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ANATOMY OF INTERNAL ORGANS

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МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
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КАФЕДРА НОРМАЛЬНОЙ АНАТОМИИ

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АНАТОМИЯ ВНУТРЕННИХ ОРГАНОВ

ANATOMY OF INTERNAL ORGANS

Учебно-методическое пособие

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Содержит материалы и рекомендации по изучению строения внутренних органов, перечень анатомических терминов, и контрольные вопросы к занятиям по разделу «Спланхнология».

Предназначено для самостоятельной работы студентов 1-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке.

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INTRODUCTION

The guide manual “Anatomy of internal organs” is complementary to the textbook and is intended to help students learning theoretical material and gaining practical skills on “Splanchnology”. It can be used for independent work in the classroom or out-of-class work.

All material is organized in lessons (topics) according to the teaching plan for the 2nd semester of the curriculum in Human Anatomy. Each lesson contains the “Guidelines”, in which recommendations how to examine anatomical specimens and study the theoretical material are given, and points requiring particular attention are emphasized. Besides, some aspects of organ structure difficult for students understanding or absent in the textbook are explained.

The lists of anatomical terms and structures students should know and be able to identify in anatomical specimens are given in accordance with the International anatomical terminology (2009). Besides English terms with their synonyms (in brackets), the most important Latin terms, as well as some of commonly used terms and eponyms (in paracenteses), are given.

Questions for self-control cover all the material of the lesson and help to select the principal points out of profound information presented in the textbook. These questions can be used not only for self-study but also for the in-class current control.

The «Anatomy of internal organs» is composed considering the methodological recommendations to the laboratory classes for 1st year students of the medical faculty (in Russian), issued in 2012 (authors: S. D. Denisov, P. G. Pivchenko, V. V. Rudenok, M. I. Bogdanova, L. A. Davydova, G. P. Dorohovich, G. E. Konopelko, L. D. Chayka, S. P. Jaroshevich, Y. A. Guseva, N. A. Trushel, T. V. Sakcharchuk, A. A. Pasjuk). Special thanks to T. G. Novickaya, lecture of the Department of Foreign Languages.

LESSON 1

Topic: Overview of organs of the digestive (alimentary) system. Mouth: oral cavity, lips, cheeks, hard and soft palate. Teeth: milk and permanent.

Learning aims:

– to understand general anatomy of internal organs and systems of internal organs, general patterns of parenchymatous and tubular (hollow) organs structure, general structural characteristics of the alimentary (digestive) system: digestive tract and accessory digestive organs;

– to know the structure of the walls of the oral cavity: lips, cheeks, floor of the mouth, hard and soft palate; structure of the teeth, groups of teeth and their typical groups characteristics; dental formula; eruption times and order for deciduous and permanent teeth;

– to explain terms: periodontium, dental arch, physiological and pathological occlusion (bite);

– to be able to define in the sagittal section of the cadaveric head: the structures of the oral mucosa and palate; muscles of the soft palate and floor of the mouth; fauces and its limiting structures; palatine tonsils;

– to be able to determine parts of a tooth and refer a tooth to its group.

Teaching aids: skull, mandible, maxilla, sagittal section (half) of the cadaveric head, teeth, museum specimens, tables, roentgenograms of teeth, endoscopic images, atlas.

Textbook: Sapin, Vol. 1, P. 306–317. (Tandon: P. 460–463).

GUIDELINES

Studying the alimentary system, you should get familiar with the structure and role of different parts of the digestive tract and related digestive glands; pay attention to the general structural plan of the digestive tube and specific features of its parts. During the study of the **mouth** pay attention to the structures that form walls of the **oral cavity**, topography of the **buccal fat pad**, the structures of the mucosa in the **vestibule** and **oral cavity proper**, structures limiting the **fauces**; and the **palatine tonsil** location. Consider that the **palatoglossal arch** is seen better when the tongue is pulled down, while the **palatopharyngeal arch** is more obvious when the soft palate is pulled up. Studying the muscles of the **soft palate** note that the **tensor veli palatine** and **levator veli palatine muscles** originate (in addition to the bony points) on the cartilaginous part of the auditory tube, and that the tensor lies in front of the levator, right behind the pterigoid process.

Studying the teeth, first learn the general structure of a **tooth**: its parts, surfaces, and composition. Pay attention to the structures that fix a tooth: **periodontal ligament** (desmodont), **cement**, **alveolar bone**, and **gum**, which are defined as "**periodont**". Consider specific structural features of **deciduous**

and **permanent teeth**. Pay attention to the position of the teeth in the **dental arcades**: maxillary (upper) dental arcade, mandibular (lower) dental arcade; draw dental formulas of deciduous (milk) and permanent teeth and learn their group characteristics. Learn the eruption time and sequence for deciduous and permanent teeth (see table 1, 2). In babies, tooth eruption is also called teething and usually begins at about six months; note that the lower teeth erupt first and the 1st premolars are ahead the canines; children usually have their full set of 20 primary teeth by the age of 3 years. Note that eruption of permanent teeth begins at about the age of six with the first molars (6 year molars) and finishes around 12 to 14 years, except for the third molars, also named wisdom teeth, which erupt between 12 and 26 years old.

Draw attention to the relationship between the upper and lower teeth when they are in contact, defined as "occlusion". In physiological bite the center of the upper and lower dental arcades coincide, the front teeth are in contact, the lingual cusps of the upper molars are between the cusps of the lower molars. The pathological bite lacks at least one of these signs. The pathological bite decreases the chewing efficiency, may cause the pathological abrasion of teeth, and even change appearance; it may be due to a congenital anomaly of the dental system, a result of tooth removal or disease or injury of jaws.

To improve the learning process of this theme examination of your own oral cavity and teeth with a mirror is recommended.

Table 1

Eruption of milk teeth (in months)

Medial incisor (m I)	**Lateral incisor (l I)**	**Canine**	**1st Molar (1st M)**	**2nd Molar (2nd M)**
Upper dental arch				
8	12	20	16	24
Lower dental arch				
6	10	18	14	22

Table 2

Eruption of permanent teeth

Teeth	**m I (1)**	**l I (2)**	**C (3)**	**1st P (4)**	**2nd P (5)**	**1st M (6)**	**2nd M (7)**	**3rd M (8)**
Age	**7** (6–8)	**8** (7–9)	**9–10** (9–12)	**9–10** (9–12)	**11** (11–12)	**6**	**12** (11–12)	**12–26**

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Mouth: oral cavity; oral fissure; oral vestibule; oral cavity proper; angle [corner] of mouth; upper/lower lip: labial commissure, frenulum of upper/lower lip; cheek; buccal fat pad; papilla of parotid duct; gingiva (gum); frenulum of tongue; sublingual fold; sublingual caruncle [papilla]; hard palate (Latin: *palatum durum*): palatine raphe, transverse palatine folds (palatine rugae); **fauces:** isthmus of fauces (oropharyngeal isthmus); soft palate (Latin: *palatum*

molle, or velum palatinum); uvula, palatoglossal arch, palatopharyngeal arch, tonsillar sinus; tonsillar fossa; palatine tonsil: tonsillar pits and crypts; **muscles of soft palate and fauces:** levator veli palatine, tensor veli palatine, musculus uvulae, palatoglossus, palatopharyngeus, palatine aponeurosis. **Tooth, teeth** (Latin: *dens, dentes*): deciduous and permanent teeth; **parts of a tooth:** crown, neck (cervix), root; cusp; incisal margin; pulp cavity: pulp cavity of crown, root (or pulp) canal; apical foramen; enamel; dentin; cement; dental pulp; periodontium; periodontal ligament (desmodont); tooth socket (Latin: *alveolus dentalis*); **groups of teeth:** incisors, canines, premolars, molars; wisdom tooth; surfaces of a tooth: vestibular, lingual (palatal), approximal: mesial and distal, occlusal [masticatory].

In roentgenograms: part of a tooth, crown cavity, root canal, periodontal ligament, alveolus.

Questions for self-control:

1. What organs are called internal organs?
2. Give examples of parenchymal and tubular organs.
3. List successively the organs of the digestive system.
4. Describe the main functions of each of them.
5. Describe the general structural plan of the digestive tract walls.
6. Name the walls of the mouth and describe their structure.
7. What do the cheeks and lips consist of?
8. Where is the buccal fad pad located?
9. Name the two parts of the mouth. How are they separated from each other?
10. Name structures of mucosa situated in the vestibule of the mouth and those located on the mouth floor under the tongue.
11. Describe the precise location of the opening of the parotid gland's duct?
12. What parts does the palate consist of?
13. What bones constitute to the formation of the hard palate?
14. Name the structures related to the soft palate.
15. Describe the muscles of the soft palate, their location and function.
16. The oral examination of the patient revealed the prolapsed soft palate and absence of the palate reflex. Which muscles of the soft palate are paralyzed?
17. What does the term "fauces" mean? Which anatomical structures surround it?
18. What are the borders of the tonsillar fossa? What does it contain?
19. What are the gums?
20. Name the parts of the tooth?
21. What does the tooth consist of?
22. What parts does the pulp cavity consist of? What is a tooth pulp?
23. Name the surfaces of the tooth.

24. Where is the periodontal ligament located?
25. What are the parts of the periodontium?
26. Name groups of teeth and indicate the number of teeth in each group. Draw their group dental formula.
27. Characterize different groups of teeth (incisors, canines, premolars and molars): shape of their crowns and number of roots. What is a wisdom tooth?
28. Draw the group dental formula for the deciduous (primary or milk) teeth. Describe their main features, timing and sequence of eruption.
29. What is the number of permanent teeth? Draw their group dental formula.
30. Describe the timing and order of eruption for the permanent teeth.
31. What does the term “bite” mean? Describe the position of the anterior and posterior teeth in the physiological bite.
32. Which teeth could cause an inflammation of the maxillary sinus, odontogenic sinusitis (haimoritis)?

LESSON 2

Topic: Tongue. Major and minor salivary glands: topography. Pharynx: topography and structure. Pharyngeal lymphoid ring.

Learning aims:

– to know the structure of the tongue (parts, surfaces, structures of the mucosa, muscles); principle structure and topography of the major salivary glands and their ducts; topography of the minor salivary glands; topography and structure of the pharynx; topography of components of the pharyngeal lymphoid ring;

– to be able to identify in the anatomical specimens and teaching aids the structures of the mucosa: on the surface of the tongue, under the tongue, on the mouth floor; major salivary glands and parotid duct; parts of the pharynx and structures located on its walls; muscles and fasciae of the pharynx; tonsils of the pharyngeal lymphoid ring; retropharyngeal space.

Teaching aids: skull, sagittal section of the cadaveric head with the salivary glands, specimen of the tongue with the larynx, museum specimens, tables, atlas.

Textbook: Sapin, Vol. 1, P. 317–330 (Tandon: P. 463–474).

GUIDELINES

When you study the dorsal surface of the **tongue** pay attention to the fact that the mucosa in front of the terminal line is covered by different kinds of papillae, as the whole root of the tongue is occupied by the **lingual tonsil**. **Filiform papillae** are the most numerous and give the tongue a velvet appearance due to the keratinized squamous epithelium which covers them.

Fungiform papillae are bigger and elevate above the surface on the apex and dorsum of the tongue. **Foliate papillae** are on the sides of the tongue and vallate papillae are right in front of the terminal line which divides the body and the root of the tongue. Keep in mind that when you examine your own tongue using a mirror you can see its tip, **dorsum**, **margins**, and **inferior surface**, but not the **root**.

The muscles of the tongue can be found in the sagittal section of the head and the specimen of the tongue with the larynx. The fibers of the intrinsic muscles of the tongue intersect but the muscles could be traced by the predominant direction of their fibers. In the sagittal section of the tongue the **longitudinal** and **vertical muscles** are cut along their bundles and, therefore, are more obvious, as the bundles of the **transverse muscle** are cut transversally. The transverse muscle is better seen in the transversal section of the tongue.

When you study the major **salivary glands** pay attention to the type of their secretion, topography of the glands and their ducts, adjacent structures, topography of the facial nerve plexus and its branches in the parotid gland.

Studying the **pharynx** (in the sagittal section of the head) one should pay attention to its skeletopy and syntopy and division into three **parts**; find the openings on the front wall of the pharynx connecting it to the nasal, oral and laryngeal cavities; find the connection between the pharyngeal and tympanic cavities on the lateral wall; determine the **retropharyngeal space** (in front of the vertebral column) and trace its connection with the posterior mediastinum; determine the location of the tonsils comprising the **pharyngeal lymphoid ring** and explain their role.

Attention should be paid to the sequence of layers in the pharyngeal wall. Note that the **pharyngobasilar fascia** forms a soft skeleton of the **nasopharynx** and can be seen on its posterior wall near the base of the skull where it is not covered by **pharyngeal constrictors**. In the lower parts of the pharynx the pharyngobasilar fascia continues with the **submucosal lay**er. The individual muscles of the pharynx can be demonstrated in the visual aids and museum specimens. The **buccopharyngeal fascia** is an outmost layer, which continues with the fascia of the buccinator muscles.

Note that each part of the pharynx has its specific function and related structural features: differences in its epithelial lining and framework (hard, bony and fibrous, in the upper pharynx and soft and stretched in the lower part).

