Program of Medicine Studies

MODULE

HOMEOSTASIS AND EXCRETION

Second Year
Third Semester

Faculty of Medicine
Kaunas University of Medicine
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1. General information

**Supervisor of the module:** Prof. dr. Edgaras Stankevičius, Institute of Physiology and Pharmacology, edgaras.stankevicius@lsmuni.lt, tel. 327257

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- Human Histology and Embryology (prof. Angelija Valančiūtė, e-mail: angval@kmu.lt, tel.327210, assoc. prof. Ingrida Balnytė, tel 327282, lect. Jolita Palubinskienė, tel 327235)
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- Physiology (assoc prof. A. Laukevičiene, ale.laukeviciene@googlemail.com, tel.327285)
- Pathological Physiology (lect. Dr. Dalia Akramienė, dalia.akramiene@med.kmu.lt, tel. 395380)
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- Environmental and Occupational Medicine (assoc.prof. Rūta Ustinavičienė, e-mail: aplinkos.katedra@med.kmu.lt, tel. 327360)
- Pharmacology (lect. dr. Rimas Jankūnas, e-mail: farma@kmu.lt, tel. 327242)
2. General contents of the module

Analyzing the problems of this module the students gain new knowledge and apply it to the following domains:

- Anatomy of the organs of the urinary system, blood circulation and innervation;
- Histology of the organs of the urinary system;
- Physiology of the organs of the urinary system;
- Kidney supply with the energy;
- Urine filtration and concentration in the kidneys;
- Reabsorption of electrolytes, glucose and amino acids in the kidneys;
- Role of the kidneys in the control of blood pH;
- Control of water balance in human organism;
- Disorders of the urinary system and their pathophysiological mechanisms;
- Pathological anatomy of diseases and syndromes of the urinary system;
- Fundamentals of examination of the organs of the urinary system;
- Homeostasis correction of surgical patients, hemocorrectors;
- Essentials of drug pharmacology affecting the organs of the urinary system.
3. Aim and objectives of the module

The student after have studied this module must know how to define, analyze, explain and relate phenomena to the cases analyzed in the module. Attaining this aim, students must gain knowledge about the kidney structure, function and disorders in pathological condition, mechanisms and principles of their examination and treatment.

- Kidneys as an organ of homeostasis maintenance (anatomy, morphology, and physiology of the organs of the urinary system);
- Transport function of renal tubules and disorders of this function: transport disorders of calcium, phosphate, sodium, potassium and water; mechanism of action of diuretics; concentration of the urine in the kidneys; acid-base balance;
- Reabsorption of electrolytes, glucose and amino acids in the kidneys;
- Pathogenesis of the consequences caused by hyperhydration and dehydration; consequences of water intoxication. Etiology of edema and mechanisms of its pathogenesis;
- Disorders of body homeostasis in surgical diseases and causes of endogenous intoxication, principles of body detoxication and treatment;
- Etiology of glomerulonephritis, pathogenesis, disorders of the body function, morphological changes and principles of treatment;
- Etiology of nephrolithiasis, pathogenesis, morphological changes, techniques of examination and principles of treatment;
- Etiology of renal failure, pathogenesis, disorders of the body function, morphological expressions and principles of treatment;
- Pathogenetic mechanisms of the disorders of the urinary system with prostate hyperplasia, morphological changes, examination, principles of treatment.
4. Tutorials

4.1. Case 1. Low weight of the baby

J.Z., a 25-year-old female with her 3 months old baby (boy) visited the pediatrician for a routine checkup. The baby was full-termed, the course of delivery was normal, the baby’s current weight is 3 380 g. The boy is the second child in the family; he has a 2-year-old sister. As the mother notes, the boy’s behavior differs from that of his sister when she was at his age. The boy eats poorly (he is nurses with breast milk) and constantly falls asleep while being fed. During the examination the physician observed: small weight (4 100 g at 3 months of age) and tachypnea. No other irregularities were observed. Despite the recommendations to continue nursing, the condition has not improved. Therefore, the boy was hospitalized because acid-base disorder was suspected.

Blood tests: Na\(^+\) 138 mmol/l (normal 135-148), K\(^+\) 2.5 mmol/l (normal 3.1-4.6), chlorides 110 mmol/l (normal 95-105), urea 3.5 mmol/l (normal 2.0-7.2 for children up to 1 year), creatinine 32 mmol/l (normal 19-54 for children up to 1 year), blood pH 7.29 (normal 7.33-7.45 in arterial blood, 7.36-7.42 in venous blood). Partial pressure CO\(_2\) 3.59 kPa (normal 4.2-6), bicarbonates 12 meq/l (normal 23-30).

Urine test: specific gravity 1.006 (1.015-1.020), pH 7, proteins, nitrites, leukocytes, glucose were not detected.

What are the causes and mechanisms of low weight of the baby?

Explain the findings: pH, partial pressure CO\(_2\) and bicarbonate.

What are potential outcomes of acid-base disorder and principles of that disorder elimination?
Concept of the problem. Regulation of blood pH.
Clinical symptoms. Low weight of the baby.

Aim
To understand and explain the etiology of acid-base disorder, pathogenesis and principles of correction.

Learning objectives and contents
To complete an analysis of this problem the student must know:

- Macroscopic structure of the kidneys, ureters, blood supply and innervation of the urinary systems.

Subject – Anatomy
Institute of Anatomy

References:

Additional readings:

- Histological structures of the kidneys involved in formation of the urine, of water and Na+ ionis balace and pH regulation.

Subject – Human Histology and Embryology
Department of Histology and Embryology

References:
To understand the mechanisms of acid-base balance maintenance and causes of their disorders.

Subject – Biochemistry

Department of Biochemistry

References:


Additional readings:


- Mechanisms of bicarbonate reabsorption in the proximal tubules and in the loop of Henle, mechanisms of reabsorption and secretion in the collecting ducts, mechanisms of hydrogen
ion secretion, mechanisms of ammonia reserve formation and transport in the loop of Henle and the collecting tubules, its impact on acidity of excreted substances.

Subject – Physiology
Department of Physiology
References:

- Etiology of metabolic and respiratory acidosis and alkalosis, pathogenesis and compensatory mechanisms.

Subject – Pathological Physiology
Department of Physiology
References:

- Classification principles of kidney diseases and syndromes and their pathological anatomy. Interpretation of macroscopic and microscopic kidney changes in regulation of pH balance.

Subject – Pathological Anatomy
Department of Pathological Anatomy
References:

- Etiology and pathogenesis of acid-alkaline balance disturbances in surgical patients. Types, methods for detection, principles of correction.

Subject – General Surgery
Clinic of General Surgery
References:

Additional readings:

**4.2. Case 2. Edema of the body**

B.Z., a 55-year-old heavily smoking patient, a week ago suddenly developed the symptoms of loss of perception and increase of weight. During physical examination swelling of the body is observed, and disorder of perception is determined.

Laboratory blood tests: Na\(^+\) 118 mmol/l (normal 135-148), plasma osmolarity 242 mosm/kg H\(_2\)O (normal 290). Urine test: Na\(^+\) 60 mmol/l and urine osmolarity 450 mosm/kg H\(_2\)O.

The physician advised the patient to limit water intake (less than 1 liter per day). Despite the recommendations, after a week the patient complained of perception disorders, nausea and vomiting. Laboratory tests: Na\(^+\) 119 mmol/l, osmolarity 245 mosm/kg H\(_2\)O.

During the X-ray examination the increase of pulmonary size was determined.

*Explain the etiology and pathogenesis of the disorder.*

*Explain the clinical symptoms on the basis of laboratory findings.*

*Explain the pathogenetical mechanisms of edema.*
Concept of the problem. Osmoregulation.

Clinical symptoms. Accumulation of water and increase of body weight.

Aim
To learn the causes of water balance disorders, positive water balance and principles of its correction.

Learning objectives and contents
To complete an analysis of this problem the students must know:

- Renal histological structures involved in water, Na$^+$ ion balance, control of blood pressure, hormonal regulation of these processes. Processes of water and Na$^+$ ion balance maintenance taking place in the kidneys.

Subject – Human Histology and Embryology
Department of Histology and Embryology

References:

Additional readings:
1. Digital atlas of Fathead Minnow Histology: Sensory organs-Renal
   www.aquaticpath.umd.edu/fhm/renal.html

2. Blue Histology-Urinary System.
   www.lab.anhb.uwa.edu.au/mb140/CorePages/Urinary/urinary.htm

3. Ed’s Histology Notes: Adrenal, kidney, Bladder
   www.pathguy.com/urinehis.htm

4. Kidneys-Kidney Histology
   www.kidneydiseases.about.com/od/kidneys101/a/Article0045.htm

- Mechanisms of water and electrolyte balance maintenance and causes of their disorders.
Subject – Biochemistry

Department of Biochemistry

References:


2. Basic medical biochemistry: a clinical approach. DB. Marks, AD. Marks, CM. Smith. Williams & Wilkins, 1996, p. 719-725

Additional readings:


- Body osmoregulation, the role of osmo- and baroreceptors in this process, mechanisms of vasopressin secretion; impact of vasopressin on transport of water and its basic principles of physiological activity; specificity of sodium and water transport in separate renal tubules; urea recirculation and mechanisms of its transport; mechanisms of urine concentration and dilution, role of vasopressin in these processes.

Subject – Physiology

Department of Physiology

References:


- Pathogenesis of consequences caused by hyperhydration and dehydration, consequences of water intoxication, etiology and pathogenesis of edema mechanisms.

Subject – Pathological Physiology

Department of Physiology

References:


- Changes of renal structures that result from disorders of water balance.
Subject – Pathological Anatomy
Clinic of Pathological Anatomy

References:

- Etiology and pathogenesis of body fluid and electrolyte balance disturbances in surgical patients. Types, methods for detection, principles of correction.

