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1. History of medicine

Medicine is among the most ancient of human occupations. It began as an art and gradually developed into a science over the centuries. There are 3 main stages in medicine development: Medicine of Ancient Civilizations, Medicine of Middle Ages and Modern Medicine.

Early man, like the animals, was subject to illness and death; therefore medical actions were mostly a part of ceremonial rituals. The medicine-man practiced magic to help people who were ill or had a wound. New civilizations, which developed from early tribes, began to study the human body, its anatomic composition. Magic still played an important part in treating but new practical methods were also developing. The early Indians, e.g., set fractures and practiced aromatherapy. The Chinese were pioneers of immunization and acupuncture. The contribution of the Greeks in medicine was enormous. An early leader in Greek medicine was Aesculapius. His daughters, Hygeia and Panacea gave rise to dynasties of healers (curative medicine) and hygienists (preventive medicine). The division in curative and preventive medicine is true today. The ethical principles of a physician were summarized by another Greek, Hippocrates. They are known as Hippocrates Oath.

The next stage of Medicine's development was the Middle Ages. A very important achievement of that time was the hospital. The first ones appeared in the 15th century in Oriental countries and later in Europe. Another advance in the Middle Ages was the foundation of universities during 13—14th centuries. Among other disciplines students could study medicine. During 18th century new discoveries were made in chemistry, anatomy, biology, others sciences. The advances of that time were invention of the stethoscope (by Rene Laennec), vaccination for smallpox, coveries were made in chemistry, anatomy, biology, others sciences.

During the 19th century the first hospitals appeared in the 12th century. Among other disciplines studied in medicine were those of the Middle Ages was the formation of universities during 13—14th centuries. Another advance in the Middle Ages was the foundation of universities during 13—14th centuries. Among other disciplines students could study medicine. During 18th century new discoveries were made in chemistry, anatomy, biology, others sciences. The advances of that time were invention of the stethoscope (by Rene Laennec), vaccination for smallpox, coveries were made in chemistry, anatomy, biology, others sciences.

2. Cell

The cell is a smallest independent unit in the body containing all the essential properties of life. Many types of human cells can be grown in test tubes after being taken from the body. Cells which are functionally organized are often grouped together and operate in concert as a tissue, such as muscle tissue or nervous tissue. Various tissues may be arranged together to form a unit called organ as the kidneys, liver, heart or lungs. Organs often function in groups called organ systems. Thus the esophagus, stomach, pancreas, liver and intestines constitute the digestive system.

Cells are characterized by high degree of complexity and order in both structure and function. The cell contains a number of structures called cell organelles. These are responsible for carrying out the specialized biochemical reactions characterizing each. The many chemical reactions taking place in a cell require the establishment of varied chemical microenvironment.

Carefully controlled transport mechanisms along with highly effective barriers — the cell membranes — ensure that chemicals are present in the proper region of the cell in appropriate concentration.

The cell membranes of a mixture of protein and lipid form its surroundings.

Membranes are an essential component of almost all cells organelles. The membrane allows only certain molecules to pass through it.

The most visible and essential organelle in a cell is the nucleus, containing genetic material and regulating the activities of the entire cell.

The area outside of the cell is called the cytoplasm. Cytoplasm contains a variety of organelles that have different functions.

3. Tissue

A tissue is a group of cells working together to do a specific job. A biologist is one who specializes in the study of tissues. The cells, of which the tissues are made, contain from 60 to 99% water. Chemical reactions that are necessary for proper body function are carried on much more readily in a water solution. The water solution and other substances that make up the cells organelles. The membrane allows only certain molecules to pass through it.

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4. Epidermis

The integument consists of the skin (epidermis and dermis) and associated appendages (sweat glands, sebaceous glands, hairs, and nails). Considered the largest body organ, the integument comprises approximately 16% of total body weight. It is a highly specialized organ that functions to protect the body from injury, desiccation, and infection. It also participates in sensory reception, secretion, thermoregulation, and maintenance of water balance.

Epidermis is the outermost layer of the integument. It is a stratified squamous epithelial layer of ectodermal origin.

Layers of the epidermis from deep to superficial consist of four strata. Stratum basale, stratum spinosum, stratum granulosum, and stratum corneum.

Stratum basale is the basal cell layer, a sterile layer of columnar-like cells that contains the fibrous protein keratin. Stratum spinosum is a multilaminar layer of cuboidal-like cells that are bound together by means of numerous cytoplasmic extensions and desmosomal junctions.

Stratum granulosum consists of flat polygonal cells filled with keratinized keratohyalin granules. Stratum corneum is the superficial stratum of dead cells and consists of several to many layers of flat, anucleated, and corneolized keratinized cells. In the epidermis of the palms and soles, a thin, transitional zone of flat eosinophilic or pale-staining anucleated cells may occur as the stratum lucidum. This layer is found only in regions with a thick strata corneum.

Cells of the epidermis: keratocytes are the most numerous and are responsible for the production of the family of keratin proteins that provide the barrier function of the epidermis.
stic; in bone it is rigid due to the deposition of calcium salt in the matrix. In multicellular organisms certain cells developed to a high degree the properties of irritability and conductivity. These cells form the nervous tissues. The nervous system of higher animals is characterized by the multiplicity of cellular forms and intercellular connections and by the complexity of its functioning.

