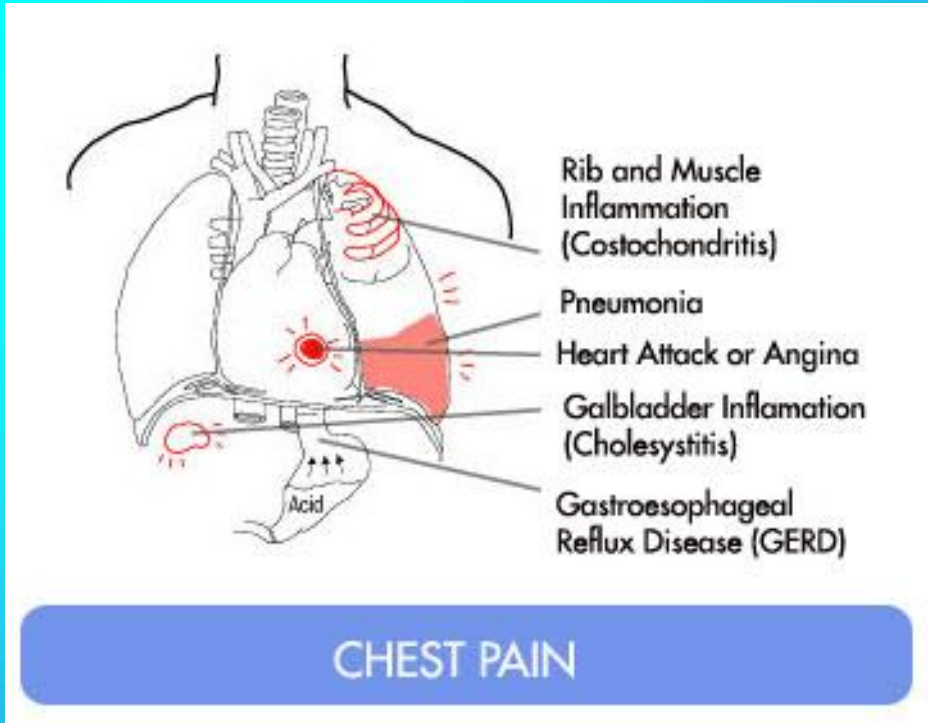
Key points

- Chest pain can be a feature of a wide range of pathology
- An accurate history is essential to direct appropriate investigation of patients presenting with chest pain

Chest pain

Medical history point towards aetiology

- Location may help
- Duration
- Relieving factors



The cause of chest pain could belong to the various systems.

A) Cardiovascular system. (relating to the heart and the blood vessels)

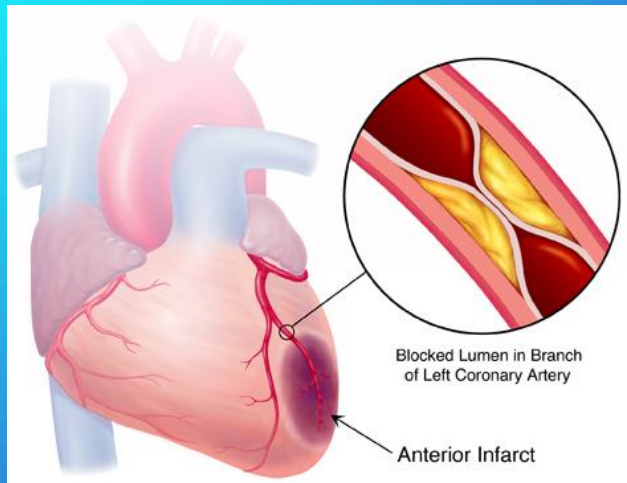
B) Pulmonary system. (relating to the lungs)

C) Digestive system

D) The Bony system

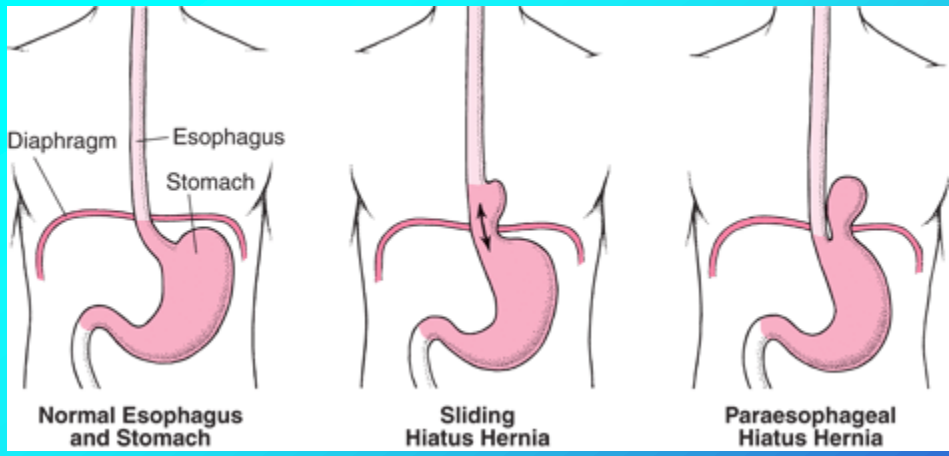
E) The muscular system

F) The Skin



Chest pain

- Exclude life-threathing disease ex:
  - Acute coronary syndrome
  - Oesophagus rupture
  - Aorta dissection/aneurisme
  - Pulmonary emboli
  - pneumothorax
- Intermediate diseases
  - Angina
  - Pneumonia
  - Pleurisy
  - Gastric ulcer
- To “less” dangerous diseases: ex
  - Myosis
  - Gall bladder pain
  - GOR etc.



Hemoptysis

- Expectoration of blood or bloody sputum from the lungs or tracheobronchial tree.

- May be confused with bleeding from the mouth, throat, nasopharynx, or GI tract

Hemoptysis

Identifying hemoptysis

These guidelines will help you distinguish hemoptysis from epistaxis, hematemesis, and brown, red, or pink sputum.

Hemoptysis

Commonly frothy because it's mixed with air, hemoptysis is typically bright red with an alkaline pH (tested with nitrazine paper). It's strongly suggested by the presence of respiratory signs and symptoms, including a cough, a tickling sensation in the throat, and blood produced from repeated coughing episodes. (You can rule out epistaxis because the patient's nasal passages and posterior pharynx are usually clear.)

Hematemesis

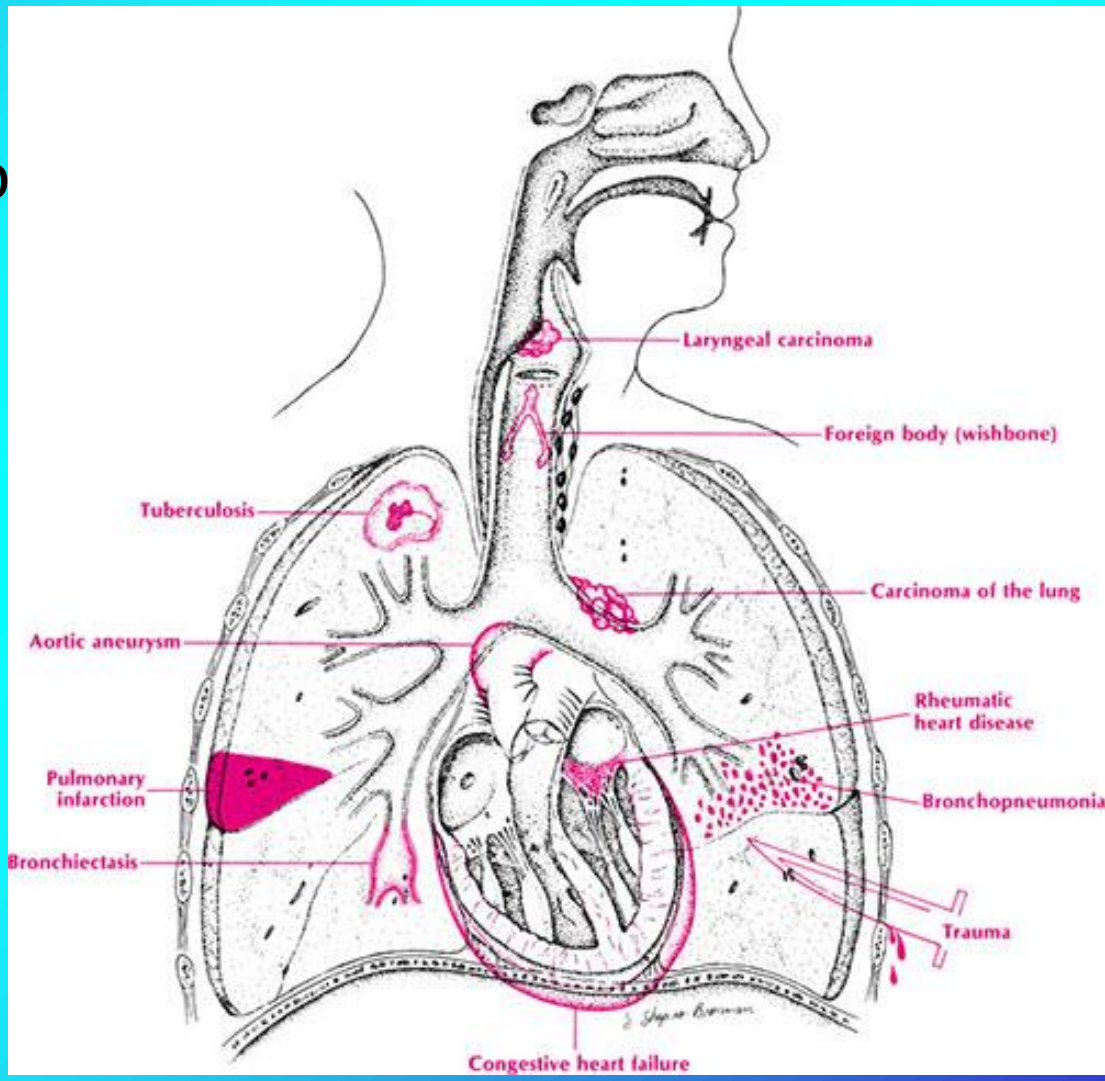
The usual site of hematemesis is the GI tract; the patient vomits or regurgitates coffee-ground material that contains food particles, tests positive for occult blood, and has an acid pH. However, he may vomit bright red blood or swallowed blood from the oral cavity and nasopharynx. After an episode of hematemesis, the patient may have stools with traces of blood. Many patients with hematemesis also complain of dyspepsia.

Brown, red, or pink sputum

Brown, red, or pink sputum can result from oxidation of inhaled bronchodilators. Sputum that looks like old blood may result from rupture of an amebic abscess into the bronchus. Red or brown sputum may occur in a patient with pneumonia caused by the enterobacterium *Serratia marcescens*. Currant-jelly sputum occurs with *Klebsiella* infections.

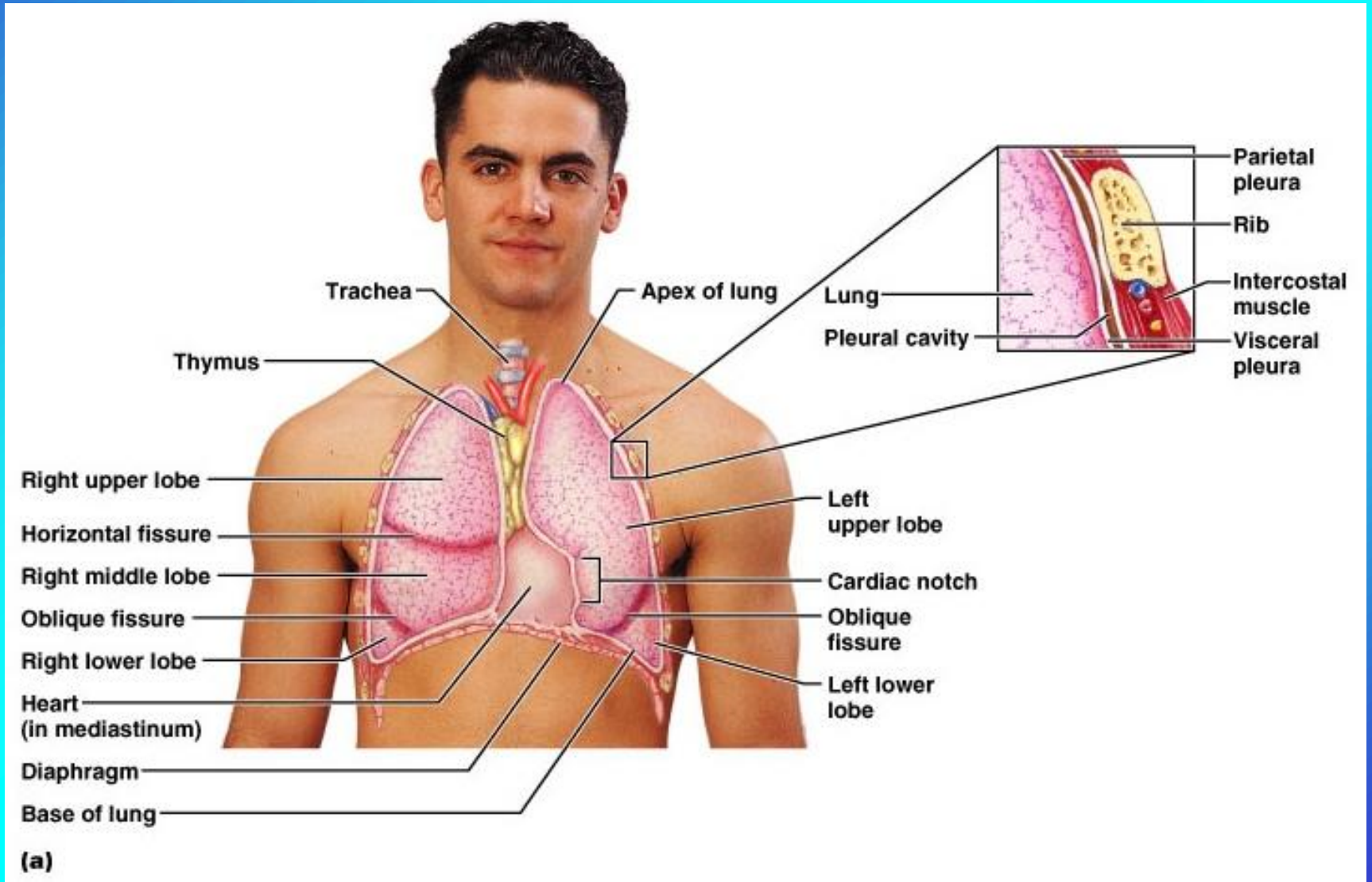
Haemoptysis

- Needs further follow-up
- First think and exclude:
  - Tuberculosis
  - Cancer
  - More often and less severe
    - pneumonia
    - PE
    - Anticoagulant therapy



: http://www.bettermedicine.com/books/differential-diagnosis-in-primary-care/hemoptysis