Subject – General Surgery
Clinic of General Surgery

References:

Additional readings:
4.3. Case 3. Blood in urine

A.J., a 38-year-old patient, having arrived at the emergency room complains of an intense pain (colic) in the right lumbar area that spreads down into the groin. The pain developed suddenly at night, woke him up and lasted for about 40 minutes. The pain was intermittent. The patient didn’t mention either painful, more frequent micturition, or fever and chills. The patient was nauseous, vomiting, there was some blood noticed in the urine. It was discovered from the anamnesis that the patient had been suffering from a nervous stress, smoked heavily, drank a lot of coffee, and had inadequate nutrition. He denies taking alcohol or drugs. According to the familial anamnesis his father and his father’s grandfather suffered from nephrolithiasis, and the mother had arterial hypertension.

Objectively – positive Jordan’s symptom on the right side. Spasmolytic drugs relieve pain.

Temperature –37.0°C; respiration rate – 22 breaths/min., arterial blood pressure – 145/90 mm/Hg, pulse rate – 100 beats/min.

Laboratory blood test: Hb – 148 g/l; erythrocytes. – 5.0×10^{12}/l; leukocytes. – 12×10^{9}/l.

Laboratory urine test - 200 erythrocytes in the visual field (hematuria).

Echoscopy readings – collector system of the right kidney is extended up to 4.0 cm in width.

X-ray examination: the shadow of concrement detected in the third part of the right ureter.

Explain the pathophysiological mechanisms of the pain and changes in the urine.

What pathological processes do you think are involved, and what diagnostic tests would be the most informative?

What are the potential complications and causes of death, if there are any, what are they and what are the main principles of treatment?
Concept of the problem. Formation of calculi in the urinary system.

Clinical symptoms. Pain in the lumbar area, hematuria.

Aim
To learn the structure of the ureters, their constricted sites, innervation. To understand histophysiology of urine formation and to relate histophysiological variations of renal histological structure to the development of nephrolithiasis, techniques of patients examination, principles of treatment.

Learning objectives and contents
To complete an analysis of this problem the students must know:

- Peculiarities of renal innervation.

Subject – Anatomy
Institute of Anatomy

References:

Additional readings:

- To know what structures are involved in water absorption and urine formation and relate to occurrence of nephrolithiasis.

Subject – Human Histology and Embryology
Department of Histology and Embryology

References:
Mechanisms of transport in the renal tubules, role of basolateral membrane in the transport in the renal tubules, role of basolateral membrane in the transport, mechanisms of secretion and reabsorption in the kidney.

Subject – Physiology

Department of Physiology

References:


Subject – Pathological Physiology

Department of Physiology

References:


Kinds of urinary calculi, changes caused by urinary nephrolithiasis, complications and potential cause of death.

Subject – Pathological Anatomy

Clinic of Pathological Anatomy

References:


Techniques of examination of the patients with diseased organs that excrete urine (anamnesis, inspection, palpation, percussion, tapping) and their application to the detection
of nephrolithiasis. Standards of the urine tests and pathological values of quantative and qualitative changes.

**Subject – Essentials of Medical Diagnostics**

**Clinic of Internal Diseases**

**References:**


**Additional readings:**

3. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

- Radiological techniques in the examination of the kidneys, in diagnosing nephrolithiasis, assessment of the examination findings, echoscopy, techniques of ultrasound examination of the kidneys and bladder in diagnosing nephrolithiasis.

**Subject – Radiology**

**Clinic of Radiology**

**References:**


**Additional readings:**

4.4. Case 4. Color of the urine like “Coca-cola”

Patient A.S., a 8 years old girl, is brought to the physician because of fever, nausea, oliguria, puffy skin around the eyes, frequent micturition and the color of the urine similar to the drink “Coca-cola”.

Her mother states that the daughter is a healthy child. The mother said that two weeks ago the girl had returned from school with a sore throat. Therefore, she didn’t attend classes for two days and afterwards medical advice was sought.

Examination – temperature 39°C; arterial blood pressure – 130/84 mm Hg, respiration and pulse rate is normal. Periorbital edema of the tissues is observed, and a pain in the lumbar area is present. Laboratory blood test: the amount of urea and creatinine level are slightly increased; reduced C₃ and cryoglobulin concentration and an elevated antistreptolysin O (ASO) titer. Analysis of urine reveals mild proteinuria (to 3 g/l) and hematuria (100 erythrocytes in the visual field).

What pathology could be thought of and what tests might be the most informative?
In what way is the immune system involved in the etiology of kidney damage and what is the pathophysiological mechanism of pathology occurrence?
What are the potential complications, are there any potential causes of death, if any, what are they and what are the main principles of treatment?
**Concept of the problem.** Glomerulonephritis.

**Clinical symptoms.** Fever, proteinuria.

**Aim**

To study the etiology of glomerulonephritis, pathogenesis, disorders of the body function, morphological changes, peculiarities of examination and principles of treatment.

**Learning objectives and contents**

To complete an analysis of this problem the students must know the internal macrostructure of the kidneys (cortex, medulla), peculiarities of blood circulation in the kidney.

**Subject – Anatomy**

**Institute of Anatomy**

**References:**


**Additional readings:**


- To know and differentiate structural elements of the kidneys, histophysiology of the urine formation, structure and function of the urine filtration barrier.

**Subject – Human Histology and Embryology**

**Department of Histology and Embryology**

**References:**


- Regulation of the renal blood flow, mechanisms of glomerular filtration.

