POLTAVA STATE MEDICAL UNIVERSITY

Anatomical and physiological features of respiratory system in children. Semiotics of lesions and major respiratory diseases in children.

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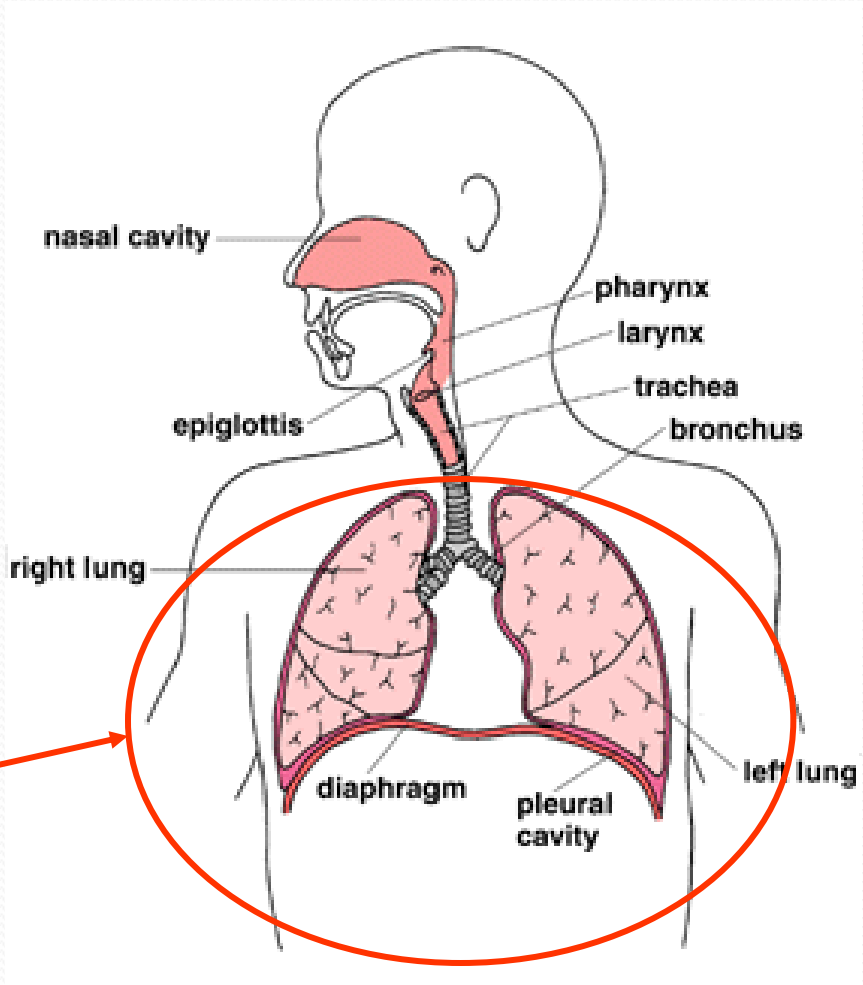
Plan of the lecture

- 1. The anatomical characteristics of the upper respiratory tract in children.
- 2. The anatomical characteristics of the lower respiratory tract in children.
- 3. Anatomy and physiology of chest cavity.
- 4. The mechanizm of breathing.
- 5. Semiotics of lesions and major diseases of the respiratory system
- 6. Features of anamnesis of children with pathology of the respiratory system.
- 7. Clinical and laboratory characteristics of respiratory failure.

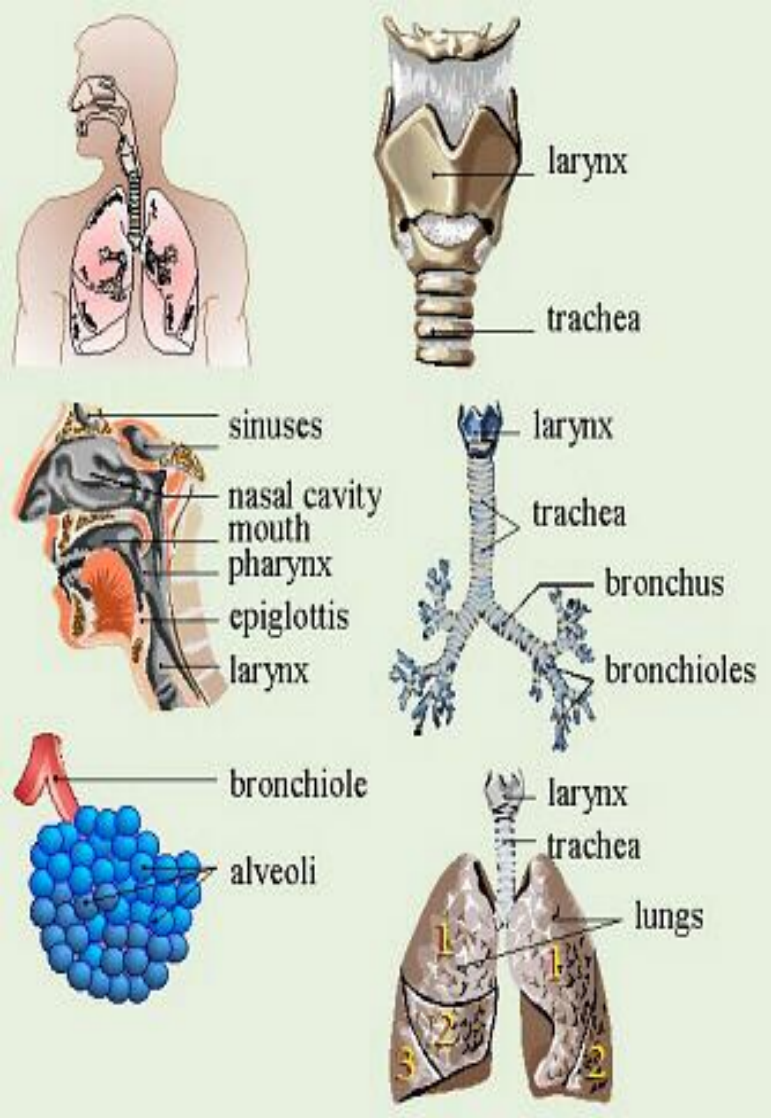
Respiratory system

- The respiratory system is divided into two parts: upper and lower respiratory tract;
- The border of this division is the lower edge of the cricoid cartilage.
- **Upper respiratory tract** includes the paranasal sinuses, nasal cavity, pharynx and the Eustachian tube and other parts;
- **Lower respiratory tract** includes the trachea, bronchi, bronchial and alveolar capillary.



Anatomical characteristics

Upper respiratory tract



• The nose, nasal passages (airways), sinuses infancy are comperatively narrow + Mucosa is rich for vascular tissue } ⟶ **that makes child vulnerable to infection and oedema;**

• Infection, swelling of the nasal cavity and nasal congestion contribute more narrow or blocked of nasal airways, causing difficulty in breathing and sucking.

• There are not inferior (lower) nasal passages (until 4 years) and as a result rarely epistaxis in infants;

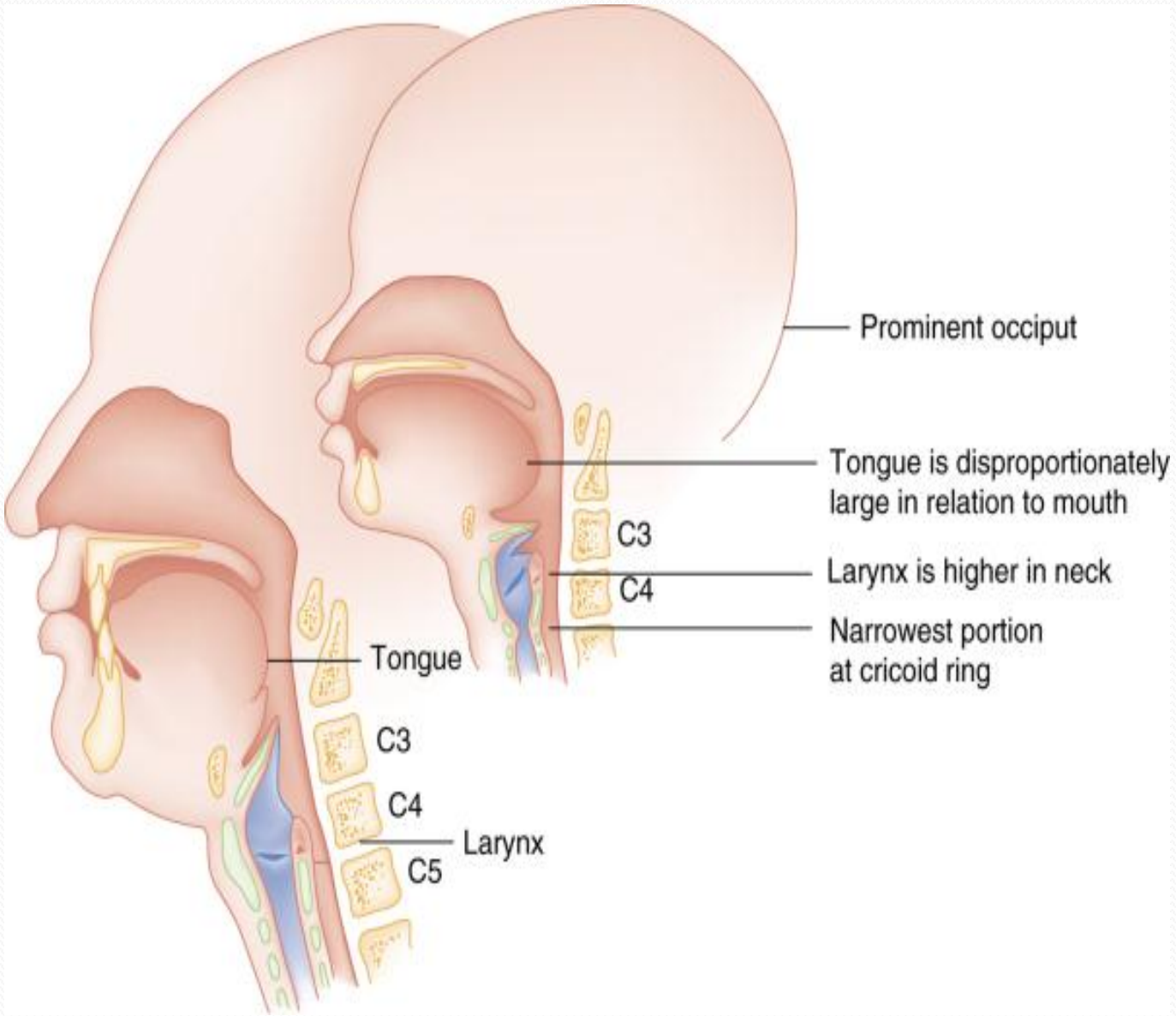
• **Nasolacrimal duct is short, the opening valve, hypoplasia valve may be the cause of conjunctivitis with upper respiratory tract infection**

