Unit 1. Physical examination of the respiratory system (18/03/2013).

1. Inspection, palpation, percussion in the examination of the respiratory system.
2. Auscultation of the respiratory sounds.

Inspection (observation).
Inspection is used to estimate:
- symmetry of the chest,
- the state of ribs, intercostal spaces, sternum, clavicles, scapulas, sub- and supraclavicular foveae,
- sub- and suprapectoral regions,
- shape of the thorax,
- respiration mobility,
- presence of pathological tumours and pulsation,
- respiration path,
- respiratory rate.

The respiration mobility can be examined with inspection, palpation and percussion method. In inspection method, standing close to the patient you estimate the extension of both halves of thorax during deep respiration. The palpation method is more precise: you put both hands on symmetrical parts of the patient thorax: on the back on the suprapectoral regions and below scapulas and on the front of thorax at the top and bottom. In percussion method estimation is in the same lines as in comparative percussion (see below). After reaching the lower lung border you examine while patient is breathing deeply. Normally deep inspiration lowers the lung border by about two fingers.

Patterns of breathing:
- abdominal respiration — in the respiration dominates diaphragm; characteristic for men,
- thoracic respiration — dominates thorax; characteristic for women.

Respiratory rate:
Normal respiration is regular, rhythmic and its frequency is about 16-18/min, inspiration is 2-3 times longer then expiration. Increased respiratory rate is called polypnoe and decreased — oligopnoe.

II. Palpation.
Palpation is used to estimate:
- respiration mobility,
- vocal fremitus,
- pleural friction — occurs in pathologically changed pleura.

Vocal fremitus — during loud speaking phonetic waves are conducted to the chest wall and there can be palpated as vocal fremitus. It is examined comparatively in symmetric halves of the chest by the same part of the same hand. During examination the patient is saying: one, two, three...

III. Percussion.
1. Comparative percussion — performed to compare the percussion sounds in symmetric places:
   - II intercostal space in midclavicular line,
   - IV intercostal space externally from midclavicular line,
   - VI intercostal space in midaxillary line,
   - in the middle of suprapectoral region,
   - in the middle of suprapectoral region,
   - on both sides of interscapular region,
   - in scapular line two fingers below scapula.
2. Topographic percussion — performed to estimate:
   - character of percussion sounds,
   - the lower lung border,
   - respiration mobility of the lower lung border (see above).

IV. Auscultation.
Patient breathes through the nose. Auscultation is performed in areas of comparative percussion. Two physiological respiratory sounds are heard:
- vesicular sound,
- bronchial sound.

Vesicular sound is heard in healthy patients in the region of lungs adjacent to the chest wall, consists of inspiratory part (weaker) and expiratory part (shorter, lasts for 1/5 of inspiration time).
Bronchial sound is longer and stronger during expiration, heard over trachea, sternum and in interscapular region.
Other sounds occur in pathology.
Physiological bronchophonia: During examination patient is speaking (one, two, three...) and you put the stethoscope on the chest wall in the places of the bronchial murmurs auscultation. While patient is speaking voice is conducted to the chest wall. The voice is heard without the precise articulation. This voice is called physiological bronchophonia.

Obligatory terms and problems:
2. Respiratory muscles, chest respiration movements, changes of pressure in airways, alveolar pressure and intrapleural pressure, compliance of the lung and chest wall.
3. Alveolar surface tension, surfactant, elastance, and hysteresis loop.

Attention:
On March 20th: first halves of all groups should be prepared for Unit 2, second halves of all groups – for Unit 3.
On March 25th: first halves of all groups should be prepared for Unit 3, second halves of all groups – for Unit 2.
Unit 2. Mechanics of respiration (20/03/2013 & 25/03/2013).
2. Minute alveolar ventilation.

Obligatory terms and problems:
1. Lung volumes and capacities (TLC, VC, RV, IRV, ERV, TV, IC, FRC) respiratory rate and minute alveolar ventilation, maximal breathing capacity (ventilation), maximal voluntary ventilation.
2. Functional division of airways, anatomical dead space, control of airways smooth muscles, protective roles of airways, airway resistance components and values, effect of alveolar pressure on the pulmonary blood flow, anatomical and physiological venous shunt, physiological dead space, diffusion of gases in lungs, diffusion capacity of lungs.

Unit 3. Dynamic examination of the respiratory system. Regulation of respiration (20/03/2013 & 25/03/2013).
1. Indirect assessment of the maximum oxygen consumption (VO₂ max) with Astrand – Ryhming nomogram.
2. Adaptation of the respiratory system to physical exercise.
3. Neural and humoral regulation of the respiratory system.

Terms and problems:
1. Reflexes affecting the respiratory muscles on the dorsal medulla level. Neural centres of the medulla and pons controlling the respiratory system. Chemical regulation of respiration. Pulmonary receptors – types and functions.

2. Concept of the renal clearance.
3. Clinical significance of clearances.

Obligatory terms and problems:
4. Tubular transport of Na⁺ and K⁺ Counter–current mechanism.

1. Calculation of glomerular filtration rate (GFR) and maximum tubular transport (Tm).
2. Function of the respiratory system and kidneys in maintaining of homeostasis.

Obligatory terms and problems:

Unit 6. Urinalysis and tests other Repetition of failed and/or absent in cycle 5 (15/04/2013).
1. The urinary sediment analysis.
2. Repetition of failed and/or absent activities in cycle 5.

Seminar XVII. Functions of the nephron (22/03/2013 & 12/04/2013).
1. Renal circulation – RBF, RPF, RF, FF.
2. Glomerulus:
   - Filtration barrier
   - Composition of ultrafiltrate/primary urine (GFRx – filtered load)
• Effective filtration pressure
• Glomerular filtration rate (GFR)
• Clearance – definition; test substances.

3. Tubules:
• Mechanisms of transport in renal tubules
• Function of tubules: proximal, distal tubule, collecting duct, loops of Henle.
• Transport maximum (T_{\text{max}}), renal threshold.

Seminar XVIII. Neuroregulation of respiratory system (08/04/2013).
2. Respiratory cycle.
3. Classical understanding of function of respiratory neurones.
   • Inspiratory centre.
   • Expiratory centre.
   • Apneustic centre.
   • Pneumotaxic centre.
   • DRG (Dorsal Respiratory Group of Neurones).
   • VRG (Ventral Respiratory Group of Neurones).
   • NPBL (Nucleus Peribrachialis of pons).
   • Bötzinger Complex.
5. Factors affecting pattern of ventilation.
   • Chemoreceptors and chemosensitive area).
   • Pulmonary receptors.
   • Reticular system.
6. Defensive reflexes of respiratory system.

Seminar XIX. Resistance in the respiratory system (22/03/2013 & 12/04/2013).
1. Resistance in the respiratory system – division.
2. Elastic resistance:
   • Retractility,
   • Elastic recoil of the chest wall.
5. AWR – airway resistance – regulation via autonomic nervous system.
6. Static, dynamic (hysteresis loop) relationships of volume and pressure.
7. Elastic and non-elastic work.

Credit of the cycle 5. Topic discussed on seminars XVII -XIX and units 1-6.
2. Diaphragm and intercostal muscles. Rib cage and diaphragm during ventilation. The sequence of events leading to changes in pulmonary volumes.
3. Division of the total lung capacity (TLC). Changes of the volume of airways, the depth and frequency of ventilation – their influence on minute alveolar ventilation.
5. Respiratory complex of the brain stem: its components and interrelations. Central respiratory pattern generator – principles of its automatic function. Regulation of respiration in relation to alveolar air. Specific and non-specific reception areas in the respiratory complex. Regulation of respiration in the spinal cord and higher structures of the central nervous system. The idea of Hering-Breuer and contemporary views on the generation of the respiratory rhythm. The function of the vagus nerves in regulation of the respiratory system.
6. Respiration during sleep (sleep apnoea syndrome). Voluntary regulation of the respiratory function. Periodic respiration. Other (non-respiratory) functions of the respiratory system.
9. Various substances excretion according to their concentration in plasma, GFR and Tm. Mechanisms of urine concentration and dilution.