האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Respiratory system of the healthy person - 96202

Last update 21-08-2018

HU Credits: 3.5

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Medicine

Academic year: 0

Semester: 1st Semester

Teaching Languages: Hebrew

Campus: Ein Karem

Course/Module Coordinator: Dr. Zvika Granot

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Course/Module description:
The course will review the structure and normal functions of the respiratory system

Course/Module aims:
To attain comprehensive knowledge and understanding of the respiratory system in terms of function and basic structure.

Learning outcomes - On successful completion of this module, students should be able to:
Comprehend the macroscopic structure of the lung and the respiratory system, its innervation and vascularization.

Comprehend the histological structure of the lung and the respiratory system and explain the physiology of blood and air flow in the lung.
Describe the functional anatomy of the different areas of the lung focusing on aeration, blood flow and their coordination.

Describe the basis and methodology for determining lung functionality.

Describe the role played by the lung in regulating oxygen concentration, carbon dioxide concentration and acid/base balance in arterial blood.

Describe the main respiratory diseases and their physiological basis.

Describe the nervous and autonomous regulation of the respiratory system.

Cognize the interaction of the respiratory system with the cardiovascular and renal

system for the homeostasis of the extracellular fluid.

Attendance requirements(%):
No obligatory attendance in the frontal lectures. 100% attendance required in the small study groups and the anatomical dissections.

Teaching arrangement and method of instruction: Frontal lectures given by experts in each section and module as well as small study groups going over central and important modules. In addition there will be anatomical dissections as well as histological labs

Course/Module Content:
1. Anatomy of the lungs and airways: 6 hrs
Respiratory system anatomy lab: 6 hrs

2. Histology: 3 hrs
Histology lab (computerized): 3 hrs

3. Embryology: 1 hrs

4. Imaging: 2 hrs

5. Physiology:25 hours
1. Introduction:
1.1 The main functions of the respiratory system
1.2 Physical properties of air and oxygen (gas contents of dry and wet air, partial pressure of gases, water vapor pressure, Dalton's and Henry laws)
1.3 Respiratory system in the in vertebrates, vertebrates and mammals
2. Mechanics of respiration
2.1 Static relationships
2.1.1 Pressure and volumes in the respiratory system
2.1.2 Respiration with positive and negative pressure
2.1.3 Respiratory muscles and their work
2.14 Pressure-volume relationship in the isolated lung (lung compliance, hysterics and air-fluid tension, surfactant)
2.1.5 Volume pressure relationship in the full system (lung+chest), The functional residual capacity (FRC) as the equilibrium point.
2.2 Dynamical relationships
2.2.1 Air flow and resistance
2.2.2 Pathophysiology of obstructive lung diseases.
2.2.3 Measurement of lung resistance to air-flow (Plethysmograph, Flow-volume

curves)
2.2.4 Dynamic closure of airways during forced expiration
2.3 Integration of static and dynamic relationship in the respiratory system
2.3.1 The work of ventilation
2.3.2 Differential diagnosis of obstructive vs. restrictive lung disease (Flow volume curves and FEV1.0)
3. Lung volumes – description and measurements
3.1 Lung volumes as measured by Respirometer
3.2 The hidden lung volumes (the residual volume and the FRC)
3.3 FRC measurement
3.3.1 Physiological methods (Helium dilution and N2 washout)
3.3.2 Anatomical methods (plethysmograph)
3.4 Conduction and respiratory area in the lung – the dead space, total and alveolar ventilation
3.5 Measurement of the dead space and the alveolar ventilation
3.5.1 Single breath of 100% O2
3.5.2 CO2 expiration
3.6 The ventilation equation (the relationship between the alveolar ventilation and the arterial and end-tidal CO2)
3.7 Regional difference in the ventilation of the lung (in the erect position)
3.8 The closing volume
3.9 Physiological and pathophysiological changes in lung volumes
4. Diffusion of gases across the air-blood barrier
4.1 Anatomy of the air-blood barrier
4.2 Diffusion laws
4.3 Diffusion vs. perfusion limits in transfer of gas across the blood-air barrier
4.4 O2 transport from the air to the blood
4.5 CO2 transport from the blood to the air
4.6 Measurement of the lung diffusion capacity
4.7 Pathophysiological changes in the lung diffusion capacity
5. Lung blood perfusion
5.1 Forces and resistance (comparison of the lung and system blood systems)
5.2 Factors that affect lung resistance to blood flow (arterial and venous blood pressure, lung volume, hormones and drugs, partial pressure of O2 in the alveoli)
5.3 Clinical measurement of lung blood pressure and perfusion
5.4 Regional difference in lung perfusion in the erect position
6. Gas transport in the blood
6.1 Transport of oxygen (in the solution and bound to hemoglobin)
6.2 The O2-hemoglobin dissociation curve
6.3 CO2 transport
6.4 The CO2 dissociation curve
6.5 Cross connection between the O2 and CO2 transport systems
7. Ventilation-perfusion matching
7.1 Ventilation-perfusion (V/P) relationship in a single alveolus
7.2 Ventilation-perfusion relationship in the whole lung
7.3 Efficient and less efficient lung areas