• **Development sinuses of infants continued after 2 years of age and finished to 12 years; the maxillary sinuses is usually present at birth; the frontal sinuses begin to develop in early infancy; Babies can suffer from sinusitis; the ethmoid, maxillary sinuses are most vulnerable to infection.**

Upper respiratory tract in children

• Larynx is located on level the 3-4th (neck) vertebrae;

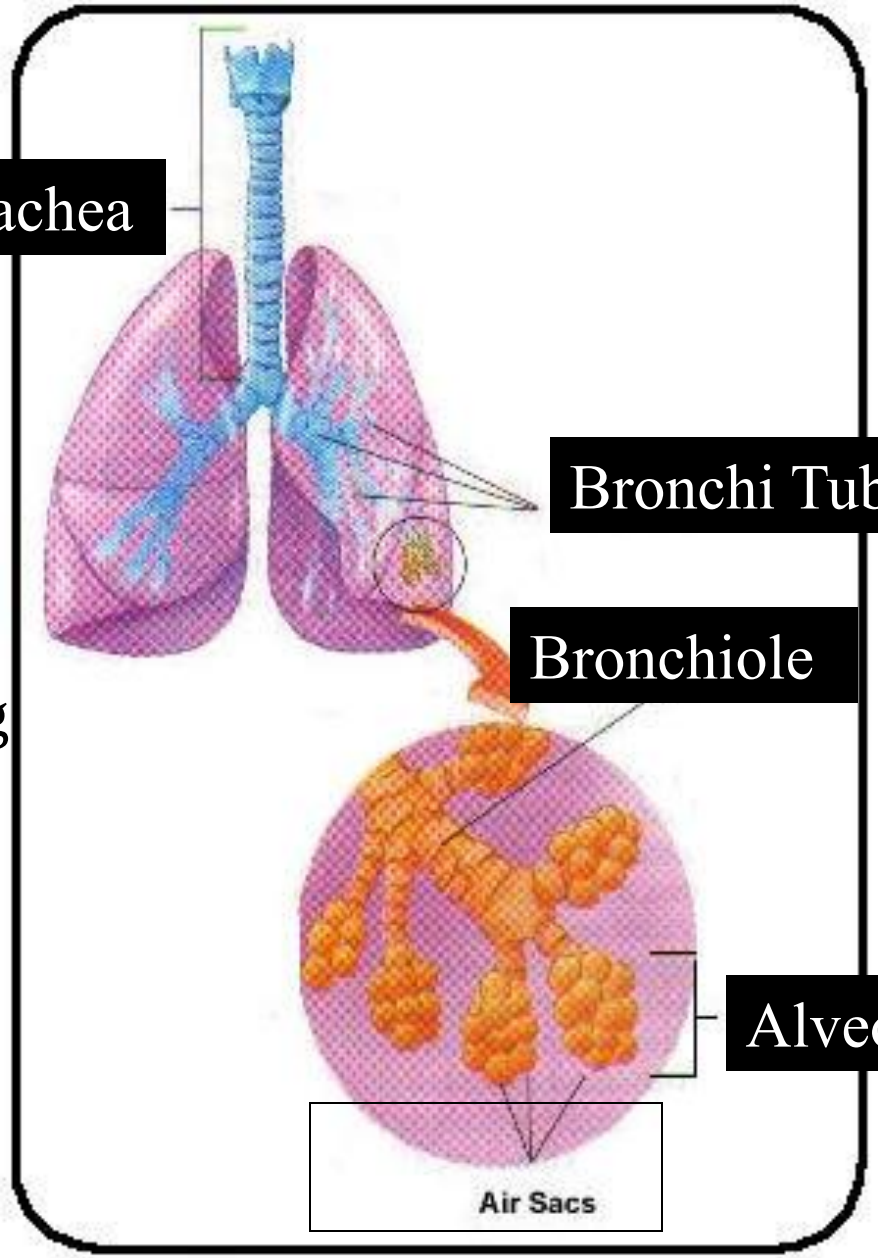
•Vocal and mucous membranes are rich blood vessels and lymphatic tissue, prone to inflammation, swelling, due to babies suffering from laryngitis (viral croup), airway obstruction, inspiratory dyspnea.



Anatomical characteristics

Lower respiratory tract

- **The trachea** is short**;**
- **Tracheal and bronchial** passes in children is relatively small, cartilage soft, the lack of elastic tissue
- **Right bronchus** more straight, like a direct extension of the trachea (causing the right lung atelectasis or emphysema);
- **Left bronchus** is the separation from the trachea;
- **The bronchus** is divided into **inter-lobe** bronchus, **segmental** bronchus, **bronchioles**.

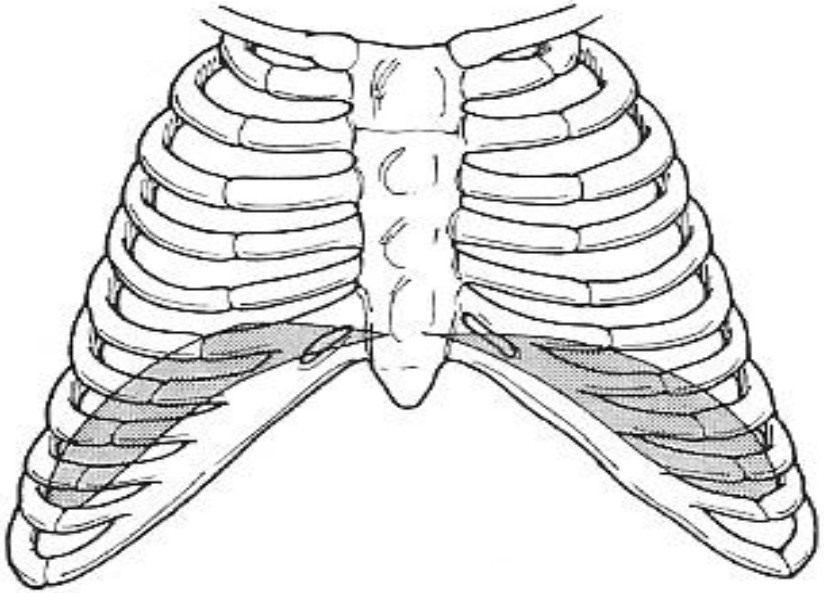


LRT – vulnerable, easy to cause airway narrowing and obstruction

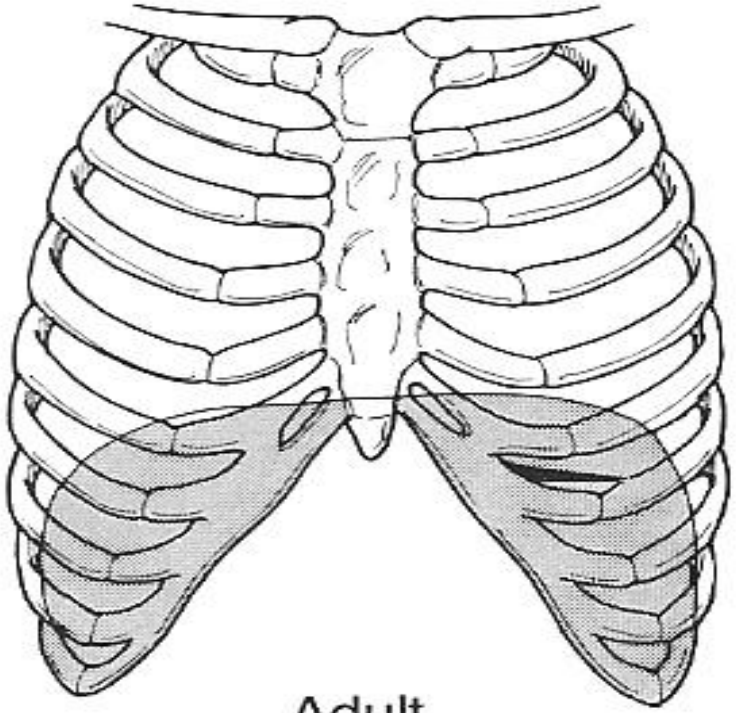
- **Bronchioles** – no cartilage, smooth muscle imperfect development, mucosa rich in blood vessels, mucous glands hypoplasia, lack of secretion of mucus, poor mucociliary movement;

Anatomy and physiology of chest cavity

- The ribs are cartilaginous and perpendicular relative to the vertebral column (horizontal position), **reducing the movements of the rib cage.**
- The infant chest wall is remarkably compliant and compliance decreases with increasing age.
  - The orientation of the ribs is horizontal in the infant; by 10 years of age, the orientation is downward.



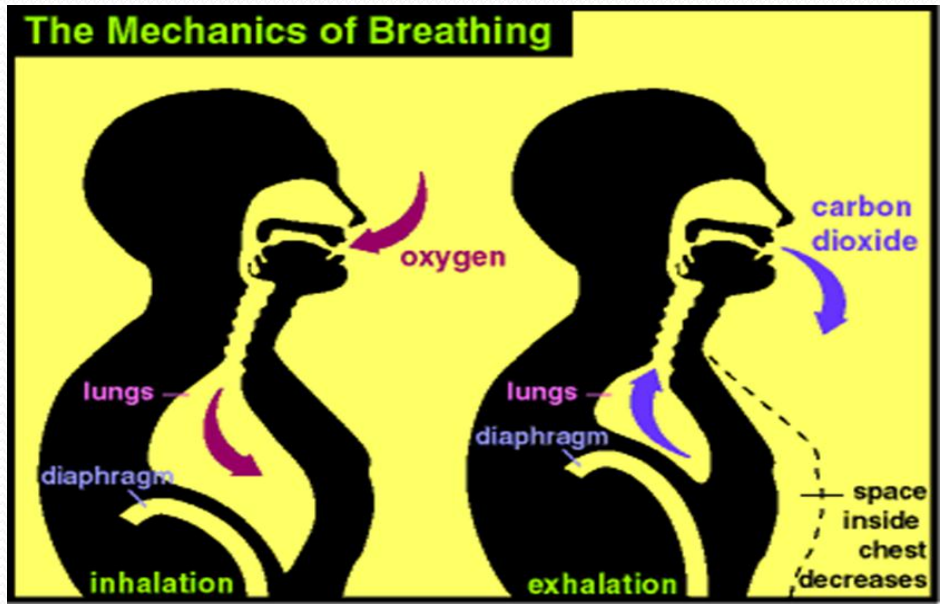
Newborn



Adult

The mechanizm of breathing

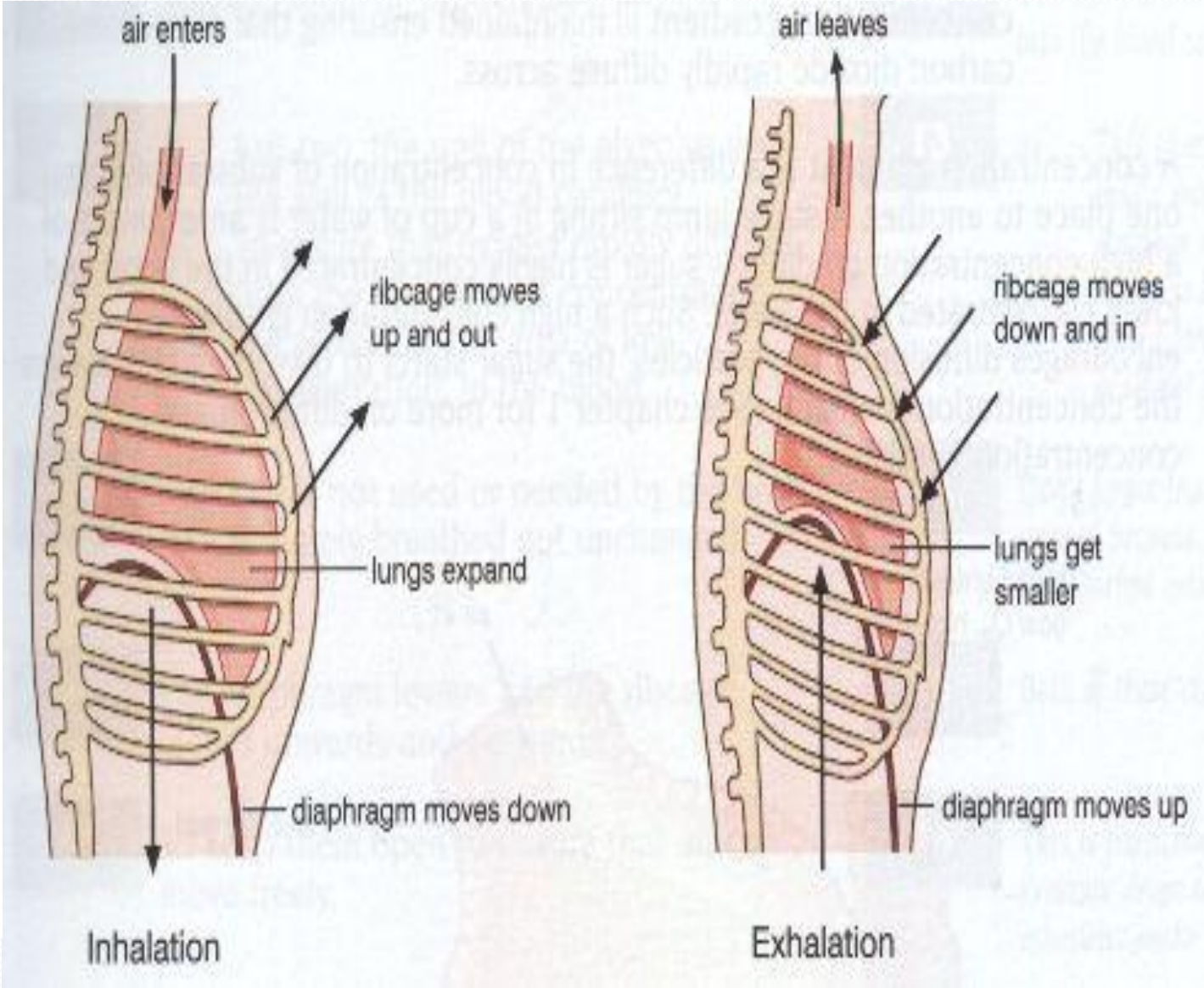
- Contraction of external intercostal muscles > elevation of ribs & sternum > increased front- to-back dimension of thoracic cavity > lowers air pressure in lungs > air moves into lungs
- Contraction of diaphragm: diaphragm moves downward > increases vertical dimension of thoracic cavity > lowers air pressure in lungs > air moves into lungs:



Anatomy and physiology

• The intercostal muscles and accessory muscles of ventilation are immature.
As a result, children are more reliant **on the diaphragm for inspiration**.

• Increased respiratory effort causes **subcostal and sternal recession**, and the mechanical efficiency of the chest wall is reduced.



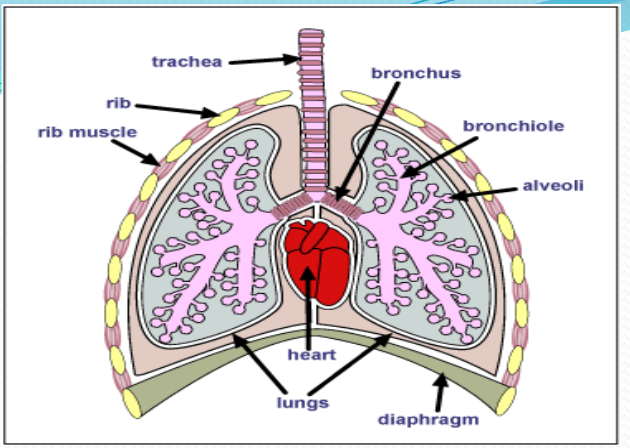
The type of respiration

from birth to 2 years is abdominal.

After 2 years of age it becomes mixed.

Subsequently, to 8-9 years of age a predominantly abdominal type of respiration develops in boys and costal type in girls.

Resume



- The considerable differences in respiratory physiology between infants and adults explain why infants and young children have a higher susceptibility to more severe manifestations of respiratory diseases, and why respiratory failure is common problem in neonatal and pediatric intensive care units.
- The appreciation of the peculiarities of pediatric respiratory physiology is not only essential for correct assessment of any ill child, but also for correct interpretation of any pulmonary function test performed in this population.

An average respiratory rate at rest of the child of different age is:

- newborn 40-60 per minute,
- infant at 6 months 35-30 per minute,
- at 1 year 30 per minute,
- 5 years 25 per minute,
- 10 years 20 per minute,
- 12-18 years 16-20 per minute.