**Subject – Physiology**

**Department of Physiology**
References:

- Biochemical principles of renal function and significance to homeostasis. Biological role of urea and creatinine and molecular mechanisms of synthesis.

Subject – Biochemistry

Department of Biochemistry

References:

Additional readings:

- Changes of the urine amount and composition with glomerulonephritis. Autoimmune renal diseases, their etiology and pathogenesis.

Subject – Pathological Physiology

Department of Physiology

References:

- Morphological changes developed in glomerulonephritis, classification of glomerular lesions, terminology; peculiarities of clinical-morphological glomerulonephritis, peculiarities of its course, causes of death.

Subject – Pathological Anatomy

Clinic of Pathological Anatomy
• Techniques of examination of the patients with diseases of the urinary system (anamnesis, inspection, palpation, percussion, tapping) and their application to the detection of nephritic syndrome. Main symptoms of nephritic syndrome.

Subject – Essentials of Medical Diagnosis

Clinic of Internal Diseases

References:

Additional readings:
3. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

• Drugs affecting urine excretion (diuretics), their classification taking into consideration mechanisms of action and chemical composition. The most important representatives of separate classes of medicinal preparations, their mechanisms of action, clinical effect, pharmacokinetic properties, indications, side effects.

Subject – Pharmacology

Department of Basic and Clinical Pharmacology

References:
1. Lecture material


- Techniques of ultrasound examination of the kidneys in diagnosing glomerulonephritis, clinical values of findings of ultrasound examination of the kidneys.

Subject – Radiology

Clinic of Radiology

References:
4.5. Case 5. Sweet urine

A.B., an 82-year-old female with chronic diabetes mellitus seeks medical help because of shortness of breath and palpitation. Her niece explained the course of the patient’s disease. It was discovered that hemodialysis had been performed three times a week over three recent years. Type II diabetes mellitus was determined when she was 49, and currently she takes insulin. From the family anamnesis (medical history) it turned out that her sister, brother and mother’s grandfather suffered from diabetes mellitus as well. Hemodialysis was performed on her mother for the first time when she was 65, and after 10 years she died of renal failure. Her grandfather died from a heart attack aged 62.

Examination: temperature 40°C, respiration rate 23 breaths/min, arterial blood pressure 155/91 mmHg, pulse rate 102 beats/min. The patient is obese, she looks her age. Respiration in the apex of the right lung is weakened, rales are auscultated, friction of pericardium is present on the left and lower lateral side of the breastbone. Cyanosis is not observed, there are no edema in the limbs except subcutaneous edema in both knee joints.

Laboratory blood tests: glucose 15.57 mmol (normal 3.33-5.55), Na⁺ – 146 mmol/l, K⁺ – 5.2 mmol/l, Cl⁻ – 90 mmol/l, HCO₃⁻ – 5 mmol/l, urea – 39 – 27 mmol/l and creatinine 442 µmol/l; Hb 80 g/l; Ht 0.24, thrombocytes – 150×10⁹/l, blood culture × 2: E. Coli sensitivity is not determined; urine test – glucose +++, no ketones, proteins+, nitrites+, leukocyte esterase+, blood 2+, a lot of precipitates.

Explain the causes of chronic renal failure, the disorders of body function and morphological expressions.

What are the potential complications of other organs and their systems and causes of death?

Principles of treatment in renal failure and its effects on pharmacokinetics and pharmacodynamics.
**Concept of the problem.** Renal failure.

**Clinical symptoms.** Uremia, glucosuria.

**Aim**

To learn the structure of the glomerular filtration barrier and histological physiology and relate it to the occurrence of the analyzed pathology;

To learn the causes and pathogenesis of renal failure, techniques of examination and principles of treatment.

**Learning objectives and contents**

To complete an analysis of this problem the students must know:

- Regulation of Na\(^+\) excretion. Regulation of extracellular fluid composition and volume. Effects of disordered renal function.

**Subject – Physiology**

**Department of Physiology**

**References:**


- Causes and pathogenesis of renal failure. Changes in the balance of body fluids and electrolytes, in the skin, skeleton, blood, and in the cardiovascular, immune and nervous systems in chronic renal failure.

**Subject – Pathological Physiology**

**Department of Physiology**

**References:**

• Pathogenesis and morphology of uremic syndrome, causes of death, complications of hemodialysis.

Subject – Pathological Anatomy

Clinic of Pathological Anatomy

References:

• Techniques of examination of the patients with diseases of the urinary system (anamnesis, inspection, palpation, percussion, tapping) and their application to the detection of renal failure syndrome.

Subject – Essentials of Medical Diagnosis

Clinic of Internal Diseases

References:

Additional readings:
3. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

• The impact of renal failure on pharmacokinetics and pharmacodynamics; principles of drug dosage to the patients with renal failure. Drugs used to treat clinical symptoms of renal failure. To know excretion of drugs and their nephrotoxic effect.

Subject – Pharmacology

Department of Basic and Clinical Pharmacology

References:
Lecture material

Additional readings:

- Techniques of ultrasound examination of the kidneys in diagnosis of renal failure and clinical value of findings.

Subject – Radiology
Clinic of Radiology

References:

M.M., a 65-year-old male having visited the physician for physical examination complains of an ache in the lower abdominal area that spreads down into the perineum, weakened urination flow and more frequent urination. Symptoms of this kind occurred a year ago, and they have become more intense.

Prostate-specific antigen (PSA) 3.8 ng/ml (normal 3 ng/ml).

Echoscopy readings – prostate of 40 ml volume, residual urine 45 ml; hypoechoogenic formation in the right lobe of the prostate. During palpation – the prostate is stiff, the right lobe is slightly rough.

Laboratory tests: Hb – 148 g/l; eryth. $4.5 \times 10^{12}$/l; leukocytes. – $8 \times 10^9$/l; Ht – 0.30.

What pathology do you think it is, and what tests might be informative?

What are the pathological mechanisms of micturition disorder?

What are the potential complications and principles of treatment?
**Concept of the problem.** Hyperplasia of the prostate

**Clinical symptoms.** Disorders of micturition

**Aim**

To teach anatomical and histological peculiarities of the prostate, etiology and pathogenesis of micturition disorders, techniques of examination, principles of treatment.

**Learning objectives and contents**

To complete an analysis of this problem the students must know:

- The structure, surfaces, lobes and skeletotopy of the prostate. The structure of the bladder and urethra, and skeletotopy.

**Subject – Anatomy**

**Institute of Anatomy**

**References:**


**Additional readings:**


- Histological structure of the prostate, bladder and urethra.

**Subject – Human Histology and Embryology**

**Department of Histology and Embryology**

**References:**


• Mechanisms of micturition and the function of organs and systems involved in it as well as an impact of nervous and humoral factors on this regulation.

Subject – Physiology
Department of Physiology
References:

• Disorders of micturition, pathophysiological mechanisms of their occurrence due to pathology of the prostate. Potential impact of the urine flow disorders on kidney pathology.

Subject – Pathological Physiology
Department of Physiology
References:

• Dishormonal hyperplasic prostatopathy and morphology of the prostate tumors, complications and causes of death.

Subject – Pathological Anatomy
Clinic of Pathological Anatomy
References:

• Techniques of examination of patients with diseased urine excreting organs and their application to the detection of disordered urination syndrome.

Subject – Essentials of Medical Diagnosis
Clinic of Internal Diseases
References:
Additional readings:
3. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

- Techniques of ultrasound examination of the bladder and prostate in diagnosing pathology of the prostate.

Subject – Radiology

Department – Clinic of Radiology

References:
5. Lectures

5.1. Structure of the organs of the urinary system (2 hrs.)

Institute of Anatomy

**Responsible person** – assoc.prof. V. Aželis

*Description*


5.2. Histophysiology of the organs of the urinary system (2 hrs.)

Department of Histology and Embryology

**Responsible person** – prof. A.Valančiūtė

*Description*


5.3. Role of kidneys in homeostasis (2 hrs.)

Department of Physiology

**Responsible persons** – prof. E.Kevelaitis

*Description*

5.4. Regulation of water and electrolyte homeostasis with hormones (2 hrs.)

Department of Biochemistry

Responsible person – prof. L.Ivanovienė

Description

Structure of mineralcorticoids, synthesis, regulation of secretion, molecular mechanisms of aldosterone action, cellular targets, secretion disturbances, renin-angiotensin system, structure of vasopressin, regulation of secretion, cellular targets, molecular mechanisms of action, disturbances of secretion and action, types of atrial natriuretic peptides (ANP), secretion, molecular mechanisms of action will be analyzed. Role of antidiuretic hormone (vasopressin) in regulation of water balance. Molecular mechanism of antidiuretic hormone action.


Acute and chronic renal failure, etiology, mechanisms of pathogenesis, disorders of body functions (2 hrs.)

Department of Physiology

Responsible persons – lect. dr. D.Akramienė

Description

5.6. Structural principles of homeostasis and pathology of the organs of the urinary system (2 hrs.)

Department of Pathological Anatomy

Responsible persons – prof. R. Gailys

Description


5.7. Environmental factors, influencing homeostasis and renal function (2 hrs.)

Department of Environmental and Occupational Medicine

Responsible person – assoc. prof. R. Ustinavičiūnė

Description

Environmental factors (physical, chemical) influencing human body homeostasis and the urinary system.

5.8. Examination of the patients with diseases of the urinary system. Laboratory and instrumental diagnosis. Main clinical syndromes (2 hrs.)

Clinic of Internal Diseases

Responsible person – assoc. prof. P. Leišytė

Description

Examination of the patients with diseases of the urinary system. The most important aspects of anamnesis and objective examination. Principal laboratory and instrumental tests. Main clinical, morphological and functional syndromes.
5.9. Preparation of a surgical patient for an operation, correction of homeostasis. Hemocorrectors (2 hrs.)

Clinic of General Surgery

Responsible persons – lect. S.Bradulskis

Description

Kinds of body homeostasis disorders. Etiology and pathogenesis of water, electrolyte, acid-base disorder in surgical diseases, types, ways of determination, principles of correction. Corrections and principles of replacement and maintenance therapy. Hemocorrectors.

5.10. Radiological diagnostics of the kidney, bladder and prostate disorders (2 hrs.)

Department – Clinic of Radiology

Responsible person – lect. dr. D.Mitraitė

Description

Radiological imaging of the organs of the urinary system. Comparative value of various techniques – radiography, echoscopy, computerized tomography, scintigraphy, angiography – in diagnostics of diseases of the urinary system.

Impact and significance of intravenous contrast media in radiological examination of the kidneys.

Early radiological diagnostics of oncological diseases of the urinary system.

Application of the most modern technologies to the radiological diagnostics of the urinary system.

5.11. Intake of drugs in chronic renal failure (2 hrs.)

Department of Basic and Clinical Pharmacology

Responsible person – lect. R.Pilvinienė

Description
An impact of renal function failure on drug pharmacokinetics and pharmacodynamics. Principles of drugs dosage to the patients with renal failure are explained. Mechanisms of drug excretion through the kidneys are analyzed. Information about nephrotoxic effect of drugs is presented.

5.12. Drugs affecting urine excretion – diuretics (2 hrs.)

Department of Basic and Clinical Pharmacology

Responsible person – lect. R. Pilvinienė

Description

Diuretics - drugs stimulating the urine excretion. Five main groups of diuretics: carbonic anhydrase inhibitors, osmodiuretics, loop diuretics, thiazides, aldosterone antagonists are described. Mechanism of action of each drug group, site of effect and triggered pharmacological effect are discussed. Information about the properties of the most important representatives of separate classes of drugs, indications and side effects are presented.

5.13. Extremal states and changes of body functions (2 hrs.)

Institute of Physiology and Pharmacology (Pathological physiology)

Responsible person – lect. dr. D. Skaudickas

Description

6. Practical work

6.1. Structure and skeletotopy of the organs of the urinary system (6 hrs.)

Institute of Anatomy

Description

Microscopic structure of the kidneys, ureters, bladder, prostate and urethra.

References:


6.2. Structure and skeletotopy of the organs of the urinary system (6 hrs.)

Institute of Anatomy

Description

Microscopic structure of the kidneys, ureters, bladder, prostate and urethra (II part).

6.3. Histology of the organs of the urinary system (3 hrs.)

Department of Histology and Embryology

Description

Histology of the kidneys, ureters, bladder, prostate and urethra.

References:


6.4. Diseases and syndromes of the kidneys and their morphological changes (3 hrs.)

Clinic of Pathological Anatomy

Responsible persons – prof. R.Gailys, prof. V.Lesauskaitė

Description

Studying electronograms, histological and macroslides and doing modeled morphological tasks the students learn morphological manifestations of diseases and syndromes of various hierarchical structural lesions of the organs of this system (glomerulonephritis, pyelonephritis, nephrotic and uremic syndromes, urinary nephrolithiasis, tumors). Morphological expressions of diseases and syndromes, complications and potential causes of death.

Mitochondrial swelling. Electronogram (x32,000). Note, that mitochondria are enlarged, edematous, their cristae are fragmented and decomposed. Compare them with the normal ones.

Glomerulonephritis. Electrogram (x30,000). Pay attention to the changes of glomerular filter: swollen endothelium with pinocytic vacuoles, edematous, irregularly arranged fibrillary structures basal membrane with deposits, morphological changes of foot processes of podocytes: compare these changes with the common structure of glomerular filter.

Hydrosis et proteinosis cytoplasmatica nephrocytorum. Histological slide (H+E). Find tiny protein granules and water vesicles in the swollen cellular cytoplasm of the renal tubular epithelium.


Pyelonephritis chronica. Histological slide (H+E). Observe focal infiltrates of the immune cells (macrophages, lymphocytes, plasmocytes, granulocytes) in the interstitial fluid and granulocytes in the tubular lumen and scarring with atrophic tubules. Pay attention to the dilated tubules with atrophic epithelium which lumen is filled with protein-carbohydrate cylinders and sclerotic renal glomeruli, and blood vessels.

References:

6.5. Examination of the patients with diseases of the urinary system (4 hrs.)

Clinic of Internal Diseases

Description

Anamnesis, inspection, palpation, percussion, tapping, auscultation. Laboratory and instrumental diagnostics.

References:

Additional readings:
3. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

6.6. Changes in homeostasis of a surgical patient (3 hrs.)

Clinic of General Surgery

Description

Normal fluid and electrolyte balance; their loss through the digestive tract, drains, burnt surface; disorders of water, Na+, K+, and acid-base balance; monitoring of a patient.

References:


Additional readings:
6.7. Radiological diagnostics of the kidneys, bladder and prostate diseases  
(3 hrs.)

Clinic of Radiology

Description

Various techniques of radiological examination of the urinary system (X-ray images, ultrasound, computerized tomography, radionuclide). Usage of contrast media in the examination of the urinary system.

References:


Additional readings:


6.8. Drugs affecting urine excretion (3 hrs.)

Department of Basic and Clinical Pharmacology

Description

Diuretics. The most important representatives of separate classes of drugs. Mechanism of action, clinical effect, pharmacokinetic properties, indications, side effects.

References:

Lecture material
6.9. Disturbance of water balance in the body

Institute of Physiology and Pharmacology (Pathological physiology)

Description

Determination how changes in osmotic pressure influence water balance in the body.

References:

7. Seminars

7.1. Hyperchloremic metabolic acidosis (3 hrs.)

Department of Biochemistry

Description

Concepts of metabolic acidosis and hyperchloremic metabolic acidosis, their causes and damaging effects, mechanisms of HCO$_3^-$ reabsorption in the kidneys, which mechanisms function and in what membranes, and how this relates to the increased amount of HCO$_3^-$ in the urine.

References:


7.2. Molecular principles of ion and water reabsorption in the kidneys (2 hrs.)

Department of Biochemistry

Description

To understand the importance of the kidneys in homeostasis, to explain how the kidneys are supplied with energy, how reabsorption of electrolytes, glucose, amino acids takes place in the kidneys, what is a biological role of these processes.

References:

7.3. Nephrotoxic factors of occupational environment (3 hrs.)

Department of Environmental and Occupational Medicine

Description

Occupational factors of chemical origin, those have a toxic effect on the organs of the urinary system.

References:

Casaret and Doull’s Toxicology C.D.Klaassen. 2001, p. 491-514.

7.4. Main clinical syndromes of the organs of the urinary system (3 hrs.)

Clinic of Internal Diseases

Description

Syndromes: edema, renal hypertension, nephritic, nephrotic, acute and chronic renal failure.

References:

4. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

7.5. Principles of homeostasis correction of a surgical patient (3 hrs.)

Clinic of General Surgery

Description

Hemocorrectors; correction principles of homeostasis changes.

References:

Additional readings:

7.6. Radiological techniques used in the examination of the organs of the urinary system (4 hrs.)

Clinic of Radiology

Description
Radiological techniques used in the examination of the kidneys, bladder and prostate, to evaluate clinical value of findings of various radiological examinations of the urinary system. To introduce the students with early radiological diagnostics of oncological diseases of the urinogenital system.

References:


Additional readings:


7.7. Intake of drugs in chronic renal failure (3 hrs.)

Department of Basic and Clinical Pharmacology

Description
References:

1. Lecture material

8. Module examination questions:

8.1. Anatomy

1. Position, form of the kidneys and their innervation.
2. Extraorganic circulation of the kidneys.
3. Skeletotopy of the ureters, innervation, macrostructure, constrictions and their sites, and innervation.
4. Structure of the bladder and urethra, their skeletotopy, blood circulation, innervation.

8.2. Histology and Embryology

2. Histological characteristic of the cells that make up Bowman’s capsule and tubules.
3. Histological structure of the juxtaglomerular apparatus.
4. Structure of the glomerular filtration barrier.
5. Histophysiology of the prostate.
6. Histological characteristic of the urinary bladder, ureters and urethra.

8.3. Biochemistry

4. Renin-angiotensin system, action mechanisms, and physiological function.
7. The most important buffer systems in human organism: their composition, principles of action, distribution in various media of human organisms. Renewal of components of buffer systems.
8.4. Physiology

3. Clearance, its peculiarities and practical application.
5. Function of the loop of Henle, distal tubules and collecting ducts, transport processes and their mechanisms.
7. Mechanisms of micturition and the function of the organs and systems involved.

8.5. Pathological Physiology

1. Negative water balance, causes, types. Changes of the body functions during dehydration.
4. Acute renal failure, etiology, pathogenesis, changes of the body functions.
5. Chronic renal failure, etiology, pathogenesis, changes of the body functions.
7. Shock: causes and classification, levels and complications.
10. Crush syndrome, etiology, pathogenesis, stages and changes of the body functions.

8.6. Pathological Anatomy

2. Pyelonephritis, its pathogenesis, classification, morphology, complications and causes of death.
5. Causes of acute and chronic uremic syndrome development, morphological expressions and causes of death.

8.7. Essentials of medical diagnosis

1. The most important complaints of patients with diseases of the uropoetic system, their clinical meanings.
2. Changes in micturition and urinary output, their characteristics and clinical meanings.
3. Inspection, palpation, percussion of the patients with diseases of the uropoetic system, pathological findings, causes.
4. Specific gravity of the urine: normal values, pathological changes, their clinical meanings; protein in the urine: normal values, pathological changes, clinical meanings.
5. Urinary sediment examination: normal and pathological findings, standards, pathological meanings of quantitative and qualitative changes.
7. Creatinine clearance: definition, method of performance, normal values, pathological findings, clinical meanings.
8. Main symptoms of nephritic and nephrotic syndrome, clinical meanings.
10. Syndrome of chronic renal failure: definition, causes, clinical and laboratory findings, clinical meanings.

8.8. Pharmacology

1. The influence of renal failure on drug pharmacokinetics and pharmacodynamics.
2. Carbonic anhydrase inhibitors and osmotic diuretics.
3. Thiazide and thiazide-like diuretics.
4. Loop diuretics.
5. Potassium-sparing diuretics.

8.9. Radiology

1. Potentials of radiological imaging of the organs of the urinary system. Comparative value of the different methods.
2. Potentials of early radiological diagnostics of oncological diseases of the urinogenital system.
3. Kidney and bladder indications for computerized tomography (CT).
4. Radiological examination of nephrolithiasis and obstruction.
5. Influence and significance of intravenous contrast media on radiological examination of the kidneys.
6. Radiological diagnostics of kidney cancer and cysts (X-ray images and CT).
7. Significance and potentials of radionuclide investigation of the kidneys.
9. Significance and potentials of ultrasound examination of the kidneys.
10. Potentials of ultrasound examination of the bladder and prostate.

8.10. General Surgery

   Main hormones in regulation of fluid exchange. Signs of dehydration.
5. Methods for detection of electrolytes imbalance and principles of correction.
8.11. Environmental and occupational medicine

1. What physical environmental factors may influence the functions of the urinary system?
2. Describe the etiology of overheat, a heat stroke, their symptoms and first aid.
3. What environmental pollutants may influence the functions of the urinary system?
4. Legal acts restricting pollution of chemical factors in the environment.
Appendix

8.12. Questions for the seminar “Molecular principles of reabsorption in the kidneys” (2 hrs.)

Department of Biochemistry

Responsible person – prof. V. Borutaitė

Questions:

1. How are the kidneys supplied with energy?
2. How does reabsorption of sodium and chloride take place in the kidneys?
3. How does reabsorption of potassium take place in the kidneys?
4. Explain what hormones and how they regulate reabsorption of the electrolytes in the kidneys?
5. How does reabsorption of glucose take place in the kidneys?
6. How does reabsorption of amino acids take place in the kidneys?

References:

Additional readings:


8.13. Questions for the seminar “Hyperchloremic metabolic acidosis” (3 hrs.)

Department of Biochemistry

Responsible person – prof. V. Borutaite

Questions:

Questions:

1. Explain the concepts of acidosis and alkalosis.
2. Explain the causes of metabolic and respiratory acidosis development, molecular mechanisms and consequences.
3. Explain the causes of development of metabolic and respiratory alkalosis, molecular mechanisms and consequences.
4. Explain what hyperchloremic metabolic acidosis means, what may cause it and what it is harmful for.
5. What systems carry out reabsorption of HCO$_3^-$ in the kidneys, their localization and molecular mechanisms of action?

References:

Additional readings:

8.14. Questions for the seminar “Principal clinical syndromes of the organs of the urinary system” (3 hrs.)

Clinic of Internal Diseases

Responsible person – asocc. Prof. Palmira Leišytė, assist Edita Mašanauskienė

Questions:
1. The most important complaints of patients with diseases of the uroepoetic system, their clinical meanings.
2. Changes in micturition and urinary output, their characteristics and clinical meanings.
3. Inspection, palpation, percussion of the patients with diseases of the uroepoetic system, pathological changes, causes.
4. Specific gravity of the urine: normal values, pathological changes, clinical meanings; protein in the urine: normal values, pathological changes, clinical meanings.
5. Urinary sediment examination: normal and pathological findings, standards, pathological meanings of quantitative and qualitative changes.
7. Creatinine clearance: definition, method of performance, normal values, pathological findings, clinical meanings.

8. Main symptoms of nephritic and nephrotic syndrome, clinical meanings.

9. Syndrome of acute renal failure: causes, principal clinical and laboratory changes, clinical meanings

10. Syndrome of chronic renal failure: definition, causes, principal clinical and laboratory changes, clinical meanings

11. Causes of renal hypertension and renal eclampsia, the most important clinical and laboratory changes, clinical meanings.

References:

Additional readings:
3. Walter, M.D. Siegenthaler (Author), A. Aeschlimann (Contributor), E. Baechli (Contributor), C. Bassetti (Contributor), E. Battegay. Differential Diagnosis in Internal Medicine: From Symptom to Diagnosis 2007.

8.15. Questions for the seminar “Nephrotoxic factors of occupational environment” (3 hrs.)

Department of Environmental and Occupational Medicine

Responsible persons – assoc.prof. R.Ustinaviciene

To acquaint students with occupational factors of the chemical origin that have a toxic effect on the organs of the urinary system.

Questions:
1. What are chemical occupational factors or groups of chemical substances that have an effect on the urinary system?
2. In what working activities, professions are chemical substances used that have an effect on the urinary system?
3. Individual and organization preventive measures used in prevention from intoxication with chemical substances?

4. Legal acts, regulating protection from chemical substances in the working place.

References:

8.16. Questions for the seminar “Potentials of radiological investigation of the organs of the urinary system” (4 hrs.)

Clinic of Radiology

Responsible person – lect. D.Mitraite

Questions:
1. Indications of the kidneys and bladder for radiological examination.
2. Indications of the kidneys, bladder and prostate for ultrasound examination.
3. Indications of the kidneys and prostate for computerized tomography.
4. Indications for digital subtraction renal angiography and endovascular revascularization.
5. Indications for radionuclide examination of the kidneys.
6. X-ray examination of nephrolithiasis and renal obstruction.
7. Ultrasound diagnostics of inflammatory diseases of the kidneys.
10. Ultrasound semiotics of various nephropathies, and nephrocalcinosis.
11. Ultrasound semiotics of the bladder tumors, prostate hyperplasia and cancer.
12. Algorithm of radiological examination of the patients with kidney diseases.

References:

Additional readings:
