PNEUMOLOGY - Part I

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FUNDAMENTALS OF LUNG AUSCULTATION | NEJM

CHARLES UNIVERSITY IN PRAGUE
FIRST FACULTY OF MEDICINE

REVIEW ARTICLE

Fundamentals of Lung Auscultation

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Pediatric Pneumology

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INFANTS

- Metabolism↑
- Higher risk of apnoe
- Resistence of upper respiratory tract ↑
- Resistence of lower airways ↑
- Lung volume↓
- Efficacy of respiratory muscles ↓
- Respiratory muscle endurance ↓

REASONS

Oxygen consumption↑

Immaturity of the Respiratory Centre

Nasal breathing

Size of tongue

Diameter of airways↓

Colapsibility of airways↑

Diameter of airways↓

Compliance of airways ↑

Lower lung elasticity↓

Number of alveols ↓

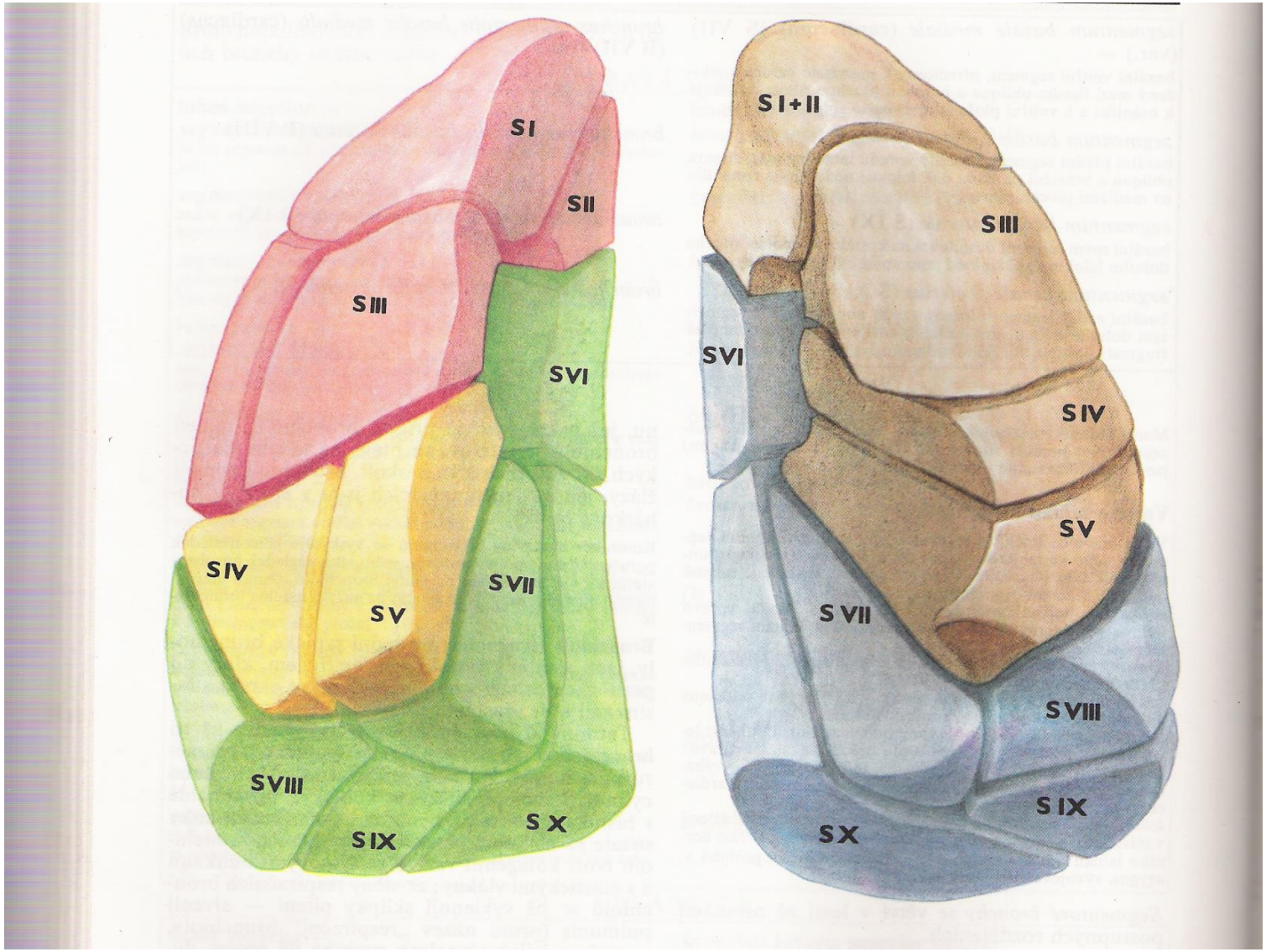
Efficacy of diaphragm ↓ – horizontal insertion

Compliance of ribcage ↑

Horizontal position of the ribs

Respiratory rate ↑

Number of fatigue resistance muscle fibers↓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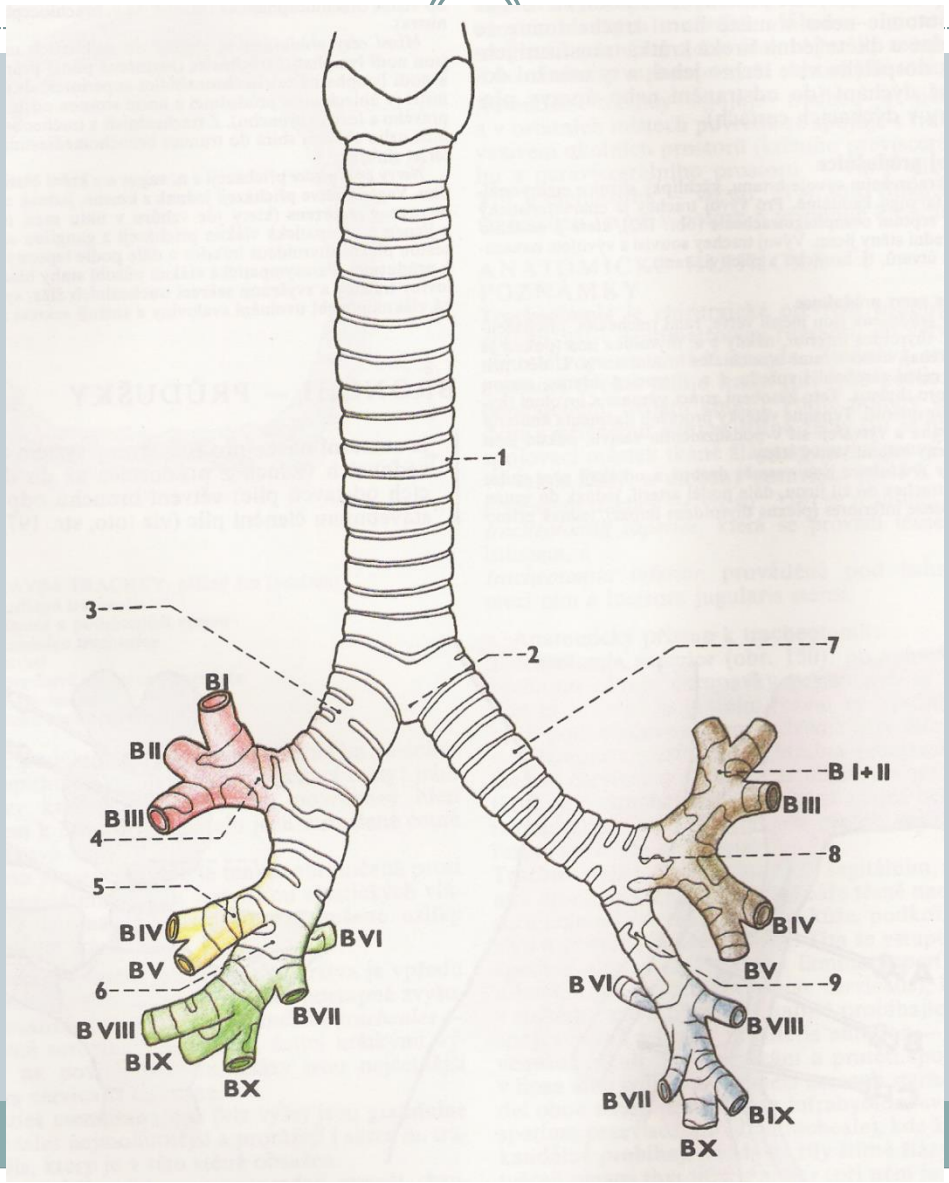
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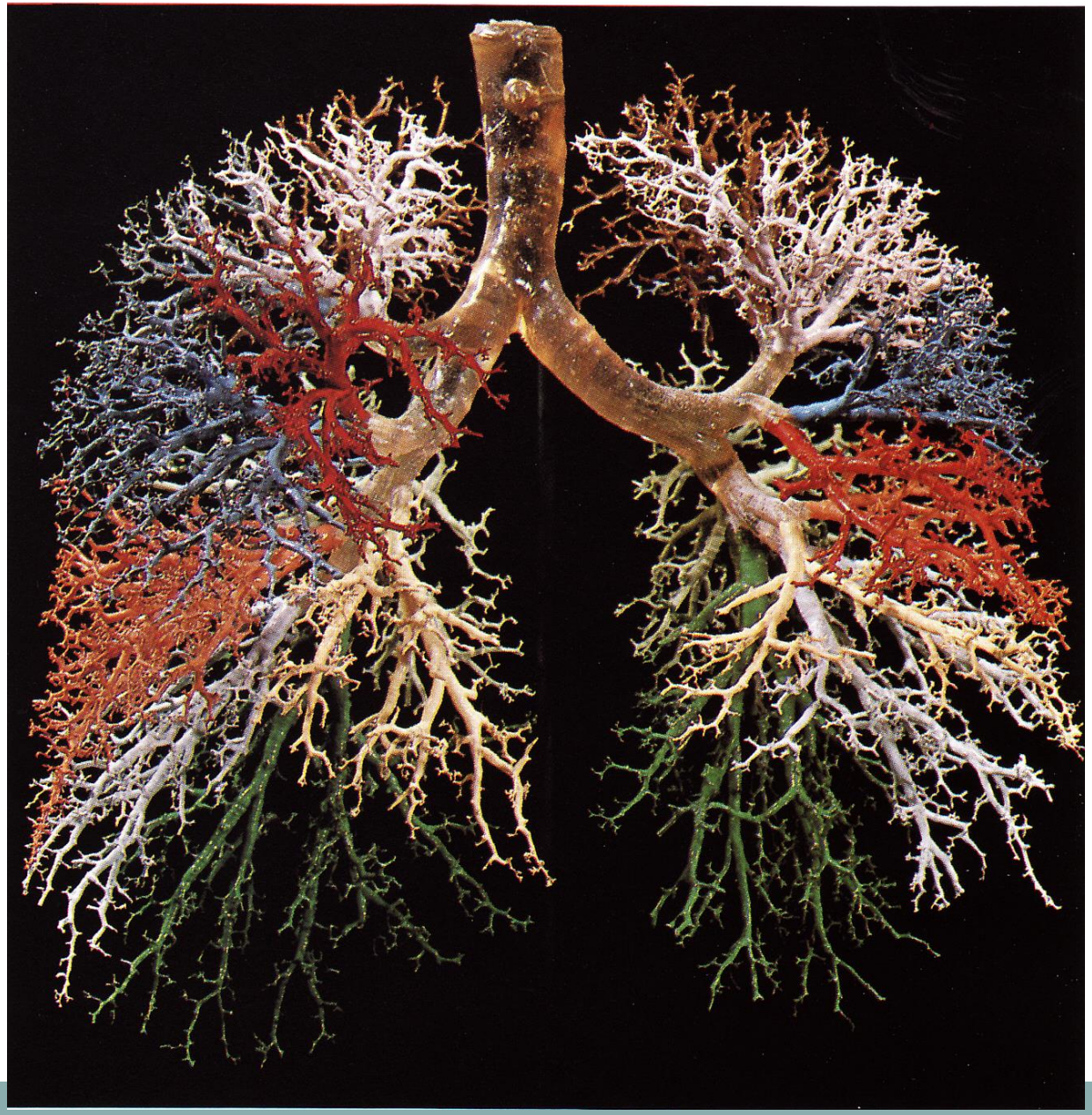

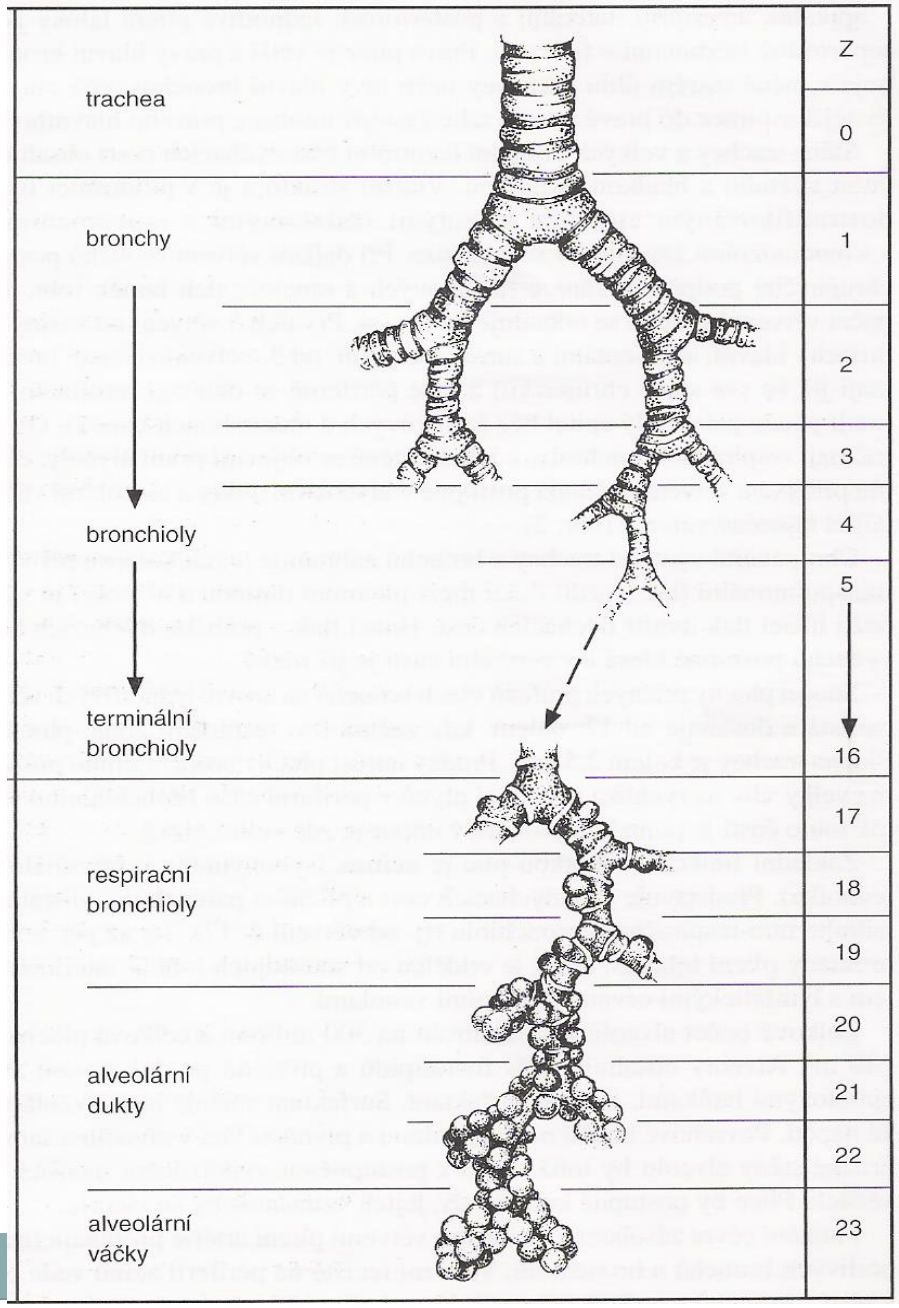
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RESPIRATORY PHYSIOLOGY - AIRWAYS

