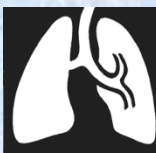


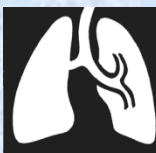
Emergencies in pneumology

Libor Fila



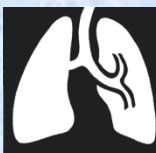
Emergencies in pulmonology

- Pneumothorax
- Haemoptysis
- Foreign body aspiration
- Acute severe asthma
- ARDS



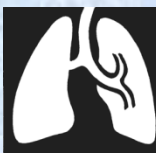
Pneumothorax (PNO)

- The presence of air in the pleural cavity
- Communication through the chest wall, the bronchial tree or the gastrointestinal system
- Accompanied with a partial or complete collapse of the lung



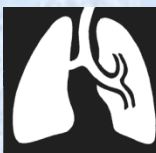
Pathophysiological types of PNO

- Closed PNO: communication is closed
- Open PNO: communication persists
- Tension PNO: communication opens in inspirium and closes in expirium; the air accumulates in the pleural cavity



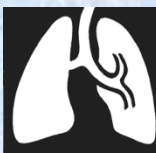
Consequences of PNO

- According to the extent of collapse of lung and to the state of lung parenchyma
- Ventilation is limited in the collapsed lung, there is decreased ventilation/perfusion ratio
- Total lung collapse leads to right-to-left shunt
- The patient is hypoxemic, usually without hypercapnia because of compensatory hyperventilation of contralateral lung



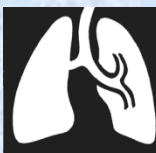
Consequences of PNO /2

- Closed PNO: stable condition
- Open PNO: pendulum-like movement of mediastinum and air between lungs (with increasing dead space) following respiratory movements
- Tension PNO: lead to mediastinal shift to contralateral side with compression of unaffected lung and worsening of venous return



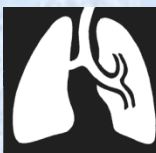
Clinical classification of PNO

- Primary spontaneous PNO: with no known underlying lung disease
- Secondary spontaneous PNO: in the terrain of lung disease
- Traumatic PNO: after blunt or penetrating chest injury
- Iatrogenic PNO: as consequence of medical procedure
- Catamenial PNO: during menstruation



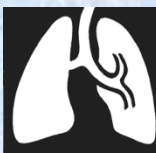
Primary spontaneous PNO

- In asthenic individuals in the second and third decade of life
- 5x more frequently occurs in men, often recurs
- The risk increases with smoking (22x in men, 9x in women)
- On the basis of apical bullae and "blebs" (subpleural air spaces)
- Rupture occurs at changes in barometric pressure (diving, traveling by plane), as well as when sneezing and coughing or there is no apparent cause



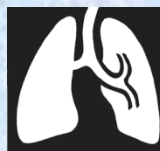
Secondary spontaneous PNO

- As a complications of underlying lung disease
- Maximum incidence in the fifth, sixth and seventh decade of life
- Chronic lung diseases: COPD, AB, IPF, sarcoidosis, LAM, PLCH, CF, ...
- Acute pulmonary diseases: cavitary necrotising pneumonias (Staphylococcus, Klebsiella) and pneumocystis pneumonias in AIDS patients
- Extrapulmonary disease: e.g. esophageal cancer



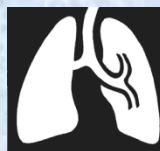
Traumatic PNO

- In chest injuries
- External PNO: communication through the chest wall (penetrating trauma: stabbing and gunshot wounds)
- Internal PNO: communication with the alveolar space (blunt trauma: car accidents, falls, injuries by the blast wave or lightning)
- At the same time may be present: hemothorax, rib fractures, contusions or lacerations of the lung and rupture of trachea and large bronchi



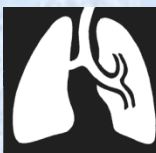
Iatrogenic PNO

- Thoracocentesis (for pleural effusion)
- Transparietal biopsy of lung or pleura
- Transbronchial (cryo-)biopsy of lung
- Cannulation of superior caval vein
- Curative PNO for TB
- Barotrauma during mechanical ventilation
- Injury after indirect heart massage (CPR)
- Injections against upper back pain
- Acupuncture (points LU 1 and BL 13)



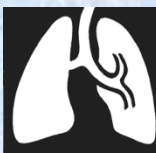
Catamenial PNO

- Recurrent PNO during the onset of menstruation
- Up to 30% of primary spontaneous PNO in women, usually in the third and fourth decade of life
- The causes are not clear
- Sometimes is present endometriosis (ectopic occurrence of uterine mucosa in lungs or in pleural cavity)
- Sometimes accompanied with catamenial hemoptysis or catamenial hemothorax



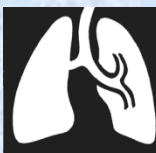
Symptoms of PNO

- May be asymptomatic
- Usually stinging pain, cough, breathlessness, collapse in case of circulatory failure
- Physical examination: hyperresonant percussion, weakened or inaudible vesicular breathing
- Confirmation on chest X-ray (beware of skinfolds in bedridden patients)
- Can be also evaluated using artifacts analysis on chest ultrasound
- Sometimes is required chest CT for confirmation (e.g. in large bullae in COPD)



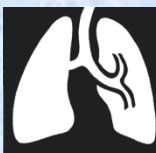
Treatment of PNO

- Open PNO: covering the wound
- Tension PNO: urgent puncture
- Small PNO: observation, oxygen
- Significant PNO: needle aspiration or chest tube (water seal or active suctioning)
- Recurrent PNO: thoracoscopy, solving of possible lung defect, pleural abrasion
- VTS intolerable cases: autohaemopleurodesis



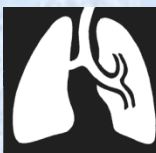
PNO: practical notes

- Insert chest tube in every PNO in patients on mechanical ventilation (risk of tension PNO !)
- Never clamp chest tube without supervision, eg. for transport (risk of tension PNO !)
- In case of unsuccessful attempt on one side, never insert central venous catheter in superior caval vein on contralateral side without previous chest X-ray (risk of bilateral PNO !)
- In case of atelectasis, never insert central venous catheter in superior caval vein on contralateral side (risk of PNO !)



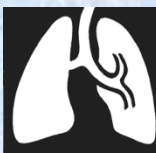
Haemoptysis

- It's a **symptom** of an underlying disease
- Haemoptysis: coughing up blood
- Haemoptoe: spitting up blood
- Epistaxis: bleeding from nose
- Haematemesis: vomiting blood
- Differentiate: bleeding from upper airways or upper parts of digestive system
- May be problematic: vomiting of swallowed blood from airways vs. coughing up aspirated blood from upper airways or digestive system



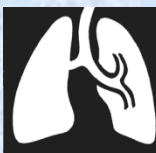
Quantification of haemoptysis

- The amount of blood is usually overestimated
- Blood streaking in sputum: small amount of blood in sputum
- Common way of quantification: number of coffee or soup spoons in certain period
- Massive haemoptysis: life-threatening, various criteria (> 500 mL/day or > 200 mL daily for several consecutive days)
- Risk of suffocation (not exsanguination) !



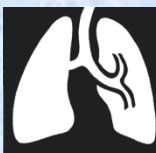
Sources of haemoptysis

- Bronchial arteries: 75-90% of cases
- Systemic non-bronchial arteries: 5-20%
- Branches of pulmonary artery: only 5%
- Large BE: up to 7% of cardiac output !



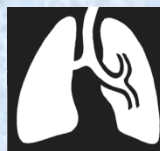
Causes of haemoptysis

Common (≥5%)	Lung cancer 25%, cryptogenic 20%, BE 18%, bronchitis 13%, pneumonia 5%, TB 5%
Rare (1-4 %)	Other tumors, mycetoma, lung abscess, pulmonary embolism, lung mycobacteriosis, left heart failure, chest injuries, iatrogenic (bronchoscopy, biopsy, right heart catheterization, insertion of chest tube)
Very rare (<1 %)	Mycoses and parasitoses, foreign body, amyloidosis, sarcoidosis, A-V malformation, LAM, mitral valve stenosis, endometriosis, bronchovascular fistula, DAH, lung sequestration, drug toxicities



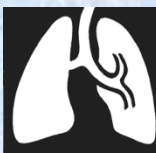
DAH: diffuse alveolar haemorrhage

- Around 70% of cases have haemoptysis
- Alveolar involvement with hypoxemic RI
- Vasculitis and immunopathologic conditions (Wegener's granulomatosis, Goodpasture syndrome, MPA, SLE...)
- Other causes: ARDS, cocaine abuse, post irradiation lesion, uremia, thrombocytopenia, coagulopathy, congestive heart failure, bone marrow transplantation ...
- BAL: last portion is most hemorrhagic



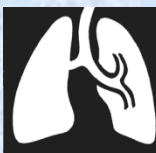
Massive haemoptysis

- 5% of cases of haemoptysis; 20% mortality
- Lung cancer
- BE
- TB
- Mycetoma
- Lung abscess
- A-V malformation
- Bronchovascular fistula



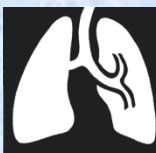
Haemoptysis in lung cancer

- The first symptom in 7-10% of cases of lung cancer
- In 20-30% of lung cancer patients in the course of disease
- 3 % of cases of lung cancer died on terminal massive haemoptysis (involvement of large vessels in mediastinum)



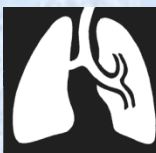
Haemoptysis in TB

- TB was most frequent cause of haemoptysis in the past
- Posttuberculous BE and TB caverna are the causes of heamoptysis
- Up to 5% of patients with TB caverna have Rasmussen's aneurysm (dilated branch of pulmonary artery in caverna) with risk of massive (terminal) haemoptysis



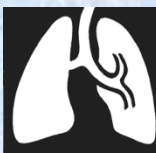
Approach to patient

- ? source of bleeding (? upper airways, ? digestive system)
- Blood count, coagulation, ANCA, chest X-ray:
? blood losses, ? coagulopathy, ? vasculitis,
? localization of side of bleeding
- Chest CT (AG) : localization of side of bleeding, cavitation, BE, (pulmonary embolism)
- Bronchoscopy, bronchial arteriography: diagnostic and therapeutic procedures



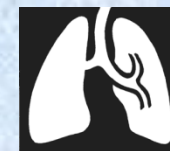
Treatment of haemoptysis

- Bedrest, position on the affected side, ice packs
- Treatment of the underlying disease
- Correction of coagulopathy, antifibrinolytics
- Correction hypertension
- Vasopressin and its analogues
- Antitussives, sedatives
- Immunosuppression or plasmapheresis in vasculitis

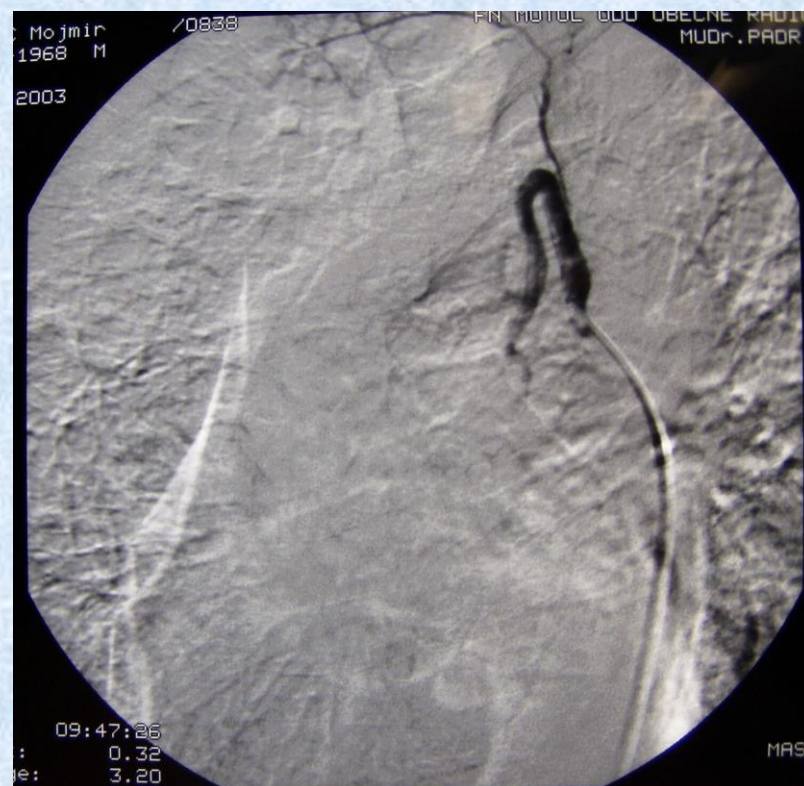
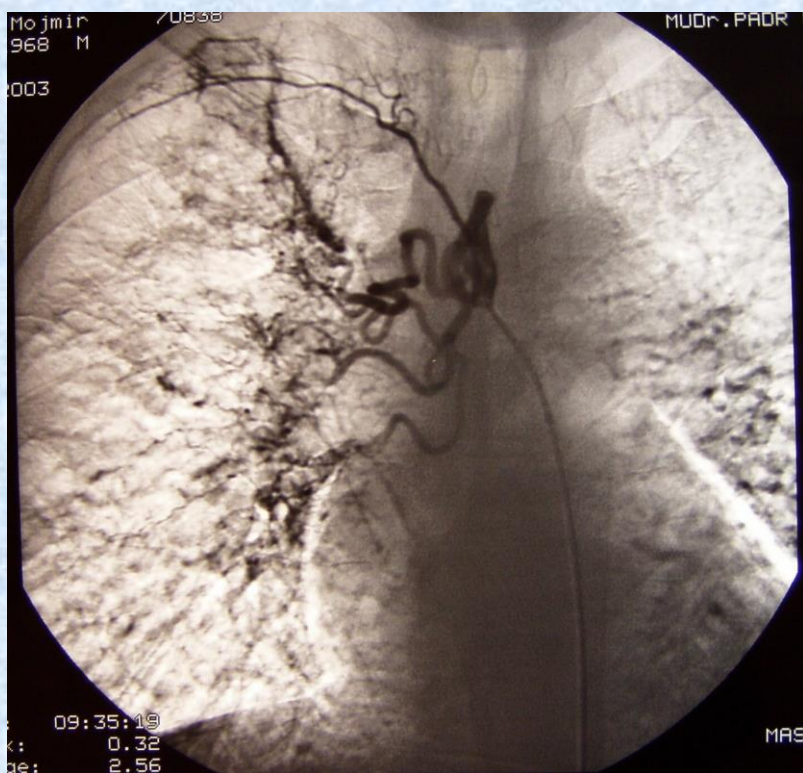


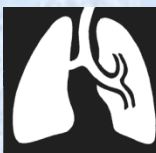
Treatment of massive haemoptysis

- Urgent chest CT, (\pm bronchoscopy), bronchial arteriography with therapeutic embolization
- Frequently is required intubation (selective intubation of non-bleeding lung)
- Bronchoscopic intervention: lavage with iced saline, administration of epinephrine or vasopressin, laser, balloon tamponade (Fogarty catheter)
- Surgeon: ligation of bronchial arteries in lung hilum, resection of bleeding site (usually lobectomy)



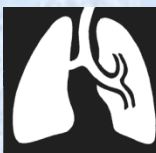
Therapeutic embolisation





Foreign body aspiration

- Complete obstruction of the large airways leads quickly to suffocation
- Large bodies are trapped in the pharynx or larynx, sometimes is present laryngospasm
- Smaller bodies are trapped in the trachea and main bronchi



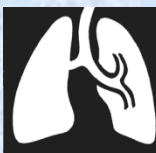
Risk factors

- Respiratory: vocal cord paresis, anesthesia of throat or larynx (eg. after bronchoscopy)
- Digestive: tracheoesophageal fistula, obstruction of the esophagus, vomiting
- Neurological: epilepsy, Parkinsonism, ALS, MS, pseudobulbar syndrome



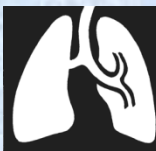
Treatment

- Use forceful back-blows between the shoulder blades or the Heimlich maneuver
- Extraction of objects from pharynx or larynx manually or using Magill's forceps; if it is not possible, then perform urgent coniotomy or tracheotomy
- Extraction of bodies using bronchoscopy or surgery (thoracotomy, bronchotomy)



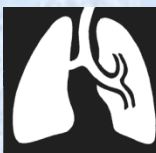
Severe acute asthma

- Severe shortness of breath, one-word answers, restlessness or lethargy → unconscious
- Tachypnea $>30/\text{min.}$, wheezing → „quiet chest“, paradoxical breathing
- Tachycardia → bradycardia
- PEF $<60 \text{ L/min.}$ or unmeasurable
- $\text{SpO}_2 <90\%$
- pO_2 continues to drop and pCO_2 starts to rise



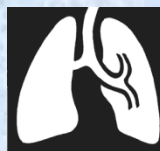
Boclese classification

Stage	p_aO_2	p_aCO_2
I	=	↓
II	↓	↓
III	↓↓	=
IV	↓↓↓	↑



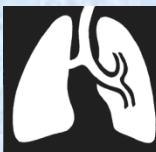
Treatment

- 1st line: RABA inh., SCS p.o./i.v., O₂
- 2nd line: SAMA inh., MgSO₄ 2 g i.v.
- 3rd line: i.v. theophyllines/betamimetics; if not successful, then intubation and mechanical ventilation
- Target: S_pO₂ ≥92 %, children and pregnant women ≥95 %



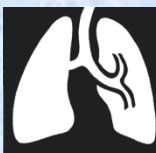
ARDS

- Acute respiratory distress syndrome
- „non-cardiac lung edema“
- HI (hypoxic index): $7,5 * pO_2 / FiO_2$
pO₂ in kPa; FiO₂ in decimal number (e.g. 0.4)
- ALI: HI <300
- ARDS: HI <200



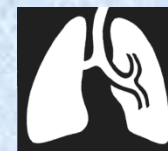
Causes of ARDS

Pulmonary	Extrapulmonary
Pneumonia	Sepsis
Inhalation trauma	Anaphylaxis
Aspiration of stomach content	Polytrauma
Lung contusion	Burns
Radiotherapy	Transfusion reactions
Drowning	Cardiopulmonary bypass
	Drug and chemical toxicities



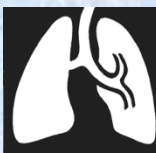
Pathophysiology

- Exudative phase: interstitial and alveolar edema, hyaline membranes, microthrombosis of capillaries, neutrophil infiltration
- Proliferative phase: proliferation of type II alveolar cells, organization of hyaline membranes
- Fibrotic stage: alveolar septal fibrosis, fibrotic and bullous lung degeneration



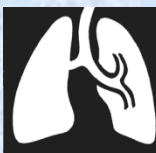
Clinical presentation

- Severe dyspnea, tachypnea, cough with foamy sputum expectoration
- Crackles on both lungs
- Bilateral infiltrates on chest X-ray
- Refractory hypoxemia, high A-aDO₂ gradient, low lung compliance



Treatment

- Treatment of the underlying disease
- Corticosteroids to prevent fibrotic changes
- Restrictive fluid regimen, inotropic agents
- Intubation, aggressive ventilation modes (high FiO_2 , high PEEP) with the risk of barotrauma
- Alternative modes: prone position (lying on stomach), use of ECMO or NO inhalation



Nitric oxide in airways

- Nitric oxide = NO
- In the respiratory tract, NO relaxes smooth muscles in blood vessels and bronchi, stimulates mucociliary clearance and defense against infection
- Produced mainly in the paranasal sinuses ("aerocrine secretion")
- Improves perfusion in better ventilated alveoli (improvement in the ratio V / Q)