7.4 Measurement of ventilation-perfusion relationship
7.4.1. in the normal lung and in patients with COPD
7.4.2 Quantification of V/P relationships
8. Differential diagnosis of hypoxia and hypoxemia
8.1 Integration of ventilation, perfusion and gas transport
8.2 The respiratory exchange ratio – R
8.3 The alveolar gas equation
8.4 Differential diagnosis of hypoxia and hypoxemia (hypo-ventilation, diffusion problems, Shunt, mismatch between ventilation and perfusion)
9. Acid-base balance
9.1 Hydrogen ions, importance, size, and the pH scale
9.2 Chemistry of acid, base and buffers
9.3 Sources of acid in the body (fixed and volatile acids)
9.4 Buffering of acid in the body (chemical, lung and kidney)
9.5 Hendersson-Hasselbach equation for body acids
9.6 Graphical representation, with an emphasis on Devenport plot, of body acid-base status
10. Acid-bas dis-balance
10.1Primary (respiratory and metabolic) acid base disorders
10.2 Compensatory (secondary) changes in acid-base balance
10.3 Quantification of acid base balance – the base excess
11. Control of ventilation
11.1 The structure of the system as a negative feedback system (sensors, controllers and effectors)
11.2 Factors that affect alveolar ventilation (CO2, 02, pH, others)
11.3 Pathophysiology of ventilation control
12. Exercise Physiology:

12.1 Response to exercise, role of nutrients and metabolic pathways (anaerobic and aerobic) at different exercise intensities, oxygen uptake (consumption), cardiovascular response, respiratory response.

12.2 The anaerobic threshold: definition and identification, ventilatory compensation in response to metabolic acidosis, isocapnic phase. Thermodynamics in exercise, energetic efficiency

12.3 Principles of incremental cardiopulmonary exercise testing.
12.3.1 Normal response to exercise during incremental cardiopulmonary exercise test, determination of maximal exercise capacity.
12.3.2 Exercise pathophysiology, response to exercise in COPD, heart failure and pulmonary hypertension.
13. Basic pulmonary Physiological lab:
Mechanical lung model – Pa, IPP, positive breathing, pneumotorax
Gas exchange- alveolar gas equation, inspiratory point, alveolar point
Simple spirometry – SVC, FVC
14. Advanced pulmonary Physiological lab:

Endurance test – partial gas pressures, TV, heartbeat, anaerobic threshold, isocapnic period
Plathysmograph – diffusion, airway resistance, physiological FRC, anatomical FRC

Required Reading:
Respiratory physiology, J. West.

Additional Reading Material:
Extended reading – Breathing under extreme conditions (height, diving).

Course/Module evaluation:
End of year written/oral examination 72 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 10 %
Reports 0 %
Research project 0 %
Quizzes 10 %
Other 8 %
Anatomy (practical)

Additional information: