



بسم الله الرحمن الرحيم ، والصلاة والسلام على أشرف الخلق سيدنا محمد "❤"

Pathophysiology-Respiratory Pathophysiology

Faculty of Pharmaceutical Sciences

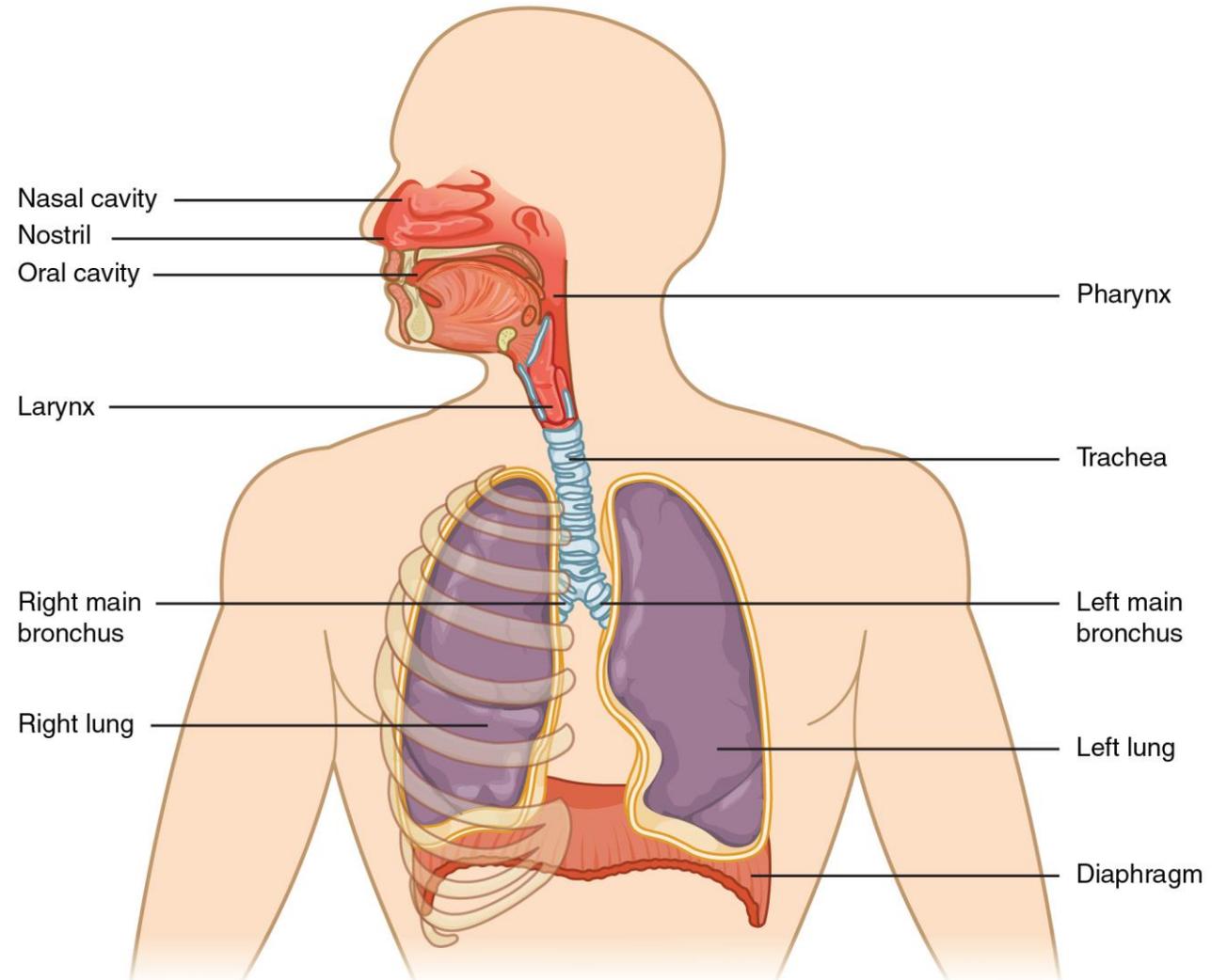
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Respiratory System

- The respiratory system consists of 6 organs:

خلونا نتذكر بشكل سريع مكونات الجهاز التنفسي

- **Nose**
- **Pharynx**
- **Larynx**
- **Trachea**
- **Bronchial tubes**
- **Lungs**
- **All organs should work together to perform respiration**



راح احكي بشكل مختصر كيف بتصير عملية التنفس

بنبلش بالـ inhalation

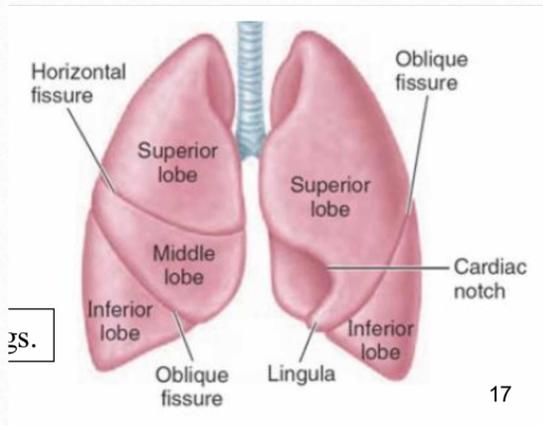
بدايةً بصير عنا contraction of major muscles (diaphragm & intercostal muscles) الـ راح
يؤدي لتمدد الرئة (expansion of lungs) increase in lungs volum = decrease in alveoli <-
pressure

فبيصح الـ pressure inside the lungs (alveoli pressure) is Low than the pressure that
outside the lungs (atmospheric pressure)
فبنتقل الهواء من الضغط المرتفع إلى الضغط المنخفض

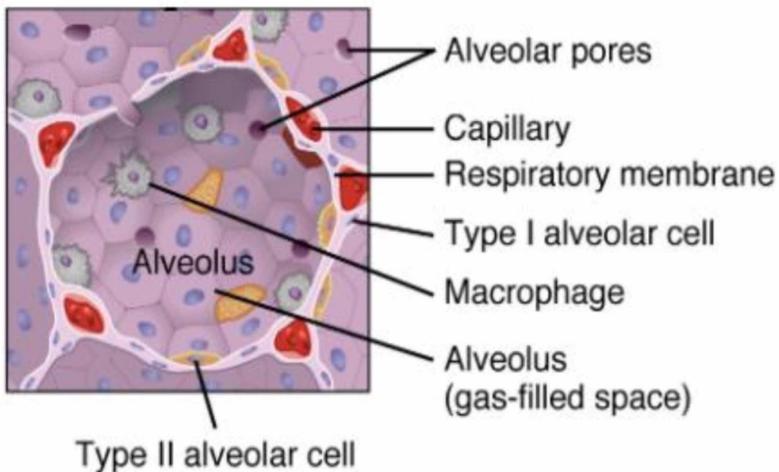
والعكس بصير في عملية الـ exhalation

Relaxation of diaphragm and intercostal muscles = recoiling lungs (normal. volume.)
= increase alveoli pressured= decrease atmospheric pressure

Air transport from high pressure(lung) to low pressure (atmosphere)



Lungs



2 lungs; right lung has 3 lobes and left lung has 2 lobes.

A lung is the total collection of the bronchi, bronchioles, and alveoli.

Spongy because they contain air.

Protected externally by the ribs.

الرئة محمية من الخارج بعظام القفص الصدري ومن الداخل بغلاف من طبقتين pleura بينهم
pleural cavity التي تحتوي على سائل pleural fluid لتقليل الاحتكاك بين الطبقتين عند تمدد الرئة

Protected internally by a double membrane called the pleura.

Pleura is folded to form a sac around each lung = pleural cavity.

Serous fluid is between the two pleural layers to reduce friction when the two layers rub together during ventilation.

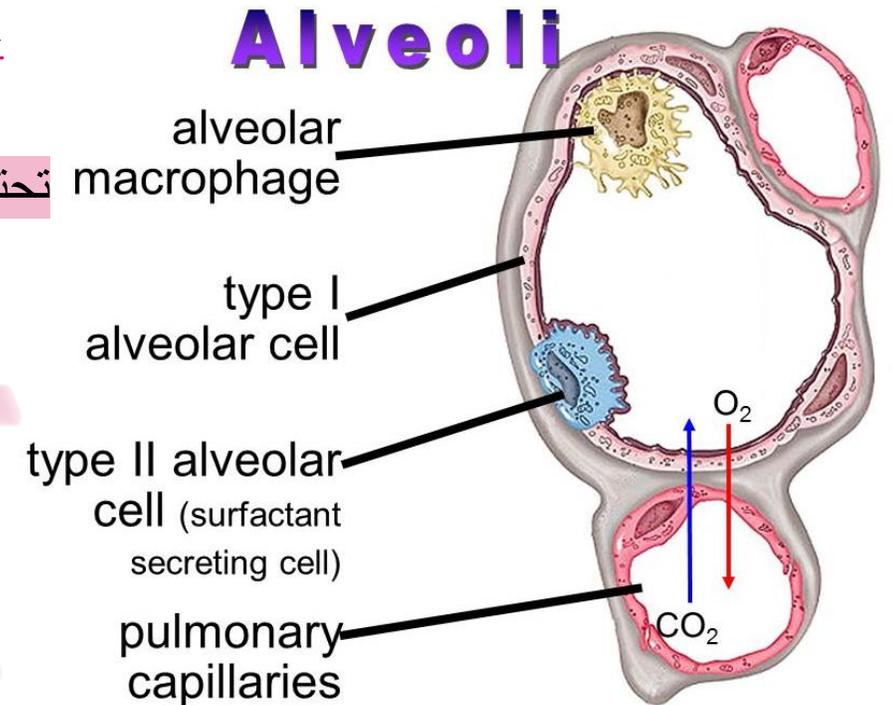
Function of the respiratory system

- * The primary function is gas exchange, with oxygen from the air being transferred to the blood and carbon dioxide from the blood being eliminated into the atmosphere. تحتوي الحويصلة على نوعين من الخلايا 1 & 2 alveolar cell

- There are two types of alveolar cells:

- مسؤولة عن تبادل الغازات
Alveolar cell I: provides surface area for gas exchange function of the lung.

- مسؤولة عن افراز الـ surfactant
Alveolar cell II: secretes surface active surfactants that serve to decrease surface tension and mediate the immune destruction of pathogens that have entered the lung.



وظيفة الـ surfactant مثل الـ lubricante فلو بتتذكروا حكيانا انه يقلل من الـ surface tension فما بخلي الـ alveoli يلزقوا ببعض ، وحكيانا الأطفال الي بنولدوا قبل أوانهم يكون عندهم هاي المادة قليلة بالتالي لما بتنفسوا بعملوا inhalation طبيعي بس لما يعملوا exhalation فالـ alveoli بصيرلهم collapse فبصير عنا (respiratory distress syndrome)

Lung blood supply

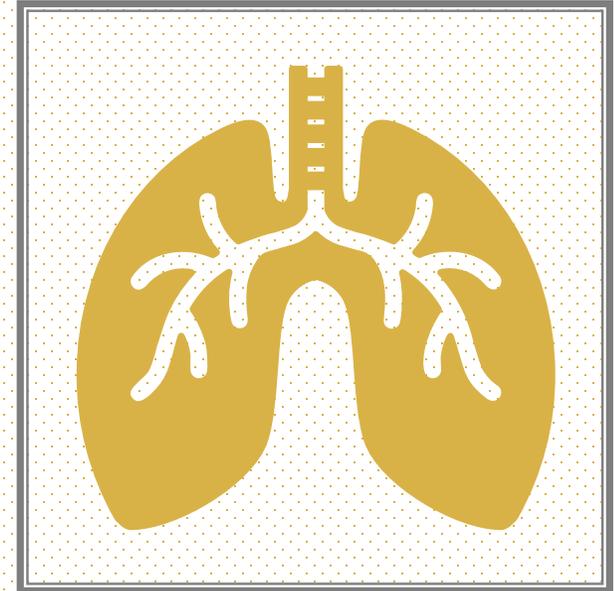
- The lungs are provided with a dual blood supply:

عشان يصير gas exchange و يرجع الدم للقلب ومن ثم لباقي اعضاء الجسم

✓ **The pulmonary circulation** provides for the gas exchange function of the lungs.

✓ **The bronchial circulation** supplies blood to the conducting airways and supporting structures of the lung.

لتوصيل الدم المحمل بالغذاء والاكسجين لخلايا الرئة لأنها عضو و يحتاجهم لحتى يقوم بوظيفته



عملية الـ ventilation ممكن تكون voluntary or involuntary

Voluntary ---> during speaking or singing ... etc.

Involuntary ---> ASN ---> sympathetic and parasympathetic

Sympathetic = Heart rate  = respiratory rate  = bronchial dilatation
= respiratory secretion  = easy ventilation

Parasympathetic = Heart rate  = respiratory rate  bronchial
construction = respiratory secretion  = difficult ventilation

لما واحد يستنشق مواد ضارة (irritating agent)، موجودة بالهواء أول ردة فعل من الجسم راح تكون الكحة (cough reflex) عشان اطلع هاي المواد الي دخلت، ردة الفعل الثاني راح تكون افراز respiratory secretion من الـ mucosal layer عشان يحمي الرئة، فالكحة وظيفتها تطلع المواد هاي عشان الـ mucosal layer ما تضل تفرز respiratory secretion وبعدها تعلمي مشاكل بالتنفس

Function of the respiratory system

The intervention of the lungs occurs by the way of sympathetic and parasympathetic divisions of the autonomic nervous system.

Parasympathetic innervation produces airway constriction and an increase in respiratory secretions.

Sympathetic innervation produces bronchodilation and a decrease in respiratory tract secretions.

Breathing involve the movement of atmospheric air into and out of the alveolar structures in the lung.

It requires a system of open airways and alternating pressure changes resulting from the action of respiratory muscles in changing the volume of chest cage.

← ذمكرتها فوق بستر ح
عملية التنضى

bronchus -> bronchi -> bronchioles

يعني الـ diameter راح يقل في بالتالي الـ
resistance راح تزيد

خلي ببالك انه

Airway resistance increase = exhalation (recoil)

Airway resistance, decrease = inhalation (expansion)

Normal ventilation -> at rest , involuntary
(contraction and relaxation for major
muscles “ diaphragm and intercostal muscles
“

Forced ventilation -> exercise, stress,
diseases ... etc. voluntary (major and
accessories muscles)

^{توسع}
- The ease with which the lungs can be inflated reflects the elastic forces of the lung tissue (surface tension).

^{تعريف}
^{عائق}
Airway resistance refers to the impediment to flow that the air encounters as it moves through the airways.

It varies with airway radius and lung volume, being the greatest in the bronchi with medium-sized radii and lowest in the bronchioles with their smaller radii.

Airway resistance decreases as the lungs expand and pull the airways open during inspiration and it increases as the lungs deflate during expiration.

Lung volumes reflect the amount of air that is exchanged during normal and forced breathing.

Pulmonary ventilation involves the movement of the diaphragm, intercostal muscles, and other respiratory muscles. These muscles are controlled by neurons of respiratory centers in the brain.

Lung volumes

Note: a **capacity** is a sum of ≥ 2 physiologic **volumes**.

Inspiratory reserve volume IRV

Air that can still be breathed in after **normal inspiration**

Tidal volume TV

Air that moves into lung with each quiet inspiration, typically **500 mL**

Expiratory reserve volume ERV

Air that can still be breathed out after **normal expiration**

Residual volume RV

Air in lung after **maximal expiration**; RV and any lung capacity that includes RV cannot be measured by spirometry

Inspiratory capacity IC

IRV + TV
Air that can be breathed in after normal exhalation

Functional residual capacity FRC

RV + ERV
Volume of gas in lungs after normal expiration

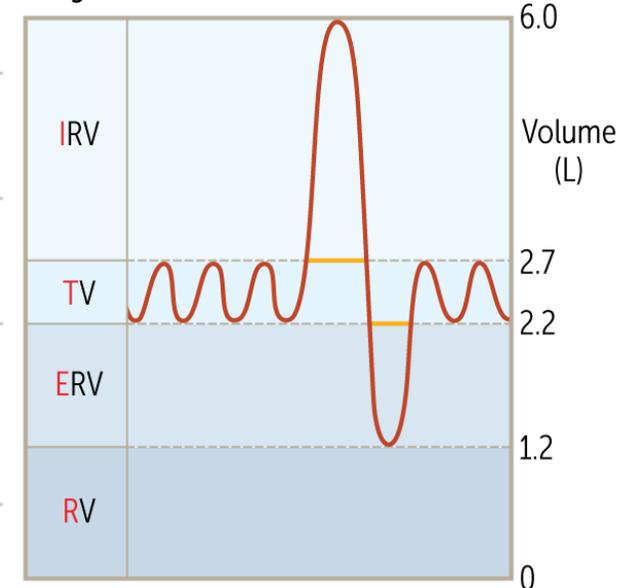
Vital capacity VC

TV + IRV + ERV
Maximum volume of gas that can be expired after a maximal inspiration

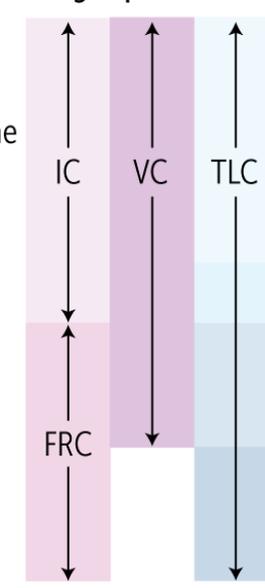
Total lung capacity TLC

IRV + TV + ERV + RV
Volume of gas present in lungs after a maximal inspiration

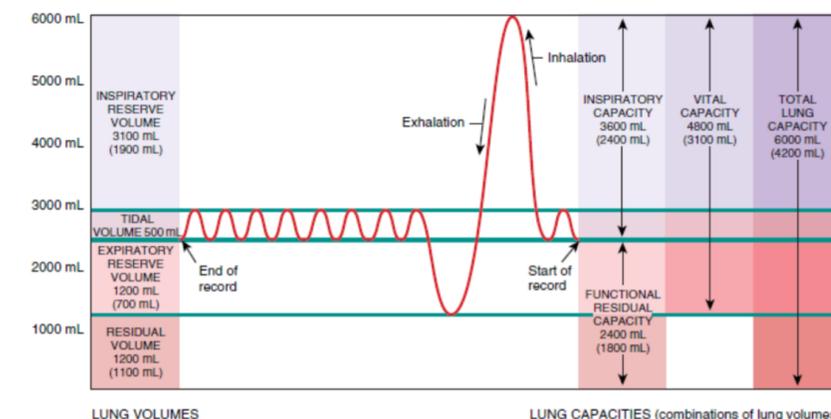
Lung volumes (LITER)



Lung capacities



Rx



LUNG VOLUMES

LUNG CAPACITIES (combinations of lung volumes)

هو كمية الهواء التي داخله وطالعة من ال lungs في الوضع الطبيعي

الي بضل بالرنة بعد ال forced exhalation

Control of breathing

Control of breathing has both **automatic** and **voluntary components**:

The automatic regulation of ventilation is controlled by two types of receptors:

- **Chemoreceptors** ^{تأثر بـ} monitor blood levels of carbon dioxide, oxygen, and pH.
- **Lung receptors**: monitors the status of breathing as airway resistance and lung expansion.

تراقب حالة التنفس عندي

Voluntary respiratory control is needed for integrating breathing and actions such as speaking, blowing, and singing.

Control of breathing

- The cough reflex protects the lungs from the accumulation of secretions and from the entry of irritating and destructive substances. It is the primary defense mechanism of the respiratory tract.

صعوبة بالتنفس - Dyspnea: is a subjective sensation of difficulty in breathing that is seen in cardiac, pulmonary, and neuromuscular disorders.

Blood vessels disorder-> vasoconstrictio-> accumulation of secretion-> difficulty breathing

- It can present as air hunger, brought about by inadequate ventilation, labored or difficulty breathing due to weakened respiratory muscles, or chest tightness that occurs with bronchoconstriction.

الناس اللي عندهم dyspnea
بنسميها air hunger
: not being able to get
enough air

Hypoxia ↓ O₂

Hypercapnia = CO₂ ↑

عملية انتقال الـ O₂ & CO₂ بين الرئة والهواء بتكون ineffective

- ❖ Is a decrease in blood oxygen level that results in a decrease in tissue oxygenation.
- ❖ It can occur as a result of hypoventilation, diffusion impairment, shunt, and ventilation-perfusion abnormalities.
- Acute hypoxemia is manifested by increased respiratory effort (increased respiratory and heart rates), cyanosis, and impaired sensory and neurological function.
ازرقاق
suddenly فبسبب ارتفاع مفاجئ في الـ H.R & R.R وازرقاق
وضعف في الوظائف الحسية والعصبية
- The body compensates for chronic hypoxemia by increased ventilation, pulmonary vasoconstriction, and increased production of RBCs.
كيف الجسم يتعامل مع الـ chronic hypoxia
عشان هي اللي بتنتقل الـ O₂ وبتخلصنا من الـ CO₂

Muscle contraction

Lungs expansion = easy ventilation

Respiratory diseases to be discussed

- Hay Fever. حُمى الكلا
- Bronchial asthma. ربو قصبي
- Chronic Obstructive Pulmonary Disease (COPD).
- Emphysema. انتفاخ الرئة
- Pulmonary tuberculosis. السل الرئوي
- Cancer.

واحد عنده حساسية الربيع مثلاً فهون المواد الي بالجو بتسببه تهيج والتهاب inflammation

Inflammation = stimulate histamines secretion

افراز الهستامين بعمل عندي عدة أعراض " راح أرقمهم تحت " ف هون بكون الحل إنه أعطيه Antihistamine drug

Hay fever (seasonal allergic rhinitis)

موسمية بسبب مواد مهيجة موجودة بالجو

- Characterized by sensitivity to airborne allergens, especially from pollens of olive trees and grasses.
- Respiratory mucosa secretes excessive mucus causing a runny nose and congestion.
- Mucosal surfaces of the eyes also react to the allergens causing redness, watery secretions, and itching.
- Because the release of histamine causes these unpleasant effects, a substance that counteracts its action, an antihistamine, may give relief.



الربو القصبي

صعوبة بالتنفس

Bronchial asthma

منه نوعين acute and chronic

- Asthma is the most common chronic disease of childhood.

أكثر ناس
معرضين
ليدخلوا
الطوارئ

Children younger than 4 years of age have the highest rate of emergency department visits and hospitalizations.

لما بيكبروا بتحسنا (٣٠٪ - ٧٠٪) منهم

- by early adulthood, 30 to 70% will markedly improve or be symptom-free.
- Higher prevalence in minorities:
 - Urbanization.
 - Poor access to care.
- Significant burden on the healthcare system.
- Can be life-threatening if not properly managed:
 - Education is key to the prevention of death from asthma.

ممکن يكون هاد المرض life threatening يعني بشكل

خطورة على حياة الشخص لو ما تمت معالجته بالطريقة

الصحيحة " ممكن يكون علاج هالمرض بخاخ لكن المريض بعرفش يستخدمه

صح فيزيد من الأمر خطورة " فأنا لازم اعلمه كيف

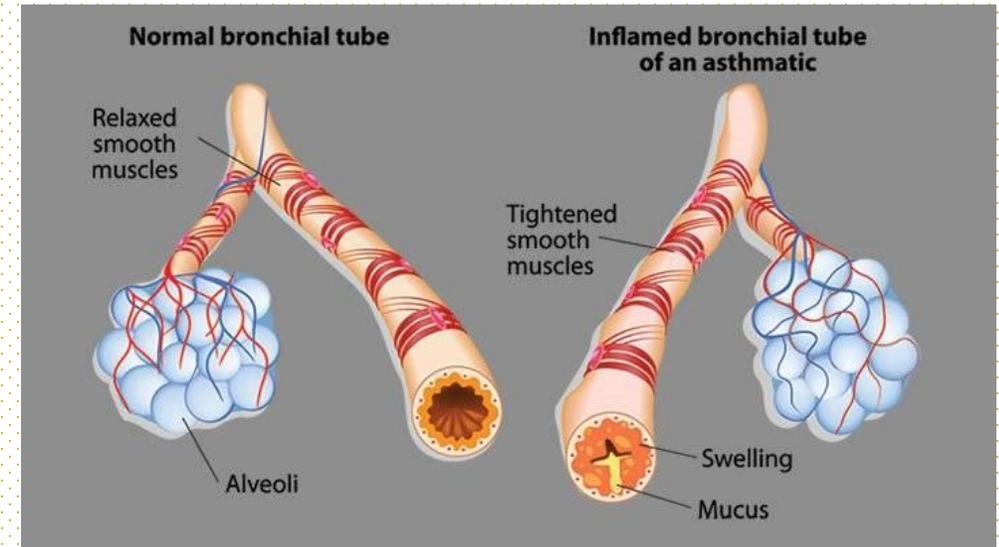
الناس الي عندهم asthma

٨٠٪ أطفال

٥٠٪ بالغين عندهم حساسية لشي معين

Bronchial Asthma

- Characterized by hypersensitivity to various allergens like dust, mold, pollen, animal dander, and various foods
مواد بتسبب حساسية ↗
- Eighty percent of children with asthma and fifty percent of adult asthmatics have allergies.
- The allergens trigger constriction of smooth muscle in the walls of the bronchi, narrowing the lumen of the tubes. The spasm is a sustained contraction of the musculature, making breathing, particularly expiration, very difficult.



