Translational Medicine – Pathophysiology I-II.

5th semester

Credit value: 3
Subject code: AOKTLM740_1A
Number of lessons per week: 42 **lecture:** 21 **practical course:** 21
Academic year: 2022/2023 Semester 1
Name of the course leader: Zoltán Benyó MD, PhD, DSc
His/her workplace, phone number: Institute of Translational Medicine, 06-1-210-0306
Position: Director, University Professor
Date and registration number of their habilitation: 2008, 259

Objectives of the subject, its place in the medical curriculum:
The objective of the course is to have the students understand the complex mechanisms responsible for the development of functional disturbances in common conditions affecting the function of the entire organism through integration of the knowledge imparted by initial courses (most importantly anatomy, biochemistry and physiology), as well as the regulatory processes that are activated in order to fend off these disturbances. Having assimilated the knowledge encompassing organ systems and disciplines and the integrative approach, the students will be ready to understand, in the course of their clinical education, the mechanisms and symptomatology of various diseases and the respective therapeutic possibilities.

Place where the subject is taught (address of the auditorium, seminar room, etc.):
Centre of Theoretical Medicine, 37–47 Tűzoltó street, 1094 Budapest
Theoretical Building, 4 Nagyvárad square, 1089 Budapest

Successful completion of the subject results in the acquisition of the following competencies:
Based on their basic training in anatomy, biochemistry and physiology, the students will become capable of understanding the manifestation, on the organism level, of the pathological processes underlying the most common diseases, their symptoms, causes and potential therapeutic outcomes. Helped by practice sessions closely linked with the theoretical material, the students will acquire the skills necessary for following causality relationships in the disturbances of physiological processes and for recognizing the effects of these disturbances on the totality of the function of the organism, and will gain experience in test methods utilized in clinical practice, their theoretical bases, margins for interpretation and actual execution.

Course prerequisites:
Anatomy, final exam Macroanatomy: AOKATN667_2A
Biochemistry, final exam Biochemistry II.
Physiology, final exam Physiology II.

Number of students required for the course (minimum, maximum) and method of selecting students:
Based on registration in the Neptun system; offered in the autumn semester for the entire class.

How to apply for the course:
In the Neptun system

Detailed curriculum:
Lectures (1.5 lessons/week)

Semester 1
Lectures (70 min. lectures weekly)
Week 1 Hypertension – Zsuzsanna Miklós
Week 2 Congestive heart failure – László Tornóci
Week 3 Obesity – Éva Ruisanchez
Week 4 Diabetes I: Pathogenesis of Type 1 and 2 diabetes – Domokos Gerő
Week 5 Diabetes II: Pathogenesis of diabetic complication – Domokos Gerő
Week 6 Atherosclerosis and disorders of lipid metabolism – Éva Margittai
Week 7 Disorders of Hemostasis – Zoltán Benyó
Week 8 Endocrine diseases I: Thyroid gland –Tamás Ivanics
Week 9 Endocrine diseases II: Adrenal gland– Tamás Ivanics
Week 10 Endocrine diseases III: Pituitary gland and reproductive system– Zoltán Benyó
Week 11 Menopause – Zsuzsanna Miklós
Week 12 Osteoporosis. Calcium and phosphate hoemostasis – Gábor Kökény
Week 13 Systemic autoimmune diseases and joint disorders – Gábor Kökény
Week 14 Consultation lecture

Practices (135 min. lessons biweekly)
Weeks 1-2 Hypertension, ABPM and Clinical case discussion
Weeks 3-4 Blood pressure measurement, arterial pulse wave, ankle-brachial index
Weeks 5-6 Obesity and Diabetes, and Clinical case discussion
Weeks 7-8 Diabetic neuropathy diagnostic procedures
Weeks 9-10 Diabetic vascular function task
Weeks 11-12 Adrenal gland and Thyroid gland, and Clinical case discussion
Weeks 13-14 Menopause and Osteoporosis, and Clinical case discussion

