Pneumonia in children. Diagnostics and treatment.

Plan of the lecture

- 1. **Definition pneumonia**
- **2. Etiology**
- **3. Pneumonia pathogenesis**
- **4. Classification of pneumonia**
- **5. Pneumonia treatment**

Pneumonia is a group of acute focal infectious inflammatory diseases varied in etiology, pathogenesis and morphologic characteristic with predominant involvement in pathologic process of respiratory tract with invariable presence of alveolar inflammatory exudate.

Predisposed anatomy-physiologic peculiarities in children to pneumonia

- Trachea and big bronchi are short and wide – easy penetration of infection
- Little bronchi and bronchioli are narrow and are deficient in connective and muscular tissue – they are easily collapsed and obstructed
- Inadequate drainage of several segments due to peculiarities of bronchial branching – frequent involvement of I, II, IX, X, VI segments bilateral and of IV, V segments of left lung
- Lack of elastic fibers and surfactant –lung rigidity, inclination to atelectasis and emphysema development
- Insufficient mucocilliar clearance – difficulties in foreign bodies removing
- Insufficient synthesis of interferon and IgA – incompatibility immune response
- Plethoric lung parenchima, rich in interstitial vascularization; in perinatal period is collapsed

Predisposing premorbid factors for pneumonia

- Premature newborns
- Severe perinatal pathology: prenatal hypoxia, asphyxia, intrapartum trauma
- Vomiting and regurgitation syndrome
- Artificial feeding
- Constitution anomalies
- Rickets
- Malnutrition
- Congenital heart diseases
- Cystic fibrosis
- Congenital lung malformations
- Surgical treatment
- Inherited immunodeficiencies
- Hypovitaminosis
- Chronic focuses of infection
- Smoking

Pneumonia etiology

- **Streptococcus Pneumonia** (60-80% cases of community acquired pneumonia
- **Hemophilus influenzae**
- **Moraxella Catarrhalis**
- In newborns and infants – **Staphylococcus, gram (-) microflora**
- **Mycoplasma pneumonia, Chlamidia psittaci, Chl.pneumonia** (10-12%).
  - Severe pneumonia are caused by mixed micriflora
  - **Pneumocystis** pneumonia can develop only in immune compromised host (deep prematurity, combined immunodefficiancy, AIDS, imunosuppression)
- Viral pneumonia is rare disease. It can be caused by flu, (hemorrhagic pneumonia,), in bronchiolitis, adenoviral and RS viral infection

All microorganisms from sputum are divided into 3 groups

- pathogenic
- provisional pathogenic
- nonpathogenic

Pathogenic are microorganisms with complementary receptors to surface cell receptors in respiratory tract. It gives them opportunity to adhere and multiply on mucus membrane of respiratory tract.

They are Pneumococcus, Hemophylus influenza, Legionella, Mycoplasma, Ricketsia, Mycobacterium tuberculosis etc.

Provisional pathogenic **are** microorganisms that have no receptors and can't be fixed on epithelium. Protective mechanisms can easily eliminate them. Only impairment of these mechanisms lead for their penetration, spreading and multiplying (ARD, overcooling, immune suppression etc)

Nonpathogenic microbes **–**microorganisms that can cause inflammation only in cases of severe degree of immunodeficiency. They are aerobe and anaerobe saprophytes from upper respiratory tract.

Diagnostic criteria of bacterial pneumonia

- ***Anamnestic data***
- Hospital acquired pneumonia is developed in 48 hours after hospitalization and 48 h after discharging from hospital
- ***Bacterial intoxication symptoms***
- *Clinical:*
- Fever more than 3 days
- Tachycardia
- Paleness, regurgitation
- *Lab data:*
- Neutrophyl leukocytosis
- Elevated ESR
- ***Functional respiratory disturbancies***
- Increased respiratory rate more than 20% from age norma
- Accessory musculature involving in respiration
- Cough or its equivalents
- Cyanosis (perioral, periorbital, diffuse)
- ***Local symptoms in pneumonia:***
- Percussion sound shortening (dullness)
- Breathing sound conductivity changes (attenuation, rales)
- ***Radiologic confirmation***