كيف بيصير هاد المرض

لما توصل المادة المهيجة بصير عندي

Bronchi construction = mucosal layer secretes, respire tree secretion = narrowing the lumen tube = difficult ventilation

Bronchial Asthma

- The mucous membrane becomes swollen with fluid, also narrowing the lumen. Excessive secretion of mucus adds to the obstruction. Stale air becomes trapped, which decreases the amount of fresh air that can enter the lungs.

صوت خشخشة

- The wheezing sound results from air passing through the narrowed tubes. Psychogenic factors such as anxiety are frequently associated with an asthma attack.

ال emotions ممكن تكون سبب آخر لل asthma

- A tense situation or an emotional experience such as stress can trigger an attack.

Bronchial Asthma

Bronchi Inflammation

- Other nonallergic causes are overexertion, infection, or bronchitis. Exposure of the bronchial mucosa to irritants such as cigarette smoke, aerosol sprays, or perfume can also trigger an attack.
- There is no cure for asthma, but attacks may become less severe with age. It is important to identify the offending allergens and avoid contact with them as much as possible.
- Because overexertion may be involved, it is important for the athlete to take some extra time to “warm-up” and get adjusted to the situation before participating in physical activities and sports.

حدد المواد التي
بتسبب التهيج
واتجنبها

مجهود زائد

لهيك الناس الرياضية بنقلهم اعملوا warmig up قبل ما يلعبوا رياضية ، عشان الناس الي بتلعب رياضة شديدة بشكل مفاجئ ممكن يتعرضوا للاصابة بـ asthma

Drug-Induced Asthma

بسبب بعض الادوية

بشابت ال inflammation راح ناخذ عن ال arachidonic acid
انه بمشي بـ 2 pathway

1. Cyclooxygenase pathway (الاسبرين باثر عليه وبعمله تثبيط)
2. Lipoxygenase rout

لو تعرضوا كثير
للاسبرين شو
بصير معهم

- Several pharmacologic agents provoke asthma, aspirin being the most striking example.

Patients with aspirin sensitivity present with recurrent rhinitis and nasal polyps, urticaria, and bronchospasm.

- The precise mechanism remains unknown, but it is presumed that aspirin inhibits the cyclooxygenase pathway of arachidonic acid metabolism without affecting the lipoxygenase route, thereby shifting the balance of production toward Leukotrienes that cause bronchial spasm

حسب الشغل

Occupational Asthma

عشان الي بشتغلوا باللابات بتعرضوا لمواد كيميائية او الي بشتغلوا بالبناء بتعرضوا لغبار .. الخ

- This form of asthma is stimulated by fumes (epoxy resins, plastics), organic and chemical dust (wood, cotton, platinum), gases (toluene), and other chemicals.
- Asthma attacks usually develop after repeated exposure to the inciting antigen(s).

Asthma Pathophysiology Have 2 respnse

Early-Phase Response :

أحيانا بيوصل
بعد ما يتعرض للallergic agent تضييق Peaks 30-60 minutes post-exposure, subsides 30-90 minutes later

- Characterized primarily by bronchospasm
- Increased mucous secretion, edema formation, and increased amounts of tenacious sputum. بلغم
- Patient experiences wheezing, cough, chest tightness, and dyspnea.

بعد الـ bronchoconstriction ونتيجة لتجمع المخاط فبصير
عندي inflammation وبتحفز افراز الـ chemical
mediators like histamine وهاي المواد بتكون.
Hyperresponsiveness للمواد المهيجة فبتزيد من الأعراض

(بتزيد الطين بلة)

Histamine= bronchoconstriction= increase resistance

Asthma Pathophysiology

فبصير عندي air. Trapping. فبدخل الهواء وما
بطلع فبعمل hyperinflation
وأكيد لو ما تمت معالجتها تؤدي إلى irreversible
lung damage

Late-Phase Response:

- Characterized primarily by inflammation.
- Histamine and other mediators set up a self-sustaining cycle increasing airway reactivity causing hyperresponsiveness to allergens and other stimuli.
- Increased airway resistance leads to air trapping in alveoli and hyperinflation of the lungs.
- If airway inflammation is not treated or does not resolve, may lead to irreversible lung damage.

Treatment and Prognosis of Asthma

Treatment

ادوية واحاول ابتعد عن المواد الي بتعملي تهيج

Medication and allergy shots can reduce the incidence or severity of asthma attacks.

To counteract an ongoing attack, substances that dilate the bronchi are effective. **Ephedrine sprays** and **epinephrine** (adrenalin) **injections** are often effective.

Bronchodilators like **albuterol** and **metaproterenol** are sometimes prescribed.

Cortisone-like drugs and **antihistamines** are sometimes used, but these carry a risk of side effects.

Treatment and Prognosis of Asthma

ناس ما بتستجيب للعلاج الي ذكرناه فوق

- The most severe form of an asthma attack is called **status asthmaticus**, in which the patient fails to respond to the usual treatment. A procedure as drastic as a **tracheotomy**, an opening of the **trachea surgically**, may be required. If not treated, status asthmaticus may end in respiratory failure and death.

ازالة ال trachea

ولو ما استجاب فممکن تؤدي لل respiratory failure and then death

- Asthma kills **at least 15 people daily** in the United States, according to the American Lung Association.

COPD



Two types:

هدول الامراض الي ممكن تسبب ال COPD

التهاب مزمن بالقصبات

نتيجة accumulation of mucus

1 Chronic Bronchitis: Characterised by mucous production.

انتفاخ الرئة

2 Emphysema: Characterised by structural changes.

COPD is not usually a clear cut, the above 2 conditions co-exist.

هو مش بالضرورة يلحق هالمرضيين لكن لو بده يصير فهم بكونوا السبب غالبا

Causes:

- Smoking: 99% of COPD cases.
- Environmental exposure: dust, silica, air pollutants.
- α -1 antitrypsin deficiency: due to genetic factors or it might be from liver failure. بنصنع بالكبد Enzyme *
لسا من يومين امتحننوا فيها بالبيوكيم لو متزكرينها *

COPD Pathophysiology

- Walls of the small airways and alveoli lose their elasticity and thicken.
- Closes off some of the smaller air passages and narrows the larger ones.
- Air can enter the alveoli but becomes trapped due to the collapsed airways:
 - ✓ Affects gas exchange and pathological changes occur.
- Blood is poorly oxygenated and tissue perfusion is less efficient.

Carbon dioxide may accumulate to critical levels:

✓ Respiratory acidosis.

✓ Respiratory failure.

- Strains the heart: pulmonary artery and veins متصلين بالـ حتى بالقلب يعمل مشاكل لأنه كلنا بنعرف انه الرئة والقلب

✓ Right ventricle can enlarge and thicken.

Arrhythmia

✓ Abnormal rhythms called cor pulmonale.

بتأثر على الـ smaller vessels يعني بتسكرهم بشكل كامل والـ large vessels بتعمللهم تضيق بشكل كبير فبفقدوا المرونة تبعثهم والسبب الرئيسي يكون تجمع المخاط الي يؤدي لمحاصرة الهواء فتؤثر على عملية تبادل الغازات فبصير الـ oxygenated blood والـ tissue perfusion اقل. فعالية

COPD Symptoms

Early:

- Early morning cough with clear sputum. بلغم
- Periods of wheezing during or after colds.
- Shortness of breath on exertion.

Late:

- Mouth breathing. بتنفسوا من تمهم
- Puffing. بتنفسوا مثل هيك " ابووف ابووف " جربوا جربوا 🤔
- Use of accessory muscles of breathing.
- Inability to finish sentence without catching one's breath.
- Sleep in semi-sitting position.

هدول قلنا بشتغلوا بال forced ventilation
فهون بصيروا بشتغلوا بال normal

مش متمددين بالكامل يعني

COPD Treatment

1 Oxygen.

2 Medications:

- Bronchodilators.
- Corticosteroids.
- Antibiotics: infection لو عندهم
 - First sign of infection.
 - Yellow or green sputum.
- Other drugs to treat associated symptoms
 - Diuretics. fluid accumulation لو عندهم
 - Analgesics.
 - Cough suppressants.
 - Anxiolytics. Anti-stress

As a surgical treatment

Other COPD Treatments

- **Bullectomy or lung reduction.** بشيلوا الرئة
- **Pulmonary rehabilitation:** اعادة تهيئة ال pulmonary system
 - ✓ **Exercise.**
 - ✓ **Oxygen.**
 - ✓ **Nutritional support.**
- **Intermittent mechanical ventilator support.** اشي يساعدهم على التنفس
- **Relaxation techniques:**
 - **Breathing techniques.**
- **Clearing airway passages:** ازالة للمواد المتراكمة بال airway ←
 - **Postural drainage.**
 - **Chest percussion.**
 - **Controlled coughing.**
 - **Tracheal suctioning.** سحب ال excess fluid

COPD complications

لأن ال hypoventilation بعمل hypoxia فكيف الجسم كان يستجيب لل hypoxia بعمل
bronchoconstriction فينسميها hypoxic vasoconstriction

- Decrease ventilation leads to hypoxic vasoconstriction, which leads to pulmonary hypertension, then increase the workload on right ventricle which can lead to right ventricular hypertrophy and failure (cor pulmonale).