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Tongue (Latin: *lingua*) and its parts: body (Latin: *corpus*), apex (tip), root (Latin: *radix*), margins of tongue, dorsum and inferior surface of tongue. Mucous membrane of the tongue: frenulum of tongue; midline groove (median

sulcus) of tongue, terminal sulcus of tongue, foramen caecum of tongue, lingual tonsil; papillae of tongue (lingual papillae): filiform (conical), fungiform, vallate, and foliate papillae. Muscles of the tongue: extrinsic (genioglossus, hyoglossus, styloglossus, and palatoglossus); intrinsic (superior/inferior longitudinal muscle, transverse muscle, vertical muscle); lingual septum; lingual aponeurosis. **Salivary glands:** major salivary glands: parotid gland, parotid duct, submandibular gland, submandibular [Wharton's] duct, sublingual gland, major sublingual duct, minor sublingual ducts; minor salivary glands: labial, buccal, molar, palatine, lingual glands. **Pharynx:** cavity of pharynx; **nasopharynx:** vault of pharynx, pharyngeal (adenoid) tonsil, pharyngeal opening of auditory tube, torus tubarius, tubal tonsil; **oropharynx:** epiglottic vallecula, median/lateral glosso-epiglottic fold; **laryngopharynx:** piriform fossa (recess); **pharyngeal wall:** mucosa (mucous membrane), pharyngeal glands; submucosa, pharyngobasilar fascia; pharyngeal muscles: superior/middle/inferior constrictors, pharyngeal raphe, pterygomandibular raphe, palatopharyngeus muscle, stylopharyngeus muscle; buccopharyngeal fascia; retropharyngeal space.

Questions for self-control:

1. Name parts and surfaces of the tongue.
2. What is the border between the body and the root of the tongue?
3. Where is the foramen cecum of the tongue located? Explain its origin.
4. Describe papillae of the tongue and specify their location. Which of them contain taste buds, and which serve as tactile organs?
5. Name the muscles of the tongue (extrinsic and intrinsic), indicate their location and actions.
6. As a result of a brain hemorrhage (stroke) the patient lost ability to move his tongue forward. The function of which muscle has failed?
7. List the small salivary glands.
8. Describe the topography of the parotid gland and its duct.
9. Describe the topography of the submandibular gland and its duct.
10. Describe the topography of the sublingual gland and its ducts.
11. Before filling in a tooth cavity the dentist should dry the area around the tooth. Where should he put a cotton swab to block the ducts of the large salivary glands?
12. Name the parts and walls of the pharynx. What cavities are connected with the pharyngeal cavity? Name these connections.
13. List the layers forming the wall of the pharynx.
14. Name all tonsils of the pharyngeal lymphoid ring and specify their location.
15. The child experiences difficulty with nasal breathing and his hearing is also affected. The growth of which tonsil can cause these symptoms?

16. Name muscles of the pharynx, describe their location and actions.

17. Specify the level (vertebrae) corresponding to each part of the pharynx and its transition to the esophagus?

18. What anatomical structures are located in front, behind, laterally and above the pharynx?

LESSON 3

Topic: Esophagus: topography and structure. Roentgen anatomy of the esophagus. Abdominal regions. Abdominal and pelvic cavities and their walls. Peritoneal cavity. Stomach: topography and structure. Roentgen anatomy of the stomach.

Learning aims:

– to know the topography, structure, constrictions of the esophagus;

– to know the regions of the abdomen; structure of the wall of the abdominal cavity;

– to understand the terms: abdominal and pelvic cavities; peritoneum; peritoneal cavity; extraperitoneal space; intra-, meso-, and retroperitoneal organs;

– to know the topography (syntopy, skeletopy, and holotopy) and structure of the stomach, variations in its shape and position associated with the constitutional body types;

– to be able to identify the esophagus, its parts and constrictions in the anatomical specimens, cadavers, teaching aids, and roentgenograms;

– to be able to position the stomach considering its location in the body;

– to identify the parts, orifices, sphincters and mucosal structures of the stomach in anatomical specimens, visual aids, cadavers, and roentgenograms.

Teaching aids: skeleton; anatomical specimens: sagittal section of the head, stomach; cadaver with the dissected chest and abdominal cavity; museum specimens; models and other visual aids; radiographs and endoscopic images; textbook, atlas.

Textbook: Sapin, Vol. 1, P. 330–339 (Tandon: P. 259–260; 474; 233–234; 271–273).

GUIDELINES

When you study an internal organ you should learn its structure and position in the body, or topography. Topography of an organ is determined by its syntopy, skeletopy, and holotopy. **Skeletopy** is a location of an organ in relation to the various bones of the body. **Syntopy** is defined as a position of the organ relative to other organs. **Holotopy** is a relationship of the organ to the body as a whole, for internal organs it is a projection of the organ on the body walls.

To help physicians to determine holotopy of organs, i. e. their surface projections, and pain sites, the abdomen is divided into 3 areas and 9 regions. The two horizontal planes divide the abdomen into 3 areas, **epigastrium, mesogastrium**, and **hypogastrium**: 1) subcostal plane passing through the inferior borders of the costal arches (10th costal cartilage on each side); 2) intertubercular plane passing through the iliac crests.

The two vertical, right and left **midclavicular lines**, passing from the midpoints of the clavicles to the midpoints of the inguinal ligaments (or pubic tubercles), divide each area into 3 regions as follows: **epigastrium** — into the **right** and **left hypochondriums (hypochondriac** regions) and **epigastric** region in the middle; **mesogastrium** — into the **right** and **left flanks** (**right** and **left lateral regions)** and **umbilical** region; and **hypogastrium** — into the **right** and **left groins (inguinal) regions** and **pubic** region.

In order to understand topography of the abdominal organs, you should learn the definitions for the peritoneum, abdominal and peritoneal cavities, extraperitoneal space.

The **abdominal cavity** is a greater part of the abdominopelvic cavity. It is bounded superiorly by the diaphragm, anteriorly and laterally by the abdominal muscles with their aponeuroses, posteriorly by the lumbar part of the spine, muscles: psoas major (minor), quadratus lumborum, and latissimus dorsi, and iliac wings with iliac muscles. Inferiorly the abdominal cavity it continues with the pelvic cavity. **Endoabdominal** and **pelvic fasciae** form the internal layers of the abdominal and pelvic walls.

The **peritoneum** is a serous membrane, which lines the internal wall of the abdominal cavity (**parietal peritoneum**) and covers most of its organs, or vescera (**visceral peritoneum**). The p**eritoneum** is a continuous sheet which extends from the abdominal wall to the organs and between organs forming ligaments, mesenteries, omentums, and folds.

The **peritoneal cavity** is a system of slit-like spaces between the parietal and visceral peritoneum, and between adjacent areas of the visceral peritoneum. It contains a small amount of **serous fluid** that acts as a lubricant. **Extra-(retro-) peritoneal space** is between the parietal peritoneum and the endoabdominal or pelvic fasciae filled with fatty or loose connective tissue.

Depending on relation to the peritoneum abdominal organs are referred to as **intraperitoneal** (covered from all sides), **retroperitoneal** (covered from one side), and **mesoperitoneal** (covered from three sides).

Studying the **esophagus**, you should pay attention to the topography of each part of the organ and the structure of its wall; use a sagittal section of the head, specimens of the stomach, museum specimens, visual aids, and a cadaver. On radiographs of the esophagus pay attention to its curves, constrictions, and relationships with the vertebral column, trachea, and aorta.

To position a specimen of the **stomach** correctly, considering its location in the body, firstly, you need to find an outlet of the stomach — pyloric orifice — which is determined by the thickening of the muscle layer. Then the stomach should be placed in such a way that the inlet — cardial orifice — is directed left, up, and slightly posterior, while the pylorus is on the right, down, and forward, with the greater curvature facing to the left and down, and the lesser curvature facing to the right and up. To determine the parts of the stomach, take into account that its fundus is above the cardial orifice, and the conventional boundary between the body and pyloric part corresponds to the angular incisure (notch) on the lesser curvature.

Pay attention to holotopy, skeletopy, and syntopy of the stomach, its relation to the peritoneum, and its wall structure. On radiographs of the stomach you should determine its orifices, parts, sphincters, an air bubble, and shapes of the gastric folds. Pay attention to the individual variations in shapes and positions of the stomach and to the typical features associated with the particular constitutional body type (endomorph, mesomorph, and exomorph).

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Esophagus: cervical, thoracic, abdominal parts; constrictions: pharyngo-oesophageal, broncho-aortic, diaphragmatic; mucosa: epithelium, lamina propria, muscularis mucosae; submucosa (tela submucosa); esophageal glands; muscular layer (or muscularis externa), adventitia, serosa. **Stomach** (Latin: *ventriculus*): anterior/posterior wall, greater/lesser curvature, angular incisure (angular notch), cardial orifice, cardial part, cardial notch, fundus (fornix) of stomach, body of stomach, pyloric part: pyloric antrum and pyloric canal, pylorus, pyloric orifice, pyloric sphincter; mucosa of stomach: gastric folds (rugae), gastric areas, gastric pits, pyloric valve; submucosa; muscular layer: longitudinal and circular layers, oblique fibers; serosa; ligaments: hepatogastric ligament, gastrocolic ligament, gastrosplenic ligament.

In radiographs: parts and constrictions of the esophagus; orifices, parts, sphincters (cardial, pyloric, antral), mucosal folds of the stomach.

Questions for self-control:

1. What is the general structural plan of the digestive tract wall? Describe its layers.
2. How do the serosa and adventitia differ?
3. What is the function of the esophagus?
4. What is the length of the esophagus? Name its parts and indicate their boundaries.

5. What sphincters regulate the movement of bolus of food from the pharynx to the stomach?

6. Name the main anatomical structures (such as vertebral column, neurovascular bundle of the neck (carotid sheath), trachea, left bronchus, lungs, pericardium, aorta, liver) located in front, laterally and back to each part of the esophagus.

7. Specify anatomical constrictions of the esophagus lumen and locate them in the roentgenogram.

8. What layers does the esophagus wall consist of? What are the specific features of each of them?

9. What lines (planes) are the boundaries of areas and regions of the abdomen? Name these areas and regions.

10. Give definitions of the terms “abdominopelvic cavity”, “abdominal cavity”, “pelvic cavity”. List anatomical structures that make up the walls of the abdominal and pelvic cavities.

11. What is the capacity and size of the stomach in adults?

12. Name the openings, borders, and parts of the stomach.

13. What is the conventional border between the body and the pyloric part of the stomach?

14. What are the subdivisions of the pyloric part?

15. What is the origin of the terms “cardia” and “pylorus”?

16. Describe the holotopy of the full and empty stomach.

17. Indicate the skeletopy of the stomach inlet and outlet.

18. Describe the sintopy of the stomach.

19. List the layers of the stomach wall.

20. What structures are located within and on the surface of the stomach mucosa? Name the tree types of the gastric glands?

21. Endoscopy of the stomach did not show any pathological changes in the relief of the mucosa. What are the patterns of gastric folds on the walls, greater and lesser curvatures, and pyloric part of the stomach?

22. List the layers of the stomach muscular coat. Where is the anatomical sphincter of the stomach located?

23. Why doesn’t the pressure in the stomach greatly increase as it fills?

24. What is the “physiological sphincter” of the stomach? Where is it located?

25. What is the stomach relation to the peritoneum? List ligaments of the peritoneum connecting the stomach to the adjacent organs.

26. Describe the roentgen appearance of the esophagus and stomach. What are the main variants of shape and position of the stomach? How do they relate to the constitutional body types?

27. What methods are used for examining the stomach in a living person?

LESSON 4

Topic: Small intestine: topography, structure, X-ray anatomy.

Learning aims:

– to know topography and common structural features of the small intestine, specific features of its individual portions and their relationships with the peritoneum;

– to understand how structures of the small intestine wall are related to its functions: digestion, absorption, protection, motility;

– to be able to demonstrate the duodenum and its parts, jejunum and ileum and their mesentery in a dissected cadaver and anatomical specimens;

– to be able to locate duodenal papillae in the dissected duodenum.

Teaching aids: anatomical specimens: duodenum with the pancreas, segments of the jejunum and ileum; dissected cadaver; museum specimens; models and other visual aids; radiographs; endoscopic images; atlas.

Textbook: Sapin, Vol. 1, P. 339–344 (Tandon: P. 275–277; 289–291).

GUIDELINES

When you study the small intestine, you should pay attention to its topography (holotopy, skeletopy, and syntopy), divisions and their relationships with the peritoneum. Also note that the descending part of the duodenum is crossed in front by the root of the transverse mesocolon (mesentery of the transverse colon), and the horizontal part — by the root of the mesentery of the small intestine. Therefore, the demonstration of the duodenum and other parts of the small intestine in the abdomen of the dissected cadaver should be taken in several steps. In the upper part of the abdomen you should identify the stomach, and its transition to the **duodenum**, the pylorus, which can be felt as a knobby thickening. The **superior part** of the duodenum forms a **superior duodenal flexure** under the liver and continues as a **descending part** that is crossed by the transverse mesocolon root.

A large sheet of peritoneum, suspended from the stomach, the **greater omentum**, merges with the anterior wall of the **transverse colon** and proceeds down to cover the organs in the lower part of the abdomen. After lifting the greater omentum (together with the transverse colon) the following parts of the duodenum can be identified behind the parietal peritoneum: the lower piece of the **descending part**, **inferior duodenal flexure, and horizontal part**, crossed by the running obliquely **root of mesentery**. The left portion of the horizontal part and small **ascending part** can be traced if the small intestine with its mesentery is moved to the right. On the left side of the L2 vertebra is a duodenojejunal flexure fixed to the posterior abdominal wall. This is a landmark for the beginning of the mesenteric part of the small intestine. Trace the mobile part of the small intestine from the duodenojejeunal junction to

the ileocecal junction in the lower right region of the abdomen. Note that it forms many coils, the proximal part, **jejunum**, has a thicker wall and through an imperceptible transition continues as the **ileum**.

To demonstrate the parts of the duodenum in individual anatomical specimens, you should position the duodenum in accordance with its location in the body. When you examine the mucosa note that the **pyloric valve**, which separates the stomach from the duodenum, is a circular fold; only the initial part of the duodenum, **ampulla**, contains longitudinal mucosal folds; the interior of the rest small intestine exhibits characteristic circular folds, however, they are pronounced much better in the proximal part of the small intestine. On the medial wall of the descending part of the duodenum, in the place where it accretes with the head of the pancreas, an elongated elevation of the mucosa is identified — **longitudinal fold of duodenum**. Its distal end bears the **major duodenal papilla**; the minor **duodenal papilla** is located ≈ 2 cm proximally. Palpation of this area may help to identify the **papillae** if they are not clearly visible.

In radiographs of the small intestine pay attention to the position of the parts and flexures of the duodenum, variants of its shape, position of the jejunum and ileum coils and the relief of their mucousal membrane. Notice that the ampulla of the duodenum lacks circular folds, and has an appearance of a “duodenal cap”.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Small intestine (Latin: *intestinum tenue*): duodenum, jejunum, ileum; intestinal wall: mucosa: circular folds, intestinal villi, intestinal glands (crypts), solitary/aggregated lymphoid nodules, muscularis mucosae; submucosa; muscular coat: longitudinal/circular layer; serous coat. **Duodenum:** ampulla (duodenal cap); superior/descending/inferior (horizontal)/ascending part of duodenum; superior/inferior duodenal flexure; duodenojejunal flexure; longitudinal fold of duodenum; major/minor duodenal papilla; duodenal glands. **Ileum:** ileal [Meckle's] diverticulum.

On radiographs: divisions of the small intestine, parts of the duodenum.

Questions for self-control:

1. What is the length of the small intestine in adult?
2. What structures serve as the landmarks to identify the beginning and the end of the small intestine?
3. Name the parts of the small intestine. Which of them belong to its mesenteric part?
4. What is the length of the duodenum? Name the parts of the duodenum and describe their skeletopy and sintopy.

5. Name the initial part of the duodenum. What is the direction of folds of mucousa in this part? What is the “duodenal cap”?

6. Which structures on the duodenal mucosa correspond to the openings of the pancreatic ducts and common bile ducts? Specify their location.

7. Describe the relations of different parts of the duodenum to the peritoneum?

8. Where is the transition between the duodenum and jejunum located? What is it called?

9. List the coats of the small intestine wall.

10. How many layers does the muscular coat of the small intestine consist of? Specify their orientation. What kind of movements do they produce?

11. Why does chyme (food material) move in the craniocaudal direction?

12. What macro- and microscopic structures are located on the surface and within the mucous membrane of the small intestine?

13. Which structures of mucosa increase the surface of absorption?

14. What are the circular folds, villi, and microvilli in the small intestine? What are their functions?

15. Which lymphoid structures can be found in the small intestine?

16. Which vessels in the intestinal mucosa are responsible for absorption and transport of proteins, carbohydrates, and lipids?

17. How does the jejunum differ from the ileum? Is there a border between these parts of the small intestine?

18. What is the Meckle’s diverticulum?

19. Describe the typical roentgen appearance of the small intestine, duodenum?

LESSON 5

Topic: Large intestine: topography, structure, roentgen anatomy.

Learning aims:

– to know parts of the large intestine, their topography and relationships with the peritoneum; typical (external and internal) structural features of the colon wall;

– to know structure of the caecum and appendix, variants in their positions, projection of the appendix origin on the anterior abdominal wall;

– to know parts, topography, and structural features of the rectum, its pelvic part and anal canal;

– to be able to locate parts of the large intestine and their mesenteries, demonstrate the specific features of the colon in the cadaver and radiographs;

– to be able to identify anatomical structures of the ileocecal transition, appendix, wall of the large intestine in individual anatomical specimens.

Teaching aids: anatomical specimen of ileocecal transition ("angle"), that comprises the distal ileum, cecum with appendix, and ascending colon; segment of the colon; museum specimens; dissected cadaver; models and other visual aids; radiographs and endoscopic images; atlas.

Textbook: Sapin, Vol. 1, P. 344–350 (Tandon: P. 291–296; 346–347; 335–336).

GUIDELINES

In a specimen of ileocecal transition locate the caecum, as a blind sac under the junction of the ileum (on the left) and the colon. Pay attention to the structure of the **ileocecal valve** (**ileal papilla**). Note the constant origin of the **vermiform appendix** from the postero-medial wall of the **caecum** and its relation to the **McBurney's point** on the abdominal wall: 2/3 of the way down the line from the umbilicus to the iliac crest.

In a cadaver, in the right iliac fossa, identify the ileocaecal transition, and caecum with vermiform appendix; follow the **colon** through its parts, noting their syntopy and holotopy, relationships of each to the peritoneum, find portions with a mesentery: appendix, transverse colon and sigmoid colon, and portions without a mesentery.

Note the appearance of the colon in contrast to that of the small intestine. Find 3 narrow bands, **taeniae coli**, running along its length up to the beginning of the rectum and converging at the appendix origin; notice the attachments of the transverse colon mesentery (**mesocolon**) and the greater omentum to the colon. Pay attention to location of **fatty (omental) appendices** of peritoneum and number of pouches, called **haustrae**. Note that the boundaries between adjacent haustrae protrude into the lumen of the colon as **semilunar folds**. Each semilunar fold occupies one third of the lumen circumference (between the three taeniae). Hence, all layers of the intestinal wall comprise the colon folds in contrast to the circular folds in the small intestine.

In the **rectum** pay attention to its curves, parts, their relationships with the peritoneum, specific features of the layers comprising the wall. Note the direction of the temporary and constant folds of the mucosa, pronounced submucosa, the continuous longitudinal layer of the muscularis externa, location of the voluntary and involuntary **sphincters** and **hemorrhoid plexus**.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Large intestine (Latin: *intestinum crissum*): cecum; ascending, transverse, descending, and sigmoid colon; right colic flexure (hepatic flexure); left colic flexure (splenic flexure); rectum; transverse/sigmoid mesocolon; taeniae coli: mesocolic and omental taeniae, free taenia (Latin: *taenia libera*); haustra of colon; omental appendices (fatty appendices of colon) (Latin: *appendices epiploicae*); semilunar folds of colon. **Caecum and appendix:** ileal papilla

[ileocaecal valve, Bauhin's valve]: superior/inferior ileocaecal lip; ileal orifice [ileocaecal orifice]; ileocaecal sphincter; appendix (vermiform appendix): orifice of vermiform appendix, aggregated lymphoid nodules; meso-appendix. **Rectum:** sacral/anorectal (perineal) flexure; pelvic part; rectal ampulla; anal canal; anus; internal/external anal sphincter; transverse folds of rectum; anal columns; anal sinuses; anal valves; rectal venous plexus.

In radiographs: ileal orifice, parts of the large intestine, haustrae and semilunar folds.

Questions for self-control:

1. What is the length of the large intestine?
2. Name the parts of the large intestine and specify the regions of the abdomen, which these parts correspond to.
3. What features help to distinguish the colon from the small intestine by its appearance?
4. List the taeniae coli and specify their location. In which point of the large intestine do they converge and where disappear?
5. List the layers of the colon wall and describe their specific features.
6. What layers contribute to the formation of the semilunar folds?
7. What are the typical roentgen features of the colon?
8. How does the muscular coat of the rectum differ from that of the colon?
9. How are different parts of the colon covered with the peritoneum? Which parts have mesenteries?
10. On which region of the abdominal wall does the cecum project? What anatomical structures does the cecum adjoin?
11. What are the specific structural features and function of the vermiform appendix?
12. Describe variants of the appendix position. Specify the location of the orifice of appendix.
13. Specify the projection of the appendix base on the anterior abdominal wall.
14. The patient with acute appendicitis complains of pain in the right lumbar region. What causes such atypical localization of pain?
15. What anatomical structures of the mucosal and muscular coats are located at the ileocaecal junction? What is the role of these structures?
16. Where is the rectum located? What anatomical structures are in front and behind the rectum (in men, in women)?
17. Name parts and flexures of the rectum.
18. What is the end part of the rectum?
19. Describe the structures of mucosa in the rectum.
20. Name the rectal sphincters and specify their location.
21. What is the hemorrhoidal area? Where is it located?

LESSON 6

Topic: Liver: topography, structure. Biliary ducts conducting bile and gallbladder: topography, structure. Pancreas: topography, structure. Spleen: topography, structure.

Learning aims:

– to know the anatomical structure and topography of the liver and gall bladder, their relation to the peritoneum and projection on the anterior abdominal wall;

– to know the principal structure of the classical hepatic lobule, specific features of blood supply to the liver and bile outflow;

– to understand the "functional" divisions of the liver (parts, divisions, segments);

– to know the topography, relation to the peritoneum, and anatomical structure of the pancreas and spleen;

– to be able to identify in a dissected cadaver and isolated specimens the following: anatomical structures on the liver surface (liver lobes and parts, fissures, porta hepatis), elements of the hepatic triad; gall bladder and its parts; extrahepatic bile ducts; pancreas and spleen and their parts; ligaments of the spleen and liver.

Teaching aids: anatomical specimens: liver with the gallbladder, pancreas with the duodenum, spleen; dissected cadaver; museum specimens; models and other visual aids; radiographs; endoscopic images; atlas.

Textbook: Sapin, Vol. 1, P. 351–362; Sapin, Vol. 2, P. 111–114 (Tandon: P. 279–288).

GUIDELINES

When you examine an isolated liver, first position it relative to your own body with the convex smooth diaphragmatic surface directed upwards and the sharp edge directed forward and downward. On the diaphragmatic surface find a peritoneal flap of the **falciform ligament** (may not be seen if it is torn) that seems to divide the liver into two lobes; then trace the attachment of the superior and inferior sheets of the **coronary ligament** encircling the area nuda.

Notice, that, fully, ligaments of the liver can be seen only in the cadaver. The **round ligament of liver** (obliterated fetal umbilical vein) extends from the umbilicus to the right, towards the inferior edge of the liver within the free margin of the falciform ligament. The coronary ligament can be reached deeply under the diaphragm where the peritoneum reflexes on the posterior surface of the liver; running in the frontal plane it ends at the right and left liver edges by the **triangular ligaments**. The **hepatogastric** and **hepatoduodenal ligaments** comprising the **lesser omentum** originate in the porta hepatis.

Examine the irregular **visceral surface** that contacts with a number of other organs. Determine the borders of the **quadrate** and **caudate lobes**. Identify the **porta hepatis** where the portal vein and hepatic artery enter the liver and the bile duct emerges. These tree main tubular structures are called the **"portal triad of liver"**. Out of the three, the **portal vein** is the largest with the collapsed walls; it collects venous blood from the abdominal part of the digestive system, spleen, and pancreas and takes it to the liver. The **proper hepatic artery** has a smaller diameter, but thicker resilient walls and rounded lumen; it brings arterial blood to the liver. The **common hepatic duct** is formed by fusion of the right and left hepatic ducts. It joins with the **cystic duct** from the **gall bladder** to form the (common) **bile duct** that passes towards the duodenum.

Between the layers of the hepatoduodenal ligament the "triad" position (right to left) is as follows: bile **duct**, portal **vein** (slightly behind), and proper hepatic **artery** ("ДВА" in Russian abbreviation). Ramifications of the "triad" follow together within the liver from its porta up to the hepatic lobules, and are the basis for "functional" division of the liver into 2 parts, 4 divisions, and 8 segments, i. e. the territories of the liver, which correspond to the 1st, 2nd, and 3rd order branching of the portal vein (or triad), respectively.

In the study of the vascular bed of the liver pay attention to the following points: 1) the presence of two sources of blood supply — proper hepatic artery and portal vein; 2) the "miracle network" (Latin: *rete mirabile*) of the liver — a network of intralobular capillaries (sinusoids), inserted between the two veins, lobular and central; and 3) venous blood outflows the liver via **hepatic veins** to the inferior vena cava; the hepatic veins are within the parenchyma and their gaping openings can be seen when the inferior vena cava is opened.

Note that the basic structural and functional units of the liver are **hepatic (classical) lobules** separated from each other by connective tissue. They have hexagonal shape in cross section with hepatocytes arranged in plates of 1 or 2 cells width around the central vein (like the spokes of a wheel); blood capillaries (sinusoids) between adjacent plates empty into the central vein. As blood flows through the sinusoids, hepatocytes absorb and secrete materials into the bloodstream through their exposed surfaces. Bile is secreted into a network of narrow channels (bile canaliculi) between the adjacent hepatocytes and further is transported towards the gallbladder or duodenum. The whole biliary tract comprises the intrahepatic part: bile canaliculi (Latin: *ductuli biliferi*) → bile ductules (canals of Hering) → interlobular ducts → hepatic ducts (segmental, etc.); and **extrahepatic ducts**: right and left hepatic ducts, common hepatic duct, cystic duct, (common) bile duct (Latin: *ductus holedochus*), hepatopancreatic ampulla.

Studying the **gallbladder** consider its parts, layers of its walls, presence of the **spiral fold** of the mucosa in the neck of the gallbladder, allowing bile to

flow in both directions. Note the sphincters controlling the bile flow into the duodenum, topography of the bile ducts; syntopy, skeletopy, and holotopy of the liver and gall bladder, liver borders.

Examining the pancreas consider its sintopy, skeletopy, and holotopy, the topography of **pancreatic ducts** and their relationship with the bile duct and the duodenal wall. When examine an isolated pancreas (or pancreas with the duodenum), determine its parts; position the pancreas according to its location in the abdominal cavity. Pay attention to the proper position of its body's borders and surfaces (accordingly to their names), put the head on the right to the median plane, the tail — left and slightly above the head. In the dissected cadaver the pancreas extends from the duodenum to the spleen retroperitoneally. Its **head** is surrounded by the duodenum, its **body** and tail are behind the stomach and can be accessed after opening the omental bursa through its anterior wall — via the lesser omentum or gastrocolic ligament (wider access), or through the transverse mesocolon — the inferior wall of the omental bursa. The inferior surface of the pancreas body is available for palpation if the root of the transverse mesocolon is pulled upward.

The **spleen** is a secondary immune organ, but topographically it is in proximity to the digestive system. In the study of the spleen pay attention mainly to its topography, relation to the peritoneum (ligaments), and the external structure. In order to properly position the spleen relative to the body, its borders and surfaces should be defined: mind that several notches are usually on the superior border, a convex **diaphragmatic surface** faces left and up, and a portion of the concave **visceral surface** above the hilum (gastric surface) is broader than that below it. The anterior pole of the spleen is lower than the posterior one, so that the long axis of the spleen aligns with the ribs IX–XI, to which it adjoins. The spleen is located deep in the upper left part of the abdominal cavity and can be seen when the left side of the stomach is lifted up.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Liver (Latin: *hepar*): diaphragmatic/visceral surface, inferior border, bare area (area nuda); serous coat; fibrous capsule; ligaments: falciform ligament, coronary ligament, right/left triangular ligaments, hepatogastric ligament, hepatoduodenal ligament, round ligament of liver (Latin: *ligamentum teres*), ligamentum venosum; right/left lobe of liver; fossa for gallbladder; notch and fissure for ligamentum teres (fissure for round ligament); fissure for ligamentum venosum; groove for vena cava; porta hepatis; proper hepatic artery; viena porta; quadrate lobe, caudate lobe, caudate process; lobules of liver; interlobular arteries/veins; central veins; **bile ducts:** interlobular bile ducts, right/left hepatic duct; common hepatic duct; **gallbladder:** fundus, body,

and neck of gallbladder, cystic duct, spiral fold; (common) bile duct (Latin: *ductus choledohus*), sphincter of bile duct; hepatopancreatic ampulla, sphincter of ampulla; [sphincter Oddi]. **Pancreas** (*Latin: pancreas*): head, neck, body, tail of pancreas, uncinate process, pancreatic notch; anterosuperior/antero-inferior/posterior surface; superior/anterior/inferior border; pancreatic duct, sphincter of pancreatic duct; accessory pancreatic duct; pancreatic islets. **Spleen** (Latin: *lien*): diaphragmatic/visceral surface; anterior, posterior extremity; superior/inferior border; splenic hilum; serous coat; fibrous capsule; splenic trabeculae; red/white pulp.

In radiographs: liver, gallbladder, bile ducts.

Questions for self-control:

1. What are the main functions of the liver and its role as a digestive gland?
2. Name surfaces and edges of the liver. Which of them are covered with the peritoneum? Where is the nude area of the liver?
3. Name the peritoneal ligaments of the liver and specify their location.
4. What is the ligamentum teres? Specify its location.
5. Describe sintopy of the liver.
6. On which regions of the anterior abdominal wall does the liver project? Specify the upper and lower borders of the liver projection.
7. Under the normal conditions the inferior border of the liver is at the right costal arch. Is it true for all ages?
8. What the four lobes can be distinguished in the liver? What are their borders?
9. What is the porta hepatis? What enters and leaves the liver through its porta?
10. Where are the hepatic veins located?
11. Specify the number of the liver parts, divisions, and segments. What is the anatomical basis for these divisions? Define the liver segment.
12. What is the structural and functional unit of the liver?
13. Describe the general structure of the hepatic classical lobule.
14. What vessels bring blood to the lobules and empty into the sinusoids? Where do the sinusoids empty?
15. Where does blood flow from the central veins?
16. Where is bile produced? Describe the pathways of bile flow away from the lobule.
17. What ducts form the common hepatic duct, bile duct?
18. Where are the bile duct and the pancreatic duct connected?
19. Give the diagram of the duct system that empties into the duodenum: starting from the liver, gallbladder, and pancreas up to the major duodenal papilla.

20. What are the functions of the gallbladder?
21. Name the parts of the gallbladder, specify its volume.
22. Specify the projection of the gallbladder on the abdominal wall.
23. Describe the tunics of the gallbladder wall.
24. What sphincters regulate the bile passage to the duodenum?
25. What is the sphincter of Oddi (parts, location, and significance)?
26. Radiographic examination of the patient's gallbladder showed a stone that blocked the cystic duct. Does this affect the bile flow to the duodenum?
27. Name parts of the pancreas, surfaces and edges of its body. Describe their relation to the peritoneum.
28. Describe the skeletopy, sintopy, and holotopy of the pancreas.
29. The surgery revealed a tumor of the pancreatic head. Why did the tumor block the bile passage to the duodenum?
30. What are the functions of the exocrine and endocrine parts of the pancreas?
31. What are the structural components of the pancreas? Where are the pancreatic ducts located and where do they empty?
32. What parts of the pancreas are responsible for its endocrine secretion?
33. What are the functions of the spleen?
34. Describe the exterior of the spleen: name its surfaces, extremities, and borders.
35. Describe the skeletopy, holotopy, and sintopy of the spleen.
36. How does the peritoneum cover the spleen? What ligaments fixate the spleen?
37. What is located in the splenic hilum?
38. What are the principal structures of the stroma and parenchyma of the spleen?

LESSON 7

Topic: Peritoneum. Topography of the peritoneum in the abdomen and pelvis. Development of the alimentary system. Anomalies.

Learning aims:

– to know functions of the peritoneum;

– to understand the term peritoneum, parietal and visceral; to know the derivatives of the peritoneum (ligaments, mesenteries, omentums, folds, fossae);

– to know the parts of the abdominopelvic cavity: peritoneal cavity, retro- and extraperitoneal space; to know intra-, meso-, and retroperitoneal organs;

– to know the topography of the visceral and parietal peritoneum and its derivatives; divisions of the peritoneal cavity: compartments (floors), sacs, spaces, sinuses, recesses, gutters, pouches;

– to be able to demonstrate the divisions of the peritoneal cavity and peritoneal structures in a dissected cadaver and diagrams;

– to understand the development of the digestive system; to know the sources and main stages of the digestive tube development, sources and principals of formation of the accessory digestive organs, oral cavity, pharynx, peritoneum;

– to understand the formation of the anomalies of the digestive system.

Teaching aids: dissected cadaver, museum specimens, models, diagrams, atlas.

Textbook: Sapin, Vol. 1, P. 362–381 (Tandon: P. 260–270).

GUIDELINES

In the study of the peritoneum pay attention to its role as a serous membrane and note its specific functions. Learn and understand the principal concepts and terms related to the peritoneum, such as its division into "visceral" and "parietal" peritoneum, "peritoneal cavity" and "extraperitoneal space", terms defining different variants of organ relationships to the peritoneum (most definitions are given in the guidelines for the Lessons 3); pay attention to the difference of the peritoneal sac in men and women; note which of the abdominal organs are located in the extraperitoneal space and which are mainly in the peritoneal cavity (intra-, and mesoperitoneal).

Note that the peritoneum is a continuous serous sheet that extends along the abdominal walls, from the walls to the organs, and between the organs, forming peritoneal derivatives: folds, ligaments, mesenteries, and omentums, which are boundaries of peritoneal spaces, bursae, and recesses (fossae and pouches).

Peritoneal fold is a reflection of peritoneum that is raised from the body wall by underlying blood vessels, obliterated fetal vessels, and ducts.

Peritoneal ligament is usually a double layered sheet of peritoneum that connects one organ to another one or connects an organ to the abdominal wall.

Mesentery is a double sheet of peritoneum, which passes from the posterior abdominal wall onto an organ (usually a part of the intestine), supports it and provides a different degree of its mobility. The mesenteries fix the most part of the small intestine — jejunum and ileum. The **transverse mesocolon, sigmoid mesocolon,** and **meso-appendix** (attaches to the terminal part of the ileum) fix corresponding parts of the large intestine.

Omentums are modified mesenteries, extensions (double- or four-layered) of the peritoneum passing from the stomach and proximal part of the duodenum to adjacent organs and containing some amount of fat between its layers. The **lesser omentum** relates to the lesser curvature of the stomach, as the **greater omentum** suspends from the greater curvature and proceeding down the abdomen merges with the anterior wall of the transverse colon.

Start studying the peritoneum topography with diagrams and pictures. In the diagram of the sagittal section of the body determine all organs, peritoneum derivatives, and divisions of the peritoneal cavity: **lesser sac** (omental bursa) and **greater sac** — remaining part of the peritoneal cavity, **supracolic compartment (upper floor)** and **infracolic compartment (lower floor)**, separated from each other by the transverse colon and its mesentery, and pelvic cavity below the terminal line, which corresponds to the lesser pelvis. To reinforce your knowledge draw a diagram by yourself.

In the cadaver examine peritoneal structures successively in the upper floor, lower floor of the abdominal cavity, and in the pelvis; there locate the organs, peritoneal ligaments, mesenteries (paying attention to the topography of their roots), peritoneal spaces, recesses, and fossae; consider communications between the compartments and spaces.

Note that there are several peritoneal spaces and recesses in the **supracolic compartment**. **Subphrenic space (recess)** is located between the diaphragm and the diaphragmatic surface of the liver. Posteriorly it is limited by the coronary and triangular ligaments. The falciform ligament divides the space into the right (deeper) and left regions — **right and left subphrenic recesses**. The space between the visceral surface of the liver and the transverse mesocolon is the **subhepatic space (recess)**. The peritoneal surface of the gallbladder faces this space. The **hepatorenal recess** [Morrison pouch] is a deep extension of the subhepatic space under the right lobe of the liver anterior to the kidney and suprarenal gland. Laterally to the right colic flexure, the subhepatic space communicates with the right paracolic gutter (lower floor); and to the left it communicates with the omental bursa**.** In the supracolic compartment you should find the recesses mentioned above, omental bursa, its walls, and omental foramen, ligaments of the liver, stomach, colon and spleen, lesser and greater omentums. The lesser omentum encloses the hepatic artery, portal vein and the bile duct, accompanied by minor vessels. It is very important for surgeons to be aware of these structures when resolving problems associated with the stomach or posterior abdominal wall via the lesser sac.

In the **infracolic compartment** you should locate two mesenteric sinuses, two paracolic gutters (lateral canals), and their bounderies; pay attention to their communications with the upper floor and the pelvic cavity; find the peritoneal recesses and fossae (described below) on the posterior abdominal wall, which can be sites for internal hernias.

One or two slit-like recesses, the **superior** and **inferior duodenal fossae** are located in the upper part of the left mesenteric sinus left to the duodeno-jejunal flexure; its left boundary is a peritoneal fold containing the inferior mesenteric vein. The **superior** and **inferior ileocaecal recesses** are located at the ileocecal junction, above and below the ileum, respectively. **Retrocaecal recess** is a depression in the parietal peritoneum that lodges the cecum; in some

cases it extends upwards behind the ascending colon. **Intersigmoid recess** is often present on the left side of the sigmoid mesocolon, next to the attachment of its root to the posterior abdominal wall.

Pay attention to gender differences in the topography of the peritoneum in the pelvis; note that the **recto-uterine [Douglas's] pouch** is the deepest portion of the female peritoneal cavity. On the anterior abdominal wall locate the peritoneal folds and fossae; note their relationship to the inguinal and femoral canals.

In the study of the development of the digestive system consider the germ layers which give rise to its different structures, derivatives of each division of the primitive gut, main stages of the gut development and related changes in the position of the digestive organs and their mesenteries, pay attention to the bronchial arches and their participation in the formation of the oral cavity and pharynx; notice that different anomalies of the digestive organs correlate to alteration of the specific steps of their development.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Abdominal cavity; pelvic cavity; parietal and visceral peritoneum; peritoneal cavity; exstra-/retroperitoneal space; retropubic space; greater sac; supracolic compartment (upper floor); infracolic compartment (lower floor); mesentery; transverse mesocolon; sigmoid mesocolon; meso-appendix; lesser omentum (Latin: *omentum minus*); hepatogastric ligament; hepatoduodenal ligament; greater omentum (Latin: *omentum majus*); gastrocolic ligament; gastrophrenic ligament; gastrosplenic ligament; phrenicosplenic ligament; phrenicocolic ligament; omental bursa (lesser sac); omental foramen (epiploic foramen); subphrenic space; subhepatic space; hepatorenal recess; right/left mesenteric sinus; right/left paracolic gutters; superior/inferior duodenal fossa; superior/inferior ileocaecal recess; retrocaecal recess; intersigmoid recess; median/medial/lateral umbilical fold; supravesical fossa; medial/lateral inguinal fossa; recto-uterine pouch; vesico-uterine pouch; recto-vesical pouch.

Questions for self-control:

1. Define the terms: peritoneum (parietal and visceral), peritoneal cavity, retro- and extraperitoneal space.
2. What are the functions of the peritoneum?
3. Classify the abdominal organs based on their relation to the peritoneum.
4. Give definitions to the following peritoneal structures: ligaments, mesenteries, omentums, peritoneal folds.
5. Name and describe the peritoneal folds and fossae in the anterior abdominal wall.
6. Name mesenteries of the gut and describe their location.

7. What is the lesser omentum?

8. What anatomical structures are located between the sheets of the hepatoduodenal ligament? Specify their position relatively to each other.

9. What is the greater omentum, cavity of the greater omentum?

10. What ligaments originate from the greater curvature of the stomach?

11. What are the compartments (floors) of the abdominal cavity? What are their boundaries?

12. Name the organs, recesses, and bursa located in the supracolic compartment (upper floor)?

13. Name anatomical structures that form the walls of the omental bursa and borders of the omental foramen.

14. List the ligaments fixating the liver and spleen.

15. The patient suffered from the perforated gastric ulcer of the posterior gastric wall. Which access to the affected area should a surgeon choose not to open the lesser omentum?

16. Name the main divisions of the peritoneal cavity in the infracolic compartment (lower floor), describe their boundaries.

17. What peritoneal depressions in the posterior wall of the greater sac are sites of potential retroperitoneal hernias?

18. Which divisions of the infracolic compartment are freely connected with the supracolic compartment, and which with the pelvic cavity?

19. Describe the course of the peritoneum in the pelvic cavity in males and females. Name pouches located there.

20. At what week of fetal development does the primitive gut form?

21. Which structures of the digestive system are derived from the gut endoderm and mesoderm, and what develops from the ectoderm?

22. Name the depressions on the cranial and caudal ends of the early embryo, which later connect to the gut (after eruption of the oropharyngeal and cloacal membranes).

23. What are the pharyngeal (branchial) arches, pouches, clefts? What are their derivatives?

24. What are the processes limiting the stomodeum (primitive oral cavity)? Describe their transformations during the formation of the facial structures.

25. Lack of which embryonic structures fusion causes formation of the cleft lips and cleft palate?

26. What are the derivatives of the pharyngeal gut, foregut, midgut, and hindgut?

27. What changes in shape and position does the stomach (and related organs) undergo during its early development?

28. Which part of the primitive gut forms the intestinal loop? How does it change during its development?

29. What are the primordia (anlages) that give rise to the liver, gallbladder, and pancreas? Specify their location.

30. What is the physiological umbilical hernia?

31. During surgery, the surgeon makes revision of the intestine to detect the Meckel's diverticulum. Which part of the intestine should be inspected? The remnant of which embryonic structure is the Meckel's diverticulum?

32. Give other examples of congenital malformations of the digestive system.

LESSON 8

Topic: Respiratory system. Nose. Nasal cavity. Paranasal sinuses. Larynx: topography, structure of the wall. Laryngeal cavity.

Learning aims:

– to know the organs of the upper and lower respiratory tract and their functions;

– to know the parts of the nose, structure of the walls, structural and functional subdivisions of the nasal cavity, topography of the paranasal sinuses;

– to know the structure and topography of the larynx, structures involved in sound production;

– to be able to define in the skull the bones constituting the walls of the nasal cavity;

– to be able to define in the sagittal section of the cadaveric head: the parts of the nose; choanae; nasal septum, conchae, and meatuses; paranasal sinuses and their openings;

– to be able to define in the anatomical specimens and models: cartilages, ligaments, joints, and muscles of the larynx; parts of its cavity and mucosal structures of its wall.

Teaching aids: skull, sagittal section of the cadaveric head with the larynx, specimen of the tongue with the larynx, isolated larynx, isolated laryngeal cartilages, museum specimens, models, radiographs, endoscopic images, atlas.

Textbook: Sapin, Vol. 1, P. 381–393 (Tandon: P. 452–459).

GUIDELINES

For better understanding the current topic you should revise the bony walls of the nasal cavity and the topography of the paranasal sinuses. In the sagittal section of the head find the parts of the **external nose**; consider its bony and cartilaginous skeleton; find the **nasal cavity**, its openings, divisions, and sites where the **paranasal sinuses** open into the superior and middle nasal meatuses. Follow down the pharynx up to the laryngeal inlet; note that the larynx is anterior to the lower end of the pharynx, which is due to

the origin of the embryonic laryngotracheal tube on the ventral wall of the primitive gut.

In individual specimens of the **larynx** determine the position of the laryngeal cartilages. The largest **thyroid cartilage** consists of two plate-like laminae connected at an angle projecting forward. Below it the anterior wall of the larynx is supplemented by the arch of the **cricoid cartilage**, above — by the **epiglottis**. The cricoid plate with the **arytenoid cartilages** on its top forms the posterior laryngeal wall. Note that the arytenoid cartilage is shaped as a three-sided pyramid, with two processes at its base: directed forward a **vocal process** and directed laterally a **muscular process**. After you learn the names and positions of the main cartilages it would be easy to navigate to joints, ligaments, and muscles of the larynx.

There are two paired joints in the larynx: the **cricothyroid joints** allow the thyroid cartilage to tilt forward on the cricoid cartilage, which results in changes in the length and tension of the vocal folds; the **cricoarytenoid joints** permit the rotation and gliding movements of the arytenoid cartilages upon the cricoid cartilage. Note that movements of the laryngeal parts are controlled by the striated **intrinsic laryngeal muscles**. The laryngeal muscles can be divided into 3 main groups: muscles, which adjust the tension and length of the vocal folds (1); and those which change the shape and size of the rima glottides and vestibule: narrowing them (2) or dilating them (3). The larynx as a whole can be moved, elevated or depressed, by the muscles of the neck (suprahyoid and infrahyoid) and stylopharyngeus muscles that are referred to as the extrinsic laryngeal muscles.

Note that the frontal section of the **laryngeal cavity** reminds a sandglass: the middle section is narrowed, upward and downward it is expanded. The narrow part, called **glottis**, is a space between the two pairs of folds: above — the **vestibular folds** [false vocal cords], which surround the rima vestibule; and below — the **vocal folds** [true vocal cords], which bound the **rima glottidis**. The latter is the narrowest space of the larynx. The **laryngeal ventricles** lie in the lateral walls of the larynx between the vestibular and vocal folds. Above the vestibular folds the **laryngeal vestibule** extends up to the **laryngeal inlet**. The part below the vocal ligaments is the **infraglottic cavity** that is continuous with the trachea.

Pay attention that in addition to the fibrocartilaginous framework, the larynx has an elastic framework, providing a support for the mucosa. Under the mucosa of the vestibule is a paired **quadrangular membrane**, whose lower border is the vestibular ligament. The **elastic cone** is in the infraglottic cavity; the upper free border of the elastic cone forms the vocal ligaments and down it is continues with the cricothyroid ligaments.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Nose (Latin: *nasum*): root, dorsum, apex (tip), ala of nose; ***nasal cartilages:*** lateral nasal cartilage, major/minor alar cartilage, septal nasal cartilage, vomeronasal cartilage; ***nasal cavity:*** nares (nostrils), choanae (posterior nasal apertures); nasal septum: membranous, cartilaginous, bony part; vomeronasal organ; nasal vestibule; limen nasi; superior/middle/inferior nasal concha; cavernous plexus of conchae; olfactory region; respiratory region; superior/middle/inferior nasal meatus; common nasal meatus; nasopharyngeal meatus; paranasal sinuses: maxillary, sphenoidal, frontal; ethmoidal cells; semilunar hiatus; opening of nasolacrimal duct.

Larynx. ***Laryngeal cartilages, joints & ligaments*:** thyroid cartilage: laryngeal prominence, right/left lamina, superior/inferior horn, superior/inferior thyroid notch, oblique line; cricoid cartilage: arch, lamina of cricoid cartilage; arytenoid cartilage: apex & base of arytenoid cartilage, vocal process, muscular process; corniculate cartilage; cuneiform cartilage; triticeal cartilage; epiglottis; cricothyroid joint; crico-arytenoid joint; thyrohyoid membrane: median/lateral thyrohyoid ligament; cricothyroid ligament; cricotracheal ligament; thyro-epiglottic ligament; hyo-epiglottic ligament; ***laryngeal muscles:*** cricothyroid, posterior/lateral crico-arytenoid, vocalis, thyro-arytenoid (and its thyro-epiglottic part), transverse arytenoid, oblique arytenoid; ***laryngeal cavity*:** laryngeal inlet; ary-epiglottic fold; laryngeal vestibule; vestibular fold; rima vestibuli; laryngeal ventricle; glottis; vocal fold; rima glottides [vocal rima]: intermembranous & intercartilaginous parts; infraglottic cavity [subvocal space]; mucosa (mucous membrane); fibro-elastic membrane of larynx: quadrangular membrane, vestibular ligament, conus elasticus (cricovocal membrane), vocal ligament.

In radiographs: nasal cavity and nasal meatuses, nasal septum, paranasal sinuses.

Questions for self-control:

1. List sequentially the organs of the respiratory system and describe their functions.
2. Which organs are referred to as the upper/lower respiratory tract?
3. Name the parts of the nose.
4. What structures form the skeleton of the nose?
5. What structures form the nasal septum?
6. List bones that participate in the formation of the walls (superior, inferior, lateral) of the nasal cavity.
7. What are the anterior and posterior apertures of the nose termed?
8. What are the nasal conchae? Which bones do they belong?
9. Name subdivisions of the nasal cavity.

10. Describe boundaries of the nasal meatuses? Which of them serve as air passages (respiratory region)?
11. Where is the olfactory region of the nasal cavity?
12. Describe the features of nasal mucosa.
13. What is the significance of the paranasal sinuses? Which of them open into the superior nasal meatus/middle nasal meatus?
14. Why is it preferable to breathe through the nose and not through the mouth?
15. Where does the nasolacrimal duct open?
16. Describe the skeletopy and sintopy of the larynx.
17. List the cartilages of the larynx; describe their shapes and the main parts.
18. Name the ligaments of the larynx.
19. Name the joints of the larynx, specify their location, and describe movements produced in these joints.
20. Describe the muscles, which narrow the glottis, laryngeal inlet and vestibule.
21. Describe the muscles, which widen the glottis and laryngeal vestibule.
22. Which muscles alter the tension of the vocal folds?
23. Name and describe the location of the two parts of the fibro-elastic membrane. Which ligaments form their free edges?
24. What is the shape of the laryngeal cavity? Name the subdivisions of the laryngeal cavity?
25. What structures are boundaries of the laryngeal inlet?
26. What is the lower boundary of the laryngeal vestibule?
27. Which part of the larynx is called glottis? What anatomical structures belong to this part?
28. What are the laryngeal ventricles?
29. Describe the features of mucosa of the larynx.
30. What are the upper and lower boundaries of the infraglottic cavity?
31. Which features help to distinguish between the vestibular and vocal folds, rima vestibule and rima glottidis, during laryngoscopy?
32. What position do the vocal folds take during quiet breathing, phonation?

LESSON 9

Topic: Projection lines on the thoracic wall. Trachea, bronchi and lungs: topography, structure.

Learning aims:

– to know the structure and topography of the trachea, main bronchi, lungs and their roots;

– to understand the structural division of the lungs into the lobes, bronchopulmonary segments, lobules;

– to know bronchopulmonary segments of the right and left lungs;

– to know the structure and function of the bronchial and respiratory trees;

– to be able to position the specimen of the trachea and lungs according to their location in the body, and define the structural details of the trachea, bronchi, and lungs;

– to be able to draw the imaginary lines (landmarks for organs projection) on the thorax of the skeleton.

Teaching aids: skeleton, cadaver with the dissected chest, anatomical specimens of lungs with the trachea and bronchi, individual lungs; museum specimens; models and other visual aids; radiographs and endoscopic images; atlas.

Textbook: Sapin, Vol. 1, P. 7–8, 393–402 (Tandon: P. 459; P. 208–214).

GUIDELINES

In the **trachea** find the soft posterior membranous wall; the remainder, anterolateral wall, is formed by the incomplete cartilaginous rings, C-shaped **tracheal cartilages**. The **bifurcation of the trachea** is at the level of the sternal angle (Th5 vertebra). Note that the **right bronchus** (short and wide) runs more vertically than the **left bronchus** (long and narrow). Pay attention to the similarity in structure of the tracheal and bronchial walls and their four layers: mucosa, submucosa, fibro-muscular-cartilaginous layer, and adventitia.

Examine **right and left lungs** to identify the **apex** and **basis**, three **surfaces** (costal, diaphragmatic, and medistinal), three **borders** (sharp anterior and inferior, rounded posterior), find the **cardiac notch** and **lingula** passing down along the anterior border of the left lung. The **hilum of lung** is a wide groove on the mediastinal surface where the main (primary) bronchus, pulmonary and bronchial arteries, and nerves enter the lung; and the pulmonary and bronchial veins and lymphatic vessels emerge from the lung. All the listed above structures form the **root of lung**. Consider the difference between the lungs in size, shape, number of **lobes**, and the layout of their roots elements. The right lung has three lobes and the layout of the root as follows: from the top down there are bronchus, pulmonary artery, and two pulmonary veins (BAV). The left lung has two lobes and in its root the artery is superiormost (ABV).

The main bronchi branch successively to give rise to lobar (secondary), segmental (tertiary), several orders of intrasegmental bronchi, lobular bronchi, bronchioles and terminal bronchioles; all of them constitute the **bronchial tree** serving for air passage. Note that the **bronchopulmonary segment** is supplied by the tertiary bronchus. Each **terminal bronchiole** gives rise to the **alveolar**

tree, or **acinus**, which serves for gas exchange. The acinus consists of several generations of **respiratory bronchioles** (**with single alveoli on their walls)**, **each provides alveolar ducts (2–11) ending with alveolar sacs**. The acinus can be considered as a structural-functional unit of the lung.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Trachea: cervical & thoracic part, tracheal cartilages, annular ligaments, membranous wall, tracheal bifurcation, carina of trachea, mucosa, submucosa, tracheal glands. **Bronchi:** bronchial tree, right/left main bronchus, lobar bronchi, segmental bronchi, intrasegmental bronchi; fibromusculocartilaginous layer, mucousa, submucosa, bronchial glands. **Lungs** (Latin: *pulmones*)*:* left/right lung (Latin: *pulmo dexter/sinister*), base of lung, apex of lung; costal/diaphragmatic/mediastinal surface; anterior/inferior/posterior border; cardiac notch of left lung; lingula of left lung; hilum of lung; root of lung; superior (upper) lobe; middle lobe of right lung; inferior (lower) lobe; oblique fissure; horizontal fissure of right lung; bronchopulmonary segments; lobules (secondary) of lung; lobular bronchus; bronchioles; terminal bronchioles; respiratory bronchioles; alveolar ducts; alveolar sacs; alveoli; bronchial & alveolar tree; acinus.

Bronchopulmonary segments. Right lung segments**:** ***superior lobe*****:** apical, posterior, anterior; ***middle lobe*****:** lateral, medial; ***inferior lobe*****:** superior, medial basal, anterior basal, lateral basal, posterior basal. **Left lung** segments: ***superior lobe*****:** apicoposterior, anterior, superior lingular, inferior lingular; ***inferior lobe*** — same as for the right lung.

Questions for self-control:

1. Specify the length and diameter of the trachea. Name the parts of the trachea.
2. Describe the skeletopy and sintopy of the trachea.
3. What are the skeleton landmarks of the bifurcation of the trachea?
4. Describe the structure of the tracheal wall. What is the carina?
5. What are the main bronchi? How do the right and left bronchi differ? Which one is most frequently involved when foreign objects are inhaled? Why?
6. What is the Greek name for the lung? What are the differences between the right and left lungs?
7. Describe the exterior of lungs, name their surfaces, borders, fissures, and lobes.
8. Specify the location of the cardiac notch and lingula of the left lung.
9. What anatomical structures form the root of the lung? Specify their arrangement in the right/left lung. Which of them are distinguished in the roentgenogram?

10. What is the hilum of the lung?
11. What connects the lungs to the heart?
12. What is the basis for dividing the lungs into segments? Define the bronchopulmonary segment; specify the locations of the segmental arteries and veins.
13. What is the clinical significance of the lung segmental structure?
14. Name the bronchopulmonary segments of the right and left lungs. Draw a diagram of the segments in the right and left lung.
15. List the anatomical structures forming the air passageways — bronchial tree. Why don't their walls collapse?
16. How does the structure of the bronchial wall change along the bronchial tree, from the main bronchi to the terminal bronchioles?
17. At which level can obstruction of the bronchial tree happen like in asthma?
18. What is the alveolar tree? What is the structural-functional unit of the lung?
19. Why don't alveoli collapse?
20. Name and demonstrate the vertical projection lines on the skeleton thorax.

LESSON 10

Topic: Pleura. Pleural cavity, pleural recesses, borders of lungs and borders of parietal pleura. Mediastinum. Roentgen anatomy of the trachea, bronchi, lungs, and pleura. Development of organs of the respiratory system. Anomalies.

Learning aims:

– to know the parts and topography of the pleura, projections of the lungs borders and parietal pleural reflections ("borders") on the body walls;

– to understand the concepts of the pleural cavity and pleural sinuses;

– to explain a term "mediastinum", to know its divisions and related organs;

– to know the sources and main stages of the respiratory organs development, examples of their anomalies;

– to be able to demonstrate the parts of the pleura, pleural cavity, pleural recesses in the cadaver.

Teaching aids: skeleton, cadaver with the dissected chest, museum specimens; models and other visual aids; radiographs and endoscopic images; atlas.

Textbook: Sapin, Vol. 1, P. 403–411 (Tandon: P. 459; P. 206–208; 228).

GUIDELINES

When the anterior body wall is opened tree compartments can be found in the thoracic cavity: the two pleural spaces (sacs) containing lungs, and the mediastinum between them. In the pleural sacs the **visceral pleura** is adherent to the lungs. The **parietal pleura** reflects off the lungs and lines the inner aspect of the thoracic wall and the mediastinum. The "potential" space of capillary thickness between the visceral pleura and the parietal pleura is the **pleural cavity**.

At the hilum of lung the pleura reflects onto the mediastinum and forms the **mediastinal part** of the parietal pleura. The latter runs from the attachment on the sternum to the lateral surface of the spinal column covering on its way the fibrous pericardium, root of the lung, aorta and esophagus. The parietal pleura that extends upon the apex of the lung is the **cervical part (dome of pleura)**, and that lining the ribs and the diaphragm is defined as the **costal part** and **diaphragmatic part**. The junction between the costal and diaphragmatic parts forms a deep narrow **costodiaphragmatic recess** along the lower border of the lung; on the medial aspect of the lung it continues into a shallow **phrenicomediastinal recess**. The **costomediastinal recess** cannot be seen when the chest is opened from the front. The pleural cavity — space between the parietal and visceral pleura — looks rather big because of decreased size of the lung due to its elastic recoil after air entered the chest.

The borders of lungs, i. e. projection of the anterior, inferior and posterior borders of lungs, and the borders of pleura (lines of reflection of the parietal pleura) on the body walls are more illustrative when studied on the skeleton using the projection lines on the chest wall as landmarks.

Note that the **mediastinum** is a complex of organs located between the pleural sacs; it extends from the superior thoracic aperture to the diaphragm and from the sternum to the vertebral column. For descriptive purposes it is divided into the **superior and inferior mediastinum** by the transverse thoracic plane passing through the sternal angle and the disc between T4–T5. In turn, the inferior mediastinum is subdivided into the **anterior mediastinum**, lying between the sternum and pericardium (contains remnants of the thymus, lymph nodes, fat and connective tissue); the **middle mediastinum**, containing the pericardium with the heart, roots of the great vessels related to the heart, roots of the lungs, arch of aorta, and azygos vein; and **posterior mediastinum** (behind the pericardium) containing the esophagus, the thoracic aorta, the thoracic duct, veins and nerves. Division of the mediastinum into two parts, anterior and posterior, is still in use: the border between them is an imaginary frontal plane, which passes behind the trachea and roots of the lungs.

Note that the organs of the upper and the lower respiratory tract develop from the different sources. The nasal cavity is formed from the upper part of the stomodeum (primitive mouth) after its separation from the oral cavity by

the palatine processes. It connects with the pharynx, which develops by transformation of the cranial or pharyngeal gut. The laryngotracheal diverticulum that gives rise to the larynx, trachea, bronchi and lungs, appears during 3rd–4th weeks of embryogenesis as an outgrowth of the ventral wall of the primitive gut (at the border between the pharyngeal gut and the foregut). The ectoderm forms the epithelium of the nasal cavity as well as neurosensory cells of the olfactory region. The epithelium of the pharynx and the lower respiratory organs is of an endodermal origin. Mesenchyme (of mesodermal origin) is a source of the connective tissue, cartilages, muscles, and blood and lymphatic vessels in the walls of the respiratory system. Pleural sacs separate from the celom (body cavity of the embryo) after the diaphragm formation: parietal pleura is derived from the somatopleura that lines walls of the celom, visceral pleura — from the splanchnopleura that covers the primary gut.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Thoracic cavity (thorax); endothoracic fascia. **Pleura:** visceral (pulmonary) pleura; parietal pleura: costal/diaphragmatic/mediastinal/cervical (dome of pleura, pleural cupula); pulmonary ligament; pleural cavity; pleural recesses: costodiaphragmatic/costomediastinal/phrenicomediastinal recess. **Mediastinum:** superior mediastinum; inferior mediastinum: anterior/middle/ posterior mediastinum. **Projection lines:** anterior medline; sternal; parasternal; midclavicular; anterior, middle and posterior axillary; scapular; paravertebral; posterior midline.

In radiographs: mediastinum, lung fields, roots of lungs; parts of the bronchial tree (in bronchograms).

Questions for self-control:

1. Specify the projection of the lungs borders on the body surface. How are the boundaries of the right and left lungs differ?
2. What is the pleura, visceral and parietal pleura?
3. Name the four parts of the parietal pleura. What is the dome of pleura?
4. What is the pleural cavity? What amount of pleural fluid does it contain in norm?
5. What are the pleural recesses, what is their significance? Which recess is the dippiest one?
6. What happens to the lung if the integrity of the pleural sheet is disrupted?
7. Specify the borders of the parietal pleura (projection of its reflections on the thoracic wall). Where don’t they coincide with the borders of the lungs?
8. What are the main tree compartments in the thoracic cavity? How do they look like in the roentgenogram?

9. Define the mediastinum, name its parts.

10. What is the conventional boundary between the superior and inferior mediastinum?

11. Name the parts of the inferior mediastinum and organs located in each part. What organs are located in the superior mediastinum?

12. Which fascial spaces of the neck connect with the anterior and posterior mediastinum? Why are these connections important?

13. What are the sources for development of the upper respiratory organs and the lower respiratory tract and lungs?

14. Give examples of anomalies of the respiratory system. Explain the formation of the congenital esophageal-tracheal fistulas (connections)?

LESSON 11

Topic: Urinary system. Kidney: topography, structure. Ureter, urinary bladder: topography, structure. Roentgen anatomy of the urinary organs. Development of the urinary organs. Anomalies.

Learning aims:

– to know the structure and topography of organs of the urinary system and their functions;

– to understand the features of the kidney blood vessels, concepts of renal segment and lobule;

– to know the structure and function of the nephron;

– to know the sources of development and associated variants and anomalies of the urinary organs;

– to be able to locate the kidneys, urinary bladder, ureters and their parts in the cadavers;

– to be able to position individual kidneys and a urinary bladder (male and female) considering their location in the body; to identify their surface and internal structural details in individual specimens and visual aids.

Teaching aids: anatomical specimens: kidney (whole organ and frontal section), male and female urinary bladder, museum specimens; models and other visual aids; radiographs of urinary organs; atlas.

Textbook: Sapin, Vol. 2, P. 3–17, 59–62, 65–66 (Tandon: P. 303–308; 347–350).

GUIDELINES

To determine the position of the kidney, note that it has a convex anterior surface, and concave medial margin that contains the renal hilum and the renal peduncle attached. The elements of the latter are usually in the following order: the renal vein anteriorly, the renal artery in the middle although its segmental branches may run in front of the vein, the ureter (which position is the most constant) posteriorly and it directs downward.

Pay attention to the kidneys' skeletopy, syntopy, and holotopy; mechanisms of their fixation and protection that includes their coverings. The latter are: 1) the **fibrous capsule** of the kidney; 2) the **perinephric (perirenal) fat** — a layer of adipose tissue that is continuous with the fat in the renal sinus; 3) the dense **renal fascia** connected with the fibrous capsule by the fibrous bandles. The posterior layer of the renal fascia is bound to the subperitoneal fascia (behind which is the paraphrenic fat); the anterior layer is attached to the peritoneum. The long axes of the kidneys intersect above them (level of T 9–10 vertebrae); this changes if a kidney descends.

In the section of the kidney identify the **renal cortex** and **renal medulla**. Note that the **renal columns** have texture and color (lighter than pyramids) similar to those of the cortex. The **renal pyramid** with the adjacent cortex constitutes the **renal lobe**; the tip of the pyramid, **renal papilla**, projects into the **renal sinus**. Pay attention to the blood supply to the kidneys and division of kidneys into segments; intraorganic blood vessels and their specific features; structure and function of the nephron which is the structural and functional unit of the kidney. Note that there are two types of **nephrons**: cortical and juxtamedullary, and be able to explain the difference between them. Pay attention to the collecting system (tubules and ducts) within the pyramids; fornicate apparatus (renal papilla with the minor calyx); consider variations of the **renal calyces** and **pelvis**: branching type, ampullary type, intra- and extrarenal locations of the renal pelvis. Note that the anatomical structures for urine transport, storage, and elimination (renal calyces and pelvis, ureters, urinary bladder, and the proximal part of urethra) have similar principal structure of their wall; in particular, the mucosa is lined by the transitional epithelium that can stretch to accommodate increasing volumes of urine.

Consider the topography of the **ureter**, its **parts: abdominal, pelvic and intramural**, and sites of its **constrictions**; note that the intramural part passes through the bladder wall at an oblique angle that prevents reflux of urine. Note that the correct position of the bladder is with the ureters connected to its posterior wall, the apex of bladder directed upward and forward and the fundus accreted with the prostate (in males) inferiorly. Pay attention to syntopy of the lower part of the ureter and the bladder that is different in males and females, holotopy of the bladder and its relationship with the peritoneum that depends on the fullness of the bladder. On the inner surface find the **trigon of bladder**, the area on the posterior wall where mucosa is devoid of folds, and its bounderies: the **ureteric orifices**, **interureteric crest**, and **internal urethral orifice**; find uvula of bladder, which is a rounded elevation at the neck of the bladder (formed by the convergence of muscle fibers terminating in the urethra), in men it marks the location of the middle lobe of the prostate.

In radiographs of kidneys pay attention to their smooth outline, position in relation to the vertebrae and ribs (level of the poles and hilum), and direction of

their long axes. The calyces, renal pelvis, ureters (their direction, parts, and constrictions), and bladder can be clearly observed with contrast. The urinary bladder mucosa is examined by cystoscopy.

Note that in the embryonic development there are three successive generations of the kidney: pronephros, mesonephros, and metanephros. The definitive kidney develops from two sources: metanephrogenic tissue and metanephric duct: its ureteric bud. Development of the bladder is associated with the transformation of the cloaca, allantois, and lower segment of the mesonephric ducts. Note that variations and anomalies of urinary organs are common and caused by disruption of their normal development. Be ready to explain the formation of some anomalies (anomalies in the number, position and structure of kidneys, doubling of the ureter, etc.).

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Perinephric fat (perirenal fat capsule), [adipose capsule]; paranephic fat; renal fascia. **Kidney** (Latin: *ren*): fibrous capsule; anterior/posterior surface; superior/inferior pole (extremitiy); lateral/medial border; hilum of kidney; renal sinus; renal cortex: medullary rays; renal medulla: renal columns, renal pyramids, renal papilla, cribriform area, openings of papillary ducts; renal segments; renal lobes; major/minor calyx(-ices); renal pelvis: branching type, ampullary type; **nephron** (cortical and juxtamedullary): renal corpuscle, glomerulus, glomerular capsule, proximal convoluted tubule, nephron loop, distal convoluted tubule; afferent & efferent glomerular arteriole; collecting system: connecting tubule, collecting tubule, papillary duct. **Ureter:** abdominal/pelvic/intramural parts; adventitia; muscular layer; mucosa. **Urinary bladder** (Latin: *vesica urinaria*)*:* apex, body, fundus, neck (Latin: *cervix*) of bladder; trigone of bladder; ureteric orifice (right and left); interureteric crest; internal urethral orifice; uvula of bladder; mucosa; submucosa; muscular layer: detrusor (muscle), internal urethral sphincter; serosa; subserosa.

In radiographs: kidney, major and minor calyices, renal pelvis, abdominal and pelvic parts of the ureter, constrictions of the ureter, urinary bladder.

Questions for self-control:

1. List the urinary organs. What are their main functions?
2. Describe the holotopy of the kidneys and their relation to the peritoneum.
3. Describe the skeletopy of the right and left kidneys.
4. What is the direction of the kidneys longitudinal axes in norm?
5. Describe the sintopy of the right and left kidneys.

6. What anatomical structures protect kidneys and help to maintain their position?

7. What are the relationships of the kidneys with the renal fascia and retroperitoneal (paranephic) fat?

8. Describe the exterior anatomy of the kidney: name its surfaces, poles, and borders.

9. Define the location of the hilum of kidney. What anatomical structures are in the hilum of kidney? Indicate the relative position of these structures.

10. Where is the renal sinus, what does it contain?

11. What are the two layers distinguished in the kidney parenchyma?

12. What are the renal pyramids and renal papillae? Where do the papillary ducts empty?

13. What separates the pyramids from each other? What is called the renal lobe?

14. What parts can be distinguished in the renal cortex?

15. What underlies the kidney division into segments? Describe the pattern of the renal artery branching within the kidney.

16. List successively the elements of the nephron. Draw a diagram of the nephron.

17. What is the difference in location and function between the cortical and juxtamedullary nephrons?

18. Where are the minor and major calices located? Specify their number?

19. What is the renal pelvis? Describe variants of its shape and position?

20. What are the Greek names for the kidney and renal pelvis?

21. What structures form the fornicate apparatus of the kidney? Specify the significance of the fornicate apparatus.

22. In a radiograph the left kidney was found in the pelvis. What helps to decide whether the renal ectopia was congenital or acquired?

23. Which vertebra does the renal pelvis correspond in a radiograph?

24. What is the length and diameter of the ureter?

25. Name the parts of the ureter; describe its topography and relation to the peritoneum.

26. Indicate the sites of the ureter where obstruction by a stone occurs more often.

27. Describe the layers of the ureter wall.

28. What is a capacity of the urinary bladder?

29. Name the parts of the bladder.

30. Describe the sintopy of the bladder (in male, in female).

31. How is the bladder covered by peritoneum when it is filled or empty?

32. What allows the bladder to ascend above the pubic symphisis when it is full?

33. Is it possible to perform the suprapubic punction of the bladder without penetrating the peritoneum?

34. What provides fixation of the bladder to the walls and organs of the pelvis?

35. Describe the layers of the urinary bladder wall.

36. What is the trigon of bladder? How does mucosa look like in this area? What forms the base of the trigon?

37. Where is the uvula of bladder located?

38. What is called the detrusor muscle? Where is the internal urethral sphincter located?

39. What prevents the reflux of urine when the pressure in the bladder increases?

40. Describe the shape of the bladder in a radiograph.

41. Ureteral access is needed for many endourological procedures. What landmarks on the mucosa of the bladder help to find the ureteric orifices?

42. In which part of the embryo is the urogenital ridge located? What organs does it give rise to?

43. Which germ layer gives rise to the generations of kidneys? Specify the location of the pronephros, mesonephros, and metanephros. When do they appear and function?

44. What main structures constitute the mesonephros?

45. Where does the ureteric bud (metanephric diverticulum) arise form? What are the definitive derivatives of the ureteric bud?

46. What is the embryonic source for the nephrons formation?

47. At which site (in projection onto the definitive kidney) are the tubules of the developing metanephros and the terminal branches of the ureteric bud connected? What can happen if they do not connect?

48. Where is the initial and final location of the methanephros?

49. From which embryonic structures does the urinary bladder develop?

50. Give examples of congenital anomalies of kidneys (in number, position, and structure), ureters, and urinary bladder.

LESSON 12

Topic: Male genital system. Male internal genitalia. Testis, epididymis, ductus (vas) deferens: topography and structure. Spermatic cord. Descent of testes and their coverings formation. Prostate. Seminal gland (seminal vesicle). Bulbo-urethral gland. Male external genitalia: penis, scrotum. Male urethra. Development of male genital organs. Anomalies.

Learning aims:

– to know the structure, topography, functions of the male external and internal genital organs;

– to understand the concept of testis descent and its coverings formation;

– to know the sources and stages of the male genitalia development and associated anomalies;

– to be able to identify the male genital organs and their structural details in anatomical specimens and visual aids.

Teaching aids: anatomical specimens: testis with the epididymis and fragment of the spermatic cord; male urinary bladder with the prostate, ductus deferens and seminal vesicles; penis with the scrotum; sagittal section of the male pelvis; museum specimens; models and other visual aids, atlas.

Textbook: Sapin, Vol. 2, P. 17–35, 62–65, 66–67 (Tandon: P. 206–208; 350–358; 339–341).

GUIDELINES

To describe the surface anatomy of the individual **testis** you should identify its position in respect to the body. Note that the **posterior border** of the testis adjoins the **epididymis**, the widened head of epididymis is up, and the **sinus of epididymis** is open laterally. Find the **appendix of testis** and **appendix of epididymis** attached to the corresponding organs superiorly.

Studying the internal structure of the testis and epididymis consider the sites of spermatozoa formation and maturation, and elimination pathways. Define the **spermatic cord** and **ductus deferens**, pay attention to their topography and parts. Note that in the scrotum the ductus deferens lies posteriorly to other elements of the spermatic cord, and it is palpable due to its solid consistency (thick walls and tiny lumen).

You should understand that the formation of the spermatic cord, inguinal canal, and scrotum (composed by investing layers of the testis) is related to the testis descent during embryogenesis. Alteration of these processes may result in ectopic testes and other anomalies, including congenital inguinal hernia. Revise the topic: “Inguinal canal”.

Note that **the prostate**, **seminal vesicles**, and **ampulla of ductus deference** can be studied in the anatomical specimen of the male urinary bladder. The prostate lies inferior to the bladder, its **base** is attached to the bladder neck, and its **apex** points inferiorly. The **right** and **left lobes** are joined by the **isthmus** anteriorly and the **middle lobe** posteriorly. The **seminal vesicles** are found on the back surface of the bladder attaching to the base of the prostate, and between them there are ampullas of the right and left vas deference. The **ejaculatory ducts** are formed in the thickness of the prostate. Passing forward they limit the middle lobe of the prostate and open into the prostatic urethra on the **seminal colliculus**. The latter is an elevation of the **urethral crest** along the back wall of the urethra containing muscular and erectile tissue. Note that ducts of the **prostate glands** also open on the posterior wall of the prostatic urethra.

In the study of the **male urethra** pay attention to its topography and parts, curves, constrictions, expansions, and sphincters. Note that the **bulbourethral glands** are located within the perineum (in the urogenital triangle) and their ducts open into the **spongy urethra**, as well as ducts of the **urethral [Littre] glands**, which lie in the urethral mucosa.

In the study of the external male genitalia pay attention to the parts of the **penis, foreskin, frenulum of the foreskin**, internal structure of the penis, position of the urethra and **external urethral orifice**. Pay attention to the topography and structure of the **scrotum**.

Note that the male genital system in its development is tightly connected with the urinary system; in particular, with the mesonephros and mesonephric duct. Learn the sources and main stages of development of the internal genital organs, the indifferent primordia (common for males and females), their transformation in males during embryogenesis, rudimentary organs. Note that the formation of the external male genitalia is associated with the transformation of the urogenital sinus. Pay special attention to anomalies of the male genital organs associated with the testis descent and formation of the mail urethra.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Male internal genitalia. Testis (Latin: *testis, didimis*): lateral/medial surfaces; upper (superior)/lower (inferior) poles, anterior/posterior borders of testis; tunica vaginalis; tunica albuginea, mediastinum, septa of testis, lobuli of testis; testicular tubules: convoluted/straight seminiferous tubules, rete testis, efferent ductules. **Epididymis:** head, lobules, body, tail, duct of epididymis; sinus of epididymis. **Ductus (vas) deferens:** ampulla of ductus deference. **Seminal vesicle (seminal gland):** excretory duct; adventitia, muscular layer, mucosa. **Ejaculatory duct. Spermatic cord** (its elements). **Coverings** of the testis and spermatic cord. **Appendix of testis, appendix of epididymis, paradidymis. Prostate:** base, apex of prostate; anterior/posterior/inferolateral surface; right/left/middle lobes; isthmus of prostate; capsule of prostate; parenchyma: prostatic glands, prostatic ducts, muscular tissue, periurethral gland zone. **Bulbourethral gland** and duct.

Male external genitalia. Penis: root, body, crus, dorsum of penis, glans, neck; prepuce (foreskin); frenulum; corpus cavernosum & corpus spongiosum of penis; bulb of penis; tunica albuginea, trabeculae, cavernous spaces of corpus cavernosum & corpus spongiosum; fascia of penis; raphe penis. **Scrotum:** raphe; septum of scrotum; dartos muscle.

Male urethra: internal/external urethral orifice; intramural part; prostatic urethra: urethral crest, seminal colliculus, prostatic utricle; membranous urethra (intermediate part); spongy urethra: navicular fossa, urethral lacunae, urethral glands; internal/external urethral sphincter.

Questions for self-control:

1. List the internal and external male genital organs. Specify their functions.
2. Name the surfaces, borders, and poles of the testis.
3. What is the Greek name for “testis”?
4. What belongs to the stroma and parenchyma of the testis?
5. What are the lobules of testis?
6. Where are the convoluted and straight seminiferous tubules and rete testis located?
7. Where, specifically, are sperm cells produced in the testis? Where do sperm cells undergo maturation?
8. Where is testosterone produced?
9. Name the parts of the epididymis and describe their relationships with the testis. Where is the sinus of epididymis located?
10. What are the lobes (cones) of epididymis? Where is the duct of epididymis located?
11. Describe the topography of the ductus deferens; name its parts and its final segment.
12. What is the spermatic cord? List the contents and describe the topography of the spermatic cord. Describe the location of the superficial and deep inguinal rings.
13. Name and describe the coverings of the testis and spermatic cord. Which layer of the abdominal wall does each of them derive from?
14. What is the scrotum? Explain the functions of the dartos and cremaster muscles. Describe the tunica vaginalis.
15. What are the accessory glands of the male genital system? What are their functions?
16. What are the seminal vesicles? Where are they located?
17. How is the ejaculatory duct formed and where does it empty?
18. Trace the path of sperm from the site of its formation until it is released from the body.
19. Describe the shape, size, and topography of the prostate.
20. Name the surfaces and parts of the prostate. Where is the isthmus of the prostate?
21. What tissues compose the prostate? In which parts of the prostate does glandular tissue predominate, and in which — muscular tissue? What is the significance of the muscular and glandular parts of the prostate?
22. Where do the ducts of the prostate open?
23. What are the urethral crest, seminal tubercle, and utricle? What is their function?
24. Why does the proliferation of the prostate submucosal glands alter urination?

25. What are the bulbourethral (Cowper's) glands and where are they located? In which part of the urethra do their ducts empty?
26. Name the parts of the penis.
27. Name the bodies that constitute the penis. What kind of tissue forms the penile bodies?
28. Which of the penile bodies form the crura, glans, and bulb of the penis?
29. What tunic covers each penile body and what binds the bodies together?
30. What is the foreskin of the penis, preputial cavity?
31. Specify the length and diameter of the male urethra.
32. Name and describe the parts and orifices of the male urethra.
33. Indicate location of the bends, constrictions and expansions of the male urethra.
34. Which part of the male urethra is the narrowest and should be carefully passed during catheterization of the bladder? What shape does a metal catheter have and why?
35. What layers form the wall of the urethra?
36. What glands empty into the prostate urethra, spongy urethra?
37. What sphincters regulate urination? Define their location.
38. A victim of a car accident had the spongy body of the penis damaged. Can this result in urinary incontinence?
39. What are the rudimentary structures of the male genital organs and what is their significance?
40. When does the development of the genital organs begin?
41. Which germ layer gives rise to the internal genitalia?
42. What are the indifferent primordia (anlages) for the internal genital organs? Where are they located?
43. Name the sources of the indifferent gonads development.
44. Describe the process of testicular descent.
45. Give examples of congenital anomalies of gonades.
46. What transformations do the indifferent primordia undergo to form the definitive male internal genitalia? Name the derivatives of the mesonephros and mesonephric duct in males.
47. Name the indifferent primordia of the external genitalia. How do they transform during male sex differentiation? Give examples of congenital anomalies of the male external genitalia.

LESSON 13

Topic: Female genital system. Female internal genitalia. Ovary, appendages of the ovary: epoophoron and paraophoron, uterine (fallopian) tubes, uterus: topography, structure, X-ray anatomy.

Learning aims:

– to know structure, topography, and functions of the female internal genital organs; fixation of the uterus, its anatomical position;

– to be able to identify the female internal genital organs and demonstrate their structural details in anatomical specimens of individual organs, cadavers, and visual aids.

Teaching aids: anatomical specimens: uterus with the broad ligament of uterus, uterine tubes and ovaries; sagittal section of the female pelvis, museum specimens; models, tables, and other visual aids, radiographs, atlas, textbook.

Textbook: Sapin, Vol. 2, P. 35–46 (Tandon: P. 359–364).

GUIDELINES

To describe the surface anatomy of the internal female genital organs you should identify their position in respect with the body. Note that all these organs, except for the vagina, are related to the broad ligament of uterus, the double sheet of the peritoneum that attaches the uterus to the lateral walls of the pelvis. Revise the relationship of the uterus with the pelvic organs and the peritoneum. Pay attention to the shape of the uterus, note that the rounded fundus of the uterus is directed upward and anteriorly (**anteflexio**), the cervix downward, and the ovaries are attached to the posterior aspect of the broad ligament of the uterus by the **mesovarium**.

Note that the **ovaries** being in the peritoneal cavity are not covered by the peritoneum, which allows an oocyte to be released on the surface of the ovary during ovulation. The ovary is flattened in the sagittal plane with the **lateral surface** adjacent to the wall of the pelvis, the **free border** facing behind, and the **upper pole** (extremity) directed towards the **uterine tube**. Notice the two ligaments of the ovary: the **suspensory ligament of ovary**, conveying vessels and nerves from the pelvic wall towards the tubal extremity and hilum of ovary, and the **ligament of ovary** running from the uterine (lower) extremity to the border of the uterus. Note that the ligament of ovary and its continuation, the **round ligament of uterus**, are homologues of the gubernaculum of testis. Pay attention to the topography of the round ligament and its role in fixation of the uterus.

Consider the parts of the **broad ligament of uterus** and the following structures lying between its two layers: the **uterine [Fallopian] tube** in the free upper border of the broad ligament; the rudimentary structures (**epoophoron** with vesicular appendices — remnants of the mesonephros, and **paraoophoron** — a vestige of the ductus mesonephricus) in the **mesosalpinx**; the **parametrium** — accumulation of fat next to the cervix of uterus; and the **cardinal ligament (transverse cervical ligament)** around the uterine artery at the base of the broad ligament. Note that the ureter crosses behind

the uterine artery here. Keep in mind that the broad ligament with the associated organs is often referred to as the **adnexa uteri**.