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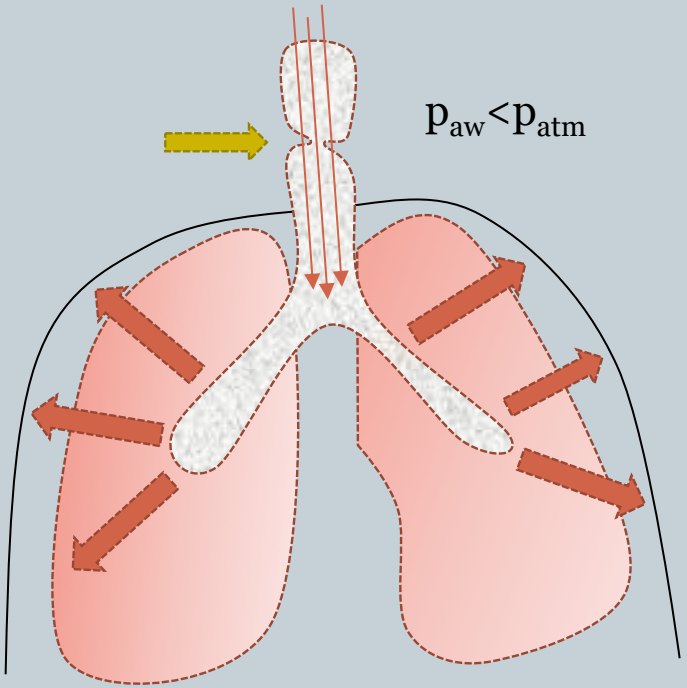
AIRWAYS

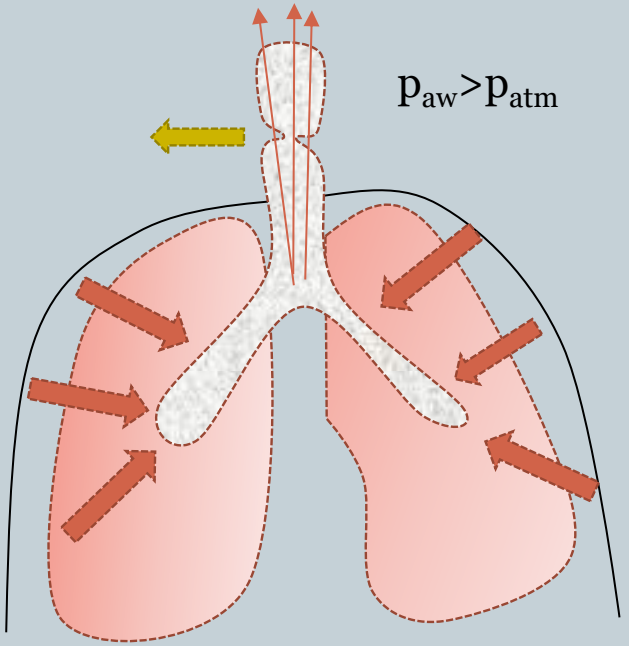
- Compressible
- Intrathoracic and extrathoracic part:
  - Elastic fibers connect airways with pleura – benefit during inspiration
  - Forced expiration increases intrapulmary pressure and worsens collapse of intrathoracic part of airways

UPPER AIRIWAY OBSTRUCTION

INSPIRATION

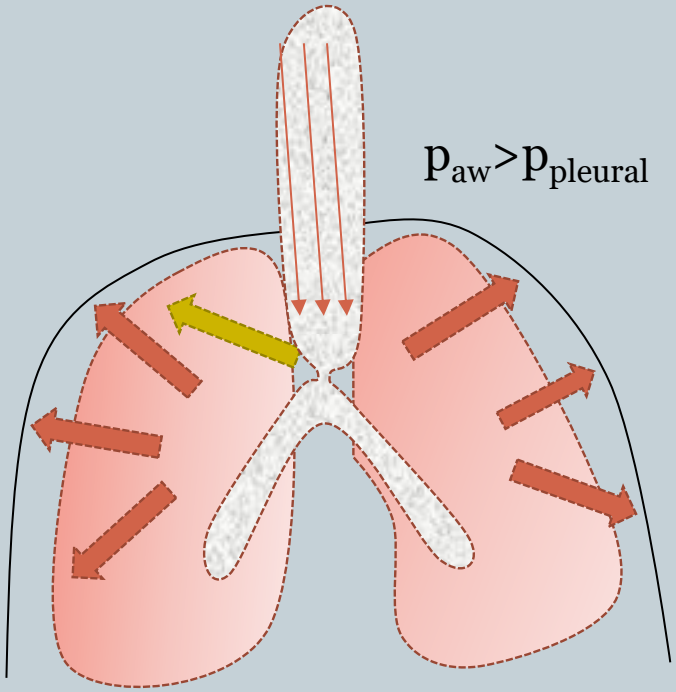


EXPIRATION

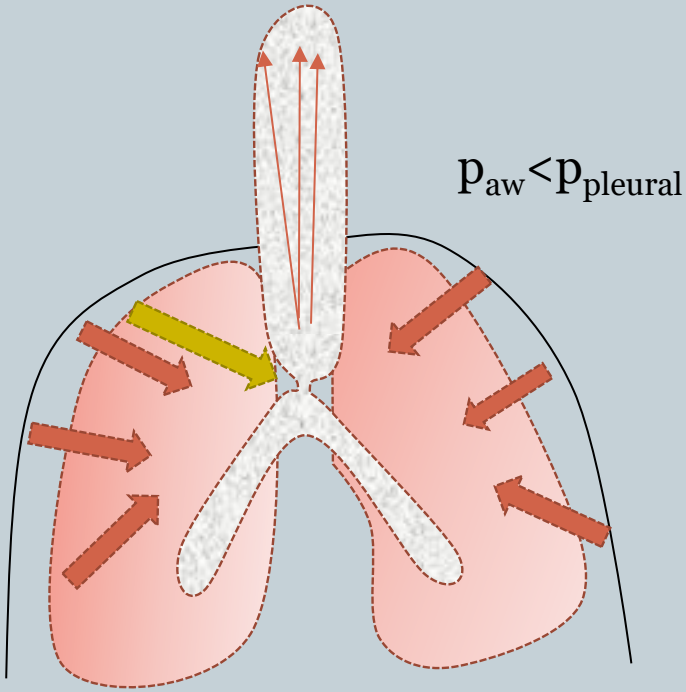


LOWER AIRWAY OBSTRUCTION

INSPIRATION



EXPIRATION



DIVISION OF AIRWAYS

- WHERE IS THE BRODER BETWEEN UPPER AND LOWER AIRWAYS ?

1. Anatomic perspective – embryological reasons
    1. Border= LARYNX – Larynx+trachea+bronchi+bronchioli develop from ventral wall of the foregut = lower airways
    2. Nasal + paranasal cavities+nasopharynx = upper
2. Surgical perspective – tracheal bifurcation
3. Physiological perspective

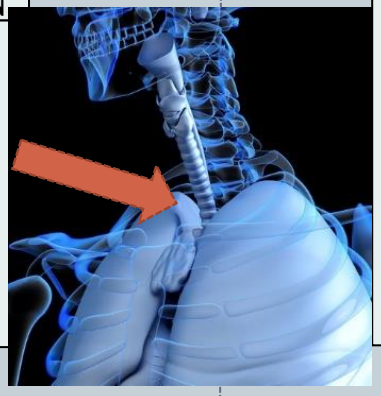
– entrance of trachea into thorax at the level of upper thoracic outlet

= border between extrathoracic and intrathoracic airways

DIVISION OF AIRWAYS

UPPER AIRWAY OBSTRUCTION (extrathoracic)

- Inspiratory dyspnea
- STRIDOR



LOWER AIRWAY OBSTRUCTION (intrathoracic)

- Expiratory obstruction
- WHEEZING

MIXED DYSNEA

Inspiratory - expiratory

- Obstruction in the middle of trachea
- Severe obstruction at any part of airways
- Cause of dyspnea out of airways – lung parenchyma, central nervous systém, metabolic reasons etc.

WORK OF BREATHING in health at rest

Inspiration = ACTIVE process at rest

- Diaphragm+ intercostal muscles – at rest

- Further accessory muscles of breathing – during physical aktivity or illness: scalenes, sternocleidomastoid, pectoralis major and minor, serratus anterior, latissimus dorsi

Expiration = PASSIVE process at rest = relaxation

- elastic recoil of respiratory tract return to the level of functional residual capacity = balance between steady position of thorac and elastic recoil of lung
- ACTIVE expiration at rest is pathologic situation
- Forced expiration during physical activity or illness is caused by abdominal wall muscles and internal intercostal muscles contraction

CLINICAL EXAMINATION

- Anamnesis
- Clinical examination:
  1. Aspection
  2. Palpation
  3. Percussion
  4. Auscultation
- Laboratory
- Imaging methodes

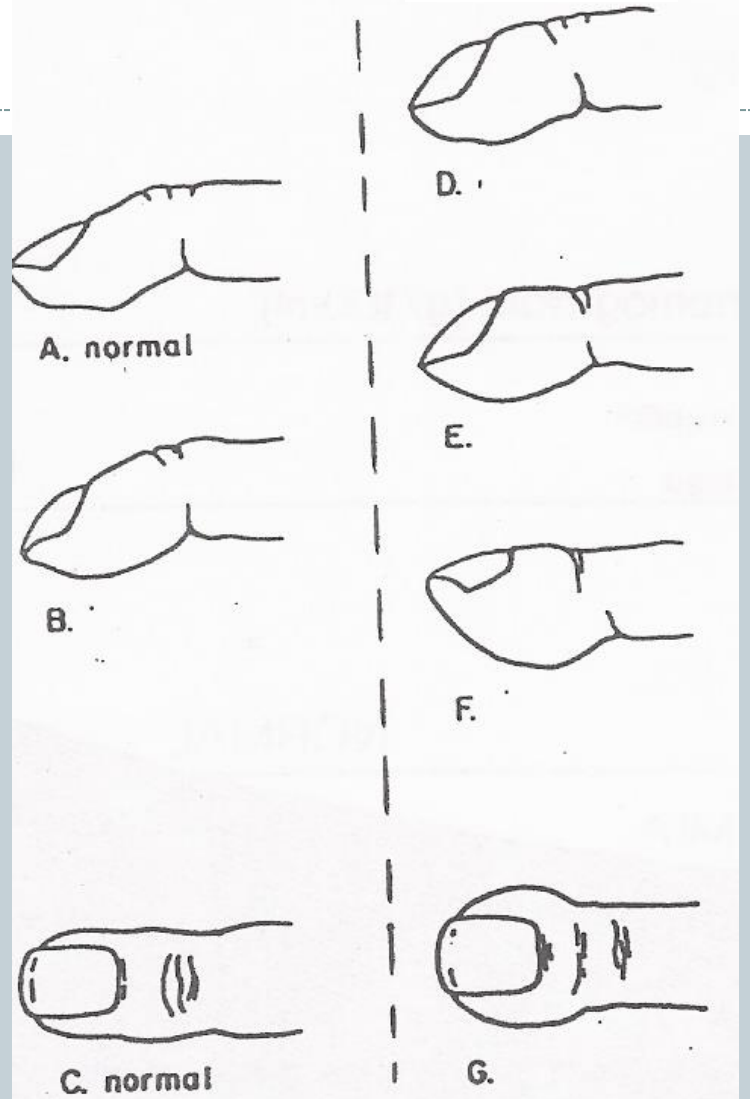
ASPECTION

- Chest shape – kyphoscoliosis, pectus carinatum, excavatum
- Abnormal breathing movements:
  1. Symmetry
  2. Retraction of jugulum, above clavicles, between ribs and below rib cage
  3. Nasal flaring
  4. Ratio inspiration/exspiration
- Colour – pale or cyanotic skin


Always
In my

Normal

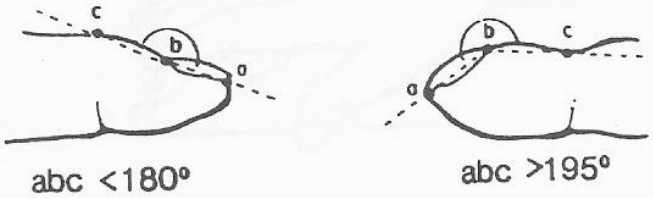
Digital clubbing



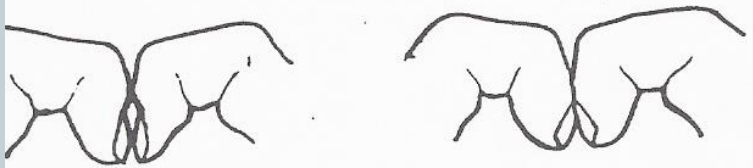
Normal

Digital clubbing

Lovibond angle



Schamroth´s sign



RESPIRATORY RATE

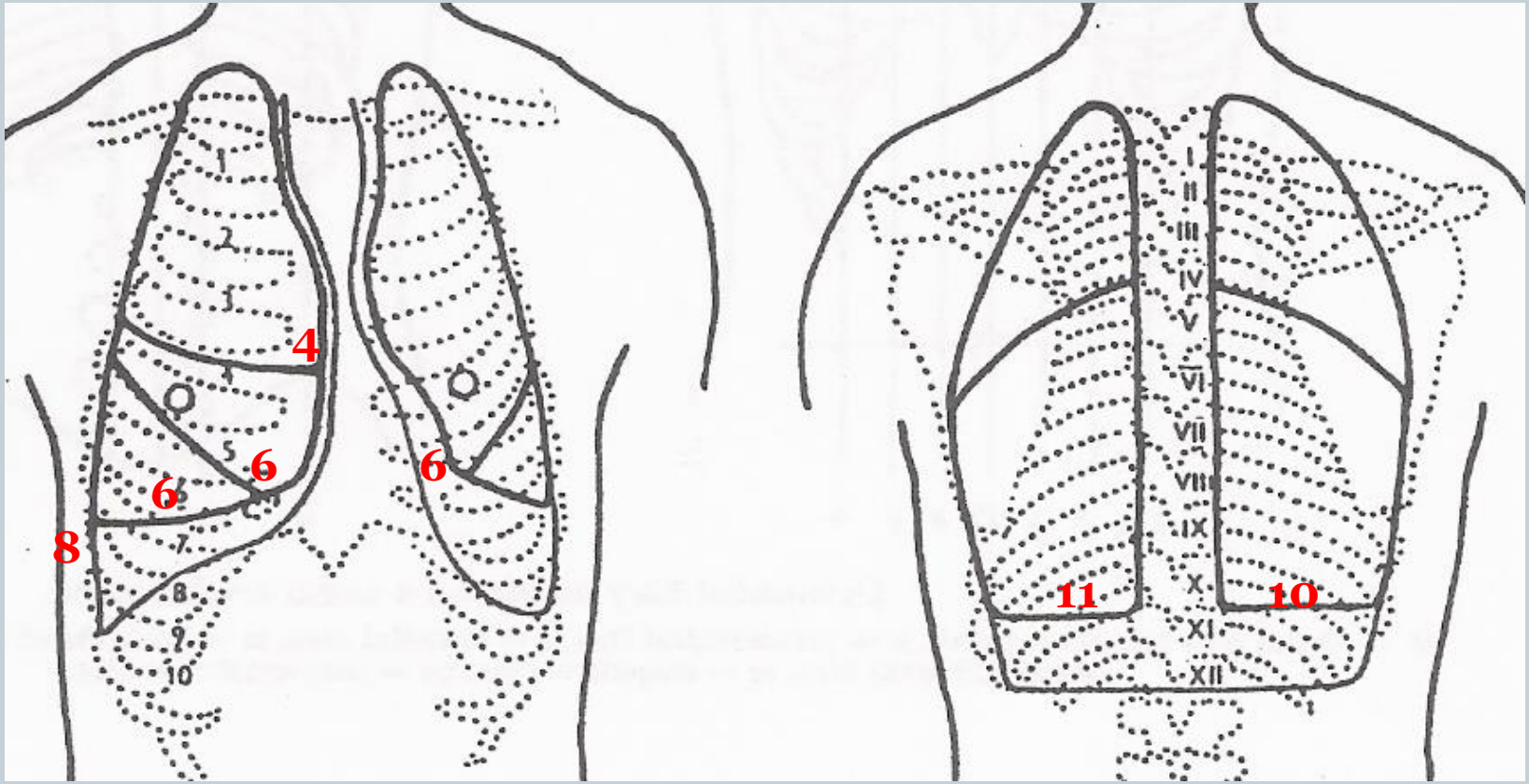
	RR per minute	HR per minute
• Neonates immature	**60-100**	**100-180**
• Neonates	**40-60**	**100-160**
• Infants	**30-60**	**100-160**
• Toddlers	**24-40**	**90-150**
• Preschool age	**22-34**	**80-140**
• School age	**18-30**	**70-120**
• Adolescents	**12-20**	**60-100**

PALPATION

- Fremitus pectoralis vocalis – tactile fremitus
  - 👎 pleural effusion, emphysema, obstruction
- Pleural friction rub
- Capillary refill < 2 s

PERCUSSION

- Borders of the lungs, interlobar fissures



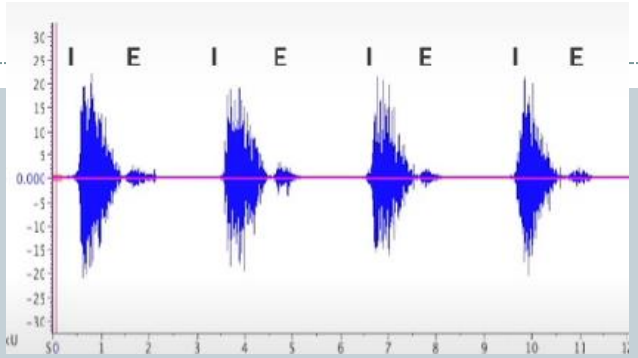
PERCUSSION

- Normal sonorous resonant percussion sound

- Hypersonorous (hyperresonant)
  - emphysema, pneumothorax
- Dull to flat
  - condensated lung (pneumonia, cancer, atelectasis, infarct)

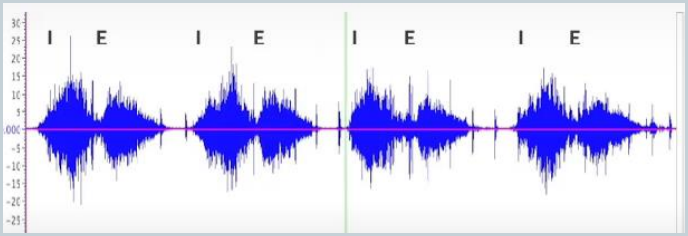
- Tympanitic percussion
  - cavities

AUSCULTATION



- Breath sounds

1. Vesicular breathing – “f“
2. Bronchial (tubular) breathing - “kh“
    1. physiological only over the larynx and trachea
    2. C7 veretebra
    3. TH4 vertebra to the right – right main bronchus
    4. in children in the axillae
3. Puerile – children below 10 years



- Pathology

1. Increased / weakened vesicular breathing
2. Vesicular breathing with prolonged exspiration
    astma bronchiale, bronchiolitis
3. Bronchial breathing = airless alveoli
    1. Pneumonia, pulmonary infarction
    2. Fluid in pleural cavity

AUSCULTATION

- Dry rales
  1. Whistles – high pitched
  2. Rhonchi – low pitched
- Moist rales (cracles)
  - Coarse (large bubbles), crepitant (medium), crackling
- Inspiratory crepitations/fine cracles
- Stridor
  - narrowing of the large airways – larynx, trachea
- Pleural friction rub

NOISES

- STRIDOR – large extrapulmonary airways
- WHEEZING – large intrathoracic airways
- SNORING - naso/pharyngeal anomaly, sleep apnea syndrome
- GRUNTING – expiratory sound - rhythmic closure of the glottis

?

HOW TO DISTINGUISH
during clinical examination:

- Pleural effusion or lung infiltration
- Atelectasis or pneumonia

- Bronchophony – auscultation of spoken sounds
- Pectoriloquy – whisper - ausculation
- Both increased in case of pulmonar consolidation:
  - Pneumonia
  - Cancer

SYMPTOMS OF PULMONARY DISEASES

- Eupnea
- Dyspnea = subjective symptom of *breathlessness*
  - *INSPIRATORY* *x* *EXPIRATORY*
- *Orthopnea* - auxiliary respiratory muscles
- Tachypnea x Hyperpnea
- Kussmaul´s breathing
- Bradypnoe
- Apnoe > 20s

COUGH

- Symptom = not disease
- Reflex – irritation of tusigennic zones (airways, external ear, esophagus, pericardium)
- DRY (unproductive) x WET (productive)
- With or without expectoration
- ACUTE x CHRONIC > 4 weeks

- CHRONIC COUGH in children
  1. Asthma bronchiale
  2. Gastroesophageal reflux – disease – GERD
  3. Postnasal drip syndrom, during epidemy - pertussis

HEMOPTYSIS

- Expectoration of blood alone or with sputum
- Origin of blood from lower airway

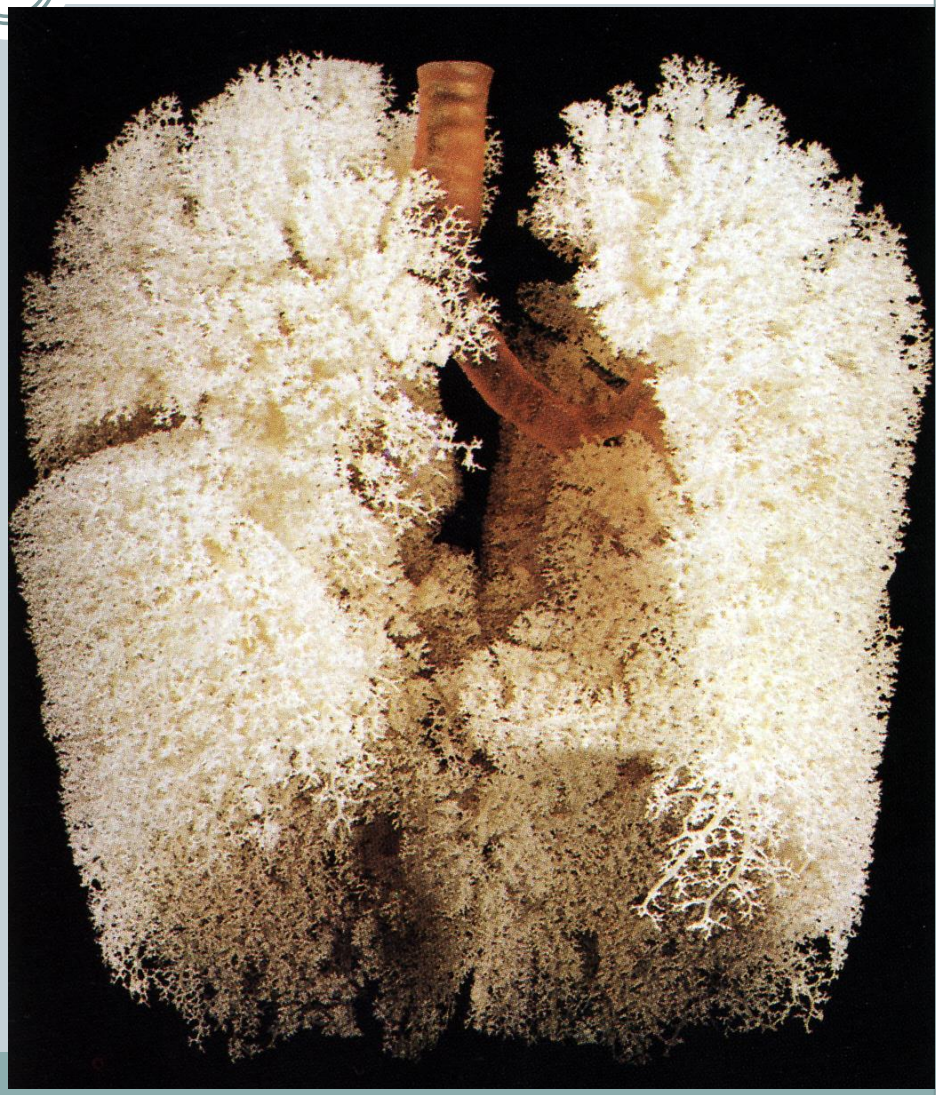
  X pseudohemoptysis – from nose, mouth, esophagus etc.

Etiology:

1. Coagulopathies (sepsis) – neonates, infants, toddlers
2. Lung and cardiac congenital anomalies (with congestion)
3. Pneumonia, TB, absces
4. Pulmonary hemosiderosis, cystic fibrosis
5. Tumours
6. Rheumatic disease
7. Aspiration

CHEST PAIN

- Are lungs painful ?
- Does exist abdominal pain of lung origin ?



CHEST PAIN

- *LUNG + visceral pleura* – no sensory nerve endings

X

- TRACHEA – retrosternal pain
- *Pleural pain* – parietal pleura involved
  - Stabbing localized pain, increased with inspiration
- Lower part of pleura involved
  - Pain of abdominal wall by 6th intercostal nerves
- Affection of central part of diaphragm = shoulder
  - Coinnervation by 3th, 4th, 5th cervical nerves (phrenic nerv)

Acute abdomen = pneumonia

CHEST PAIN

- Usually of extrapulmonary origin:
  - Tietz´s syndrom - vertebral, subluxation of sternocostal joint, muscular trauma, in young people
  - Osteochondritis – older people
  - Gastrointestinal tract – GERD, gastritis, esofagitis
  - Cardiac disease

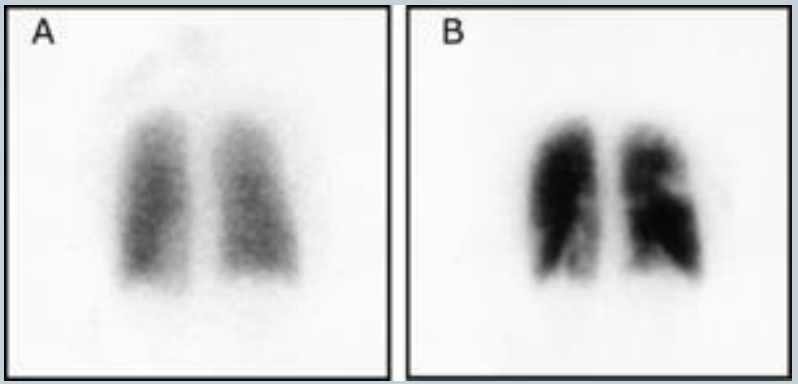
- Pulmonary origin:
  - Pneumonia, pleuritis
  - PLEURODYNIA= **Bornholm disease** – virus Coxsackie B
    - „IRON GRIP“ around the rib cage

CYANOSIS

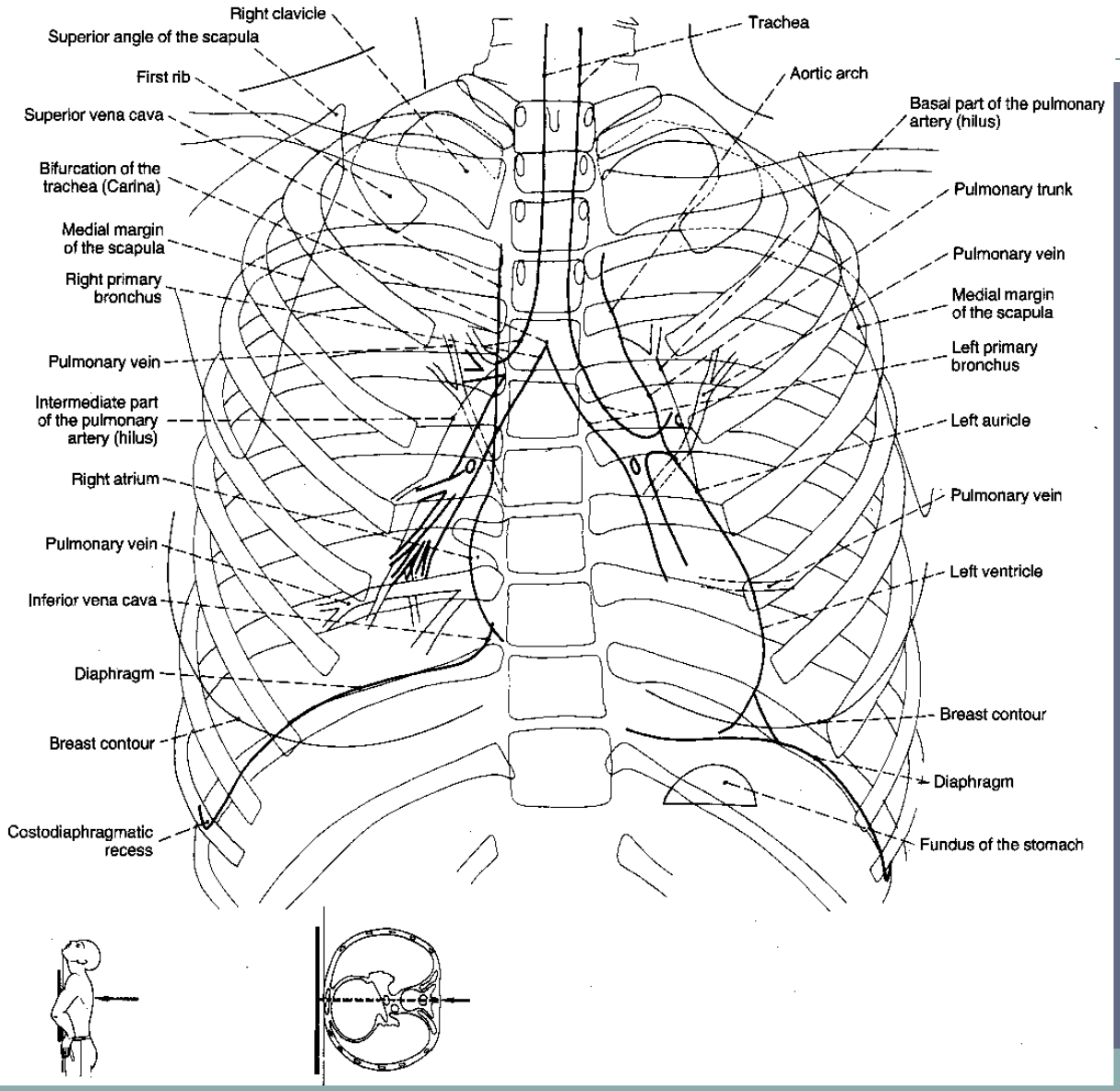
- = reduced hemoglobin above 50 g/l
- Central x peripheral
- Depends on concetration of hemoglobin:
  - Anemia = ↓ incidence of cyanosis
  - Polycythemia= ↑ incidence of cyanosis

INVESTIGATIVE METHODS

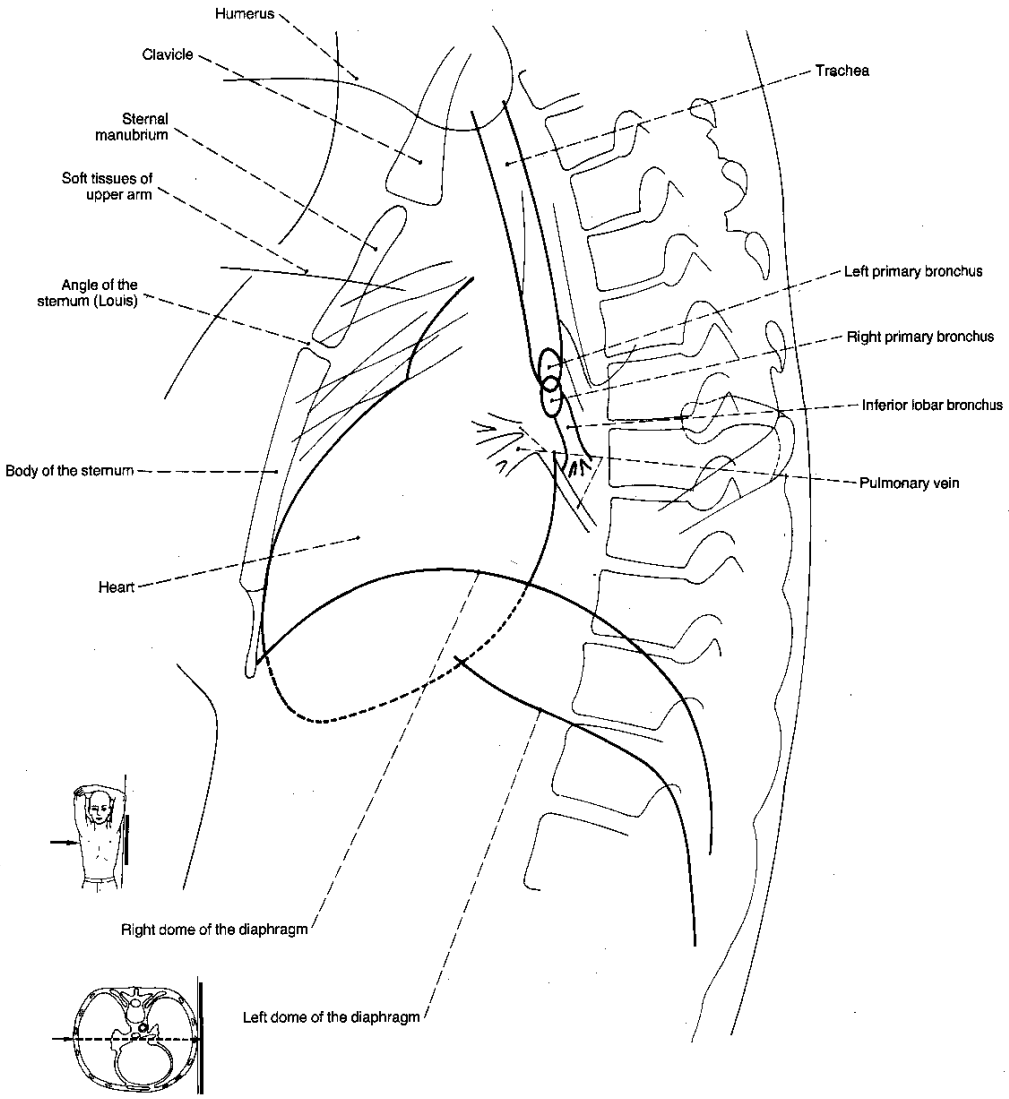
- X-Ray
- Computer tomography, high resolution CT = HRCT
- Thomography of thorax
- Angiography
- Magnetic resonance
- Ultrasonography
- Ventilation/perfusion scan
- Bronchoscopy: rigid
  flexibile
- Lung biopsy



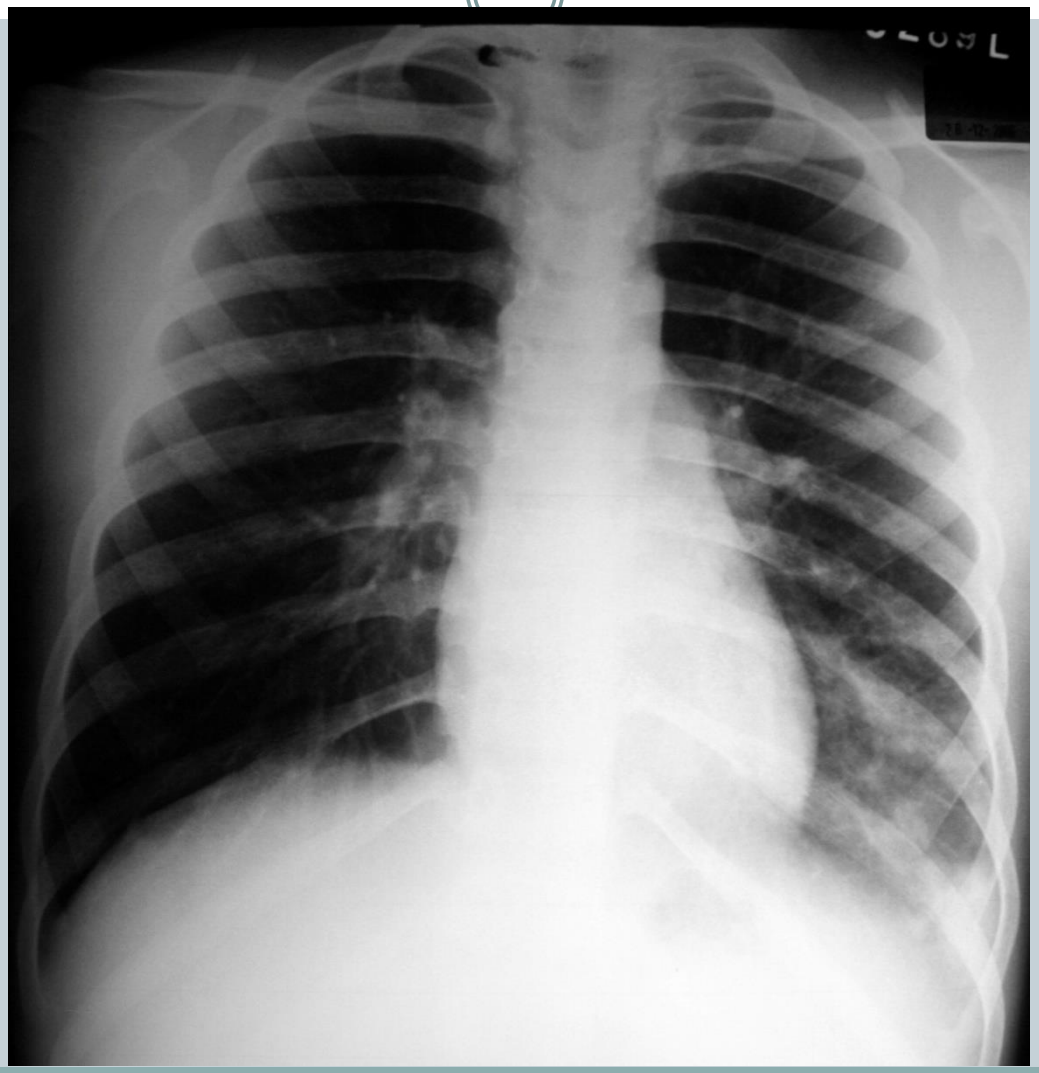
X-RAY - summation



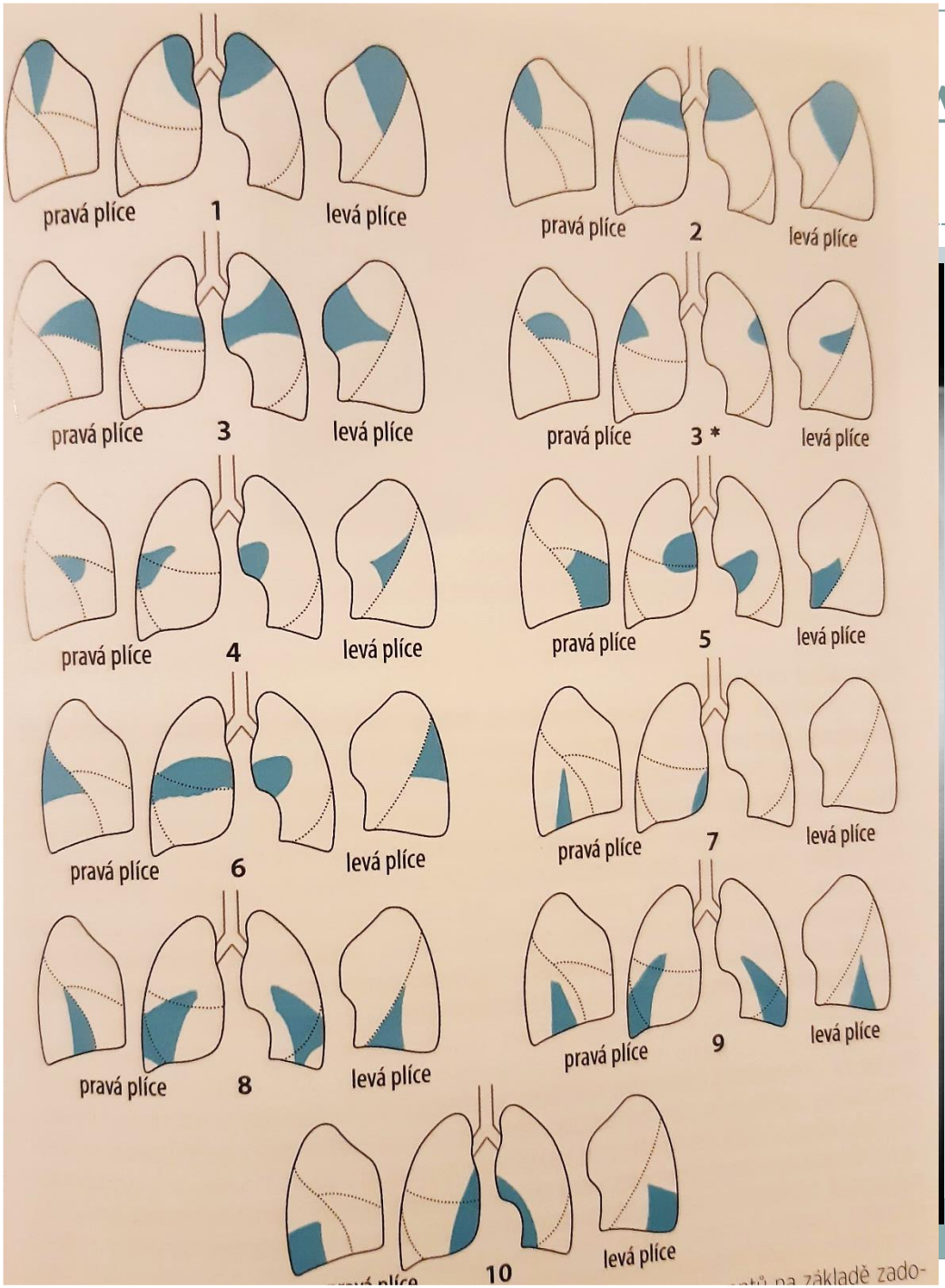
LATERAL SLIDE – X RAY



X-RAY - TRAINING



AINING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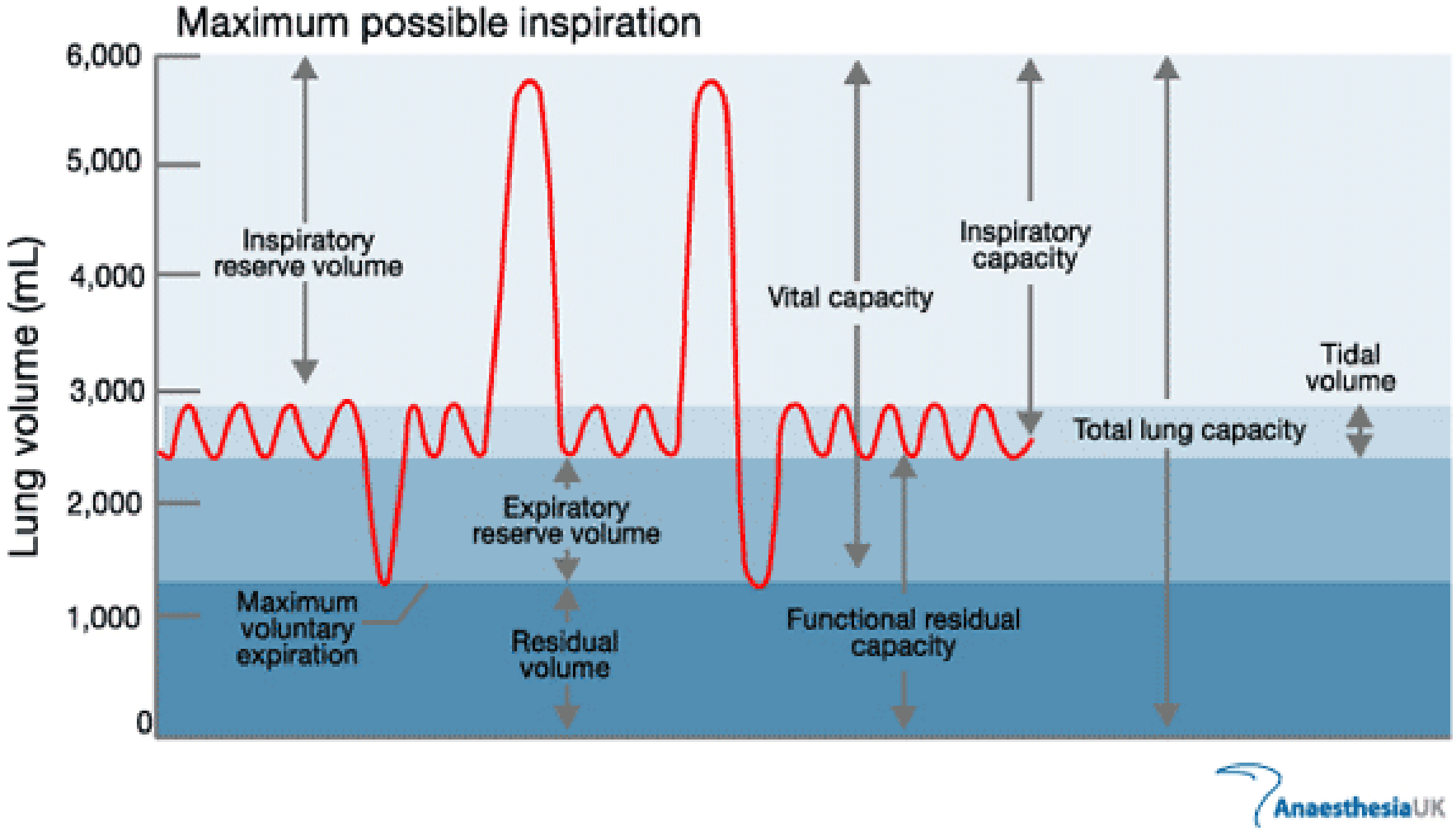
Pulmonary Function Tests

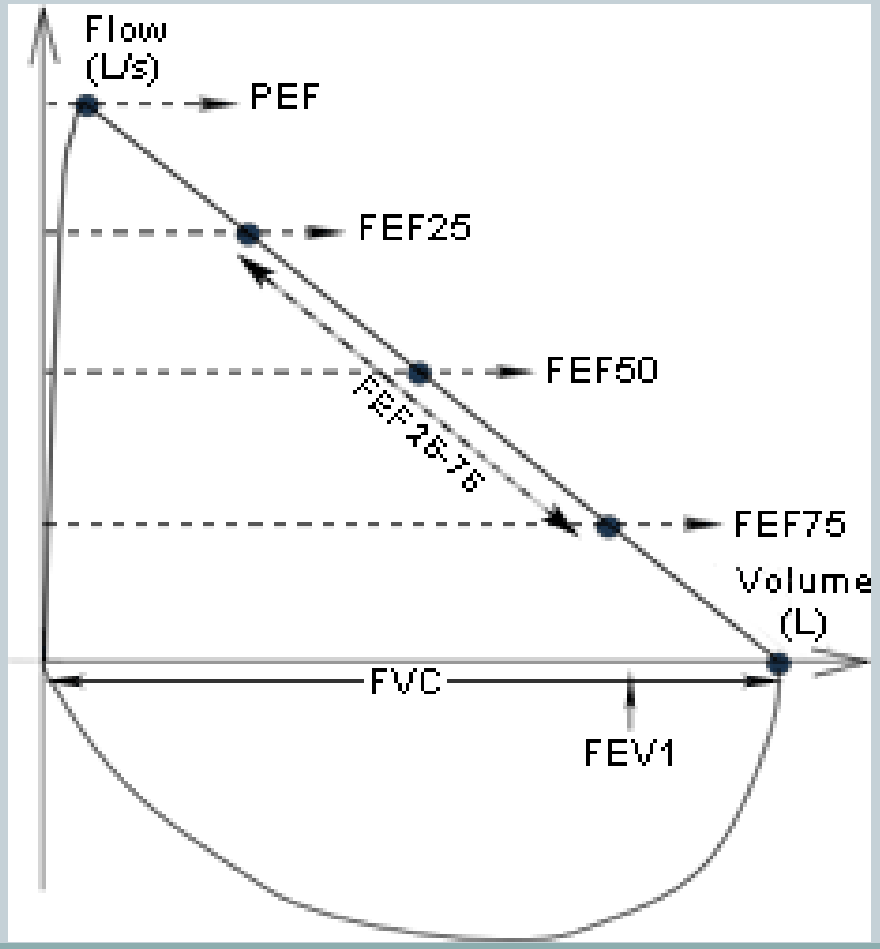
- Cooperative patients – usually ≥ 3 YEARS

- Uncooperative – infants and toddlers

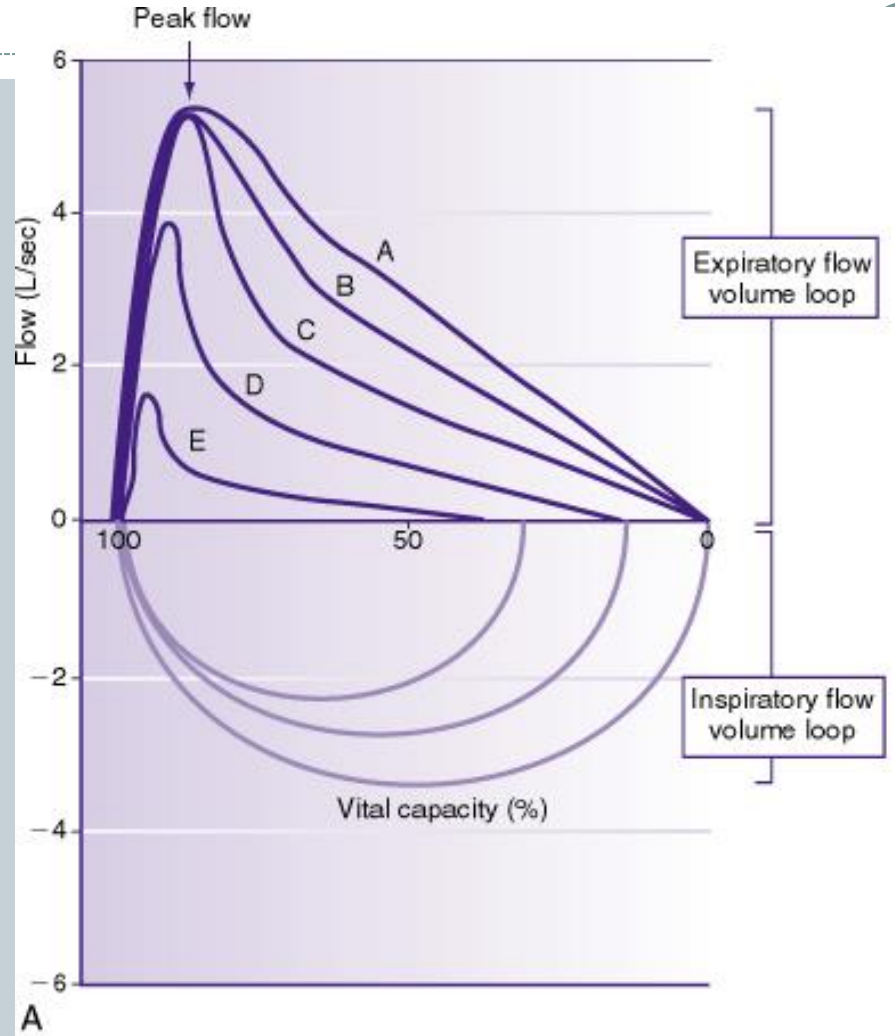
Lung Volumes and Capacities



FLOW/VOLUME CURVE



VOLUME-TIME CURVE



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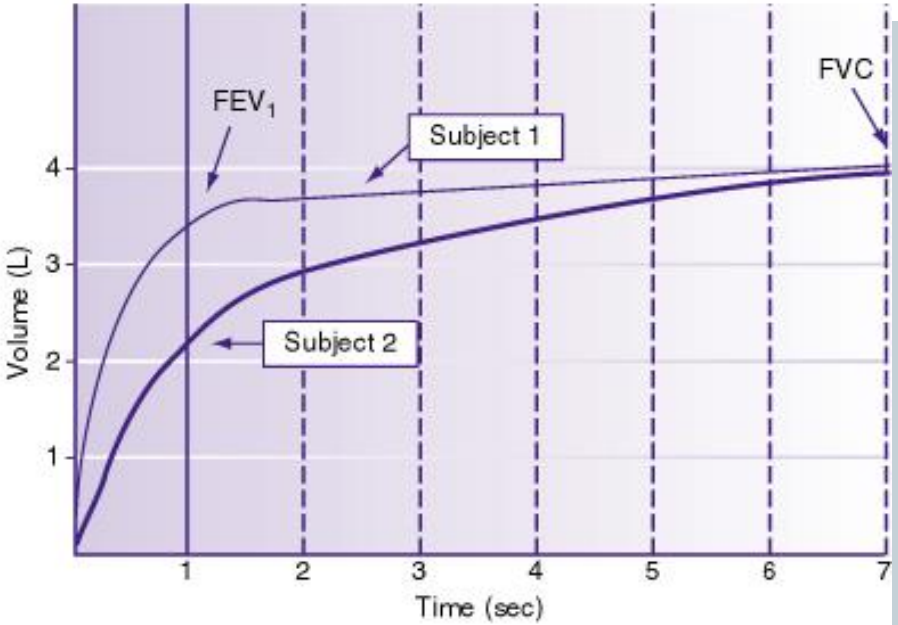
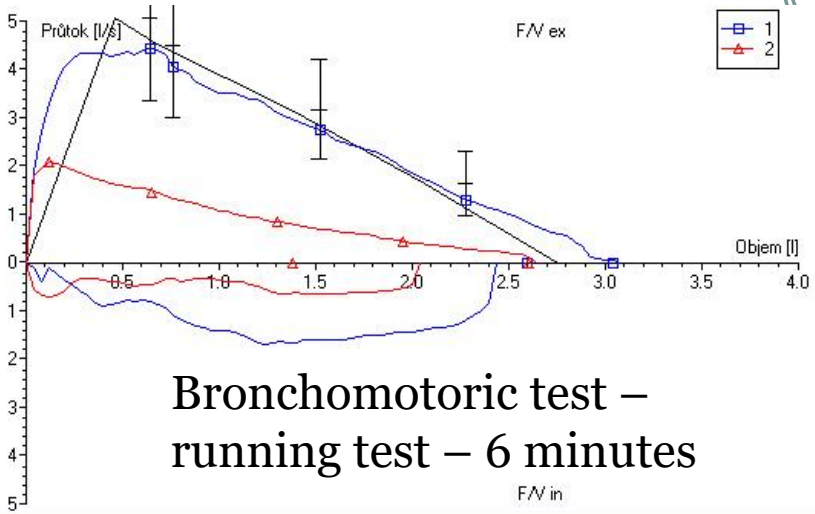


Subject 1: A non-asthmatic child
FEV_1 = 3.41 (100% of predicted)
FVC = 3.81 (100% of predicted)
FEV_1/FVC = 0.86

Subject 2: An asthmatic child
FEV_1 = 2.1 (62% of predicted)
FVC = 3.7 (97% of predicted)
FEV_1/FVC = 0.57

B

SPIROMETRY



Bronchomotoric test – running test – 6 minutes

Tabulka

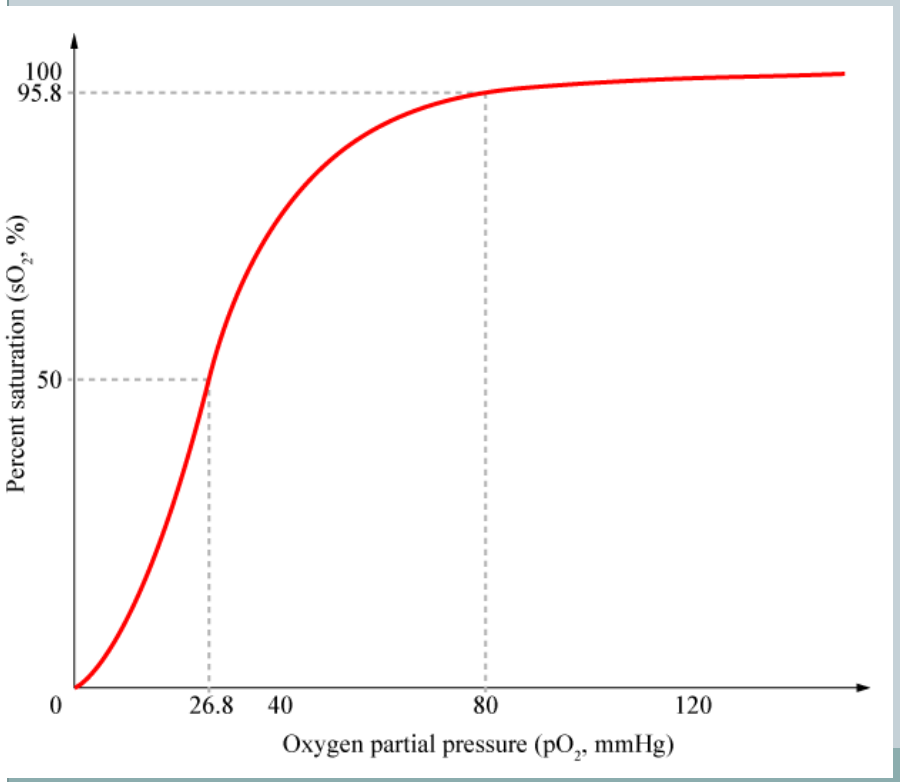
	Nál.	M1	%Nál1	M2	%Nál2	D%2/1	M2-1
Datum		090306		090306			
Čas		10:21dop		10:47dop.			
Subst.				běh			
Dávka				6 min			
VC IN	2.81	2.41	85.8	2.12	75.4	-12.1	-0.29
VC EX	2.81	3.04	108.4	2.60	92.7	-14.5	-0.44
FVC	2.75	3.04	110.5	2.60	94.5	-14.5	-0.44
FEV.5	1.79	1.81	101.3	0.84	47.1	-53.5	-0.97
FEV 1	2.30	2.59	112.8	1.38	60.2	-46.6	-1.21
FEV1%F	84.52	85.24	100.8	53.19	62.9	-37.6	-32.0
PEF	5.06	4.43	87.6	2.08	41.1	-53.1	-2.35
MEF 75	4.49	4.05	90.1	1.45	32.3	-64.2	-2.60
MEF 50	3.17	2.75	86.5	0.83	26.3	-69.6	-1.91
MEF 25	1.63	1.30	79.7	0.43	26.4	-66.9	-0.87
MEF50%		90.30		32.08		-64.5	-58.2
MMEF	2.80	2.50	89.5	0.78	27.9	-68.8	-1.72
AEX	6.96	7.61	109.3	2.45	35.2	-67.8	-5.16
PIF	4.29	1.71	39.7	0.73	17.0	-57.3	-0.98

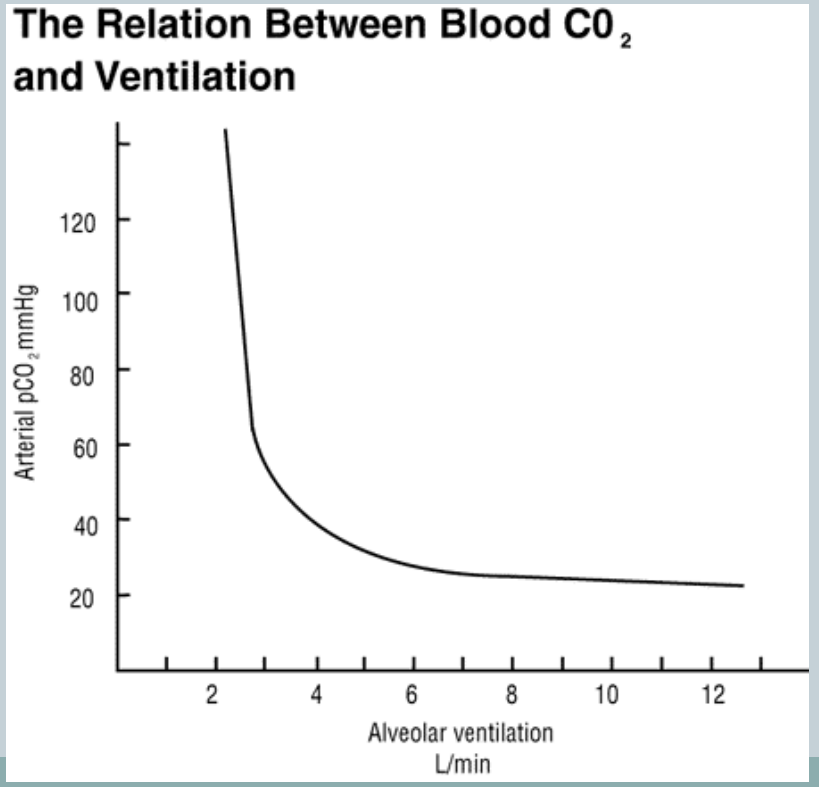
Severity of obstruction:

- mild (MEF 25,50)
- medium(+ FEV1, MEF 75)
- severe (+ FVC)
- Very severe (all < 50 %)

BLOOD GASES (Astrup)

- pO_2, pCO_2, pH – arterial x capillary





En.wikipedia.org

www.mims.com

BLOOD GASES - INTERPRETATION

Lesion	Effect	Blood Gases
Obstruction above carina Depressed resp. center Ineffective neuromucular	Global hypoventilation	Early ↑pC02 Appr. ↓02 Effect of oxygen well
Intrapulmonary airway obstruction		Mild:↓ Pco_2, ↓ Po_2 Moderate: "Normal" Pco_2, ↓↓ Po_2 Severe: ↑↑ Pco_2, ↓↓↓ Po_2
Alveolar-interstitial pathology	R to L shunt Diffusion defect	Early decrease in Po_2 depending on severity Normal or low Pco_2, ↑ Pco_2 if fatigue develops

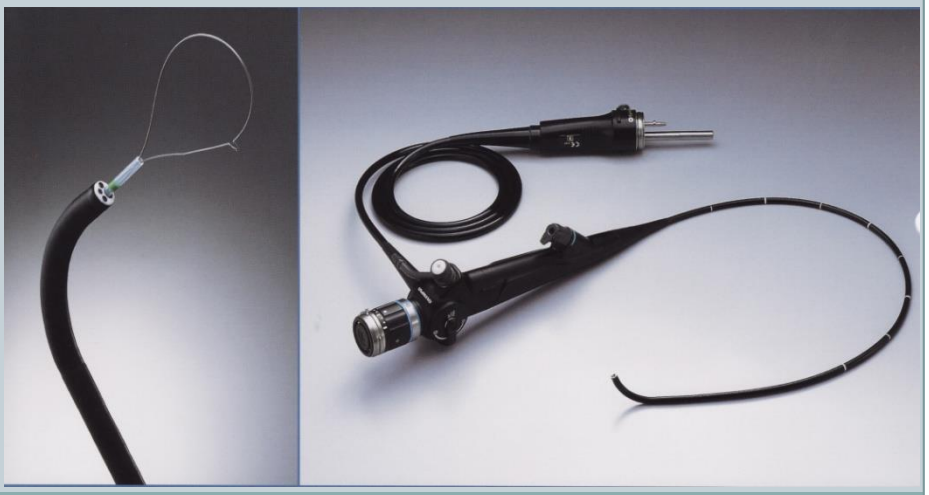
BRONCHOSCOPY

Rigid bronchoscopy

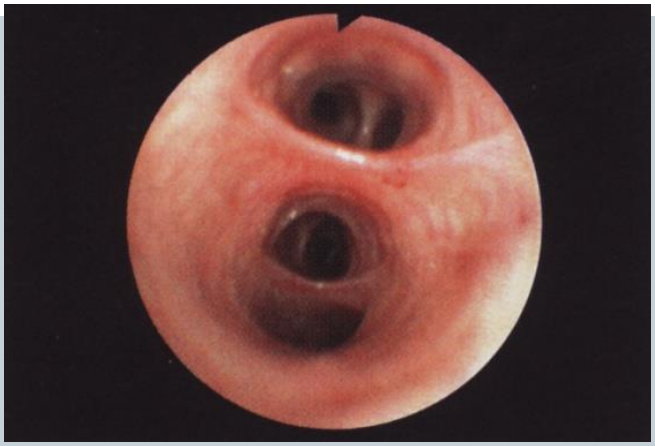
- Advantages
  - Extraction of foreign bodies
  - Therapy of bleeding
  - Ensure patency of airways with simultaneous ventilation
  - Interventions (laser)
- Disadvantages
  - Reach just lobar bronchi, oral cavity
  - General anesthesia with myorelaxation
  - Full extension of cervical spine

Flexible bronchoscopy

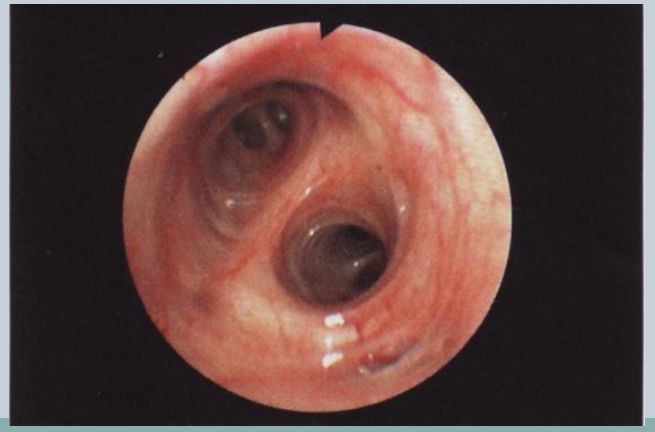
- Advantages
  - Variable position of head
  - Sedation or anesthesia
  - Spontaneous breathing
- Disadvantages
  - Limited interventions



INDICATIONS of BRONCHOSCOPY

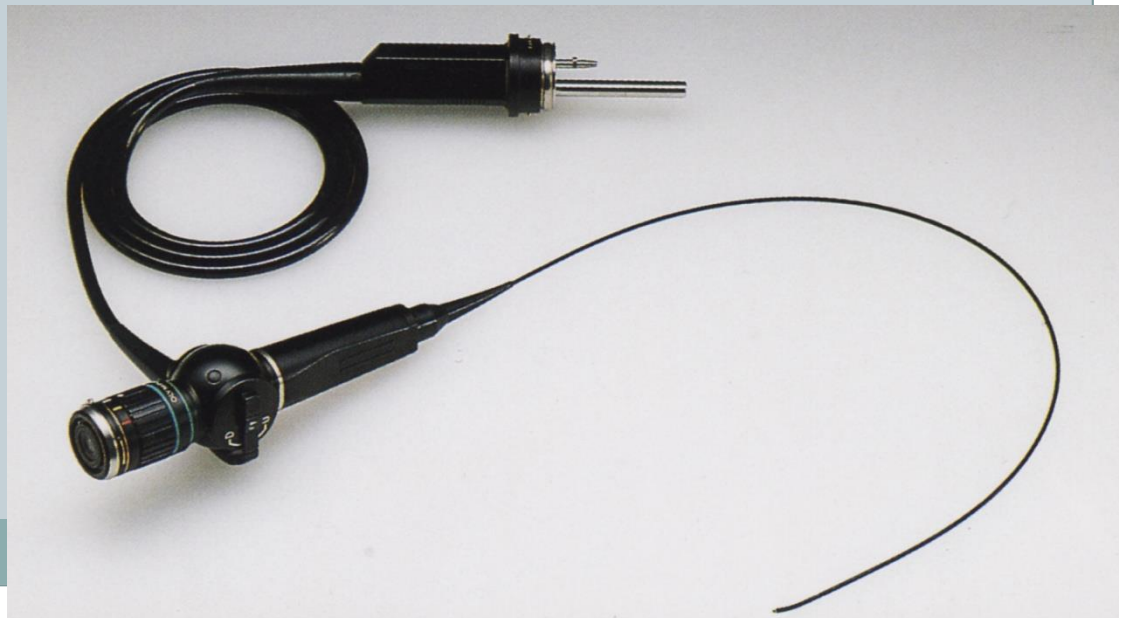


- Airway obstruction
  - Stridor
  - Chronic or recurrent wheezing
- Abnormal X-RAY of thorax
  - Atelectasis
  - Atypic or unclear infiltrates
  - Localized hyperinflation
- Chronic cough
  - Suspected aspiration of foreign body !!!!!!!!!!!!!!!!!!!!!
  - Hemoptysis
- Therapeutic bronchoscopy
  - Mucous or blood plugs
  - Patency of airways



BRONCHOSCOPY

- bronchoalveolar lavage
- „brush“ or biopsy of mucous membrane
- transbronchial biopsy
- application of drugs (mucolytics)
- endoscopic intubation



DYSPNEA

Lung and airways	**Etiology – differential diagnosis**
Infection	Laryngitis
	Laryngotracheobronchitis (croup)
	Epiglotitis
	Absces - retropharyngeal, retrotonsilar etc., tonzilitis acuta
	Bronchitis obstructiva
	Bronchiolitis
	Pneumonia
Central airways obstruction	Choanal atresia, bronchomalacia, tracheomalacia, vocal cord paralysis, mediastinal tumour, vascular ring etc.
Periferal airways obstruction	Asthma bronchiale, cystic fibrosis, α1 antitrypsin deficit
Alveoli – lung intersticium damage	ARDS, pulmonar hemoragia
Thorax	Kyphoscoliosis, diaphragmatic hernia or eventration etc.
Decreased lung mechanics	Pneumothorax
Extrapulmonar	
Cardiovascular	Left right shunt, insuficiency, pulmonary veins stenosis
Central	Encephalitis, trauma, intracranial hypertension, drugs
Metabolic	Ketoacidosis, renal tubular acidosis, hereditary metabolic disorder
Shock	Sepsis, anafylaxis, hypotension
Neuromuscular	Myopathy, Guillain-Barré syndrome, poliomyelitis, …

DYSPNOEA

Obstructive x nonobstructive

Nonobstructive dyspnoea

– without impairment of airflow caused by obstruction inside the airways or by extramural pressure

NON- OBSTRUCTIVE DYSPNOEA

- Premature infants with RDS or BPD (chronic lung disease=CLD)
- Congenital anomalies of respiratory system
- Extrapulmonar etiology – congenital heart disease or diaphragmatic hernia
- **Cardiac etiology** – cyanosis without effect of oxygenotherapy, fatigue, tachycardia or specific findings (heart murmurs, arrythmia, weakened pulsation etc.).
- **Sepsis in neonates** - tachypnea or apneic pauses, fever or hypothermia, worsened perfussion, tachycardia, bradycardia or organ dysfunction
- **Pneumonia** – signs of infection, fever, cough, chest pain, typical auscultation (diminished lung sounds, bronchial breathing, asymetric ausculation, rarely fine crackles), atypical pneumonia (radiology>clinical manifestation)
- **Pneumothorax –** dry cough, diffuse chest pain or sharp lokalised pleural pain, limited thoracical movements, tachypnea, ev. cyanosis, diminished lung sounds and hypersonoric percussion, mediastinal shift, rarely subcutaneous emphysema palpable or abdominal distension with pneumoperitoneum

UPPER AIRWAYS OBSTRUCTION (1)

- Inspiratory stridor, severe obstruction or in case of narrowing of middle trachea - mixed stridor
- Prolonged inspiration, aktivity of accesory inspiratory muscles – retractions, orthopnoic position