Dyspnoea
- Observe the patient
-Remember your anatomi

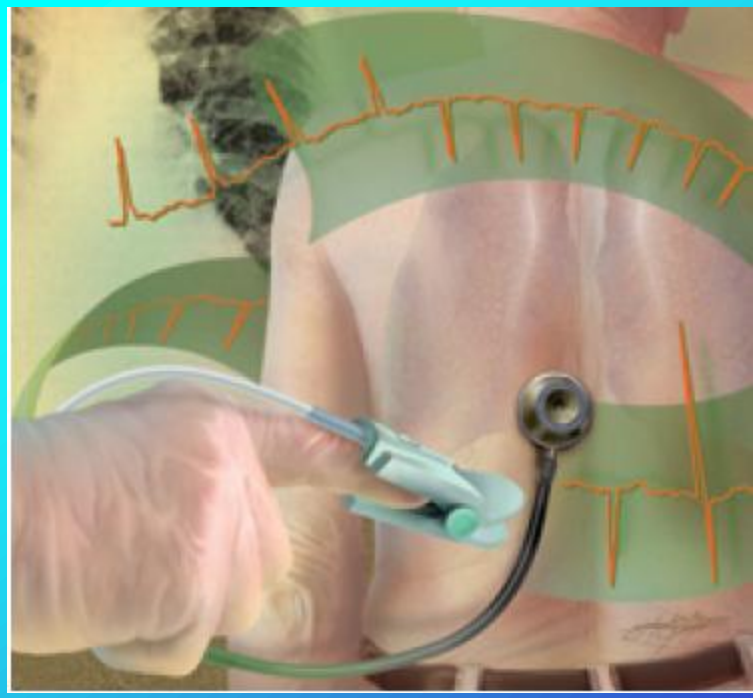


Symptoms and sign

Respiratory system

Most common symptoms!

- Cough
- Sputum
- Dyspnoea
- Chest pain
- Haemoptysis



Dyspnoea

Presentation is important?

- Acute
- Chonic

Asthma, congestive heart failure, chronic obstructive pulmonary disease, pneumonia, cardiac ischemia, interstitial lung disease, and psychogenic conditions are the cause of dyspnea in 85 percent of patients.

Dyspnoea

Anxiety symptoms may imply psychogenic causes of dyspnea, but organic etiologies always should be considered first.

Dyspnoea first “quick

Once an emergent situation has been excluded, the patient’s airway, mental status, ability to speak, and breathing effort should be reevaluated. A focused history should be obtained, and a physical examination completed.

TABLE 1
Initial Assessment of Patients with Dyspnea

Assess airway patency and listen to the lungs.
Observe breathing pattern, including use of accessory muscles.
Monitor cardiac rhythm.
Measure vital signs and pulse oximetry.
Obtain any history of cardiac or pulmonary disease, or trauma.
Evaluate mental status.

Dyspnoea

Key points

- Dyspnoea is a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity.
- Its aetiology can be elucidated to some degree by taking a medical history and physical examination.
- The mechanisms of dyspnoea are complex and multifactorial – there is no unique central or peripheral source of this symptom.
- The sense of heightened inspiratory effort is an integral component of exertional dyspnoea and is pervasive across health and disease.

- The neuroventilatory dissociation (NVD) theory of dyspnoea states that the symptom arises when there is a disparity between the central reflexic drive (efferent discharge) and the simultaneous afferent feedback from a multitude of peripheral sensory receptors throughout the respiratory system. The feedback system provides information about the extent and appropriateness of the mechanical response to central drive.
- Despite the diversity of causes, the similarity of described experiences of dyspnoea suggests common underlying mechanisms.

Dyspnoea

- Not specific !!
- Complex etiology
- Clues to causes by:
  - Medical History
    - Time
    - Medicine etc.
  - Examination

Dyspnoea

Aetiology

Dyspnoea has many pulmonary, cardiac and other causes, which vary by acuity of onset

Different causes of dyspnoea are associated with derangements of a number of functions and apparatus:

- Alveoli
- Ventilatory pump
- Upper and lower airways
- Pulmonary vasculature
- Cardiac pump
- Red blood cells
- Peripheral circulation
- Skeletal muscles

It is important to remember that the most common cause of dyspnoea in patients with chronic pulmonary or cardiac disorders is an exacerbation of their underlying disease.

	Suggestive findings
Acute cause	
Pulmonary causes	
Pneumothorax	Abrupt onset of sharp chest pain, tachypnoea, diminished breath sounds, and hyperresonance to percussion. May follow injury or occur spontaneously (especially in tall, thin patients and in those with COPD).
Pulmonary embolism	Abrupt onset of sharp chest pain, tachypnoea and tachycardia. Often risk factors for pulmonary embolism (*e.g.* cancer, immobilisation, deep venous thrombosis, pregnancy, use of oral contraceptives or other
Cardiac causes	
Acute myocardial ischaemia or infarction	Substernal chest pressure with or without radiation to the arm or jaw, particularly in patients with risk factors for CAD.
Heart failure	Crackles, S_3 gallop and signs of central or peripheral volume overload (*e.g.* elevated neck veins, peripheral oedema). Orthopnea or appearing 1–2 h after falling asleep (paroxysmal nocturnal dyspnoea).
Other causes	
Diaphragmatic paralysis	Sudden onset after trauma affecting the phrenic nerve. Frequent orthopnoea.
Anxiety disorder-hyperventilation	Situational dyspnoea often accompanied by psychomotor agitation and paresthesias in the fingers or around the mouth. Normal examination findings and pulse oximetry measurements.

Table 2. Some common causes of chronic (hours to years) dyspnoea

	Suggestive findings
Pulmonary causes	
Obstructive lung disease	Extensive smoking history, barrel chest and poor air entry and exit.
Restrictive lung disease	Progressive dyspnoea in patients with known occupational exposure or neurological condition.
Interstitial lung disease	Fine crackles on auscultation.
Cardiac causes	
Heart failure	Crackles, S_3 gallop and signs of central or peripheral volume overload (*e.g.* elevated neck veins, peripheral oedema). Orthopnea or paroxysmal nocturnal dyspnoea.
Stable angina or CAD	Substernal chest pressure with or without radiation to the arm or jaw, often provoked by physical exertion, particularly in patients with risk factors for CAD.
Other causes	
Anaemia	Dyspnoea on exertion progressing to dyspnoea at rest. Normal lung examination and pulse oximetry measurement. Sometimes systolic heart murmur due to increased flow.
Physical deconditioning	Dyspnoea only on exertion in patients with sedentary lifestyle.

CAD: coronary artery disease; S_3: 3rd heart sound.

Dyspnoea

Subacute cause	
Pulmonary causes	
Pneumonia	Fever, productive cough, dyspnoea, sometimes pleuritic chest pain. Focal lung findings, including crackles, decreased breath sounds and egophony.
COPD exacerbation	Cough, productive or nonproductive. Poor air movement. Accessory muscle use or pursed lip breathing.
Cardiac causes	
Angina or CAD	Substernal chest pressure with or without radiation to the arm or jaw, often provoked by physical exertion, particularly in patients with risk factors for CAD.
Pericardial effusion or tamponade	Muffled heart sounds or enlarged cardiac silhouette in patients with risk factors for pericardial effusion (*e.g.* cancer, pericarditis, systemic lupus erythematosus). Possibly pulsus paradoxus.

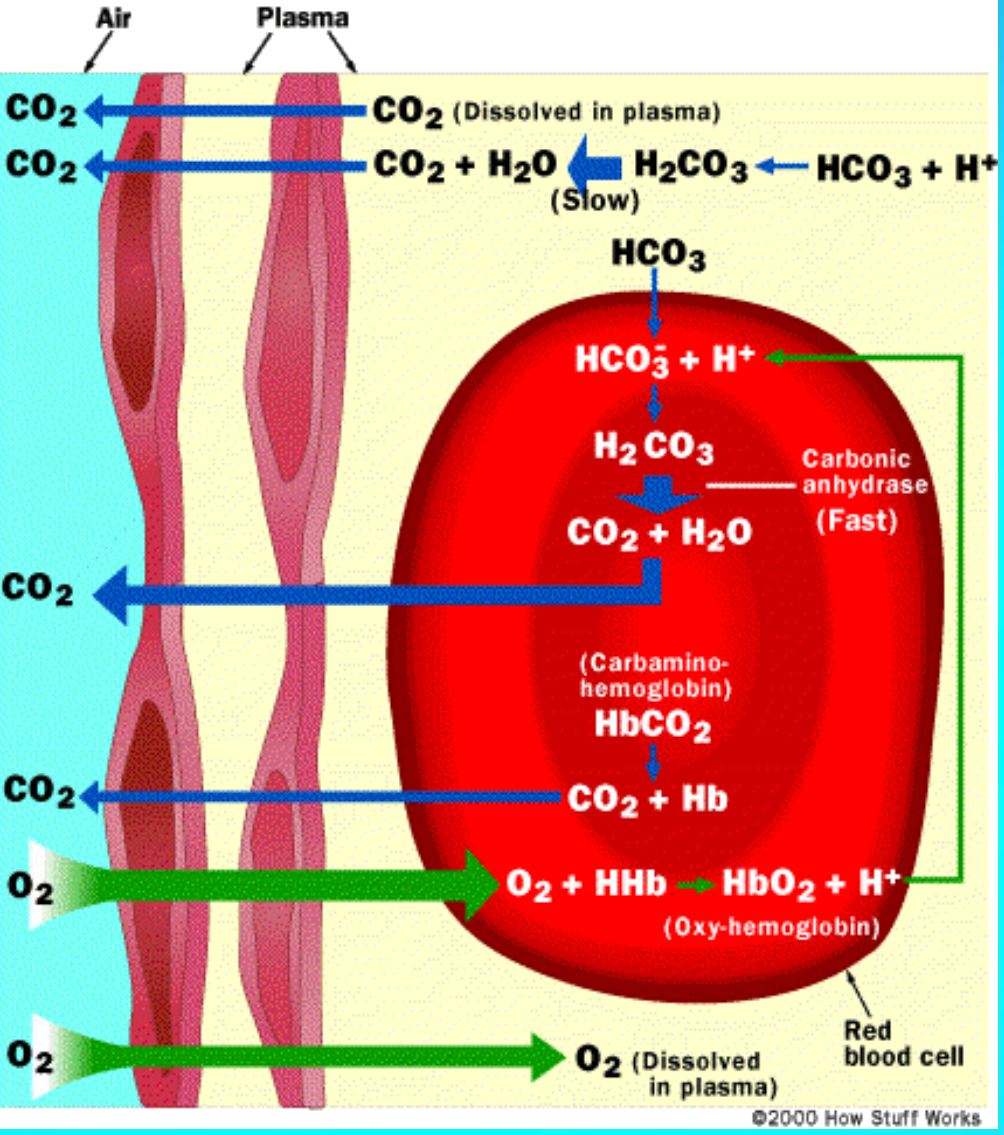
COPD: chronic obstructive pulmonary disease; CAD: coronary artery disease; S_3: 3rd heart sound.

Breathlessness

Table 1. Breathlessness: differential diagnosis according to onset

Within minutes	Think: pulmonary embolus, pneumothorax, myocardial infarction, cardiac rhythm disturbance, dissecting aneurysm, acute asthma
Over hours or days	Think: pneumonia, pleural effusion, LVF (LV dysfunction or valve dysfunction or septal rupture post-MI), asthma, blood loss, lobar collapse, respiratory muscle weakness (Guillain–Barré syndrome)
Over weeks	Think: infiltration (malignancy, sarcoidosis, fibrosing alveolitis, extrinsic allergic alveolitis, eosinophilic pneumonia), respiratory muscle weakness (motor neurone disease), main airway obstruction, anaemia, valvular dysfunction (SBE)
Over months	Think: same as for weeks plus obesity, muscular dystrophy, asbestos-related conditions.
Over years	Think: COPD, chest wall deformity, heart valve dysfunction, obesity.

LVF: left ventricular failure; MI: myocardial infarction; SBE: subacute bacterial endocarditis; COPD: chronic obstructive pulmonary disease.



Acute respiratory failure

Arterial blood gas assessment

Normal P_aCO_2 = 40mmHg

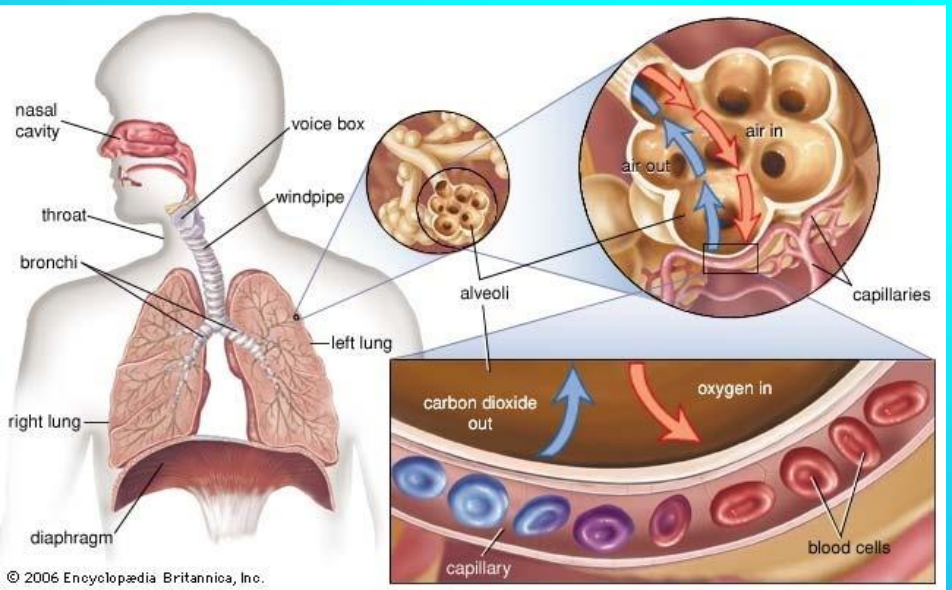
Normal P_aO_2 = 90–95 mmHg

ALVEOLAR VENTILATION

Normal HCO_3^- = 22–27 mmol/l

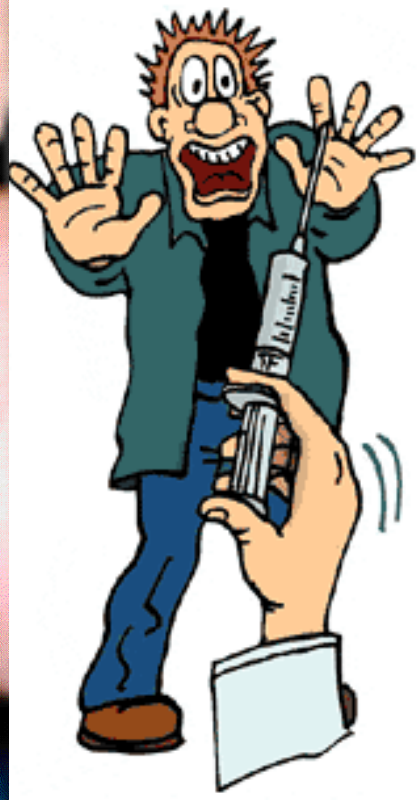
H_2O + CO_2 ⟷ H_2CO_3 ⟷ HCO_3^- + H^+

RENAL HCO_3^-



Normal $[H^+]$ = 40 nmol/l

pH = – log $[H^+]$ = 7.4 (7.35–7.45)



Normal values

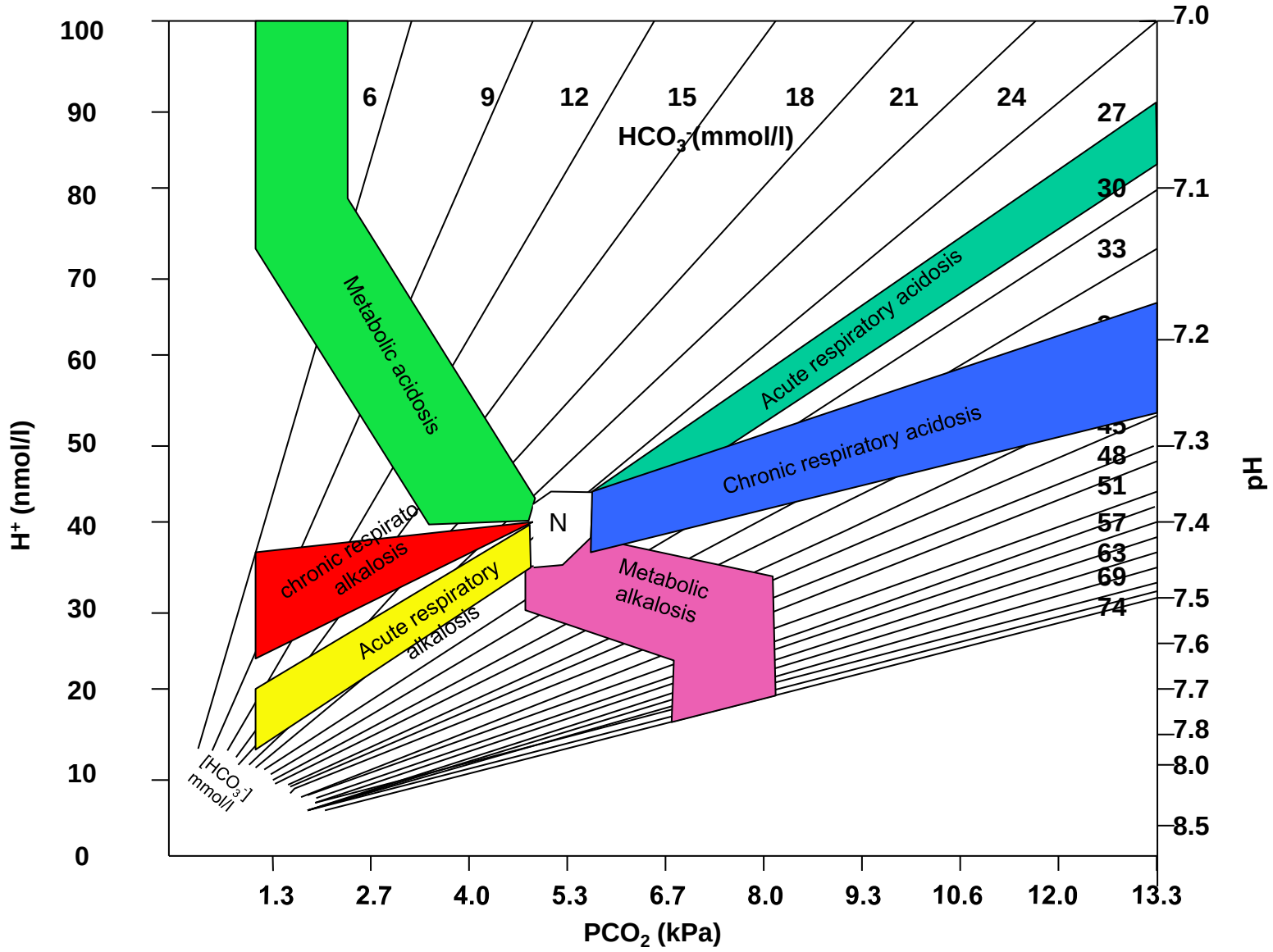
- Question: Does P_aO_2 reduce with age?

•No, meaningful reductions they are in calculated in the reference interval !!!

	2SD
pH	7,35-7,45
P_aCO_2	35-45
P_aO_2	80-100
HCO_3^-	22-27 mmol/l
Base excess	-3-+3
Saturation	95-100

Interpretation of ABG - basic

	P_aCO_2	HCO_3^-	
Acidosis	high	Normal/high	Respiratory acidosis
Acidosis	Low	Low	Metabolic acidosis
Alkalosis	Low	Normal/low	Respiratory alkalosis
Alkalosis	High	High	Metabolic alkalosis



pH - nomogram

Use 2 parametres to check the result

Normal values

- 44 years old male with dyspnoe, and before you arrive the nurse gave him 3lO_2/min
- Is there a ABG problem ?

pH	7,42	(7,35-7,45)
P_aCO_2	42	(35-45)
P_aO_2	80	(80-100)
HCO_3^-	26	(22-27)
Base excess	-2	(-3-+3)
Saturation	97	(95-100)

Interpretation !