Pay attention to the structure and position in the pelvis of the uterine tube and factors providing a passage of an egg along it. Consider the structures of the ovary performing endocrine and reproductive functions; the structure of the uterine wall and cavity, structural and functional differences between the body and the cervix of the uterus. Note that the hollow structures: **cervical canal**, **uterine cavity**, and lumen of the fallopian tubes can be visualized in the radiographs with contrast.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Ovary: hilum of ovary, medial/lateral surface; free & mesovarian border; tubal & uterine extremity; tunica albuginea; ovarian stroma; ovarian cortex and medulla; vesicular ovarian follicle; corpus luteum; corpus albicans; ligament of ovary; suspensory ligament of ovary. **Epoophoron. Paraoophoron. Uterine [Fallopian] tube:** abdominal & uterine ostium; fimbriae, ovarian fimbria; infundibulum; ampulla; isthmus; uterine part (intramural part); layers of the wall: serosa, subserosa, muscular layer, mucosa, folds of uterine tube.

Uterus: fundus, body, isthmus, borders of uterus; cervix of uterus: supravaginal part, vaginal part; uterine horn; uterine cavity; internal os; external os of uterus: anterior/posterior lip; cervical canal: palmate folds; cervical glands; parametrium; wall of the uterus: perimetrium (serousa), myometrium (tunica muscularis), endometrium (tunica mucosa); uterine glands; round ligament of uterus; cardinal ligament (transverse cervical ligament); broad ligament of uterus: mesometrium, mesosalpinx, mesovarium.

Questions for self-control:

1. List the internal female genitalia and outline their functions.
2. Describe the topography of the ovary and relationships with the peritoneum.
3. Name the borders, surfaces, extremities of the ovary, and ovarian ligaments.
4. Which ligaments bring vessels to the ovary? Where is the hilum of ovary?
5. What are the functions of the ovary? Which structures of the ovaries provide these functions?
6. Where in the ovary do oocytes grow and mature? What is ovulation?
7. What is the role of the corpus luteum?
8. Name the rudimentary structures that are found in the broad ligament of uterus. What is their significance?

9. Name the parts and openings of the uterine [Fallopian] tube and specify their position in the pelvis. Which structures help to direct an oocyte from the ovary surface to the uterine tube?

10. Describe the layers of the uterine tube wall. Which structures promote the medium for oocyte and which ones move it along the uterine tube? What is the site of fertilization of an oocyte? What is the ectopic pregnancy?

11. Explain terms “adnexa of uterus” (or uterine appendages), “adnexitis”?

12. What are the Greek names for “uterus” and “uterine tube”?

13. Specify the shape and size of the uterus in adult women. Name parts of the uterus and its cervix.

14. Describe the shape of the uterine cavity and cervical canal. Where does the cervical canal open? What surrounds the external os?

15. Name the layers of the uterus wall. Indicate the difference in mucosa structure in the uterine cavity and cervical canal.

16. What protects the uterine cavity from the vaginal content?

17. Describe the topography of the uterus, its relation to the peritoneum; name the peritoneal pouches in front and behind the uterus.

18. What fixates the uterus? List ligaments of the uterus and specify their topography.

19. Name parts of the broad ligament of uterus. How many layers does it have? What means the term “parametrium”?

20. What is the round ligament of uterus? What is the significance of this ligament for fixation of the uterus?

21. What do the terms “anteflexio” and “retroflexio” mean? How does the position of the uterus change with filling of the bladder?

22. The woman was delivered to the emergency room with the internal bleeding and suspected ectopic pregnancy. In which part of the peritoneal cavity would blood accumulate? Through which part of the vagina could the diagnostic puncture be performed?

23. During hysterectomy for the uterine cervix cancer the surgeon first ligated and then cut the uterine artery. What organ could be damaged during these manipulations?

LESSON 14

Topic: Vagina. Female external genitalia. Pudendum (vulva). Female urethra. Perineum and pelvic diaphragm: muscles and fasciae. Ischioanal fossa. Gender differences in structure of the perineum. Development of the female genital organs. Anomalies.

***Review*:** Pelvis as a whole.

Learning aims:

– to know structure, topography, and functions of the vagina and the external female genital organs;

– to know sources and main principles of the development of the female genital organs and associated anomalies;

– to know the structure of the perineum and pelvic diaphragm, their gender differences;

– to be able to identify the vagina, vaginal fornix and orifice, external female genital organs, pudendal cleft and vestibule of vagina in anatomical specimens and visual aids;

– to be able to identify perineum and its parts, muscles of the perineum and pelvic floor of males and females in anatomical specimens and visual aids.

Teaching aids: anatomical specimens: the uterus with the vagina; bony pelvis and skeleton; museum specimens; sagittal section of the female pelvis, model of the perineum and pelvic floor, tables and other visual aids, atlas.

Textbook: Sapin, Vol. 2, P. 46–59, 62–65, 66–69 (Tandon: P. 364; 339–345).

GUIDELINES

Learn the topography and structure of the **vagina**; note that only the portion of its posterior wall adjacent to the uterus has the peritoneal covering, over the rest of the vagina the muscular layer is surrounded by an adventitia of fibrous connective tissue. Pay attention to the different depth of the posterior and anterior parts of the **vaginal fornix**, position of the mucosal **rugae**, location of the **vaginal orifice** and **hymen**. Be able to identify the structures of the female external genitalia (**vulva**), and areas which they bound. Pay attention to the topography of the **vestibular glands** and erectile masses; structure and topography of the **female urethra**. Note that the female urethra passes with the vagina through the pelvic diaphragm and perineal membrane, surrounded by the **external urethral sphincter**, and opens in front of the vaginal orifice.

Note that the indifferent primordia of the internal and external genital organs are similar for males and females but the mesonephros and mesonephric duct undergo almost total reduction during female embryogenesis; the definitive external female organs resemble the indifferent fetal structures from which they develop.

Know the definitions of the **perineum** in the narrow and broad senses. Note that perineum is a complex of soft tissues (skin, muscles, fascia), lying below the **pelvic diaphragm (pelvic floor)**. Keep in mind that the old definition of the perineum includes the pelvic floor. Be able to draw the perineum (its inferior aspect) schematically, in the shape of a diamond with the tops facing the pubic symphysis and coccyx, and the lateral angles facing the ischial tuberosity. In the picture and the model of the perineum you should

define the following structures: **urogenital** and **anal triangles** and their muscles, **perineal body**, **anococcygeal body**, **ischio-anal fossa**. Note the sex differences in the structure of the perineum. Pay attention to the structure of the pelvic diaphragm; topography of the **levator ani muscle**, ischio-anal fossa, and **pelvic fascia**; relationships of the urethra, vagina, and rectum with the pelvic diaphragm and perineum.

List of anatomical terms and structures the student should know and be able to identify in the anatomical specimens and teaching aids:

Vagina. Anterior/posterior wall; vaginal fornix; vaginal orifice; hymen; muscular layer, mucosa: vaginal rugae, anterior/posterior vaginal column.

Pudendum (vulva). Mons pubis; labia majora; pudendal cleft; labia minora; vestibule of vagina; greater vestibular gland [Bartholin's gland]; lesser vestibular glands [Skene's or paraurethral glands]; bulb of vestibule; clitoris: prepuce, corpus cavernosum of clitoris, glans, body, crus of clitoris. **Female urethra.** Internal/external urethral orifice (Latine: *ostium urethrae*); muscular layer: internal urethral sphincter; spongy layer; mucosa: urethral crest, urethral glands; external urethral sphincter.

Pelvic diaphragm (pelvic floor): levator ani; coccygeus muscle; external anal sphincter; superior/inferior fascia of pelvic diaphragm; anococcygeal body (ligament); ischio-anal fossa.

Perineum. Urogenital triangle; anal triangle; perineal body (Latine: *corpus perineale, centrum perinei*); **muscles of anal triangle:** external anal sphincter; **muscles of urogenital triangle:** superficial transverse perineal muscle, ischiocavernous, bulbospongiosus, deep transverse perineal muscle; external urethral sphincter; transverse perineal ligament (in male); perineal fascia (superficial investing fascia of perineum); perineal membrane [inferior fascia of urogenital diaphragm].

Questions for self-control:

1. What is a Greek name for "vagina"?
2. Indicate the shape and length of the vagina in an adult female.
3. What is the vaginal fornix, where is it the deepest?
4. Where does the vaginal orifice open? What is the hymen?
5. List the layers of the vaginal wall, describe their specific features.
6. What are the vaginal rugae?
7. What does the term "vulva" (pudendum) stand for? List its components.
8. What are the boundaries of the pudendal cleft, vestibule?
9. Describe the structure of the labia majora and labia minora. What do they bound?
10. Where are the greater and lesser vestibular glands located? What are their functions?

11. What is the erectile tissue of female vulva?
12. Describe the location of the bulbs of vestibule, clitoris and its parts.
13. What is the length of the female urethra? Describe its topography and structure.
14. What are the sources of the ovary development? What is the initial location of gonads?
15. What are the derivatives of the paramesonephric duct in females? Give examples of anomalies caused by its abnormal development.
16. Which definitive structures develop in female from the urogenital sinus, urethral folds, genital swellings, and genital tubercle?
17. Give examples of congenital anomalies of the vulva.
18. Give the definitions of the perineum in the narrow and broad sense.
19. What are the four bony landmarks of the perineum?
20. Where is the border between the anal and urogenital triangles? In which plane is each triangle oriented?
21. Describe the anal triangle: borders, contents.
22. Describe the urogenital triangle: borders, organs in males and females.
23. Describe the muscles of the urogenital diaphragm (superficial and deep layers).
24. Name the fasciae of the urogenital triangle. What is the perineal membrane?
25. What is the perineal body?
26. What are characteristics of the female perineum?
27. What is the pelvic (floor)? What passes through it?
28. Name and describe the muscles of the pelvic floor.
29. What is the ischio-anal fossa?
30. Name the fasciae of the pelvic diaphragm. Describe the pelvic fascia.

LESSON 15

Topic: Final lesson on the section "Internal organs".

Learning aim: Control of mastering the material studied, reinforcement, consolidation and correction of knowledge.

Teaching aids: Skeleton; skull; upper and lower jaws; skull; teeth; anatomical specimens: sagittal section of the head; tongue; larynx; stomach; duodenum with the pancreas; segments of the jejunum, ileum, and colon; cecum with the appendix; liver; gallbladder; spleen; trachea with bronchi and lungs; individual lungs; kidneys; male and female urinary bladders; uterus with adnexa; testis with the epididymis and spermatic cord; external male genital organs; cadaver with the dissected chest and abdominal cavity; models; tables; radiographs.

Questions for self-control:

Digestive system.

1. General structural plan of the digestive tract wall.
2. Oral cavity: its walls and parts. Gums.
3. Floor of the oral cavity: structures of the mucosa, muscles.
4. Palate: parts. Muscles of the soft palate. Fauces.
5. Teeth: structure, surfaces. Periodontium.
6. Permanent teeth: dental formula, group characteristics.
7. Decidual (milk) teeth: structural features, dental formula, terms and sequence of eruption.
8. Tongue: structure of the mucosa.
9. Muscles of the tongue.
10. Major and minor salivary glands: structure and topography.
11. Pharynx: topography, divisions, connections.
12. Pharynx: structure of the wall. Pharyngeal lymphoid ring.
13. Esophagus: topography, structure, constrictions, functions.
14. Stomach: topography, parts, functions.
15. Stomach: structure of the wall.
16. Small intestine: topography, parts, structure, functions.
17. Duodenum: topography, parts, structure.
18. Mesenteric part of the small intestine: topography, structure.
19. Large intestine: parts, typical external features, structure of the wall, functions.
20. Cecum and vermiform appendix: topography, structure, ileocecal transition.
21. Colon: topography, parts, structure.
22. Rectum and anal canal: topography, structure.
23. Liver: syntopy, projection on the walls of the body (borders), surface structure, functions.
24. Segmentations of the liver: parts, divisions, segments, lobules. Porta hepatis, specific features of the blood supply.
25. Gall bladder: topography, structure, functions. Intra- and extrahepatic biliary ducts.
26. Pancreas: topography, structure, functions. Exocrine and endocrine parts.
27. Spleen: topography, structure, functions.
28. Peritoneum: parietal, visceral peritoneum, derivatives of the peritoneum (ligaments, mesenteries, omentums), peritoneal cavity, retroperitoneal space.
29. Topography of the peritoneum in the supracolic compartment (upper floor) of the abdominal cavity. Lesser omentum. Omental bursa. Recesses and spaces.

30. Topography of the peritoneum in the infracolic compartment (lower floor) of the abdominal cavity.
31. Topography of the peritoneum in the pelvic cavity.
32. Development of the digestive system and associated anomalies.

Respiratory system.

33. External nose and nasal cavity: structure and functions.
34. Paranasal sinuses: their connections and significance.
35. Larynx: topography, cartilages, ligaments and joints, functions.
36. Larynx: cavity, layers of the wall.
37. Muscles of the larynx: classification, topography, structure, function.
38. Trachea and main bronchi: topography, structure. Roots of lungs.
39. Lungs: topography, surface structure, projections on the body walls (borders).
40. Bronchial and alveolar tree. Segments of lungs.
41. Pleura: visceral, parietal, pleural cavity, pleural sinuses. Projection of the borders (reflections) of the parietal pleura on the body walls.
42. Mediastinum: divisions, organs, relationships with the fascial spaces of the neck.
43. Development of the respiratory system and associated anomalies.

Urinary and genital systems.

44. Kidneys: topography, fixation, external structure.
45. Kidney: internal structure. Nephron. Pathways of urine flow through the kidney.
46. Ureter: parts, topography, constrictions, structure.
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57. Uterine (Fallopian) tube: topography, structure, functions.
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60. External female genitalia (vulva).

61. Development of the female genital system and associated anomalies.
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63. Pelvic diaphragm: muscles, fasciae, ischioanal fossa.

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