كله بسبب كاه .

نفسها الـ inflation وبكون هون عنا ضعف

بالـ Lungs فبعمل عنا

chronic lung obstruction and a destruction

وهاد المرض بصير بسبب الـ trapping للهواء الي بحتوي

على كمية كبيرة من CO2 فبصير معه suffocating

feeling يعني مخنوق ومش عم بيعرف ياخذ نفس وبصير

عندهم severe pain

Emphysema

- A crippling and debilitating (weakening) disease with chronic lung obstruction and destruction.
- The word *emphysema* means inflation. The lungs become filled with air that is high in carbon dioxide. This air cannot be adequately exhaled to allow oxygen to enter. The person experiences a suffocating feeling and great distress from the inability to breathe. Severe pain accompanies the difficult breathing.
- The cause of emphysema is not known, but it is most frequently associated with heavy cigarette smoking.

معلومة سريعة عن الـ deficiency of alpha antitrypsin

انه عملي

1. Alevolar destruction

2. Emphysema

الـ air pollution لو اتعرضتله لمدة طويلة فممكن يحولي

المرض من acute لـ chronic

Emphysema

التهاب داخل الرئة

↪ An inherited form has been identified also. Individuals with a deficiency in **alpha-1-antitrypsin** are prone to **alveolar destruction** characteristic of **emphysema**.

↪ Air pollution and **long-term exposure to irritants** of the respiratory tract also seem to be **factors of its etiology**.

- **Emphysema** is a frequent **complication** of **chronic bronchitis**. Whatever the cause, the **alveolar walls break down**, **adjacent alveoli fuse**, and the **lungs lose their elasticity**.

Type your text

الـ emphysema كونها عبارة عن inflammation فـ :

١. الـ irritant بيدخل للـ alveoli

٢. تحفيز الـ inflammatory process. فبتم افراز الـ cytokines الي بتحفز الـ

immune system

٣. الـ immune system active neutrophils.

٤. الـ neutrophils تفرز بعض الانزيمات مثل الـ elastase

٥. الـ elastase بكسر الـ elastin (الي بتعطي الـ lung المرونة elasticity)



Emphysema

Irritant
inside the
alveoli

Phagocytosis by
alveolar
macrophages

Cytokines
released

Elastase
breaks down
elastin

Neutrophils
releases proteases
enzymes mainly
elastase

Cytokines
activates
neutrophils

- It's connective tissue.
- Its function is:

مسؤول عن الـ elasticity فهو مسؤول عن الـ recoiling
 وبساعد على معرفة متى الـ airway بتفتح وبتسكر ليحافظ
 عليها مفتوحة وكمان بعمل integrity of alevoli wall

Elastin

- **Recoil:** helps lungs to contract and exhale the air outside.
- **Keeps the airway open:** elastic tissues in the airway generate opposing pressure during exhale to keep the airway open.
- **Form the integrity of the alveoli wall.**
- By breaking down elastin by elastase, lungs cannot contract very well and the airway will be collapsed, in addition, to alveoli wall damage which decreases the surface area for gas exchange.

لما يصير له degradation ايش
 بعلمي اضرار

α 1- antitrypsin

بتم تصنیعه بالـ Liver هو بعمل
inhibitor for degradation
elastin antitrypsin

- Released by the **liver** to the blood.
- Its **anti-protease enzyme**.
- **It breaks down elastase** which **helps to keep the elastin intact**.
- * Deficiency leads to increase elastase levels and breaking down elastin.

مبدأ برينولي ينص على أن ضغط المائع يقل عندما تزيد السرعة.

Bernoulli principle

هنا عشان الهواء يغادر الرئة بسرعة لازم يكون الضغط قليل حسب مبدأ برينولي ، فهاد الضغط القليل بينتاج من ضغط معاكستولد من الـ elastic tissue ، فهون لو صار عندي مشكلة بالـ elasticity of lungs فيصير عندي collapsed ويؤدي لانحصار الهواء الغني بـ CO2 وقليل الـ O2 بالداخل

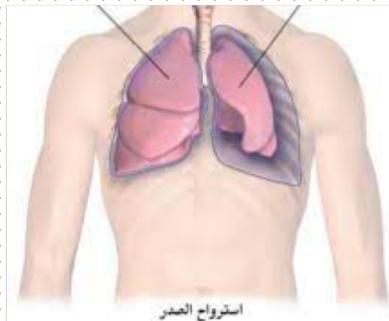
- Air leaves the lung in a high-velocity manner, so, the airway should be a low-pressure airway.
- The low pressure comes from the opposite pressure which is generated from the elastic tissue in the airway.
- If the airway loses this elastic tissue, the airway will be collapsed during exhale (against the low) which causes air trapping.

Emphysema

- Leads to:
 - Hypoxemia $O_2 \downarrow$
 - Hypercapnia $CO_2 \uparrow$
- Hypoxemia and hypercapnia are late* stages in emphysema but early* stages in chronic bronchitis.

Emphysema based on the morphology changes:

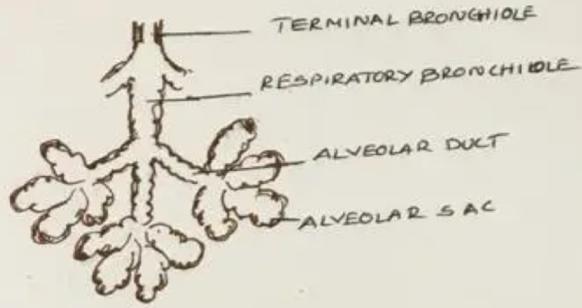
Morphology= structure



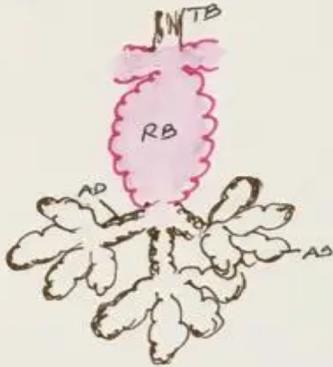
- **Centriacinar emphysema:** Changes in the alveoli wall in the upper part of the lung.
- **Panacinar emphysema:** affect the lower part of the lung.
- **Distal acinar emphysema:** affects parts near to pleura. This can cause rupture of the alveoli and lead to pneumothorax.

استرواح الصدر pneumothorax هو وجود هواء بين طبقتي غشاء الجنب (وهو غشاء رقيق وشفاف، يتألف من طبقتين، ويُغطي الرئتين ويُبطن جدار الصدر من الداخل أيضًا)، مما يسبب انخماصًا جزئيًا أو كليًا في الرئة. تشتمل الأعراض على صعوبة التنفس وآلم الصدر.

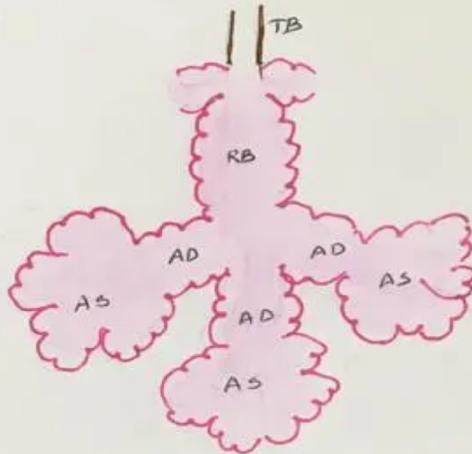
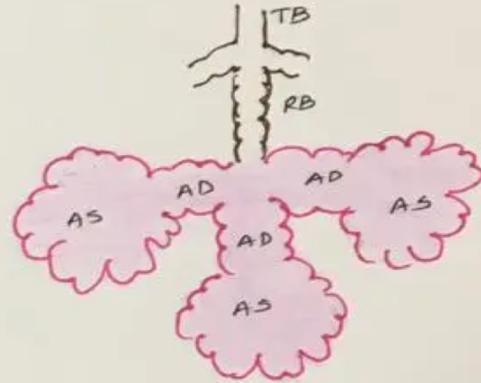
TYPES OF EMPHYSEMA



CENTRIACINAR



Distal Acinar



PANACINAR

Signs and Symptoms of Emphysema

1



Typically, a person with emphysema has an **increased rate of breathing** and a **greater than normal expansion of the chest**. This **hyperventilating** clears out **carbon dioxide that is building up internally** because of poor lung functioning.

4



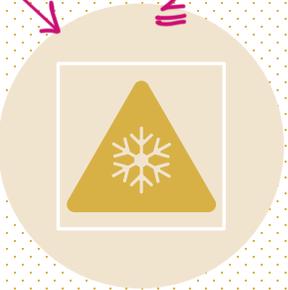
Permanent expansion of the chest (“barrel” chest); **abnormal respiratory sounds** called **rales**.

3



Right-sided heart failure or **azرقاضى cyanosis** because of marked **hypoxemia**.

2

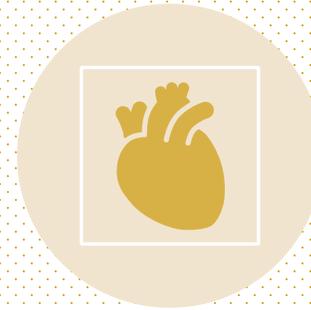


Hypoventilation **reduces oxygenation**.

Signs and Symptoms of Emphysema

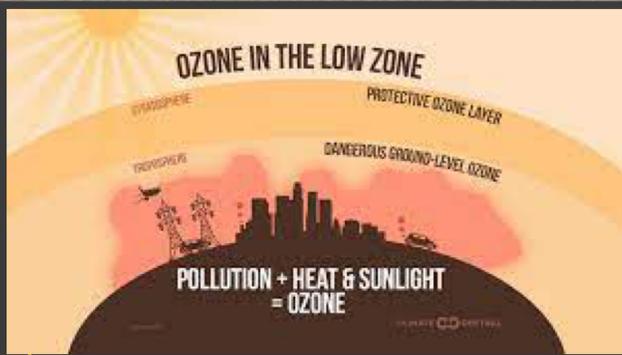
في حال طولت الحالة فبصير عنا ضرر لا يمكن معالجته بالرئة

Emphysema can last for many years, causing **irreversible damage to the lungs**. As in any serious disease, complications often develop. With the breakdown of alveolar walls, the surrounding blood capillaries are damaged.



This interference with **circulation** in the lungs can lead to an **obstruction of the pulmonary artery**. The large air sacs, formed by the fusion of the alveoli, tend to rupture. **This** allows air into the pleural cavity, the space between the lungs and the chest wall. Air in this space can cause the lung to collapse.

pneumothorax = lungs collapse



Diagnosis and Treatment of Emphysema

- **Treatment** involves **eliminating the source of the irritation**. A **smoker** will be told to **quit smoking** and to **avoid polluted air containing smoke, fumes, and irritating dust**. The **patient** should observe **ozone warnings** and **limit outdoor activity** when the **ozone level is high**.
- **Medications** that **clear mucus** from the lungs help **prevent infection**. Some medications give relief from the feeling of **not being able to breathe**, such as **albuterol** or **metaproterenol**.
- **Physical therapy** is sometimes helpful in **teaching individuals to use all the possible muscles for respiration in the abdomen and chest wall**.

كونه inflammation فأكيد حتزيد عندي الـ mucus
secretion فبعمل عندي narrowing of airways

, كل الأمراض الي ذكرناها فوق وهاي تقريبا نفس
الاسباب لكن بدني اقلكم انه التعرض المستمر للـ
irritant ممكن يعمل & hypertrophy
hyperplasia

التهاب رئة مزمن

Chronic

Bronchitis

لو بتتذكروا اخدنا إنه الـ Cilia وظيفتها تخلصنا من
الـ excessive mucus فلما يصير عندي
Chronic bronchitis بصير الها dysfunction

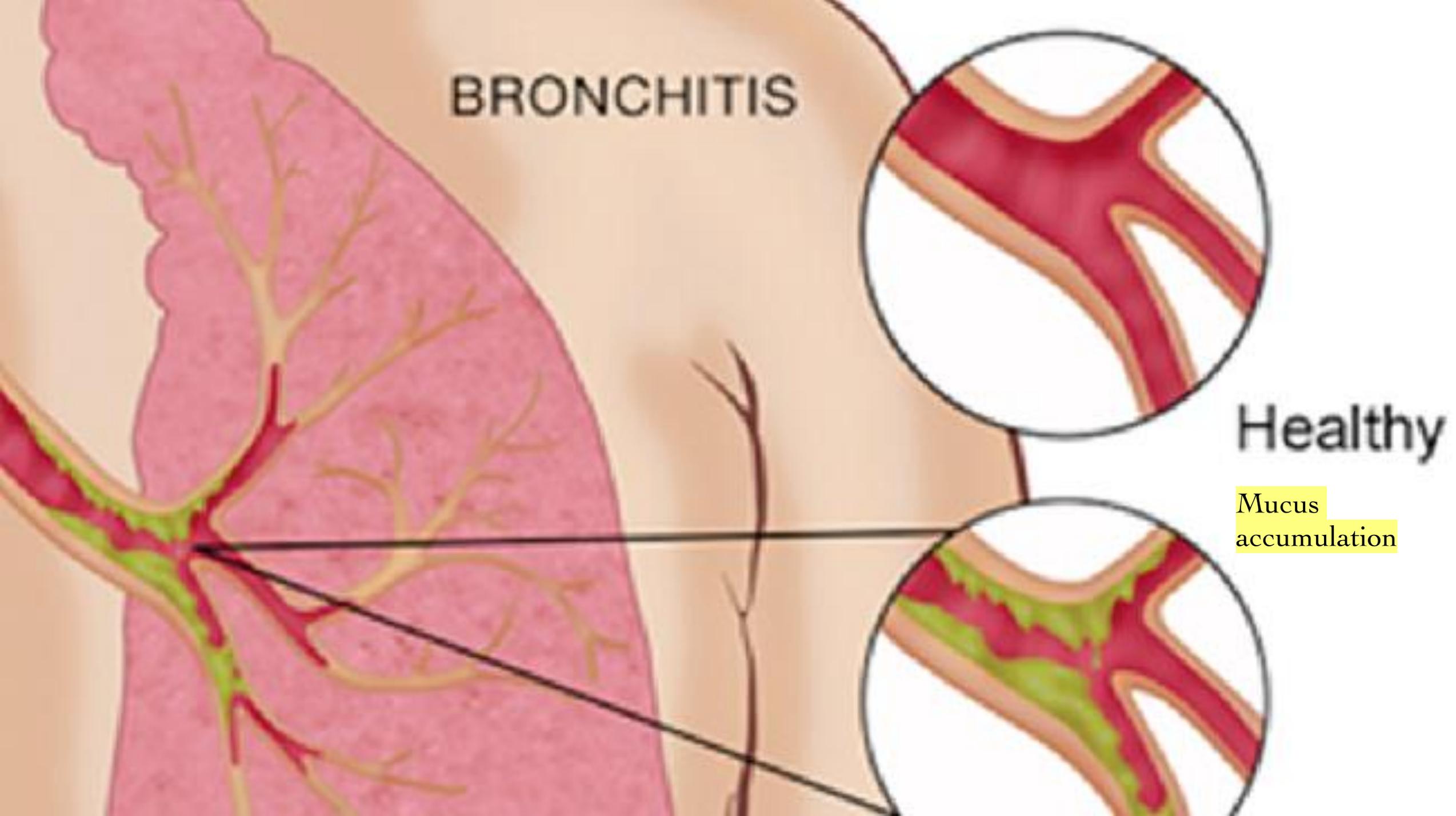
The mucous production increases significantly which severely narrows the airway.

Due to continuous exposure to irritants, hypertrophy and hyperplasia occurs to mucous glands as well as goblet cells.

Ciliary dysfunction: shortening and less motility of the cilia which make the mucous hard to be removed.

Air trapping: due to mucous accumulation, CO₂-rich air is trapped inside the lung.

BRONCHITIS



Healthy

Mucus
accumulation

- Due to **less oxygen inhaled** and **less CO₂ exhaled** the following conditions will occur:
 - **Hypoxemia**: decrease in PO₂
 - **Hypercapnia**: increase in PCO₂
- **Chronic bronchitis can lead to Pneumonia by increasing the risk of infection with:**
 - **Haemophilus influenza (H. Flu)**. انفلونزا المستدمية النزلية (بكتيريا)
 - **Moraxella catarrhalis (M. Catarrhalis)**. الموراكسيلة النزلية (البكتيريا)

السُّلُّ الرئوي

Pulmonary tuberculosis

اسم البكتيريا المسببة للمرض

بتستنشق نقط من الـ respiratory secretion وانت عم يتكح او يتعطس او حتى وانت بتبرم (بتحكي كثير خلص اسكت يا عمي عشان ما تمرض 😊)

Is a **chronic respiratory infection** caused by Mycobacterium tuberculosis.