Pneumonia classification in children

Clinical form	Contami-nation	Course	Complications	
			Pulmonic	Extrapulmonic
Focal **Segmental** **Focal Confluent** **Croupous** **Interstitial**	**Community aquired (home)** **Hospital or Nosocomial** **Due to perinatal Infection** **In patients with immune deficiency**	**Acute** (less than 6 weeks) **Lingering** (more than 6 weeks to 8 mo) **Recurrent**	**Synpneumonial pleuritis** **Methapneumonial pleurisy** **Pulmonary destruction** **Lung abscess** **Pneumotho-rax** **Pyopneumo-thorax**	**Infectious-toxic shock** **DIC-syndrome** **Cardiovascular insufficiency** **Respiratory distress Syndrome** **Toxic affection of other organs (carditis, nephritis, hepatitis, acute kidney failure, otitis, osteomyelitis**

Focal pneumonia (30-40% of pneumonia)

- **It frequently starts from bronchi – bronchopneumonia**
- **Frequently developed after ARD**
- **Cough is deep and moist**
- **Intoxication**
- **Respiratory failure can be present**
- **Percussion pulmonary clear sound or even with resonance sound but under the focus shortening of the sound**
- **Auscultation: focal bubbling rales, focal crepitation**
- **If accompanied by bronchitis – bilateral dry and moist rales**
- **Radiologic picture presence of interstitial involvement with focal infiltration of 1,5 cm in**

Focal-confluent pneumonia

Several segments are affected or the whole lobe with focal pulmonary destruction. Intoxication is prominent, massive lung tissue involvement, usually pleurisy.

As a rule ARD precedes with progressive course with involvement of bronchi.

Radiologic peculiarities

- **Infiltrative shadows are not homogeneous**
- **Process usually is unilateral more frequently in right lung**
- **At affected side intercostal and lobe pleura reaction is present**
- **Reaction of lymphnodes is absent as a rule**

Segmental Pneumonia

Pneumonia affects one or several segments. Moist rales are not typical or they disappear very quickly.

There are 3 types of course:

- With good prognosis, without symptoms
- Course is like in croupous pneumonia – sudden onset with fever and cyclic course. Pains in abdomen and chest
- Clinical picture like in focal pneumonia, but auscultative data are vague, percussion isn't clear. Frequent pleuricy, atelectasis
- Inclination for abscess formation, destruction, lingering course
- X-ray signs: more frequent localization in 1,3 segments of right and 8, 9, 10 segments of both lungs, in 5,4 segments of left lung
- Process is unilateral as a rule
- Regional lymph nodes are increased on affected side
- Pleural (costal or interlobular) reaction is visible
- Duration of pneumonia 10-12 days
- More frequent complications : atelectasis, pleuritis, destruction

Interstitial pneumonia (1% of all pneumonia)

Acute inflammation of interstitium and less manifested affection of broncho alveolar structures

- Paleness is typical
- Pertussis –like cough
- Tympanic resonance during percussion
- Respiratory sound is rough, irregular dry and various moist bubbling rales
- Prominent respiratory failure
- Pathogen can't be revealed in common way
- More frequent causative factors are fungus, **Pneumocystis, Chlamidia, Mycoplasma, Ricketsia, Legionellas**

Croupous pneumonia

Classic example of community acquired pneumonia. It is lobe or segment affection with pleura involvement (pleuropneumonia).

It's difficult to differ it from segmental pneumonia only radiologically. Clinical picture plays the clue role

- **Acute onset**
- **Cyclic course**
- **Febrile or high febrile fever, flush red on affected side**
- **Sputum is rusty, herpes labialis and nasalis**
- **Lung destruction is very rare**
- **Localization in lower lobes**
- **Chest pain due to pleuritis**
- **Abdomen pain like in appendicitis**
- **Meningeal form of pneumonia**

Respiratory Failure –is a condition of disturbed gaseous blood composition due to lung function failure or when maintaining of proper partial O2 and CO2 containing is achieved by forcing of external respiratory structures that produce functional exhaustion of organism.

Clinical classification of respiratory failure

- **Grade I**

Dyspnea after loading, in rest dyspnea is absent. Accessory musculature isn't involved, irregular perioral cyanosis more visible after agitation. BP is normal. HR ratio to RR=3,5-2,5 : 1`, tachycardia. Blood gases composition: $PaCO_2$ <4,67 Kpa : Pa O_2=8,76-10 kPa

- **Grade II**

Dyspnea in rest, accessory musculature involvement, retractions in chest, constant acrocyanosis, BP is elevated, tachycardia, flaccidity, drowsiness, adynamia. HR ratio RR = 2-1,5 : 1: PaO_2= 7,33-8,53 kPa: $PaCO_2$ = 4,67-5,87 kPa

- **Grade III**

Manifested dyspnea (more than 50% from N). Bradypnoe and dyspnoe, generalized cyanosis, paleness, marmour discoloration of skin

Main principles of pneumonia treatment

- **Treatment must be opportune and integrated**
- **Etiotropic therapy directed for eradication of pathogen**
- **Treatment of pathologic syndromes, complications and co-morbidities**
- **Rational rehabilitation process**

Indications for hospitalization

- **Infants**
- **Respiratory failure, necessity of oxygen therapy, manifested intoxication**
- **Dehydration, impossibility of oral drinking**
- **Unfavourable premorbid condition, immune deficiency, developmental anomalies**
- **Suspicion as for Staphylococcal etiology, complications like pleuritis. Ineffective home treatment within 24-36 hours**
- **Inability to organize effective home**

Pay attention for

- **Respiratory rate (main index). In children 2-12 mo old RR> 50/min and for children 12 mo- 5 y.o RR>40/min is threatening.**
- **Retractions of chest lower part**
- **Stridor**

It’s important

- **Air humidification in room where child is present**
- **Clothes must be suitable, surrounding temperature must be optimal**
- **Main task is normalization of nose passage of air**
- **Sleeping must be organized with raised head part of bed**
- **Parents mustn’t prohibit child to cough**
- **To provide with proper intake of liquids intake by oral or parenteral way**
- **Feeding must be usual for age enriched by**

Etiotropic therapy

- **Foundation of etiotropic treatment is empiric start antibiotic therapy with following its correction**
- **Empiric start antibacterial therapy is performed depending on expected causative factor**

Main groups of antimicrobial drugs

- **Beta-lactams**

1. Penicillines

2. Cephalosporines

3. Monobactams (Aztreonam)

4. Carbapenems (Imipenem, Meropenem)

- **Aminoglycosides**
- **Fluoroquinolones**
- **Macrolides**
- **Glycopeptides**
- **Nitromidazolines**
- **Tetracyclines**
- **Chloramphenicol**
- **Lyncosamines**
- **Nitrophuranes**
- **Sulfanilamides**
- **Antituberculosis**
- **Antifungal**

Main statements of antibiotic therapy

- **Antibiotic administration must peroral in community acquired uncomplicated pneumonia**
- **In case of severe course only parenteral antibiotic administration, combinations of antibiotics**
- **Ineffectiveness of beta-lactams indicate resistant or atypical microorganisms presence**
- **Duration of uncomplicated community acquired pneumonia is 7-10 days. In case of complications duration must be not less than 14 days**
- **In case of parenteral antibiotic administration condition improvement demand change antibiotic administration for oral intake so called step approach**

- **First antibiotic course mustn't combined with antifungal drugs**

Efficacy criteria of antibiotic therapy in pneumonia

- **Efficacy assessment is performed in uncomplicated pneumonia 24-48 hours after treatment beginning. If there are some complications it is performed 48-72 hours later**
- **Main criteria:**
- **Dynamics of common child's condition**
- **Disappearing of fever**
- **Normalization of respiratory rate and Ps and their ratio**
- **Improving of lab and X-ray data**

Effects of antibiotic therapy

- **Complete effect-** temperature decreasing less than 38C 24-48 hours later in uncomplicated pneumonia form or 72 hours later in complicated pneumonia, improving of condition, appetite, dyspnea reducing
- **Partly improving-** temperature is higher 38C with toxicosis resolving, appetite improving, absence of negative radiologic dynamics
- **Effect absence –** Constant high temperature more than 38 C, condition worsening and/or progressive worsening of lung and pleura changes

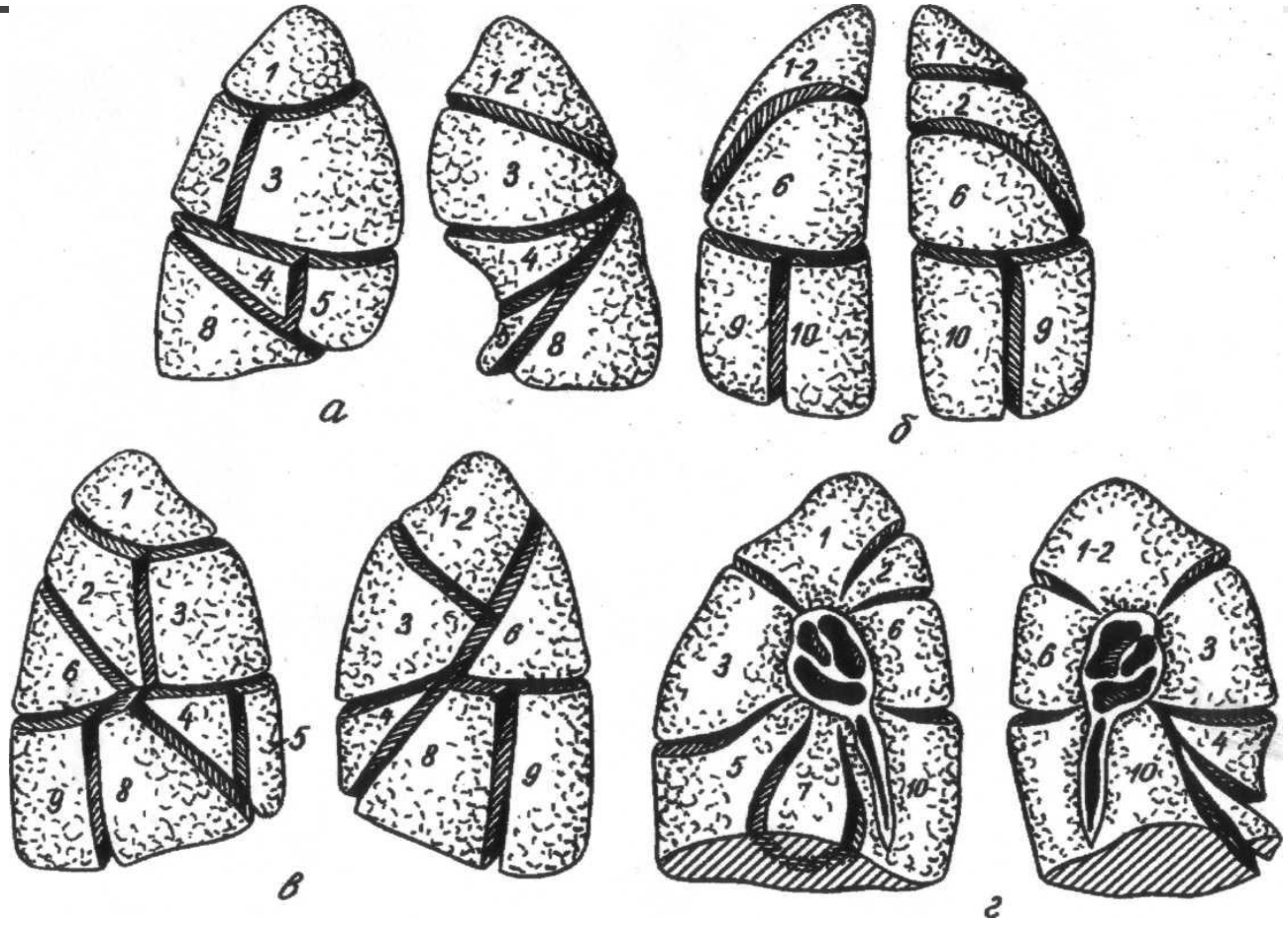
Side effects of antibiotic medication

Allergic reactions	**All antibiotics, predominantly penicillines**
Nephrotoxicity	**Aminoglycosides, cephalosporines**
Ototoxicity	**Aminoglycosides**
Disbiosis	**Cephalosporines, penicillines, macrolides**
Pseudomembranoes colitis	**Penicillines, cephalosporines**
Hepatotoxicity	**Tetracyclines, cephalosporines**
Cholestasis	**Macrolides**
Leucopoesis supression	**Chloramphenicol**
Osteogenesis disturbancies	**Tetracyclines,lincomycin**

Pathogenic treatment

- **Respiratory supplementation according to respiratory failure**
- **Desintoxication. If indications are present intravenous infusion is performed to correct acidic – basic condition, fluid and electrolyte disorders**
- **Symptomatic treatment can include antipyretics etc.**

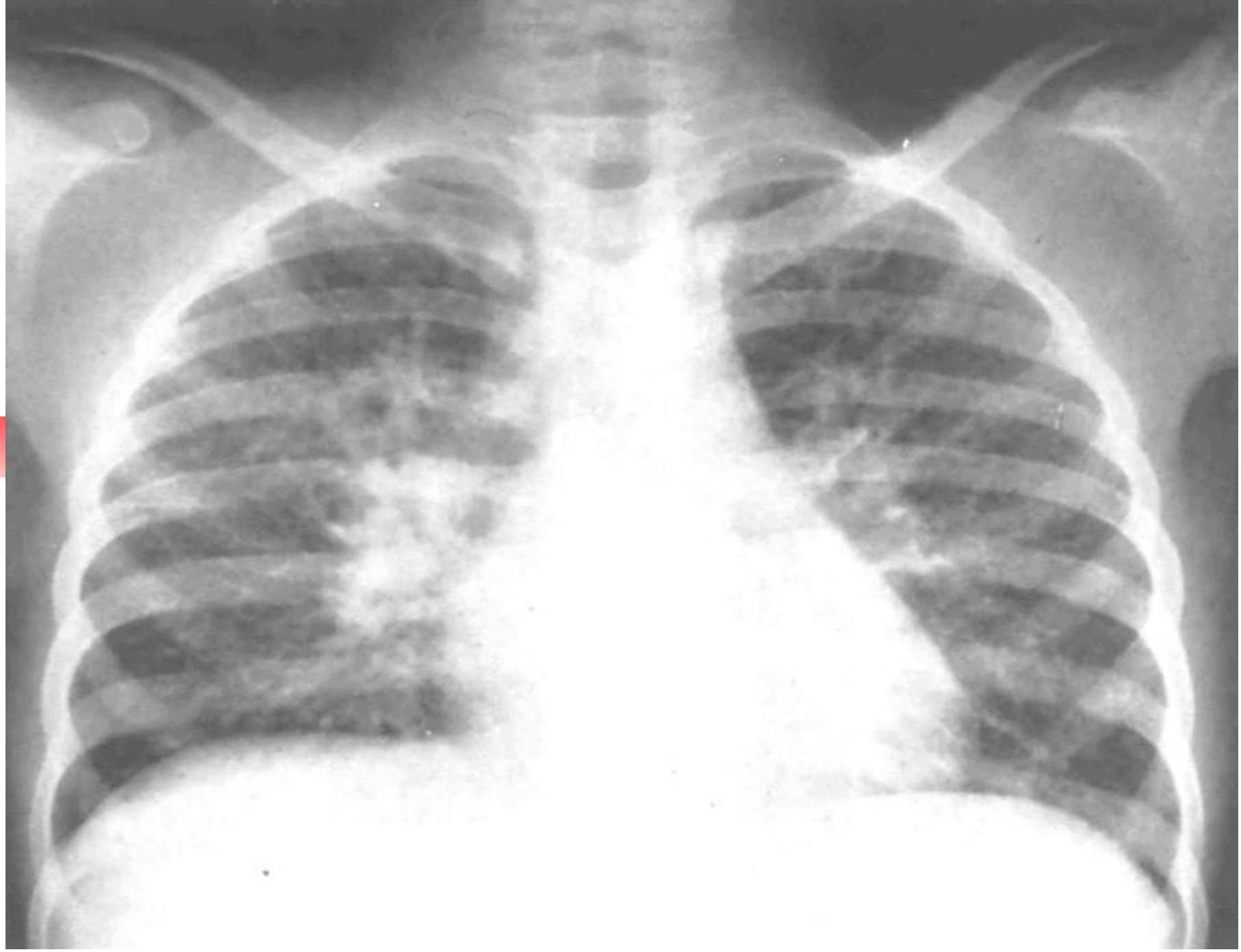
Segmental structure of lungs (scheme)