- ABG must be evaluated in the context of the oxygen fraction in the air delivered
- Normal :(FiO_2=21%)

The patient is hypoxemic !?

pH	7,42	(7,35-7,45)
P_aCO_2	42	(35-45)
P_aO_2	80	(80-100)
HCO_3^-	26	(22-26)
Base excess	-2	(-2-+2)
Saturation	97	(95-100)

Remember

- P_aO_2 values lower that 80mmHg are considered arterial hypoxaemia
- P_aO_2 values lower that 60mmHg indicates hypoxaemic respiratory failure

- The FiO_2 must be known for interpretation of the ABG

Values for PaO_2 and saturation

	PaO_2 (mmHg)	SaO_2 (%)
Normal	98	97 (95-100)
Hypoxaemia	<80	<95
Mild hypoxemia	60-80	90-94
Moderate hypoxemia	40-60	75-89
Severe hypoxemia	<40	<75

Exercise

15 years old girl, seems nerveous tells she has a prickly sensation in both hands and lips ?

ABG , interpretation ?

Likely diagnosis ?

pH	7,46	(7,35-7,45)
P_aCO_2	23	(35-45)
P_aO_2	100	(80-100)
HCO_3^-	28	(22-27)
Base excess	3	(-3-+3)
Saturation	99	(95-100)

Respiratory alkalosis

Hyperventilation syndrome

Treatment: breathing for a while true a plasticbag

pH	7,46	(7,35-7,45)
P_aCO_2	23	(35-45)
P_aO_2	100	(80-100)
HCO_3^-	28	(22-27)
Base excess	3	(-3-+3)
Saturation	100	(95-100)

Exercise

30 years old mand with sudden dyspnoe and abdominal pain

Surgent evalutes first and says there is not a intra abdominal catastrophe ….

Is there a ABG problem ?

Diagnosis ?

pH	7,33	(7,35-7,45)
P_aCO_2	24	(35-45)
P_aO_2	99	(80-100)
HCO_3^-	12	(22-27)
Base excess	-12	(-2-+2)
Saturation	99	(95-100)

- The patient is acidotic, with a low P_aCO_2 pointing towards metabolic acidosis with a certain respiratory compensation
- With a P_aO_2=99 mmHg its unlikely that the patient has a respiratory problem
- Remember: dyspnoea is unspecific and can not be separated without a ABG
- Most likely diagnosis??

pH	7,33	(7,35-7,45)
P_aCO_2	24	(35-45)
P_aO_2	99	(80-100)
HCO_3^-	12	(22-27)
Base excess	-12	(-3-+3)
Saturation	99	(95-100)

B-glucose: 250g/l

with glucose and ketons in the urine

Diabetic ketoacidosis

pH	7,33	(7,35-7,45)
P_aCO_2	24	(35-45)
P_aO_2	99	(80-100)
HCO_3^-	12	(22-27)
Base excess	-12	(-3-+3)
Saturation	99	(95-100)

Exercise

- 23 year old male with cyanosis, drowsy, pinpoint pupils and superficial respiration
- ABG, interpretation ?
- Most likely diagnosis and treatment ??

pH	7,08	(7,35-7,45)
P_aCO_2	75	(35-45)
P_aO_2	40	(80-100)
HCO_3^-	26	(22-27)
Base excess	-2	(-3-+3)
Saturation	86	(92-99)

- Respiratory acidosis
- Clinical problem: JUST hypoventilation or a potential dangerous underlying disease?

pH	7,08	(7,35-7,45)
P_aCO_2	75	(35-45)
P_aO_2	40	(80-100)
HCO_3^-	26	(22-27)
Base excess	+2	(-3-+3)
Saturation	86	(92-99)

Causes of hypoventilation

- Severe airwayobstruktion
  - Asthma
  - COPD
- Severe restrictive lungedisease
- Loss of central respiratory drive
  - narkotics
- Respiratory ”pumpfailure”
  - Kyphoscoliose
  - Neuromuskular disease

ABG

- ”Easy” to evaluate P_aO_2 when P_aCO_2 is normal
  - V/Q mismach emphysema, pneumonia, embolia, right-left shunt
  - Loss of alveoli area: emphysema, fibrosis

- However when P_aCO_2 is abnormal is it hypoventilation or which disease ???

Exercise

23 year cyanotic, drawsy, pinpoint pupills and superficial respiration

- Hypoventilation =>

Treatm. Narcanti !?

- ILT supplement !
- Effect of narcanti….

pH	7,08	(7,35-7,45)
P_aCO_2	75	(35-45)
P_aO_2	40	(800-100)
HCO_3^-	26	(22-27)
Base excess	+2	(-3-+3)
Saturation	86	(95-100)

Some practical advise

- Be worried if
  - RF > 24-30/min (or < 8/min)
  - Not able to talk half a sentence without a break
  - Agitated, confused or in coma
  - Cyanosis or SpO_2 < 90%
  - Worsening in spite of treatment
- Remember
  - A normal SpO_2 does not necessary means that there is not serious ventilatory problem