Other subjects concerning the border issues of the given subject (both compulsory and optional courses!). Possible overlaps of the syllabuses:
Pathology, immunology, laboratory medicine and general medicine

Special study work required to successfully complete the course:
None

Requirements for participation in classes and the possibility to make up for absences:
Participation at practice sessions is compulsory. Maximum of 1 absence from the practice sessions is acceptable. Absence from more than 1 of the practice sessions in a semester means that the student did not fulfil his/her semestrial study obligations. There is no possibility for making up for absence from lectures; absence from practice sessions can be made up for with another group in the same week, if there is room for additional participants.

Methods to assess knowledge acquisition during term time:
Students might give account of – *which there is no compulsory participation* - their theoretical and practical curriculum knowledge of the material so far presented in the lectures and the practical lessons on two occasions in the course of the semester, at predetermined dates/times, in the form of written test. Based on the combined results of the two competition rounds, we will prepare a grade offer for the colloquium examination

Requirements for semestral signature:
The requirement for the end-of-semester signature: absence from more than 1 practice sessions in a semester also means that the student did not fulfil his/her semestral study obligations, therefore he/she is not permitted to take the exam.

Type of examination:
Semifinal exam

Requirements of the examination:
1st Semester, Exam topics, (theory)
1. Definition of hypertension and its different forms; hypertension of known causes; complications of hypertension
2. Essential hypertension; principles of hypertension treatment
3. Heart failure, its causes and symptoms
4. Secondary effects of heart failure, therapeutic options
5. Prevalence, causes and definition of obesity
6. Adipose tissue function and dysfunction
7. Systemic consequences of obesity
8. Pathogenesis of Type 1 diabetes mellitus
9. Pathogenesis of Type 2 diabetes mellitus
10. Microvascular complications of diabetes mellitus
11. Macrovascular complications of diabetes mellitus
12. Characterization of lipoproteins, lipoprotein metabolism
13. Classification of dyslipidemias; syndromes of primary hyperlipoproteinemia
14. Syndromes associated with secondary hyperlipoproteinemia
15. Atherosclerosis
16. Conditions associated with coagulation system dysfunction
17. Conditions associated with excessive activation of the coagulation system
18. Simultaneous under- and overacting disorders of the coagulation system
19. Pathogenesis of hypothyroidism and the symptoms of hypothyroidism
20. Pathogenesis of syndromes with hyperthyroidism and symptoms of thyrotoxicosis
21. Pathogenesis of acute and chronic adrenocortical insufficiency, pathomechanism underlying the main symptoms; congenital adrenal hyperplasia
22. Pathogenesis of Cushing's syndrome, pathomechanism underlying the symptoms and diagnosis
23. Pathogenesis of primary and secondary hyperaldosteronism; the pathomechanism underlying the symptoms
24. Possible causes of overproduction of growth hormone and prolactin, the pathomechanism of the consequences
25. Male hypogonadism and androgen insensitivity syndrome
26. Disorders of the female hormonal regulation
27. Menopausal transition and menopause
28. Postmenopause
29. Hormonal regulation of calcium and phosphate metabolism in physiological and pathological conditions
30. Hormonal regulation of calcium and phosphate metabolism in physiological and pathological conditions, its effects on the skeletal system
31. Non-osteoporotic bone diseases in adults and extraskeletal effects of vitamin D deficiency
32. General mechanisms in the development of systemic autoimmune diseases
33. Autoimmune joint diseases; rheumatoid arthritis and ankylosing spondylitis
34. Pathomechanism of Systemic lupus erythematosus, systemic sclerosis and Sjögren's syndrome

1st Semester, Exam topics, (practice)
Case study presentation of relevant clinical cases to discuss the pathogenesis of typical symptoms, diagnosis and therapeutic approaches in diseases.

Case 1-4. Hypertension
Case 5-8. Obesity – Diabetes
Case 9-12. Endocrine disorder
Case 13-16. Menopause and osteoporosis

Practical tasks, device operation:
17. Methods to measure blood pressure. Practical aspects of correctly performing blood pressure measurement.

18. ABPM and its indications. How is an ABPM test performed? Why is it important to assess diurnal rhythm?
19. Diagnostic criteria of hypertension using different methods of measurement. What are the indications and benefits of home blood pressure monitoring?
20. Investigation methods of vascular ageing. The significance of pulse wave velocity and its measurement.
21. Characterization of the physiological arterial pulse wave and its changes with ageing.
22. The definition and measurement of the ankle-brachial index. Its significance.
23. Diabetic neuropathy task: the manifestations and symptoms of diabetic neuropathy, their pathomechanism
24. Examination procedures used for diagnosing neuropathy affecting somatic nerves. Explanation of the physical examination procedures presented in the practical lesson.
25. Diabetic neuropathy Diagnostic procedures used in the investigation of autonomic neuropathic abnormalities. Demonstration of the performance of the Ewing test.
26. Diabetic vascular function task: briefly describe the methods of laser Doppler flow measurement and transcutaneous partial oxygen tension measurement. Describe the blood flow response to heating and its changes in diabetic vascular dysfunction; explain the underlying pathomechanism.
27. Diabetic vascular function task: briefly describe the methods of laser Doppler flow measurement and transcutaneous partial oxygen tension measurement. Explain what post-occlusive reactive hyperaemia is and how it changes with diabetic vascular dysfunction; explain the underlying pathomechanism.
28. Diabetic vascular function: briefly describe the methods of laser Doppler flow measurement and transcutaneous partial oxygen tension measurement. Explain the venoarterial reflex and its changes in diabetic vascular dysfunction; explain the underlying pathomechanism.

Method and type of evaluation:
Semifinal exam:
The semifinal exam is oral.

Exam exemption may be obtained by achieving exceptional results in the competition, a grade “4” or “5” may be offered as the colloquium/semifinal examination grade.

How to register for the examination: Registration for exam via the Neptun system.

Possibilities for exam retake: According to the TVSZ (Study and Examination Regulations (SER))

Printed, electronic and online notes, textbooks, guides and literature (URL address for online material) to aid the acquisition of the material:
The Figures of the lectures available for download at the website, and short written extracts of the lectures (“handout”) Gary D. Hammer, Stephen J. McPhee: Pathophysiology of Diseases: An Introduction to Clinical Medicine– A LANGE medical book 7th edition (2014), 8th edition (2018)

6th semester

Credit value: 3
Subject code: AOKTLM740_2A
Number of lessons per week: 42 **lecture:** 21 **practical course:** 21
Academic year: 2022/2023 Semester 2
Name of the course leader: Zoltán Benyó MD, PhD, DSc
His/her workplace, phone number: Institute of Translational Medicine, 06-1-210-0306
Position: Director, University Professor
Date and registration number of their habilitation: 2008, 259

Objectives of the subject, its place in the medical curriculum:
The objective of the course is to have the students understand the complex mechanisms responsible for the development of functional disturbances in common conditions affecting the function of the entire organism, through integration of the knowledge imparted by initial courses (most importantly anatomy, biochemistry and physiology), as well as the regulatory processes that are activated in order to fend off these disturbances. Having assimilated the knowledge encompassing organ systems and disciplines and the integrative approach, the students will be ready to understand, in the course of their clinical education, the mechanisms and symptomatology of various diseases and the respective therapeutic possibilities.

Place where the subject is taught (address of the auditorium, seminar room, etc.): Centre of Theoretical Medicine, 37–47 Tűzoltó street, 1094 Budapest Theoretical Building, 4 Nagyvárad square, 1089 Budapest

Successful completion of the subject results in the acquisition of the following competencies:
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Course prerequisites:

Pathology I. semifinal exam
Translational Medicine – Pathophysiology I. semifinal exam

Number of students required for the course (minimum, maximum) and method of selecting students: Based on registration in the Neptun system; offered in the spring semester for the entire class.

How to apply for the course: In the Neptun system

Detailed curriculum:
Lectures (1.5 lessons/week)

Semester 2 Lectures (70 min. lectures weekly)
Week 1 Pathophysiology of gastrointestinal diseases – Gábor Kökény
Week 2 Liver and biliary tract disorders – Éva Margittai
Week 3 Acute alcohol poisoning. Acute and chronic pancreatitis – Éva Margittai
Week 4 Acute kidney injury – Péter Hamar
Week 5 Chronic kidney disease – Péter Hamar
Week 6 Acute respiratory failure – György Losonczy
Week 7 Chronic respiratory disorders – György Losonczy
Week 8 Acid-base disorders –Domokos Gerő
Week 9 Na+-, K+- and water balance:, pathophysiology of fluid and electrolyte disorders – Zsuzsanna Miklós
Week 10 Circulatory shock – Zoltán Benyó
Week 11 Septic and anaphylactic shock – Zoltán Benyó
Week 12 Pathophysiology of ageing – Zoltán Ungvári
Week 13 Disorders developing in the course of immobilization and their treatment. Cachexia. Rehabilitation – Zoltán Benyó
Week 14 Secondary disorders developing in malignant diseases – Péter Hamar

Practices (135 min. lessons biweekly)
Weeks 1-2 GI diseases and Nutritional status analysis, Clinical case discussion
Weeks 3-4 Liver diseases and Clinical case discussion
Weeks 5-6 Kidney diseases and Clinical case discussion
Weeks 7-8 Respiratory diseases and Clinical case discussion
Weeks 9-10 Acid-base disorders and Clinical case discussion
Weeks 11-12 Circulatory shock and Clinical case discussion
Weeks 13-14 Vascular cognitive disorders: fNIRS and cognitive tests

Other subjects concerning the border issues of the given subject (both compulsory and optional courses!). Possible overlaps of the syllabuses:
Pathology, immunology, laboratory medicine and general medicine

Special study work required to successfully complete the course: None

Requirements for participation in classes and the possibility to make up for absences:
Participation at practice sessions is compulsory. Maximum of 1 absence from the practice sessions is acceptable. Absence from more than 1 of the practice sessions in a semester means that the student did not fulfil his/her semestrial study obligations. There is no possibility for making up for absence from lectures; absence from practice sessions can be made up for with another group in the same week, if there is room for additional participants.

Methods to assess knowledge acquisition during term time:
Students might give account of – *which there is no compulsory participation* - their theoretical and practical curriculum knowledge of the material so far presented in the lectures and the practical lessons on two occasions in the course of the semester, at predetermined dates/times, in the form of written test. Based on the combined results of the two competition rounds, we will prepare a grade offer for the colloquium examination.

Requirements for semestral signature:
The requirement for the end-of-semester signature: absence from more than 1 practice sessions in a semester also means that the student did not fulfil his/her semestral study obligations, therefore he/she is not permitted to take the exam.

Type of examination: Final exam

Requirements of the examination:

1st Semester, Exam topics, (theory)
1. Definition of hypertension and its different forms; hypertension of known causes; complications of hypertension
2. Essential hypertension; principles of hypertension treatment
3. Heart failure, its causes and symptoms
4. Secondary effects of heart failure, therapeutic options
5. Prevalence, causes and definition of obesity
6. Adipose tissue function and dysfunction
7. Systemic consequences of obesity
8. Pathogenesis of Type 1 diabetes mellitus
9. Pathogenesis of Type 2 diabetes mellitus
10. Microvascular complications of diabetes mellitus
11. Macrovascular complications of diabetes mellitus
12. Characterization of lipoproteins, lipoprotein metabolism
13. Classification of dyslipidemias; syndromes of primary hyperlipoproteinemia
14. Syndromes associated with secondary hyperlipoproteinemia
15. Atherosclerosis
16. Conditions associated with coagulation system dysfunction
17. Conditions associated with excessive activation of the coagulation system
18. Simultaneous under- and overacting disorders of the coagulation system
19. Pathogenesis of hypothyroidism and the symptoms of hypothyroidism

20. Pathogenesis of syndromes with hyperthyroidism and symptoms of thyrotoxicosis
21. Pathogenesis of acute and chronic adrenocortical insufficiency, pathomechanism underlying the main symptoms; congenital adrenal hyperplasia
22. Pathogenesis of Cushing's syndrome, pathomechanism underlying the symptoms and diagnosis
23. Pathogenesis of primary and secondary hyperaldosteronism; the pathomechanism underlying the symptoms
24. Possible causes of overproduction of growth hormone and prolactin, the pathomechanism of the consequences
25. Male hypogonadism and androgen insensitivity syndrome
26. Disorders of the female hormonal regulation
27. Menopausal transition and menopause
28. Postmenopause
29. Hormonal regulation of calcium and phosphate metabolism in physiological and pathological conditions
30. Hormonal regulation of calcium and phosphate metabolism in physiological and pathological conditions, its effects on the skeletal system
31. Non-osteoporotic bone diseases in adults and extraskeletal effects of vitamin D deficiency
32. General mechanisms in the development of systemic autoimmune diseases
33. Autoimmune joint diseases; rheumatoid arthritis and ankylosing spondylitis
34. Pathomechanism of Systemic lupus erythematosus, systemic sclerosis and Sjögren's syndrome

2nd Semester, Exam topics, (theory)
1. The pathophysiology of the gastrointestinal system - the diseases of the stomach and the small intestine
2. The pathophysiology of the gastrointestinal system - inflammatory bowel diseases
3. Liver dysfunction I.
4. Liver dysfunction II.
5. The metabolism of alcohol
6. Acute alcohol intoxication
7. Chronic alcoholism
8. The causes and systemic consequences of acute renal failure
9. The causes and definition of chronic renal failure
10. Pathological changes in organs affected by chronic renal failure
11. Pulmonary ventilation disorders and respiratory function tests to detect them; the definition and forms of respiratory failure
12. The symptoms of acute respiratory failure; the effect of consequent hyperventilation on blood gas and acid-base values
13. The effects of prolonged smoking on the large and small airways and on the elastic fibers of the lungs
14 The correlation between FEV1 decline and arterial pO2 and pCO2 in chronic respiratory failure (COPD and pulmonary fibrosis)
15. Various types of organ damage caused by chronic global respiratory failure (mainly COPD)
16. Acid-base disorders of metabolic origin: metabolic acidosis and metabolic alkalosis
17. Acid-base disorders of respiratory origin: respiratory acidosis and respiratory alkalosis
18. Sodium (Na+) and water balance disorders
19. Potassium (K+) balance disorders
20. The definition and classification of circulatory shock
21. Forms of hypovolemic shock
22. The different phases of hypovolemic shock
23. The progression of circulatory shock
24. Organ manifestations of circulatory shock
25. Possible causes of cardiogenic shock
26. The definition and mechanism of septic shock and the principles of its treatment
27. The development and consequences of pro- and anti-inflammatory processes, coagulation disorders and endothelial dysfunction in septic shock
28. Molecular and cellular ageing
29. Organ-level manifestations of the ageing syndrome
30. The effect of the immobilization syndrome on somatic functions
31. The effect of immobilization syndrome on autonomic functions
32. Secondary disorders caused by tumours I: Disorders of other organs in cancer patients
33. Secondary disorders caused by tumours II: Systemic consequences of cancer
The pathomechanism of systemic inflammation, cachexia and pain

1st Semester, Exam topics, (practice)
Case study presentation of relevant clinical cases to discuss the pathogenesis of typical symptoms, diagnosis and therapeutic approaches in diseases.

Case 1-4. Hypertension
Case 5-8. Obesity – Diabetes
Case 9-12. Endocrine disorder
Case 13-16. Menopause and osteoporosis

Practical tasks, device operation:
17. Methods to measure blood pressure. Practical aspects of correctly performing blood pressure measurement.
18. ABPM and its indications. How is an ABPM test performed? Why is it important to assess diurnal rhythm?
19. Diagnostic criteria of hypertension using different methods of measurement. What are the indications and benefits of home blood pressure monitoring?
20. Investigation methods of vascular ageing. The significance of pulse wave velocity and its measurement.
21. Characterization of the physiological arterial pulse wave and its changes with ageing.
22. The definition and measurement of the ankle-brachial index. Its significance.
23. Diabetic neuropathy task: the manifestations and symptoms of diabetic neuropathy, their pathomechanism
24. Examination procedures used for diagnosing neuropathy affecting somatic nerves. Explanation of the physical examination procedures presented in the practical lesson.
25. Diabetic neuropathy Diagnostic procedures used in the investigation of autonomic neuropathic abnormalities. Demonstration of the performance of the Ewing test.

26. Diabetic vascular function task: briefly describe the methods of laser Doppler flow measurement and transcutaneous partial oxygen tension measurement. Describe the blood flow response to heating and its changes in diabetic vascular dysfunction; explain the underlying pathomechanism.
27. Diabetic vascular function task: briefly describe the methods of laser Doppler flow measurement and transcutaneous partial oxygen tension measurement. Explain what post-occlusive reactive hyperaemia is and how it changes with diabetic vascular dysfunction; explain the underlying pathomechanism.
28. Diabetic vascular function: briefly describe the methods of laser Doppler flow measurement and transcutaneous partial oxygen tension measurement. Explain the venoarterial reflex and its changes in diabetic vascular dysfunction; explain the underlying pathomechanism.

2nd Semester, Exam topics, (practice)
Case study presentation of relevant clinical cases to discuss the pathogenesis of typical symptoms, diagnosis and therapeutic approaches in diseases.

Case 1-3. Gastrointestinal disease
Case 4-9. Liver disease
Case 10-14. Kidney disease
Case 15-18. Respiratory disease
Case 19-22. Acid-base disorder
Case 23-26. Circulatory shock

Practical tasks, device operation:
27. What options can you name to define nutritional status? What are the advantages and disadvantages of the different methods?
28. How does the body composition monitor based on bioimpedance spectroscopy work? What are the most important parameters that are determined?
29. What are the clinical uses of bioelectrical impedance analyzers? What are the main parameters used in different areas?
30. Describe the abnormal findings in urine tests; describe the most common symptoms and their causes. Reference values.
31. Possible causes of abnormal urine colour.
32. The mechanism and clinical significance of neurovascular coupling in functional brain imaging. The theoretical background and practical application of the fNIRS method and its significance in the study of frontal cortical function.
33. Types of cognitive tests and their significance in the diagnosis of neurodegenerative disorders. The significance of the recognition of mild cognitive impairment and the theoretical basis of its differential diagnosis.

Method and type of evaluation: Final exam:
The Final exam is oral.
Exam exemption may be obtained by achieving exceptional results in the competition, a grade “4” or “5” may be offered as the Final examination grade

How to register for the examination: Registration for exam via the Neptun system.

Possibilities for exam retake: According to the TVSZ (Study and Examination Regulations (SER))

Printed, electronic and online notes, textbooks, guides and literature (URL address for online material) to aid the acquisition of the material:
The Figures of the lectures available for download at the website, and short written extracts of the lectures (“handout”).
Gary D. Hammer, Stephen J. McPhee: Pathophysiology of Diseases: An Introduction to Clinical Medicine– A LANGE medical book 7th edition (2014), 8th edition (2018)