Semiotics of lesions and major diseases of the respiratory system

Features of anamnesis of children with pathology of the respiratory system

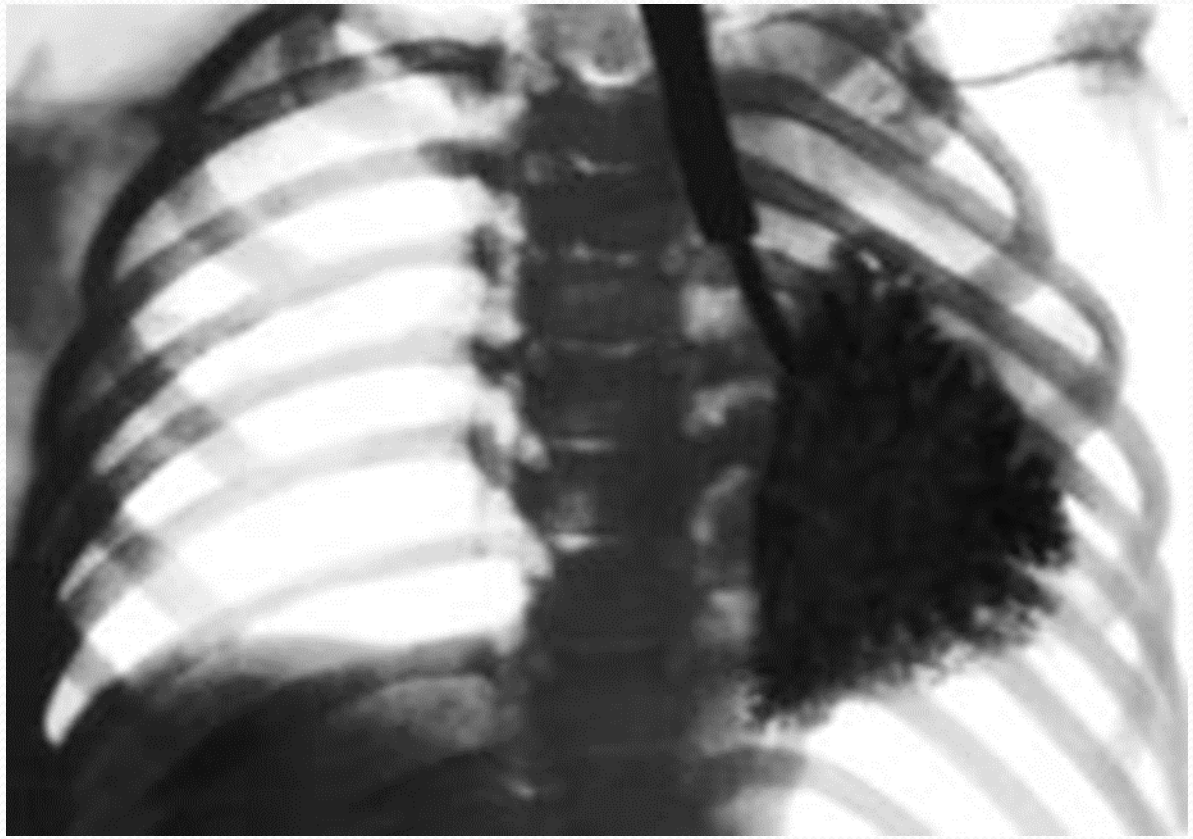
Patient's typical complaints:

- Runny nose, sneezing. Nasal congestion.
- Pain in the throat and swallowing.
- Change of voice.
- Cough. Excretion of sputum.
- Dyspnea.
- Pain in the chest.
- Fever + symptoms of intoxication.
- Relationship of manifestations of the disease with hypothermia, contact with allergens, physical activity.

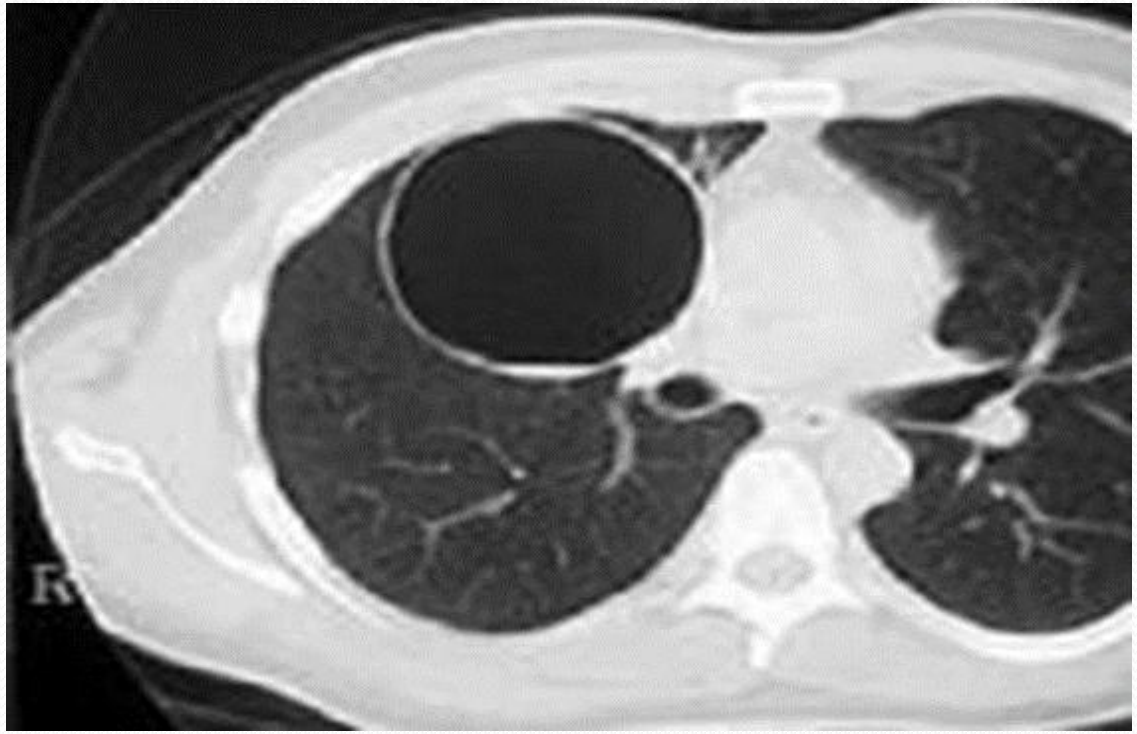
Developmental anomalies of the respiratory system

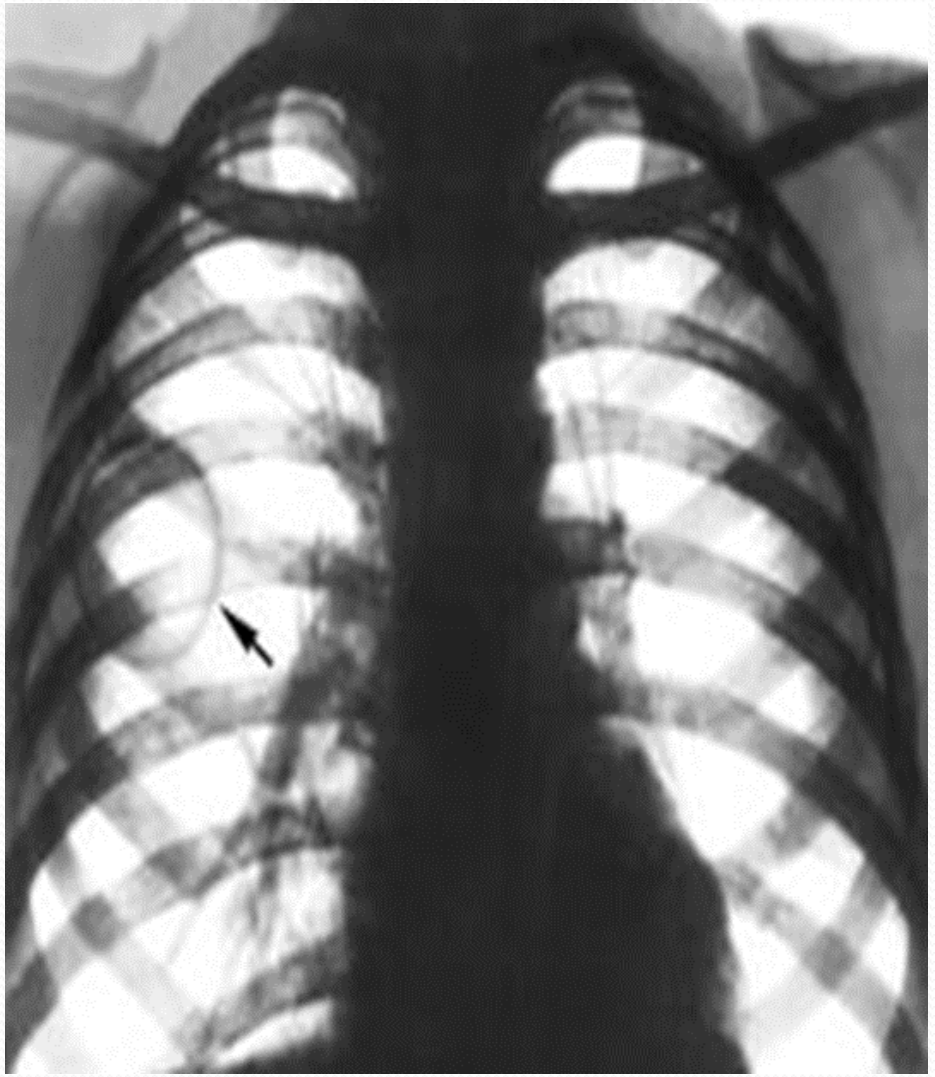
- irregular branching of the bronchial tree,
- agenesis and lung aplasia,
- hypoplasia of the lung and its lobes,
- additional light,
- tracheo-esophageal fistula,
- congenital stenoses of the trachea,
- Carthage syndrome, bronchiectasis,
- cysts and lung sequestration,
- abnormalities of the blood and lymph vessels