سبب
حدوثه

Caused by **inhaling droplets from the respiratory secretion created by coughing, sneezing or talking** of a person with active tuberculosis.

عندهم
البكتيريا بس
مش ظاهرة
الاعراض

Patient may stay asymptomatic (latent tuberculosis) as the M.O. is surrounded by T lymphocytes and macrophages to prevent spread of the disease.

Patients with weak immune system as children and HIV patients develop active disease.

ولو صار symptomatic patient يعني الاعراض ظهرت عنده بكون عنده weak immune response مثل الناس المصابة بالايذز او الاطفال

The destructiveness of the disease results from the **cell mediated hypersensitivity response** that the bacillus evokes rather than its **inherent destructive capabilities**.

Cavities are formed as a result of immune response.

ثقب بالرئة (اله صورة تحت)

تنتقل

In rare conditions the bacteria may erode to the blood leading to **spread into brain, meninges, liver, kidney and bone marrow**.

Pulmonary tuberculosis (TB)

- Infection of the lung tissue with airborne bacteria called *Mycobacterium tuberculosis*.
- It affects alveolar tissue specifically.
- *M. tuberculosis* has 3 fates inside the alveoli:
 - Elimination.
 - Retention (bacteria stays inside the macrophages): latent TB
 - Active infection: active TB.

٣ مصيريات أو مصائر (مش عارفة اجمع كلمة مصير اتحملونا 😊)

يتم ازلتها أو تبقى فبتصير خلايا TB الكامنة أو انها تصير تعدي الخلايا الي جنبها يعني بتصير خلايا TB نشطة

مرض TB كامن

TB pathophysiology

- When bacteria enter the lungs, macrophages will phagocyte them, however, mycobacteria inhibit the lysosomes activity in these macrophages, then bacteria may reproduce and get released others that will phagocyte them, and the accumulation of macrophages leads to destruct the lung and form granuloma or tuberculoma.

البكتيريا تدخل الي الرئة ف بتتحفز الـ macrophages فبتقوم ببلعمة الـ mycobacteria فبتيجي هاي الـ mycobacteris بتثبط عمل الـ lysosomes بالـ macrophages وكم ان هاي البكتيريا بتقوم بتحفيز انتاج وتحرير more and more phagocyte مما يؤدي الي تراكمها و .destruction the lung and form granuloma or tuberculoma.

TB pathophysiology

- Once granuloma is big enough to see, this is called Gohn focus.
- If the infection is not treated, the infection will spread over to the lymph node in the lungs to form Gohn complex (Gohn focus and lymph node). This is called primary infection and 90% of the TB cases are stays in this stage as latent TB which remains in the person's entire life without causing any problem.

لو ما تم علاج المرض فهاد الالتهاب راح ينتشر للعقد الليمفاوية تبعث الرئة وتسبلي Gohn complex ، وهاد بكوم التهاب أولي primary infection , ويتكون ٩٠٪ من الـ TB هي كامنة او صامته (يعني بيحمل المرض لكن الاعراض مش حتكون ظاهرة عليه ويتكون حياته عادية) و ٥٪ يكون progressive infection , والـ ٥٪ الاخيرة يكون الـ latent TB صارت active TB فبنتقل للـ secondary infection

TB pathophysiology

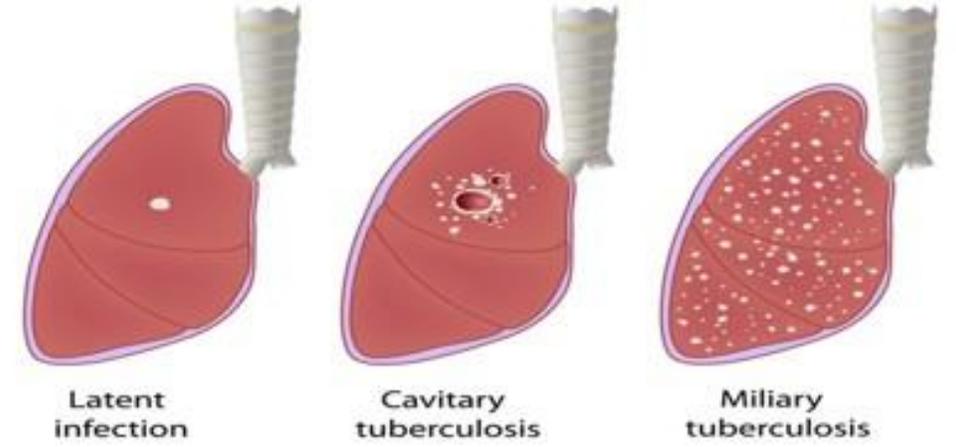
- Around 5% of the cases will have a progressive infection which manifested as tuberculosis pneumonia. Or some of them will go beyond local infection, the infection disseminates to other organs such as the liver, brain, and kidney (infection appears as tiny spots called miliary TB).

TB pathophysiology

- In the other 5% of the patients, latent TB becomes reactivated to cause the secondary infection.
- Secondary infection may happen months to years after the primary infection due to depressed immune systems, such as in HIV and chemotherapeutics, also, DM and smoking will increase the risk.



Tuberculosis (TB)



Tuberculosis Symptoms

<u>Temperature</u>	<u>Chills</u>	<u>Weight loss</u>
<u>Pain</u>	<u>Fatigue</u>	<u>Hemoptysis</u>
<u>No appetite</u>	<u>Cough</u>	<u>Irritability</u>

Pulmonary Tuberculosis-Diagnosis and Treatment

- It is diagnosed by:
 - Culture of the organism (12 weeks). اختبار عشان يعرفوا لو البكتيريا موجودة او لا
 - DNA amplification (several hours). فحص ال DNA
 - ID injection of tuberculin (detect presence of antibodies) is used for screening.
- The treatment focuses on the elimination of the tuberculosis bacilli from infected persons and eliminating its spread which requires multiple medications.
- The primary drugs used in the treatment are Isoniazid, rifampin, ethambutol and pyrazinamide for active tuberculosis for two months followed by isoniazid and rifampin for another 4 months. بعد الشهرين نستخدم فقط
- Persons who are in contact with the person with tuberculosis should be prophylactically treated usually by isoniazid.
- Drug resistance could complicate the problem, which is solved by drug susceptibility test. قد تؤدي مقاومة الأدوية إلى تعقد المشكلة ، والي بحلها عن طريق اختبار الحساسية للأدوية.

هانت هانت اخر مرض عارفة انكم
زهقتوا حتى انا زهقت وانا بفرغ 😂

Lung cancer

- Lung cancer is the leading cause of cancer death among both men and women. Death from lung cancer includes about 28% of all cancer deaths. Approximately 80% of lung cancer is related to cigarette smoking; lung cancer is ten times more common in smokers versus nonsmokers.

سبب ثاني غير التدخين

Other causes include **inhalation of carcinogens** (cancer-causing agents) which may be an **occupational hazard among workers** who are constantly exposed to air pollution including Arsenic, Chromium, Nickel, and vinyl chloride, exhaust gases, and industrial fumes.

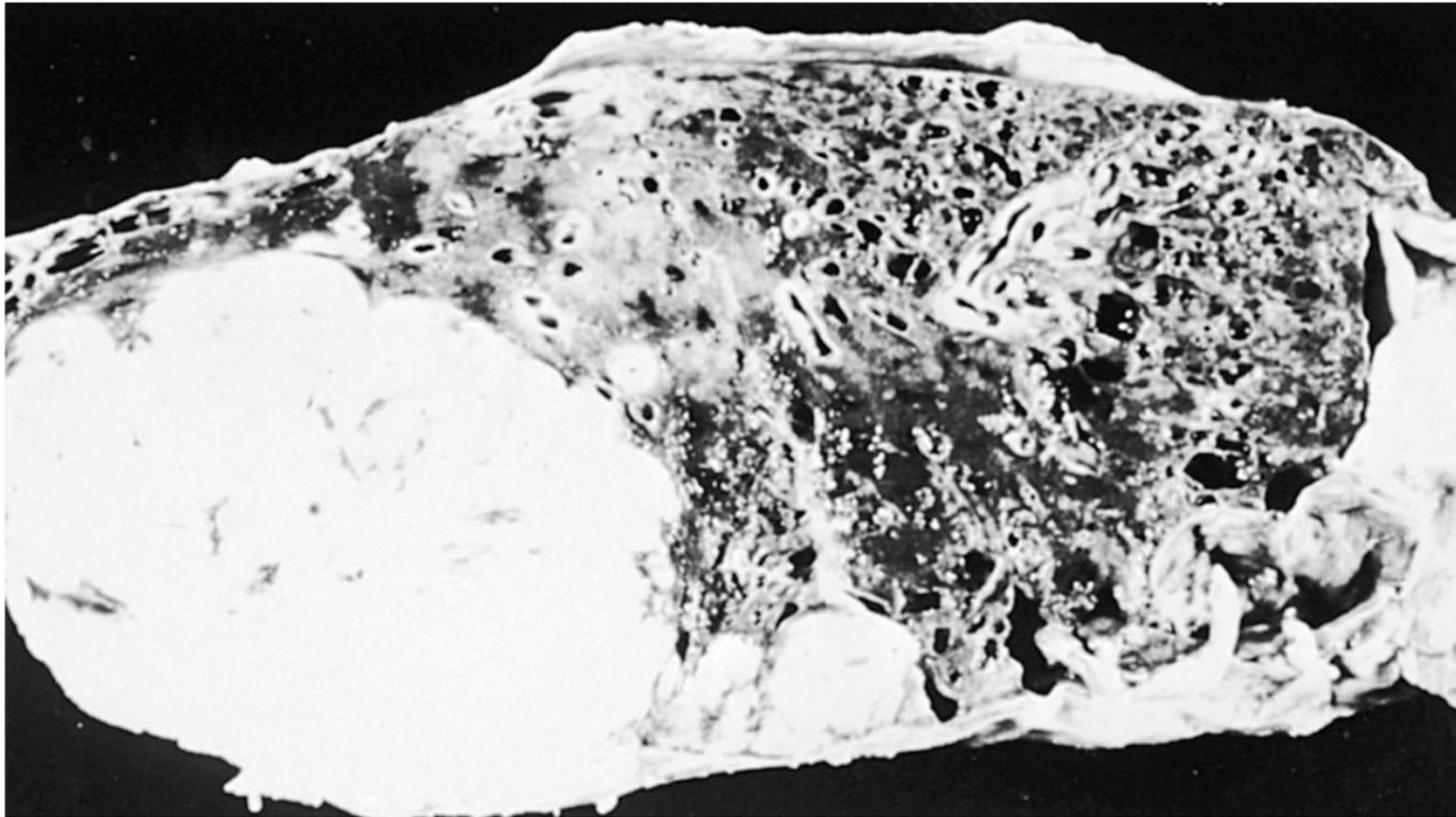
استنشاق مواد مسرطنة وغالبا ما تكون عند الناس الي بتشتغل بمكان بتكون معرضه فيه لاستنشاق مثل هاي المواد

كيف بدمر
السرطان الرئة

The great danger in Lung cancer is **blockage of the airway by the malignant tumor as it grows into the lumen of the bronchus**. The affected part of the lung collapses for lack of air.

- Danger of airway obstruction; **death** results from **complications of obstruction or from the effects of metastatic tumors**.

سرطان الرئة مافي مزح و٢٨٪ من الاشخاص المصابة بأنواع السرطان الثانية بموتوا منه ، الان السبب الاكثر تكررًا بنسبة ٨٠٪ للاصابة بهالمرض (الله يبعده عن الجميع) هو الدخان (يعني تخيل من كل ١٠ اشخاص مصابين بسرطان الرئة يكون ٨ منهم سببه الدخان !! ، نسبة كبيرة صح ! غير انه الاشخاص



**Figure 9-7: Carcinoma of the lung (large white area).
(Courtesy of Dr. David R. Duffell)**

Lung cancer

يكون بالرجال اكثر من النساء نتيجة التدخين وبتحدد بشكل مبكر بسبب وجود المخاط sputum ، بصير بال squamous cell
بس ممكن يتمدد لل major bronchi والعقد الليمفاوية تبعت الرئة

يكون الامريكيين بالنساء وغير المدخنين، يعتبر malignant خبيث، لأن هذول المرضى عندهم تراكم للمخاط و associated with pleural fibrosis و scarring

يكون الها high neoplastic characteristic فصعب انه نعملها تصنيف وبتحدث بمحيط الرئة وبال larger airway

- It divided into:

- ✓ 1 Non small cell carcinoma:

- **Squamous cell carcinoma:** more common in men and correlated to smoking. Early detected by cytological examination of the sputum. It extends to the major bronchi and pulmonary lymph nodes. Central cavitation tumor is frequent.

- **Adenocarcinoma:** the most common in north America in women and nonsmokers. It is a malignant epithelial cell tumor with glandular differentiation a mucin production by the tumor cells. Associated with pleural fibrosis and scarring with poor prognosis

- **Large cell carcinoma:** have large polygonal cell which are highly neoplastic and difficult to categorize. It occurs in the periphery of the lung, invading subsegmentally bronchi and larger airway. It has poor prognosis because of tendency to spread to distant sites early in the course.

- ✓ 2 Small cell carcinoma:

Small cell lung carcinoma

هو characteristic بـ خلايا صغيرة بتكون دائرية لبيضاوية ، هلا الـ bronchial epithelium المصابة ممكن تقوم بإفراز مواد مثل SIADH يوقف إفراز الـ ADH ،
طبعًا هاد النوع Small cell carcinoma الها ارتباط مباشر مع الـ smoking مش مثل
الـ non-small ، تقريبا ٧٠٪ من هاي الخلايا ممكن يصير meta بمعنى انها تنتشر بأماكن
أخرى بالجسم ومثال عليها الـ Brain metastasis

Small cell lung carcinoma

- Characterized by distinctive of type-small round to oval cells that are in the size of lymphocytes.
- Tumors arise from nonexocrine cells of the bronchial epithelium, and some are able to secrete hormonally active products, such as syndrome of inappropriate antidiuretic hormone secretion (SIADH) with strongest association with cigarette smoking.
- It is highly malignant with 70% of the cancers of detectable metastasis. → *بانتشر*
- Brain metastasis is very common and may give the same evidence of the tumor.
- Cure rate is excellent with 50-60% response in (limited disease) but only short term 6-8 months. Recurrence of the disease tends to have a mean survival length of 3-4 months
- The 2-year survival is 20-40% in limited disease and 5% in the extensive disease

لله الي ما انتشرت

*لله الي انتشر لانحاء تانية
بالجسم*

Symptoms of Lung Cancer

- **Lung cancers are aggressive**, locally invasive and widely metastasizing tumors.
- The clinical features depend on the **location of the tumor, the present metastasis and the occurrence of the paraneoplastic syndrome.**
- The symptoms or signs of early-stage lung cancer may be undetected, but **later there is a persistent cough, shortness of breath, wheezing and hemoptysis.** The blood in the sputum results from the erosion of blood vessels by the growing malignancy.
- Dull, intermittent, poorly localized pain is common as **pain receptors are limited.** But it becomes **persistent, more localized and more severe** when the disease invades to the **pleura.**
- Non-specific symptoms include **anorexia, weight loss, and weakness accompany the disease.** The poor oxygenation of the blood explains the generalized weakness. Symptoms include difficulty in breathing caused by the obstructed airway.
- Symptoms develop late in the disease, so prevention and early detection are essential.

Symptoms of Lung Cancer

- For some types of tumors, **hoarseness of the voice** and **difficulty in swallowing** may occur. صوت خشن وصعوبة بالبلع
- Further complication may lead to **pleural effusion**, which compress the lung leading to **dyspnea**. تجمع سوائل بالـ pleural cavity ، وصعوبة تنفس
- **Paraneoplastic syndrome** includes **hypercalcemia** due to release of parathyroid hormone-like peptide, **Cushing syndrome (ACTH secretion)**, **SIADH**, **neuromuscular syndrome** and **hematological disorders**.
نتيجة انه الـ adrenocorticotrophic hormone يتكون عالية

Diagnosis and treatment

١. صورة اشعة للصدر
٢. الكشف عن خلايا سرطانية بالمخاط
- ٣.
٤. خزعة من الورم لفحصه
٥. خزعة من الغدد الليمفاوية

- **Diagnosis** of lung cancer is made from **chest radiography, detecting cancer cells in the sputum, washings from the bronchoscopy examination, a needle biopsy of the tumor, or biopsy of lymph nodes.**

خزعة

computerized tomography scan

Magnetic resonance imaging

- **CT scan and MRI and ultrasonography** are used to locate the lesions.

- **SCLC** patients should have CT and MRI for the brain. → brain metastasis
عشان نسبته عالية انه يعمل brain metastasis

- Average age for diagnosing lung cancer is age 60.

Diagnosis and treatment

Surgery for removal of localized small tumors (lobectomy, Pneumonoectomy or segmental resection).

Chemotherapy, used singly or in **combination**, depending on the particular tumor **with radiation therapy**.

In addition to primary carcinoma of the lungs, the lungs are a **frequent site of metastases from the breast, GI tract, female reproductive system, and kidneys.**

Thank You

Batool Abusbaib