Questions

- To indicate etiologic and pathophysiologic factors at pneumonia in children
- To classify pneumonia, respiratory failure, analyze typical clinic of the pneumonia, respiratory failure in children.
- To indicate aspects of the pneumonia in newborns and to mace previous diagnose.
- To make list of the examination and to analyze data of the laboratory and instrumental examination.
- To prescribe treatment, rehabilitation, prophylaxis of the pneumonia in children.
- To diagnose and to give the first medical aim in acute respyratory failure in children.
- To perform differential diagnostic of pneumonias in children
- To make prognosis at pneumonia.
- To demonstrate morally-deontological principles of the subordination in the pulmonologic department

Pneumonia complication-pneumothorax

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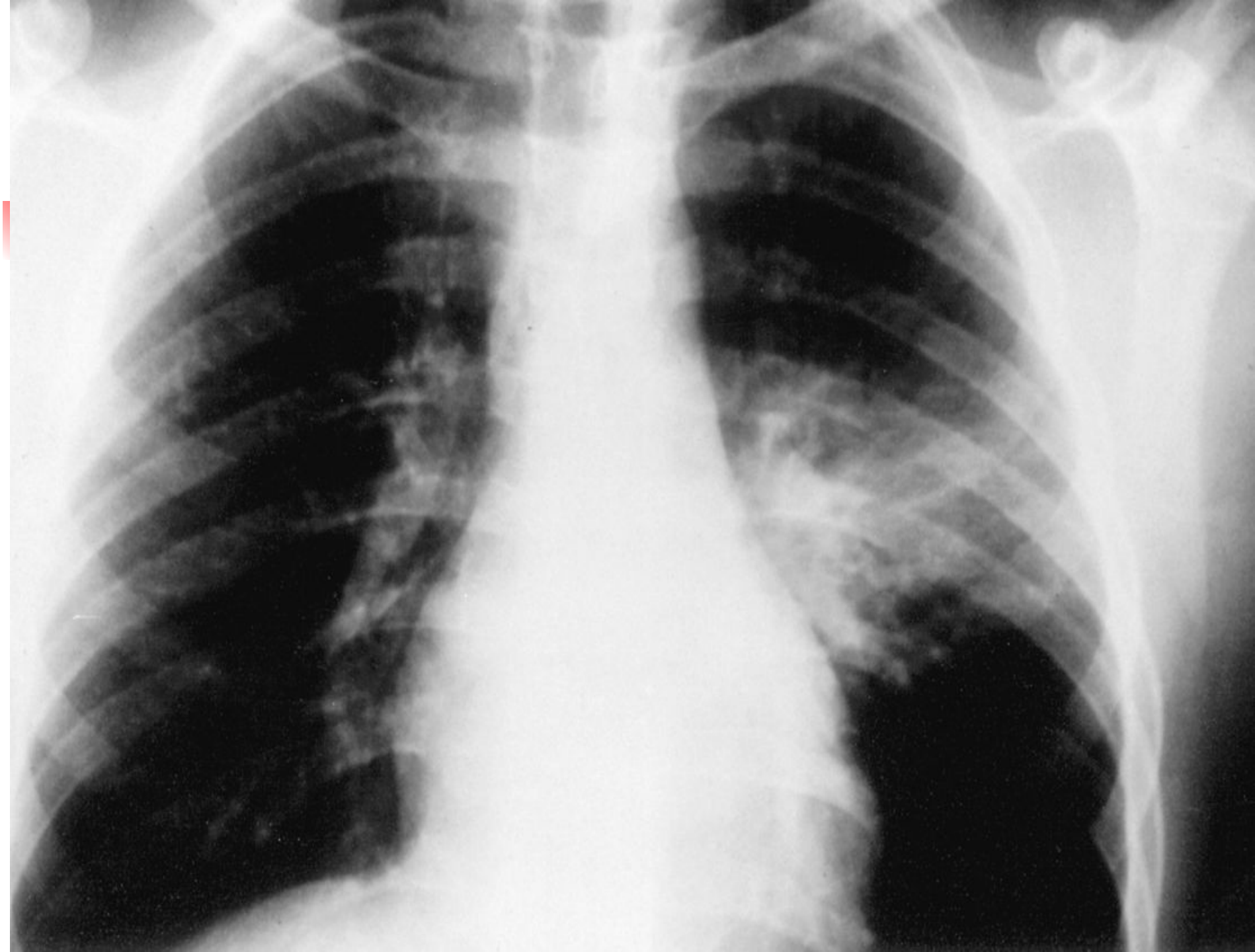