Hypoplasia of the left lung



Congenital cyst of right lung

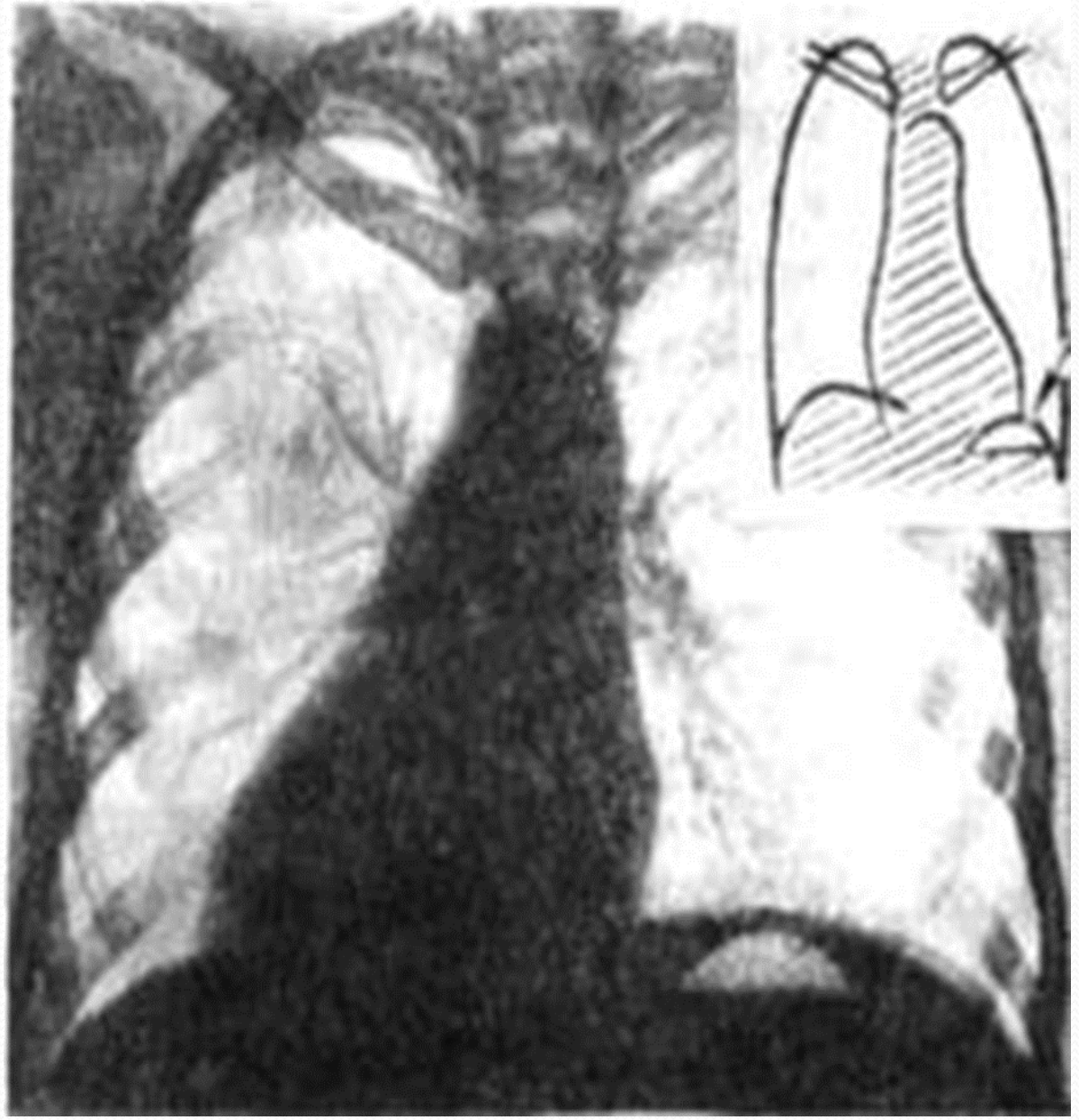




Cartagener syndrome

- combined developmental defect, characterized by the formation of bronchiectasises in combination with complete or partial inversion of internal organs

- and polyposis of the mucosa shells nose (sinusitis).



All symptoms of various respiratory diseases may be concerned to some pathological syndromes:

❖1. Croup syndrome

❖viral laryngotracheitis, diphtheritic laryngotracheitis, and measles.

2.Obstructive syndrome

bronchitis,
bronchiolitis,
bronchopneumonia,
allergic respiratory disease.

3. Syndrome of respiratory insufficiency (acute and chronic)

RDS, pneumonia, foreign body, anomaly of respiratory system, pneumothorax, atelectasis, tumors, etc.

4. Restrictive syndrome

diffuse fibrosis of lungs.

Respiratory failure.

- Insufficiency of external respiration, which does not ensure the normal gas composition of the blood, ie develops hypoxia and acidosis.

Clinical and laboratory characteristics of respiratory failure

Repiratory failure I stage.

- Dyspnea with physical exertion, without the involvement of auxiliary muscles, is not at rest.
- Cyanosis is perioral, unstable, worsens, disappears when breathing 40 to 50% oxygen, pale face.
- BP N
- Tachycardia
- Behavior is normal or minor anxiety.

Repiratory failure II stage.

- Dyspnoea at rest, constant, with the help of auxiliary muscles, wheezing.
- Cyanosis peroral, face, hands constant, does not disappear when breathing 40 - 50% O2,; but absent in the oxygen tent, generalized pallor of the skin, nail beds, sweating, blood pressure increased/
- Behavior: drowsiness, lethargy, adynamia, with periods of excitement; decreased muscle tone.

Repiratory failure III stage.

- Dyspnea, respiratory rate is more than 20 - 30% of the norm.
- Blood pressure lowered.
- Tachycardia 180 / min; p Co2 above 70 mm Hg. st; pO2 is less than 60-40 mm Hg. st.

Repiratory failure IV century.

- Hypoxic abdominal hypercapnia coma. Respiratory rate 10 and less for 1 min.

Rhinitis (rhinitis) - inflammation of the nasal mucosa

- Difficulty with nasal breathing
- Rapid fatigue in feeding
- Anxiety of the child when feedi
- Delayed weight gain in an infar

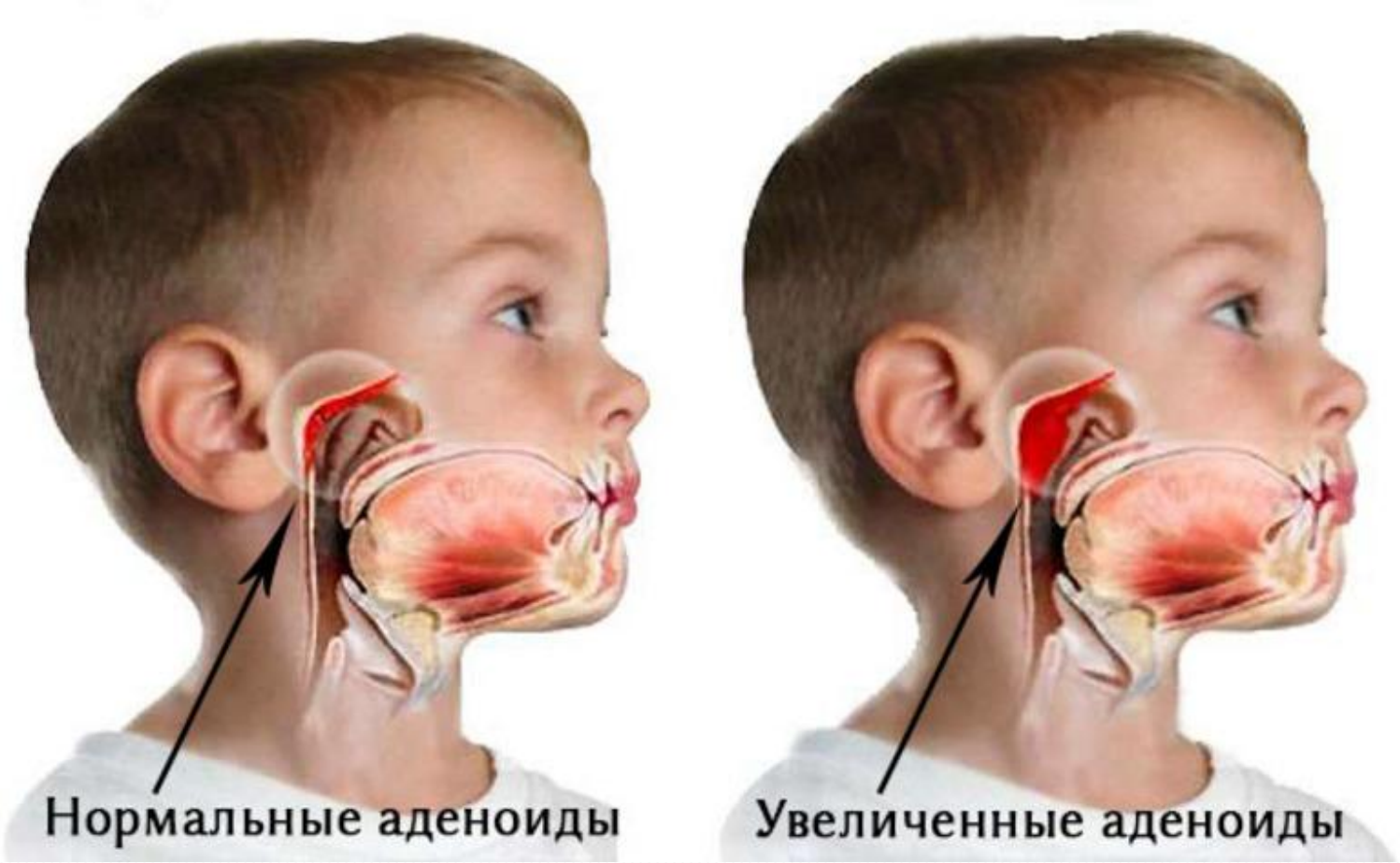
Acute rhinopharyngitis (nasopharyngitis) - inflammation of the nasopharyngeal mucosa, often accompanies the course of ARVI

Debut symptoms:

- Sneezing, nasal congestion, difficulty in nasal breathing or mucociliary discharge from the nasal passages
- From the side of the pharynx - the catarrh of the mucous membrane of the posterior pharyngeal wall, the sensation of a sore throat, pain, hoarseness of the voice
- Later, a cough is attached - at first dry, then moist - with phlegm (the flow of mucus from the nose to the back of the pharynx)

Adenoids, or adenoid vegetations, are a pathological increase (hypertrophy) of the nasopharyngeal tonsil, which can be isolated or become a manifestation of hypertrophy of the lymphadenoid tissue of the pharynx as a whole.

- The nasopharyngeal tonsil is well developed only in childhood. Therefore, adenoids, as a rule, are observed in children.
- There are 3 degrees of hypertrophy.
- The most persistent symptoms are: difficulty nasal breathing, frequent colds with abundant secretions of mucous secretion, nasal hue of the voice, restless sleep with an open mouth, snoring breath in a dream.


Нормальные аденоиды
Увеличенные аденоиды

Sinusitis - inflammation of the paranasal sinuses.

- The adnexal sinuses of the young children are very weakly developed, some are absent.
- By the age of 2, the frontal sinus appears, the maxillary cavity is enlarged.
- By the age of 4, the lower nasal passage is formed.
- The main symptoms: severe nasal congestion, intoxication phenomena, fever, headache (or pain in the projection of the sinus) - a constant, dull, bursting character, m. swelling of soft tissues. Ds: R-graphy of the sinuses

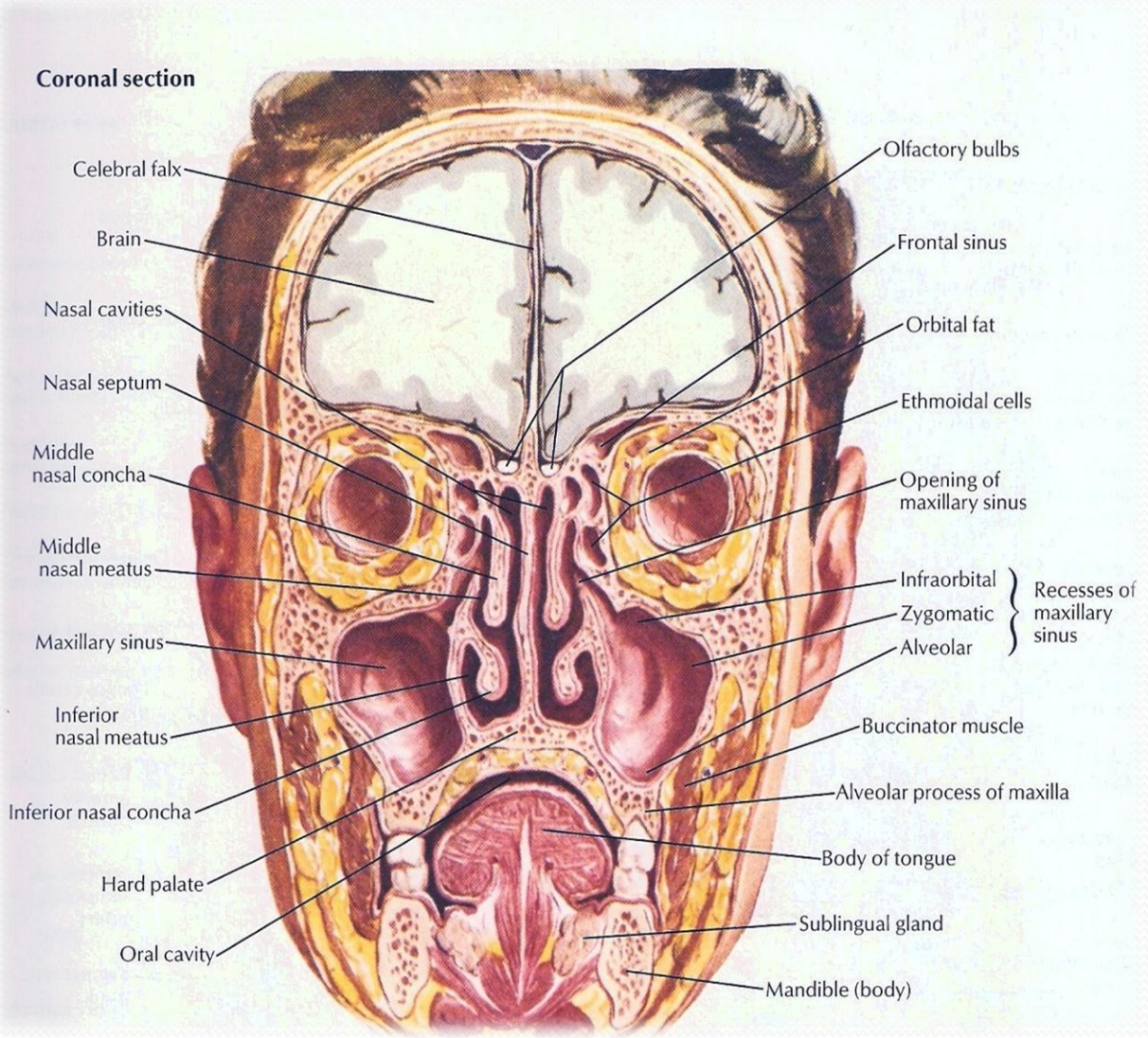
The paranasal sinuses

are undeveloped

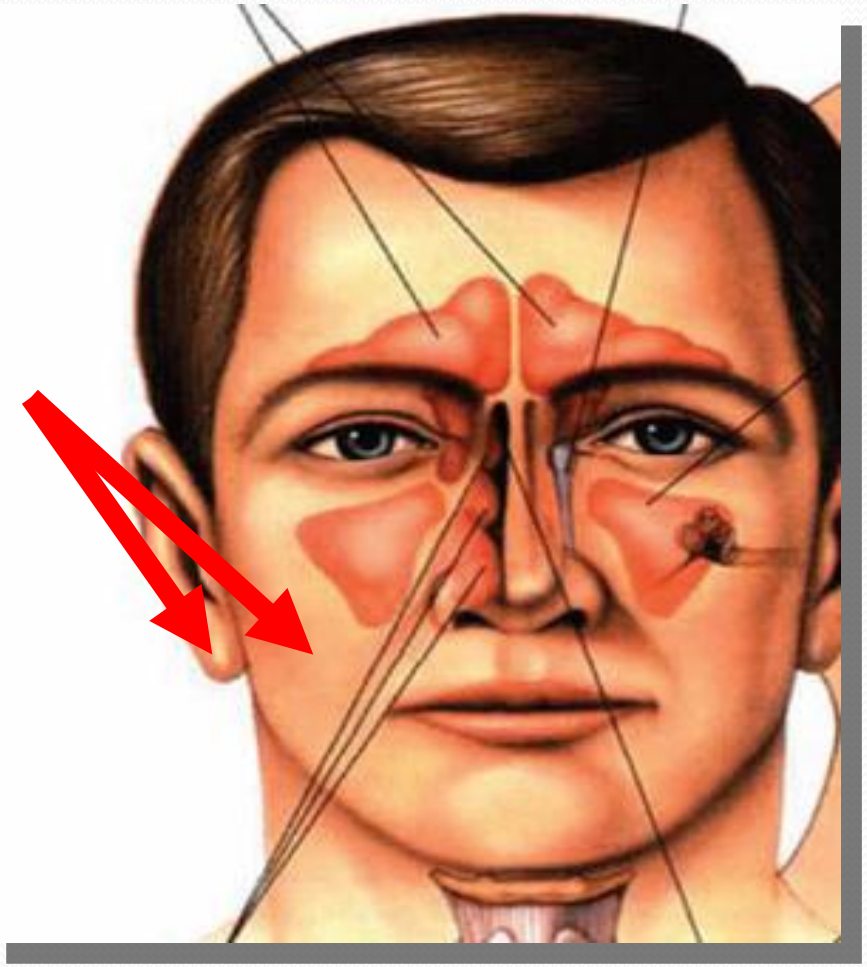
in early childhood.

The maxillary sinuses are present at birth,

but they are very small and become greater in size after 2 years of age.



The frontal sinus is absent in babies prior to 1 year of age. It appears after 2 years of age and attains its full development by 12-15 years.



Acute laryngitis - inflammation of the mucous membrane of the larynx, involvement of the vocal cords and subglottic space in the process.

A triad of symptoms are typical:

- Change of voice (dysphonia)
- Rough barking cough
- Inspiratory dyspnea

(shortness of breath)

Stenosis of the larynx - narrowing of its lumen against the background of an inflammatory reaction (with acute laryngitis) - croup!

- Croup is a syndrome, not a disease.
- The croup accompanies various infectious diseases (ARI) and combines a group of similarly symptomatic hubolevany.
- There are true and false cereals.
- With true croup, the vocal cords are affected. The true croup develops only with diphtheria, so it is also called diphtheria croup.
- False groats - acute stenosing laryngotracheitis.

Bronchitis

- Inflammatory damage of bronchi of any caliber (without lesion of pulmonary tissue!) of different etiology (infectious, allergic, toxic), developed in a short period of time.

- **The main symptom of acute bronchitis is coughing!**

Can be:

- acute bronchitis,
- acute obstructive bronchitis,
- acute bronchiolitis.

Acute bronchitis

- Most often, the etiological factor of acute bronchitis is various viruses (influenza, parainfluenza, rhinoviruses, enteroviruses), less often bacteria (pneumococcus, hemophilus, moraxella).
- Cough is dry at the beginning of the disease, in the future - more moist and productive.
- The duration of fever is an average of at least 2-3 days.
- When auscultation is found common in all pulmonary fields, diffuse coarse dry (bass - buzzing, buzzing) and moist medium and large bubbling rales.

Acute obstructive bronchitis

- is bronchitis, which occurs with bronchial obstruction syndrome. It occurs in children at 2-3 years of life more often and it is more severe than in adults.

Etiology:

- PC viruses
- Parainfluenza viruses
- Adenoviruses

Acute obstructive bronchitis

- Noisy wheezing with prolonged exhalation, audible at a distance (distal rales).
- Children can be restless, often change the position of the body, dyspnea gradually builds up. Cough is dry!
- Expressed tachypnea, mixed or expiratory dyspnea; the chest is swollen, the intercostal spaces are smoothed (flattened).
- The percussion sound is boxed. The exhalation is elongated.
- Auscultation reveals a large number of scattered moist medium- and large-bubbling rales.

Acute pneumonia

- acute infectious inflammation of the pulmonary parenchyma, mainly bacterial etiology, the diagnosis of which is based on the characteristic clinical (respiratory distress syndrome) and radiographic signs (the presence of infiltrative changes on the chest X-ray).

- **X-ray is the gold standard for diagnosing pneumonia!**

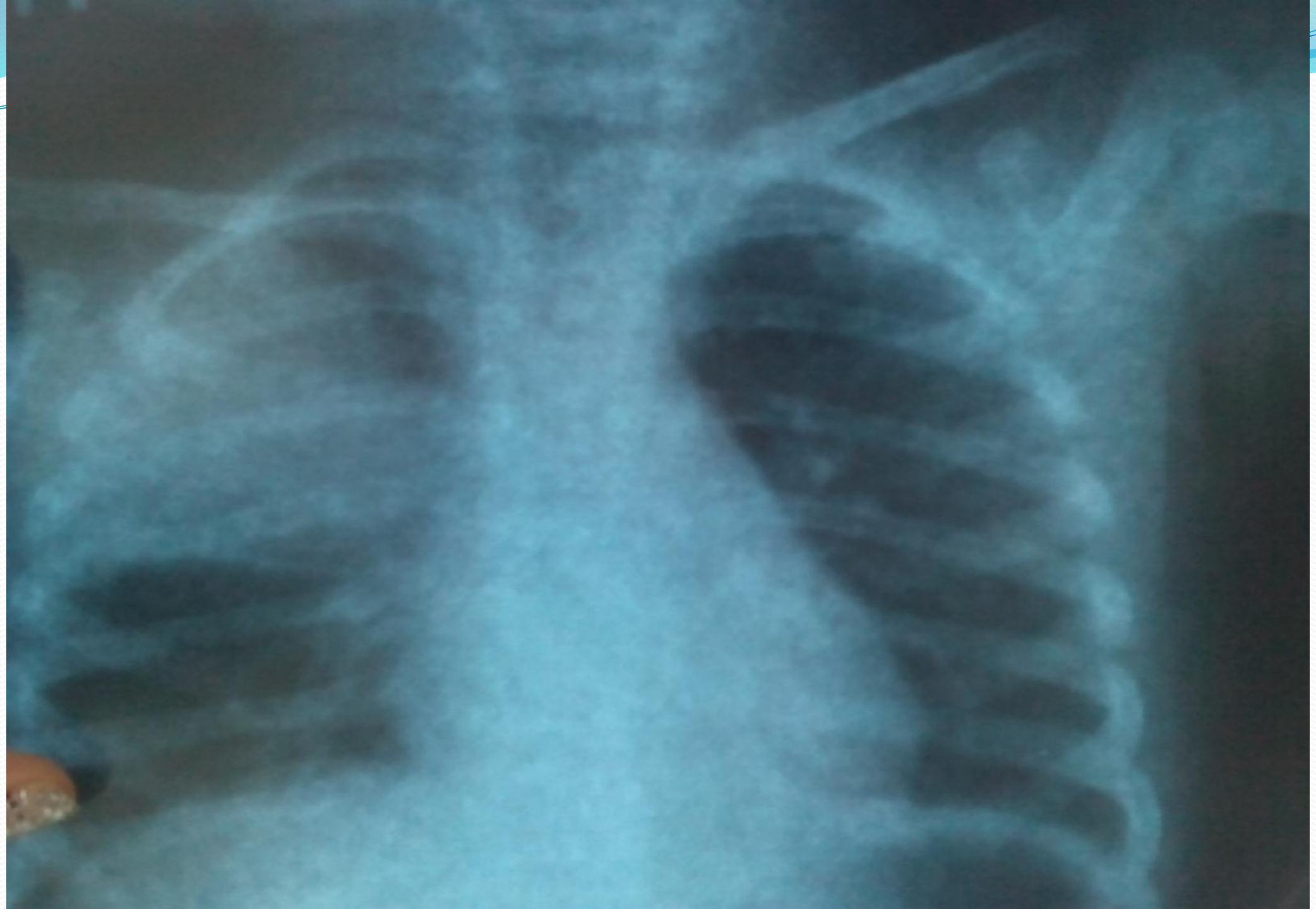
Clinical signs of pneumonia

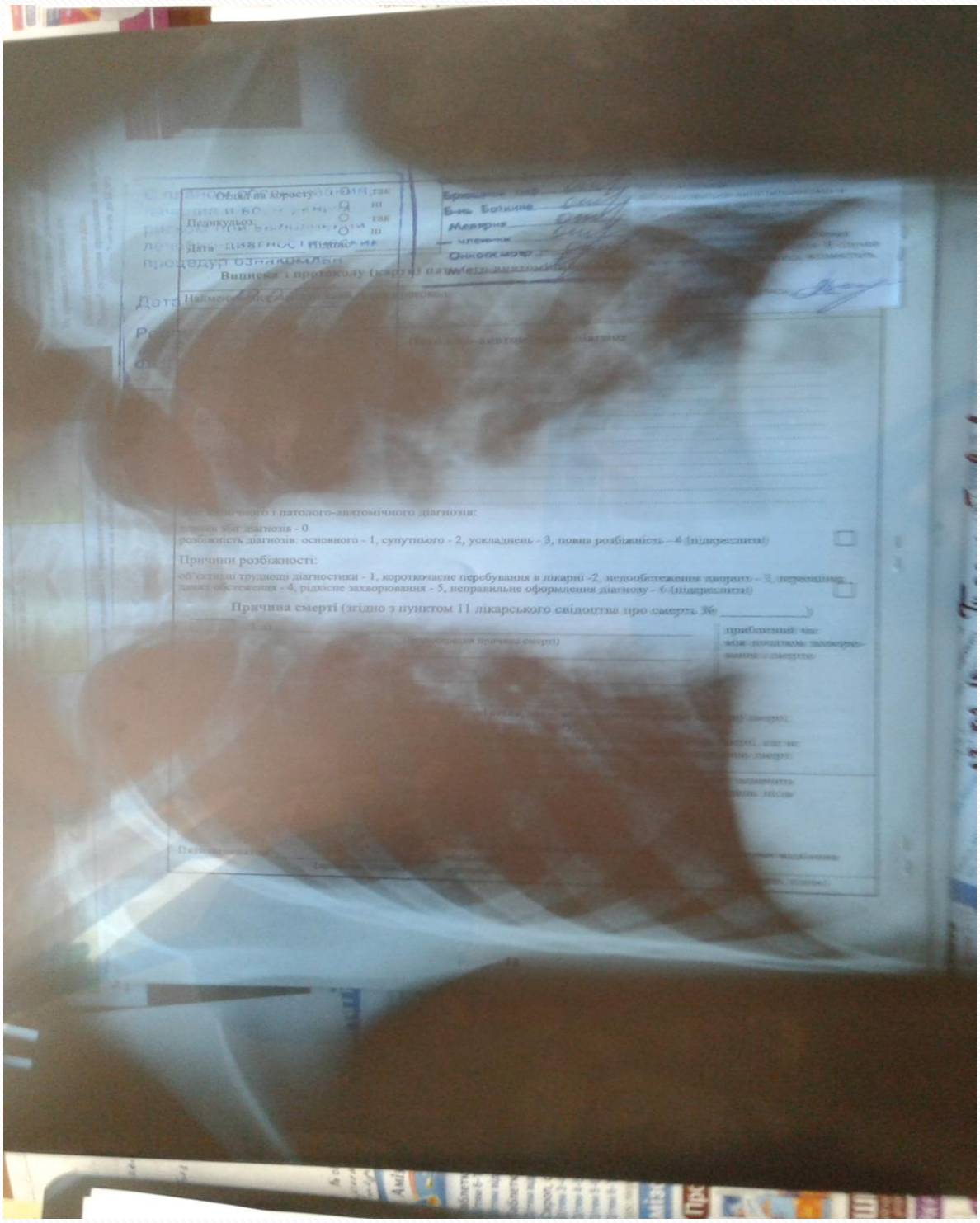
1. Clinical signs:

- acute onset with fever greater than 38.5 °;
- loss of appetite, general symptoms of intoxication;
- cough, increasing dyspnea (mixed);
- tachypnea, chest pain (with pleurisy);
- in infants up to a year - groaning breathing, swelling of the wings of the nose (equivalent to dyspnea)

2. Physical examination:

- local shortening of percussion sound;
- weakening of breathing or bronchophonia;
- local small bubbling rales and crepitation;
- asymmetry in auscultation




Вишека з протоколу (карти)
розбіжність діагнозів: основного - 1, супутнього - 2, ускладнень - 3, повна розбіжність – 4 (підкреслити)
Причини розбіжності:
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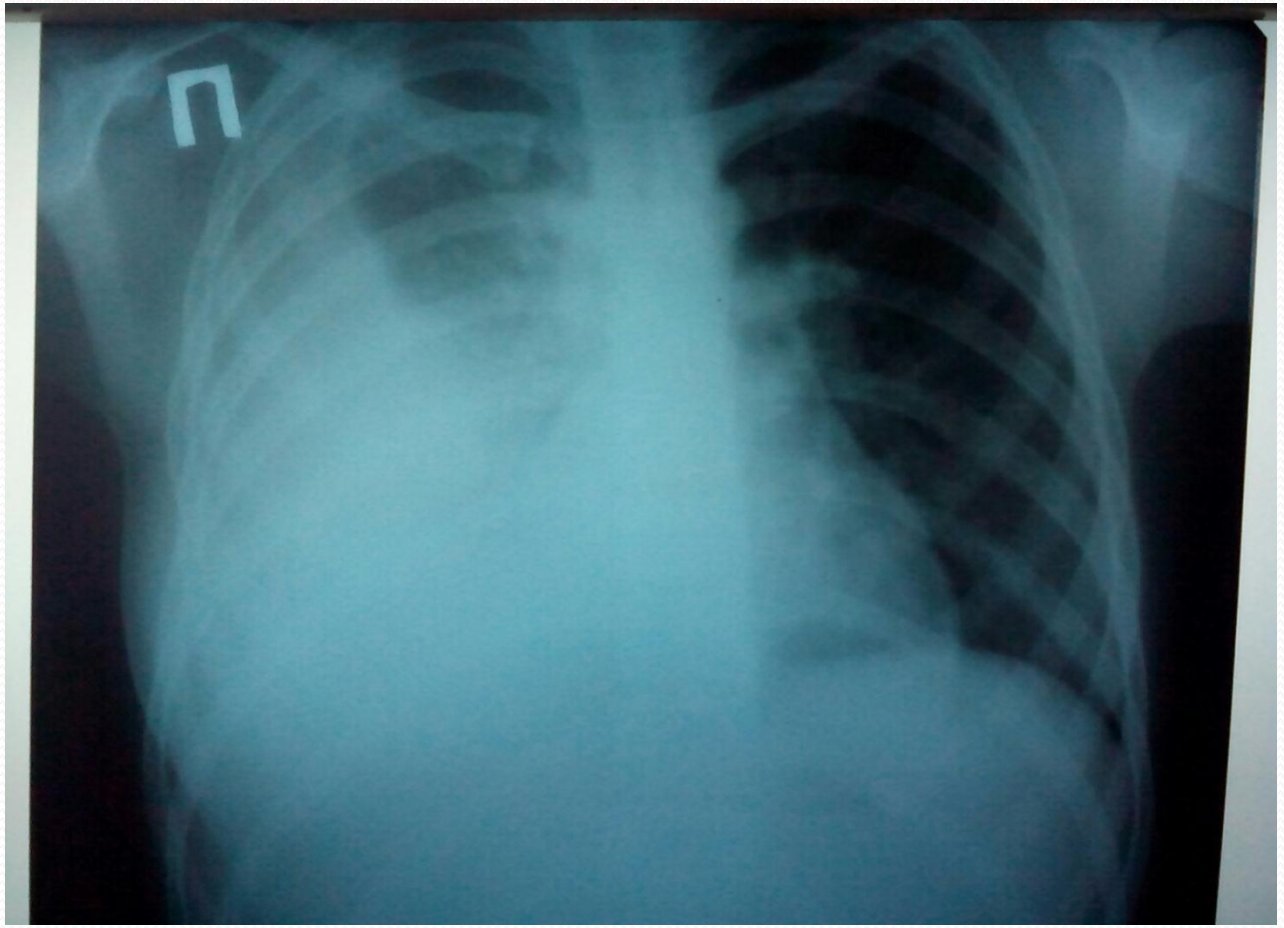

Thank you for your attention!

Literature, was used in the lecture

- 1.Nelson Textbook of Pediatrics: 21th edition / Klegman S, Geme ST, Tasker W, 2021. – 1078 p. 2. Основи педіатрії за Нельсоном: переклад 8-го англ. видання : у 2 томах. Том 1 / Карен Дж. Маркданте, Роберт М. Клігман. – К.: ВСВ «Медицина», 2019. – XIV, 378 с. 2.Пропедевтична педіатрія : підручник для студентів вищих медичних навчальних закладів IV рівня акредитації / В. Г. Майданник [та ін.]. - 2-ге вид., випр. та допов. - Вінниця : Нова кн., 2018. - 871 с. : табл., іл. 3.Педіатрія : нац. підруч.: у 2 т. / Н.Г. Гойда, Р.О. Моісеєнко, Л.І. Чернишова, Ф.І. Лапій, В.В. Бережний та ін.; за ред. В.В. Бережного; Асоц. педіатрів України МОЗ України. - К. : [б. в.], 2013 -Т. 1. - 2013. - 1037 с. : табл., іл. 4.Педіатрія : підручник для студентів вищих медичних навчальних закладів IV рівня акредитації / О. В. Тяжка [та ін.] ; за ред. О. В. Тяжкої ; Нац. мед. ун-т ім. О. О. Богомольця МОЗ України. - 5-те вид., випр. та допов., оновлене. - Вінниця : Нова кн., 2018. - 1150 с. : табл., іл. 5.Педіатрія : національний підручник : у 2 т. / Д.Д. Іванов, С.В. Кушніренко, Д.А. Сеймівський [та ін.] ; за ред. В.В. Бережного; Асоціація педіатрів України. – К. : Сторожук О.В., 2013. – Т. 2. – 1021 с. 6. Extracorporeal Life Support Organization (ELSO). ELSO Guidelines for Neonatal Respiratory Failure Supplement to the ELSO General Guidelines. 2018 Dec [cited 2018 Jun 22]; 16. Chin TW, Nussbaum E, Marks M: Pediatric Respiratory Disease: Diagnosis and Treatment. Philadelphia:WB Saunders Co.; 1993:271-281. 17. Panitch HB: Bronchiolitis in infants. Curr Opin Pediatr 2019;13:256–60. 18. Perlstein PH, Kotagal UR, Bolling C, et al: Evaluation of an evidence-based guideline for bronchiolitis. Pediatrics 2019;104:1334–41. 19. Richard P. Wenzel, M.D., and Alpha A. Fowler III, M.D. Acute Bronchitis. N Engl J Med 2016;355:2125-30. 20. Arroll B, Kenealy T: Antibiotics for acute bronchitis. BMJ 2020;322:939–40. 21. Irwin R, Madison J: The diagnosis and treatment of cough. N Engl J Med 2020;343:1715–21. 22. Bateman E.D. Global strategy for asthma management and prevention: GINA executive summary / E.D. Bateman, S.S. Hurd, P.J. Barnes [et al.] // Eur. Respir J. – 2018. – Vol. 31. – P. 143- 178. 23. Moore W. C. Update in asthma 2006 / W.C. Moore, S.P. Peters // Am. J. Respire. Crit. Care Med. – 2017. – Vol. 175. – P. 649-654. 24. Global Initative for Asthma. Global strategy for asthma management and prevention, 2016. [Електронний ресурс] / NHLBI/WHO work-shop report // National institutes of Health. National Heart, Lung and Blood Institute. – Date last updated: July 20, 2007. – Режим доступу: www. ginasthma.org.
- Інтернет – ресурси: Сайти МОЗ України: https://moz.gov.ua/protokoli Онлайн-платформа з протоколами на засадах доказової медицини Джерела клінічних настанов Інформаційні ресурси http://www.booksmed.com/pediatriya http://pediatriya.info http://health-ua.com/parts/pediatrics http://medkniga.ucoz.net/publ/pediatrija/40 http://www.medport.info/index.php?option=com_content&view=section&id=48&Itemid=73