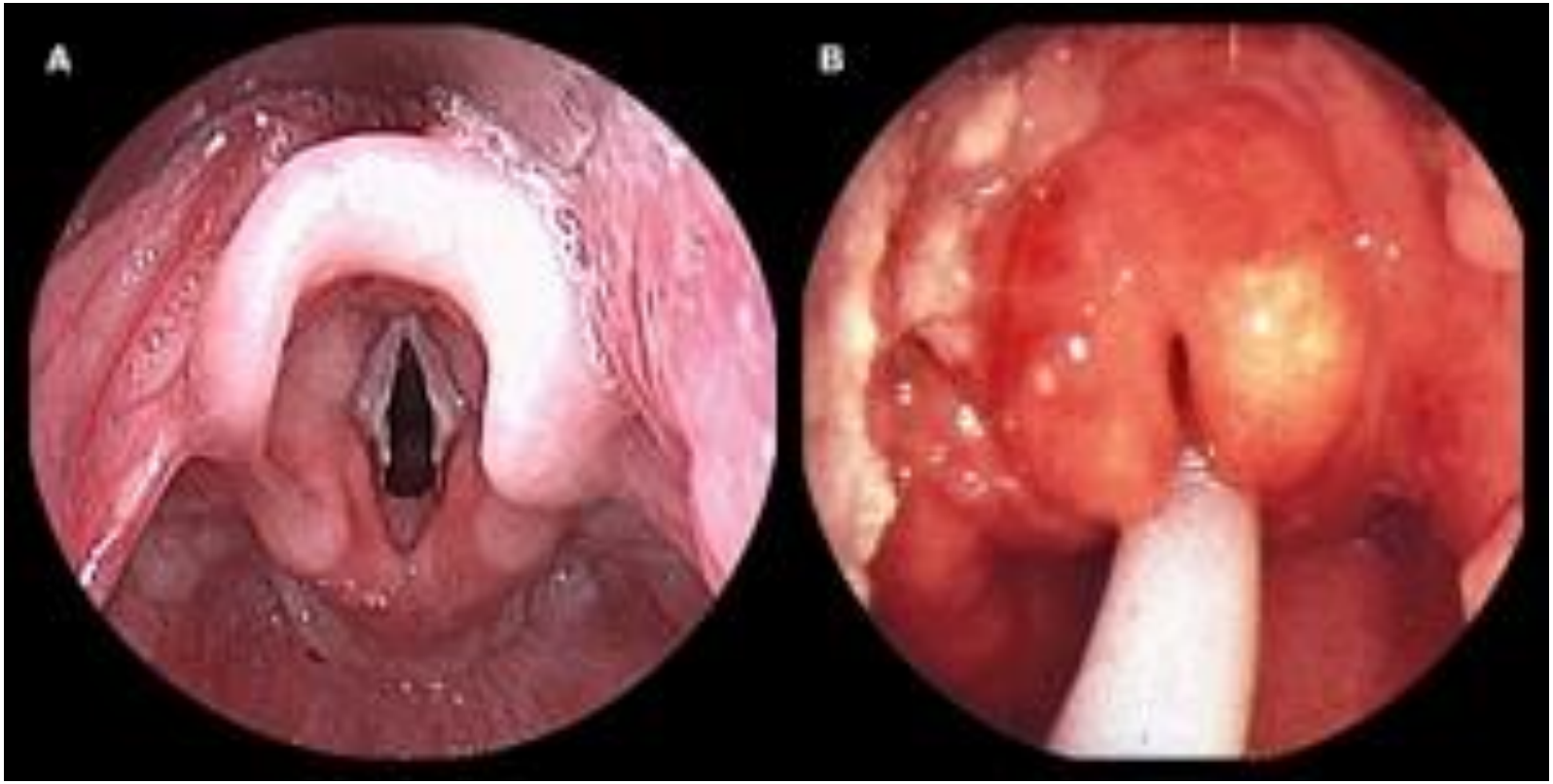
1. Acute laryngitis
2. Acute epiglottitis
3. Proximal foreign body aspiration
4. Foreign body in Killian´s space in esophagus

UPPER AIRWAYS OBSTRUCTION (2)

5. Allergic swelling – anaphylaxis – laryngeal edema, tongue and throat swelling, afebrile without signs of infection, dysphagia
6. Peritonsillar abscess - fever, odynophagia, dysphagia, trismus, asymmetric tonsillar bulge with shifted uvula
6. Retropharyngeal abscess – commonly <3-4 y (boys, fever, dysphagia, drooling, decreased oral intake, muffled voice, stridor, torticollis or nech stiffness, bulging of posterior pharyngeal wall, dg. CT
7. Bacterial laryngotracheobronchitis – mixed dyspnea, signs of bacterial infection

LARYNGITIS x EPIGLOTTITIS

- Laryngitis acuta
  - Viral
  - Subfebrile
  - Sudden onset at night
  - Signs of URTI
  - Barking cough
  - Hoarseness
  - Anxious
  - Drinks, swallow
  - Tolerate vertical position
- Epiglottitis acuta
  - Bacterial - Haemophilus
  - Febrile
  - Progressive
  - Septic appearance
  - Cough not or careful
  - Silent voice, nasal
  - Noticeable CALM
  - Drooling
  - Refuse to lie down


A
B

LARYNGITIS ACUTA – Downes score

	1 point	2 points
Auscultation	Wheezing, rhonchi	Weakened
Stridor	Inspiratory	Insp-exsp
Cough	Rough	Barking
Retractions, alar	Jugular region+ supraclavicular	+subcostal +intercostal
Cyanosis	With Fi02 0,21	At oxygen fraction 0,4

INSPIRATORY DYSPNEA- therapy

Laryngitis acuta

- Downes score

therapy - outpatient x admission
(below 2 points) x

ICU (> 7 – intubation)

- Calm moistened nebulisation
- Nebulized adrenalin
- Corticosteroids systemic

(rectal, oral, parenteral)

Epiglottitis ac.

- High risk of suffocation!!!!
- Emergency – transport to ICU with doctor, no laboratory examination, calm

DO NOT DISTURB THE BABY !!!!!!!

- Acute suffocation – open airways (intubation, mask with lateral position, coniopunction)

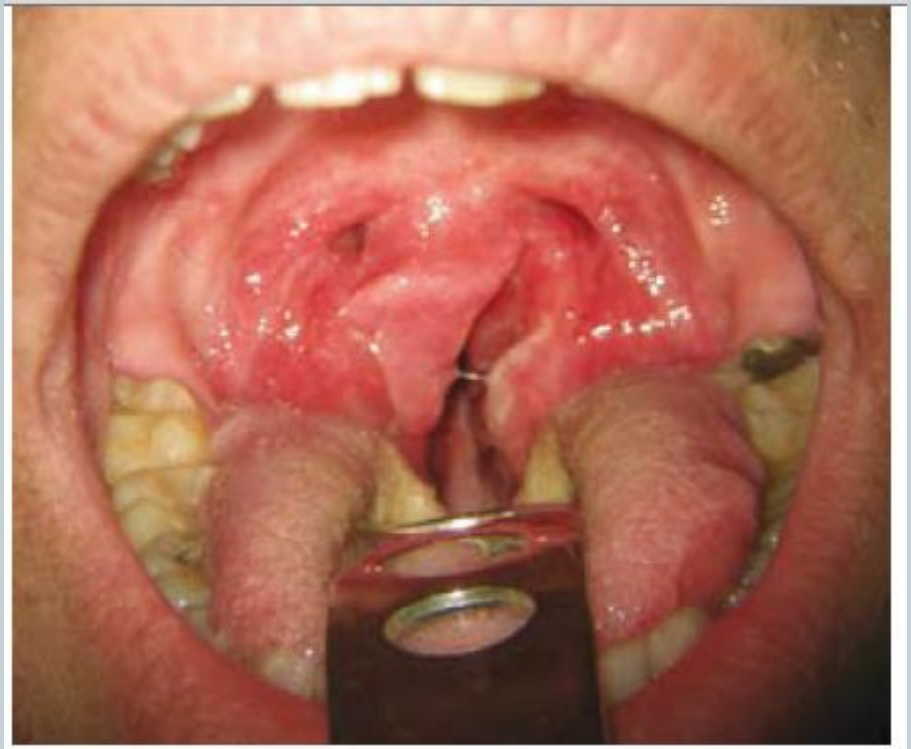
....

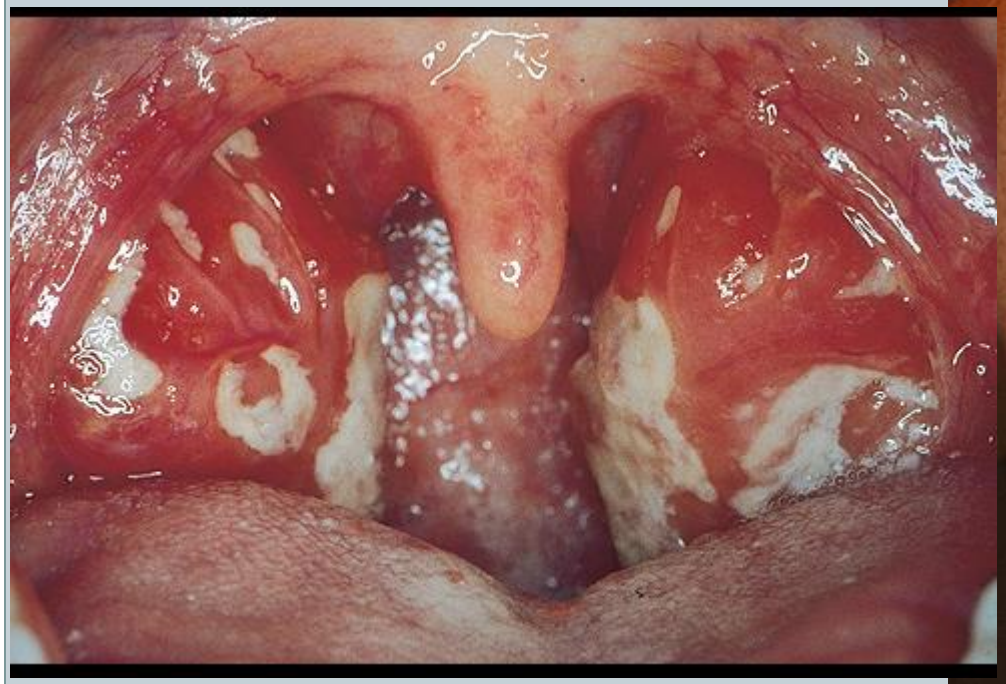
- Antibiotics
- Endotracheal intubation, ev. tracheostomy

UPPER AIRWAYS INFECTIONs

- Nasopharyngitis acuta
- Tonzilitis acuta
- Sinusitis acuta
- Epiglottitis acuta
- Laryngitis acuta
- Tracheitis acuta
- .....

Tonzilitis acuta





PHARYNGITIS, TONSILLITIS ACUTE

- Viral x bacterial x mycotic
- Streptococ. pyog. - risk of poststreptococcal complications – antibiotics apply till 9 days from first symptoms

  - clinical incertainty – CULTIVATION
- Exudative tonsillitis – viral – EBV, CMV , adenovirus..

  - mycotic

Complications:

early – peritonsilar abscess

late – poststreptococ. glomerulonephritis, rheumatic fever

TONSILLITIS acuta

- Therapy: 1. Penicillin 50.000-100.000 IU/kg/day
  every 6 to 8 hours for 10-14 days
  phenoxymethylpenicillin
  2. ev. macrolides as alternative for allergy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Department of Radiology
General University Hospital
and
First Faculty of Medicine
Charles University
in
Prague
L

SINUSITIS ac.

- Sinuses - development:
  - Neonates – ethmoid
  - Maxilar from 2 years
  - Frontal after 6th year
  - Sphenoid sinus about 10 years
- Limited form during any acute rhinitis
- Commonly follows upper respiratory infection
  x up to 13 % odontogenic origin

Sinusitis acuta

- Bacterial sinusitis:
  1. Biphasic course of respiratory infection
  2. Acute respiratory infection > 10 days, progressive worsening
- Fever, purulent nasal secretion, frontal headache, toothache, muffled voice, dysosmia, anosmia, malaise
- COUGH = sinobronchial syndrome – typically nocturnal
- Complications – neuroinfections, orbitocellulitis

SINUSITIS ACUTA - THERAPY

- Therapy:
  - Antibiotics
  - Mucolytics
  - Nasoconstrictive nasal drops
  - Ev. intranasal corticosteroids (allergy)
- Punction, surgery

LOWER RESPIRATORY TRACT INFECTIONS

- BRONCHITIS ac.
- BRONCHITIS OBSTRUCTIVA ac.
- CHRONIC BRONCHITIS
- BRONCHIOLITIS ac.
- BRONCHOPNEUMONIA

BRONCHITIS ACUTA

- Viral etiology 80-90 % - usually no need of antibiotics

- Expiratory dyspnea?
  - No – symptomatic treatment of respiratory infection
  - Yes :
    - *Obstructive bronchitis = Viral induced wheezing*
      - Exspiratory wheezing, prolonged exspiration, retractions
      - Same management as asthma bronchiale

LOWER AIRWAY OBSTRUCTION

- Expiratory dyspnea - forced active protracted expiration with activity of abdominal and internal intercostal muscles
- Dominant expiratory noises – rhonchi, wheezing
- In severe obstruction - inspiratory position of thorax because of lung hyperinflation
- CAVE – weakened lung noises – „quiet thorax“
- Infants and toddlers – obstructive bronchitis (viral induced wheezing), bronchiolitis and acute exacerbation of asthma – very tricky dif dg in children bellow 5 years
- Distal foreign body aspiration

BRONCHITIS OBSTRUCTIVA

- Term used in CZ and Europe
- Bronchitis obstructiva (formerly astmoid, spastic):
  - < 2 years (ev. 1 y) = bronchiolitis (USA)
  - > 2 y = „wheezing“ – viral induced wheezing GINA
    - Transient early wheezing (more in preterm infants)
    - Persistent early wheezing
    - Late onset wheezing – atopic sings
  - Higher risk of asthma bronchiale in child with repeated wheezing bellow 3 years
    - atopic dermatitis, asthma in parents
    - 2 out of 3 risk factors: blood eosinofilia, wheezing outside infection, allergic rhinitis

BRONCHITIS OBSTRUCTIVA -THERAPY

- Same therapy as therapy of acute asthmatic exacerbation
- Oxygenotherapy durind blood gases and pH monitoring
  - Bronchodilation - beta2 mimetics – salbutamol (SABA)
    - parasympatolytics – ipratropium
      - inhalation – spray or nebulisator
  - Corticosteroides – systemic form of application p.o.=p.e.

Inappropriate therapy:

- mucolytics – risk of progression of bronchospasm
- antitussives – severe toxicity without efficacy
- sedation (expect ICU)

BRONCHITIS OBSTRUCTIVA dif dg

Bronchitis obstructiva

- typ. infekce - virová, ev. bakteriální etiologie
- Typ. do 2 let věku
- Dominuje hypersekrece hlenu, edém sliznice, podíl bronchospazmu variabilní

Exacerbace astma bronchiale

- spouštěč infekce či alergen, chem. či fyzikální faktory
- V kojen. věku vzácné, do 3 let obtížná diagnostika
- Dominuje bronchospazmus, dále podíl hypersekrece hlenu, edému sliznice, chronické zánětl. přestavby (hypertrofie žláz, hyperplazie hl. sval. bb, fibróza, sek. malacie)

BRONCHITIS CHRONICA

- Idiopatic - rare
- Secondary
  - Cystic fibrosis
  - Primary ciliary dyskinesia (Kartagener´s syndrome)
  - Imunodeficiency primary, secondary
  - GERD with microaspirations
  - Congential developmental disease of airways – stenosis, tracheoesophageal fistula etc.
  - Congenital heart disease with significant left to right shunt with lung hyperemina (large ventricular septal defect)
  - External irritans (smokers)

BRONCHIOLITIS ACUTA

- Age < 2 y, mostly < 6 months
- RSV, ADV, influenza, parainfluenza, HMPV, B. pertussi, parapertussis, H. influenzae, Mycoplazma etc.

- Obstruction of bronchioli :

  atelectasis + hyperinflation

- Clinical symptoms:
  1. Mixed dyspnea with low effect of bronchodilatation
  2. Tachypnea, grunting, nasal falring, retractions
  3. Hyposaturation, lower Pa02
  4. Respiratory effort increasing
  5. Hypoventilation, cyanosis
  6. Global respiratory insufficiency

BRONCHIOLITIS ACUTA

- X-RAY – multiple microatelectasis, emphysematous loci, peribronchial infiltration
- Observation: saturation, RR, HR, repeated Astrups
- THERAPY:
  - Oxygenotherapy
  - Bronchodilatation – inhalated B2 agonists
  - Corticoids – high risk patients, ventilated

  ……
  - Early and gentle tracheal intubation
  - Mechanical ventilation – high risk of barotrauma - high resistence
  - BAL

BRONCHIOLITIS ACUTA

- RISK FACTORS:
  - Age below 6 weeks
  - Immaturity below 35. week
  - Bronchopulmonary dysplasia
  - Cystic fibrosis
  - Immuodeficiency
  - Congenital anomalies of heart
- PREVENTION: vaccination – PALIVIZUMAB – monoclonal antibody against RSV
  - High risk groups – neonates below 35. – age < 6 mo autumn
  - BPD on therapy – age below 2 y

ASTHMA BRONCHIALE

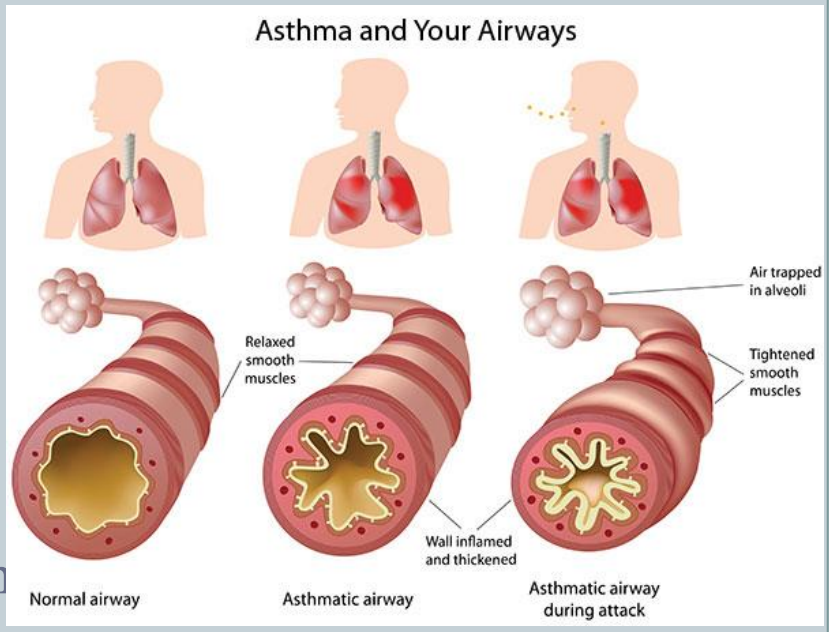
- Chronic inflammatory disease of bronch
  - Many cellular types and mediators involved
- Bronchial hyperreactivity
- Episodes of:
  1. Cough
  2. Dyspnea
  3. Wheezing
  4. Chest tightness
- Extensive temporary bronchial obstruction – reversible after treatment or spontaneously

ASTHMA BRONCHIALE

- Obstruction of lower airways – mucus, spasm, swelling of lining

- SYMPTOMS:
  - COUGH
  - WHEEZING
  - TIGHT CHEST
  - DYSPNOEA,

  breathing troubles during expiration



Diagnosis of AB – children < 5 years

Cough	Repeated or protracted dry cough – get worse at night or during physicl activity, cry or exposure to smoke in absence of apparent respiratory infection
Wheezing	Repeated wheezing during sleep or physical acitivity, cry or exposure to smoke or air irritants
Dyspnoea	During physical acitivity
Limitation of physical activity	Refuse to run, lower performance than same-age peers
Family history	Alergic diseases, atopic eczema, rhinitis AB in close relatives
Therapeutic test with ICS (and/or SABA)	Clinical improvement during 8 – 12 weeks, after withdrawal worsening

Diagnosis of AB – children > 5 years

1. Dyspnoea
2. Wheezing
3. Chest tightness
4. Cough

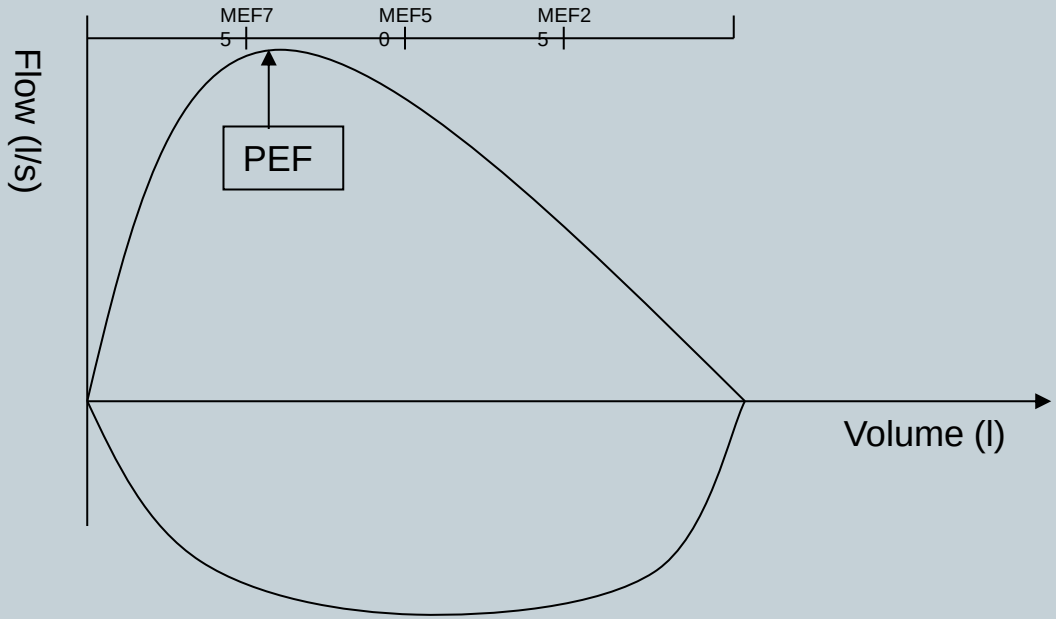
- > one signs

(in older people rarely isolated cough as a symptom of AB)

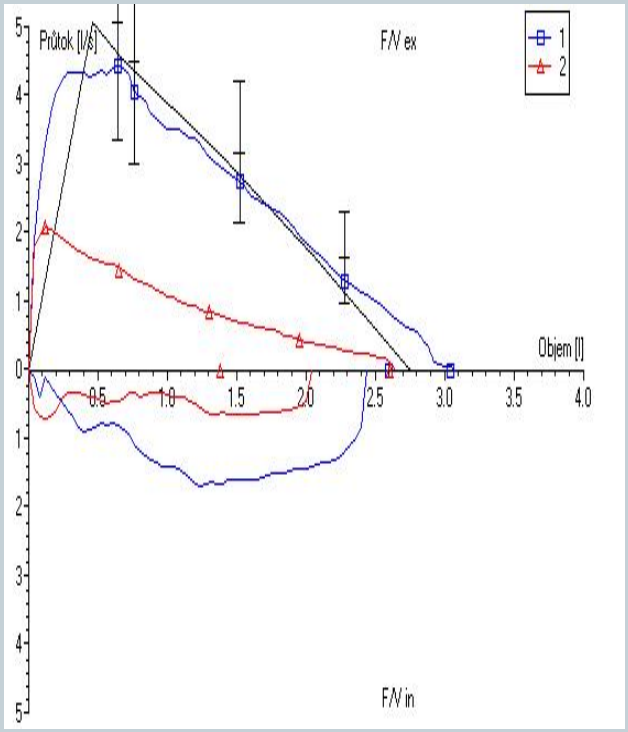
- Sings and symptoms are variable in time ant intensity
- Often worsening at night or after awakening
- Often provoked by exercise, laugh, allergens, cold air
- Presence or worsening with respirátory infections

ASTHMA BRONCHIALE

- Diagnosis – reversible obstruction according to pulmonary function test



ASTHMA BRONCHIALE



Tabulka

	Nál.	M1	%Nál1	M2	%Nál2	D%2/1	M2-1
Datum		090306		090306			
Čas		10:21dop		10:47dop.			
Subst.				běh			
Dávka				6 min			
VC IN	2.81	2.41	85.8	2.12	75.4	-12.1	-0.29
VC EX	2.81	3.04	108.4	2.60	92.7	-14.5	-0.44
FVC	2.75	3.04	110.5	2.60	94.5	-14.5	-0.44
FEV.5	1.79	1.81	101.3	0.84	47.1	-53.5	-0.97
FEV 1	2.30	2.59	112.8	1.38	60.2	-46.6	-1.21
FEV1%F	84.52	85.24	100.8	53.19	62.9	-37.6	-32.0
PEF	5.06	4.43	87.6	2.08	41.1	-53.1	-2.35
MEF 75	4.49	4.05	90.1	1.45	32.3	-64.2	-2.60
MEF 50	3.17	2.75	86.5	0.83	26.3	-69.6	-1.91
MEF 25	1.63	1.30	79.7	0.43	26.4	-66.9	-0.87
MEF50%		90.30		32.08		-64.5	-58.2
MMEF	2.80	2.50	89.5	0.78	27.9	-68.8	-1.72
AEX	6.96	7.61	109.3	2.45	35.2	-67.8	-5.16
PIF	4.29	1.71	39.7	0.73	17.0	-57.3	-0.98

AB – CLASSIFICATION - CONTROL

	Controlled asthma	**Partly controlled (Any measure)**	**Uncontrolled**
Daytimes symptoms	No (≤twice a week)	More =than twice a week	Three and more symptoms of partly controlled AB
Limitation of activity	None	Any	
Nocturnal symptoms	None	Any	
Need for relievers	No (≤twice a week)	More =than twice a week	
Lung function (PEF or FEV1)	Normal	< 80 % norm/personal best	

Suspection on Asthma in Children

- Asthma in parents
- Atopic dermatitis

- Cough induced by activity
- Frequent episodes of wheezing more than once a month
- Night cough out of infection
- Symptoms of expiratory obstruction after the 3rd year
- Symptoms during exposition of:

  - *animals, chemicals, changes of temperature, domestic dust, pollen, physical activity, smoke*
- Symptoms relieving with antiasthmatic medication

DIAGNOSIS of AB

- Anamnesis
- Clinical examination
- Therapeutic test
- Spirometry
- Degree of inflammation (NO, ECP …)
- Role of allergy, atopy

HIGH RISK ASTHMA

- Life-threating asthmatic state with mechanical on in history
- Severe exacerbation of asthma with admission to hospital during last year
- Currently or recently treatment with oral corticosteroids without inhalated corticosteroids
- Depend on rapid acting B-agonists, during last month usage of more than one packet of salbutamole
- History of psychiatric or psychosocial disease including use of sedatives
- History of noncompliance

ACUTE EXACERBATION CHILD< 5y

- Supplementation of oxygen saturation > 94 %
- **SABA** *(short-acting ß2-agonist)*

  1. hour: 2 puffs every 20 min with spacer or

  2,5 mg by nebulisation

  than 2 puffs every **2-3 hours**
- **Ipratropium**

  2 puffs á 20 min 1.hour
- **Systemic corticosteroids**

  Prednisolon p.o. 1-2 mg/kg/day up to 5 days or
  Methylprednisolon 1 mg/kg á 6 hour 1.day, á 12 hour 2. day, once daily 3. day
- **Amimophyllin - consider,**

  Initial dose 6 – 10 mg/kg,

  than continue 0,9 mg/kg/h, monitoring of serum conc.

NO LABA, no peroral bronchodilators !!!!!

AB in Child below 5 y

- CONTRAINDICATIONS during exacerbation:
  1. Sedatives
  2. Mucolytics
  3. Antitussives
  4. Adrenaline

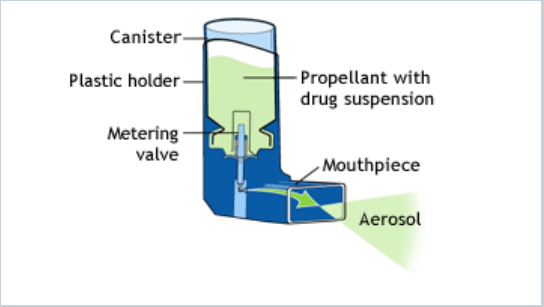
  Intravenous magnesium sulfate (no evidence of effect in young children)

AB in Children above 5 y

- **RABA** 2 – 4 puffs á 20 min in 1st hour,
  mild exacerbation - 2-4 puffs á 3-4 h
  severe exacerbation 6-10 puffs á 1-2 h
- **Supplementation of oxygen** saturation > 95 %
- **RABA + ipratropium** dose according to clinical status and PEF or FEV1
- **Oral corticosteroids** prednisolone (ekv.) 0.5-1 mg/kg/24 hour

NO: Mucolytics, strictly no SEDATIVES, no rehabilitation, mucolytics, high-volume hydration, adrenaline

THERAPY - antiasthmatics



Chamber for inhalation

ASTHMA BRONCHIALE

- AIM of therapy :
  - Allow sufficient longterm physical activity = necessary for appropriate development of child
  - To fully control the disease
- Modern drugs:
  - Treatment should be titrated to minimal drug dose/combination = allow children sufficient physical activity with asthma below full control

ASTHMA BRONCHIALE

- TREATMENT:
  1. Bronchodilatators = quick-relief medicines ("relievers") – effect within 10-15 minutes, puffs by inhalation, preferentially with aerochamber, everyone with asthma
  2. Preventive medicines ("controllers") – daily, aimed at basic cause of disease, lower risk of asthma exacerbation and chronic remodelation of airways

TO BE CONTINUED….