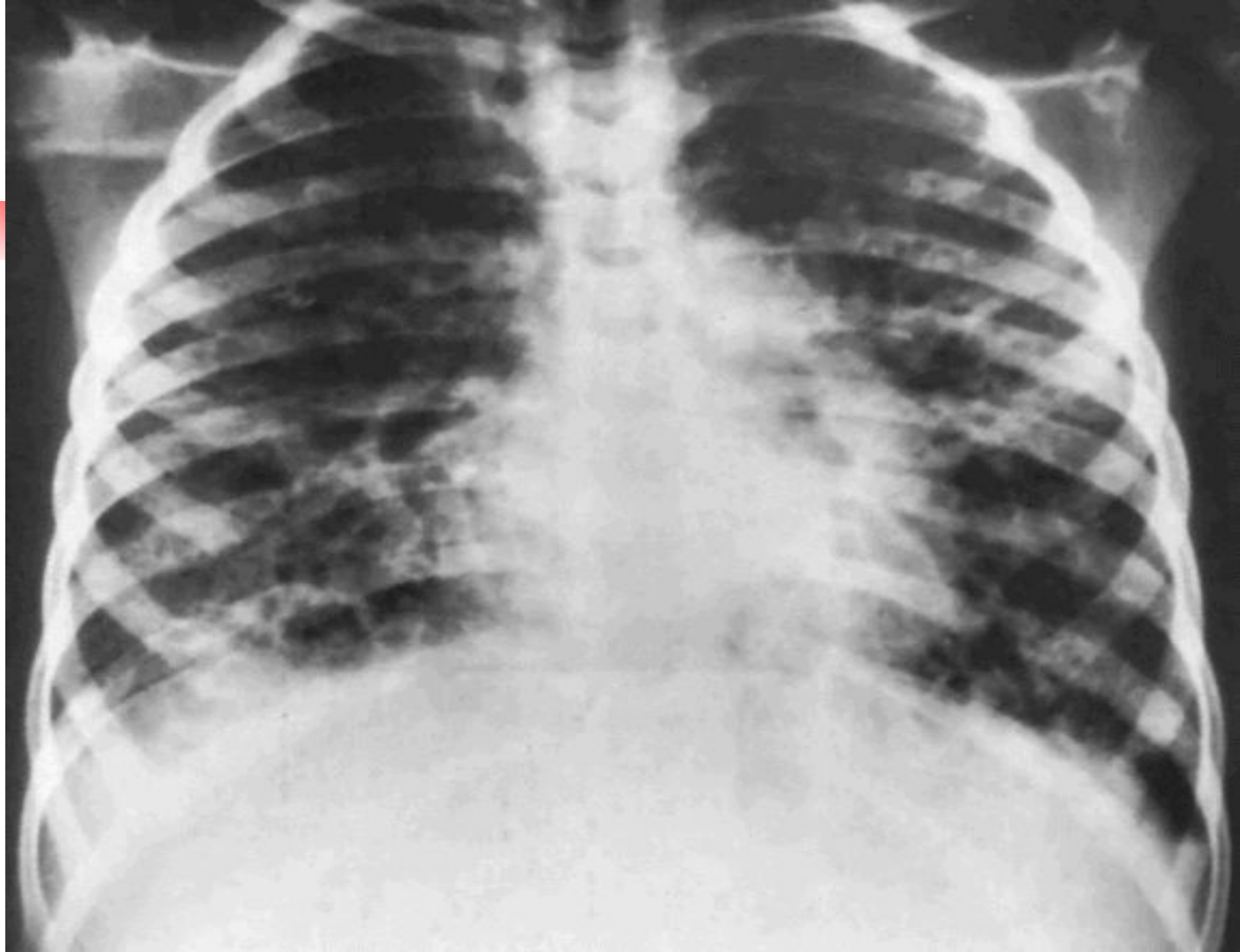


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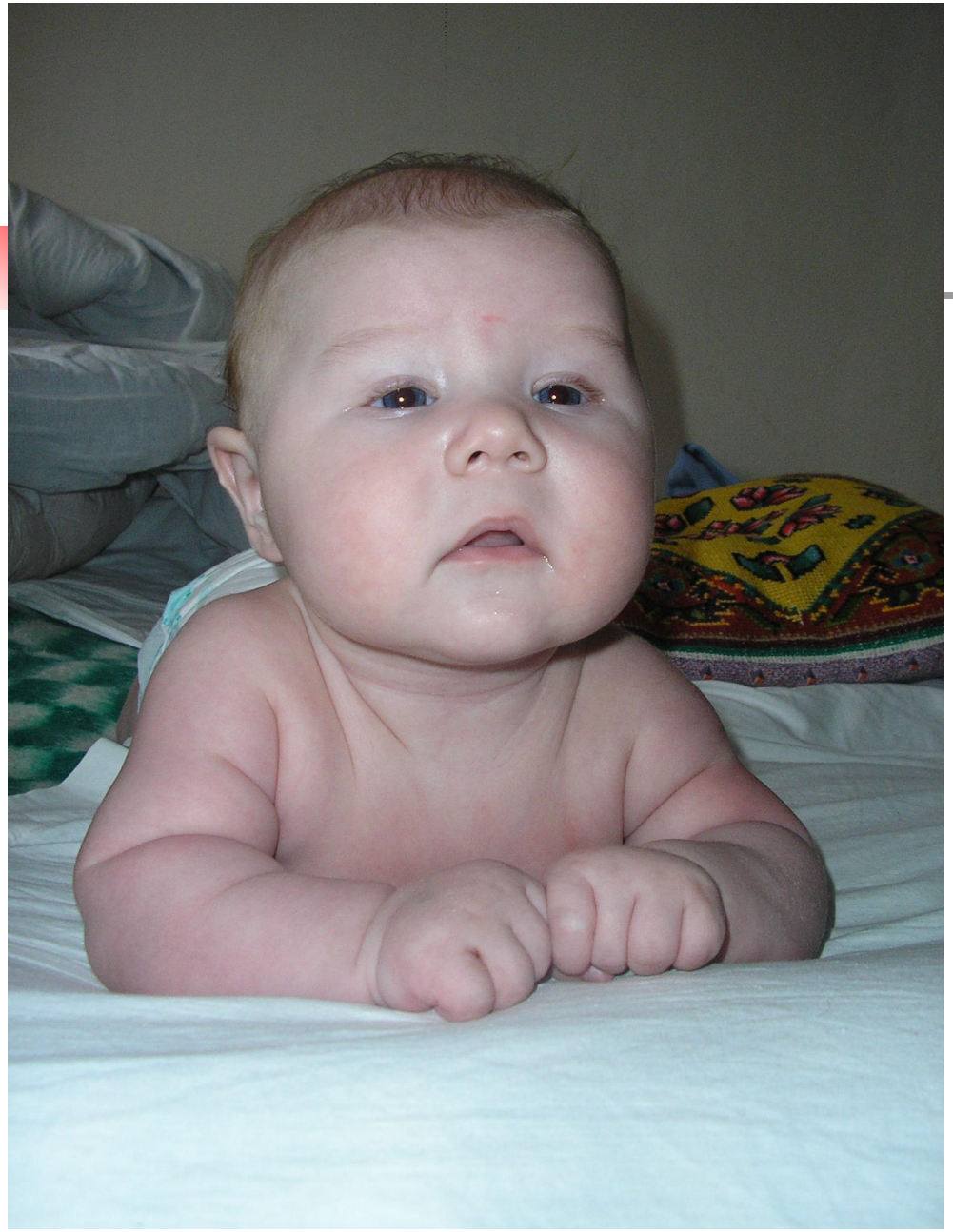

Thank you