Muscle tissue is composed of elongated cells which have the power of contracting or reducing their length. This property of contraction is ultimately a molecular phenomenon and is due to the presence of protein molecules. The following three types of muscle tissue occur in the body. Smooth muscle tissue is found in sheet or tubes forming the walls of many hollow or tubular organs, for example the bladder, the intestines of blood vessels. The cells forming this tissue are long spindles with a central oval nucleus.

Striated muscle tissue is composed of cylindrical fibres often of great length in which separate cells cannot be distinguished. Many small nuclei are found in the fibres lie just under the surface. Cardiac muscle resembles striated muscle in its structure, but smooth one in its action.

Melanocytes are derivatives of neural crest ectoderm. They are found in the dermis and are also scattered among the keratinocytes in the basal layers of the epidermis. These dendritic cells produce the pigment melanin in the form melanosomes that are transferred to keratinocytes. Langerhans cells are dendritic cells but are members of the immune system and function as antigen-presenting cells. They have also been found in other parts of the body, including the oral cavity and lymph nodes. Merkel cells are found in the basal epidermis and appear function in concert with nerve fibers that are closely associated with them. At the electron microscopic level, their cytoplasm contains numerous membrane-bound granules that resemble those of catecholamine-producing cells.

New words

<table>
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<tr>
<th>Russian</th>
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<td>liquid — жидкость</td>
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<tr>
<td>epithelial — эпителиальный</td>
<td>epithelial</td>
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<tr>
<td>layer — слой</td>
<td>layer</td>
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<tr>
<td>muscle — мышца</td>
<td>muscle</td>
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<tr>
<td>body — тело</td>
<td>body</td>
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<tr>
<td>flexible — гибкий</td>
<td>flexible</td>
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<tr>
<td>elastic — эластичный</td>
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<td>nucleus — ядро</td>
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<td>smooth — гладкий</td>
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<td>fibre — волокно</td>
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<td>cardiac — сердечный</td>
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Discovery of anesthetics and development of immunology and scientific surgery.

The next century is rise of bacteriology. Important discoveries were made by Louis Pasteur and Robert Koch. The development of scientific bacteriology made possible advances in surgery: using antiseptics and control of wound infection.

Medicine in the 20th century made enormous contribution in the basic medical sciences. These are discovery of blood groups and vitamins, invention of insulin and penicillin, practice of plastic surgery and transplantation.
5. Dermis

Dermis is a connective tissue layer of mesodermal ori- gin subjacent to the epidermis and its basement membrane. The dermis-epidermal junction, especially in thick skin, is characterized by numerous papillary interdigitations of the dermal connective tissue and epidermal epithelium. This increases the surface area of attachment and brings blood vessels and nerve endings close to the surface. The dermis, like the epidermis in general, is devoid of blood vessels. Histologically, dermis consists of two identifiable re- gions.

Papillary layer, associated principally with the dermal papillae on all over the surface of the skin. It consists of a loosely packed, irregular meshwork of collagen fibrils that contain fine blood vessels and nerve endings.

Reticular layer is the deeper dermal layer and consists of coarse collagen bundles interwoven with elastic fibers in a gel matrix. This layer is a typical dense irregular con- necrive tissue.

HYPODERMIS: this layer of loose vascular connective tissue is infiltrated with adipocytes and corresponds to the superficial fascia of gross anatomy. However, since it con- tains the deepest portions of the cutaneous glands and hairs, it is also an important part of the skin. The hypoder- mis fastens the skin to underlying muscles and other structures.

New words

- dermis — derma
- connective — соединительный
- membrane — мембрана
- junction — соединение
- to be characterized by — характеризоваться чем-то
- numerous — значительный

6. Cutaneous appendages

Cutaneous appendages are all derivatives of the epi- demis.

- Eccrine (merocrine) sweat glands are simple, coiled, tubular glands that are widely distributed over the body. Secretory portions are tightly coiled and consist of a sin- gle layer of columnar-like pyramidal cells. Duct portions, composed of two cuboidal cell layers, are corkscrew-shaped and open onto the epidermal surface. These glands are important in thermal regulation. Control of the eccrine glands is mainly by the innerva- tion of cholinergic fibers. Apocrine sweat glands are also simple, coiled, tubular glands but are much less abundant in their distribution than eccrine glands. They can be found in the axillary, ar- eolar, and anal regions. Secretory portions of these glands are composed of a sin- gle layer of cuboidal or columnar cells. They are larger and have a much wider luminal diameter than eccrine sweat glands. Myoepithelial cells surround the secretory cells within the ba- sement membrane and contract to facilitate secretion. Duct portions are similar to those of eccrine sweat glands but open onto hair follicles instead of onto the epi- dermal surfaces. Functions of these glands in humans is not at all clear. Specialized apocrine glands in the ear canal (ceruminous glands) produce a secretion in conjunction with adjacent sebaceous glands to form the protective earwax (ceru- min). Control of the apocrine glands is hormonal and via the innervation of adrenergic fibers. These glands do not begin to function until puberty. Sebaceous glands are simple, branched holocrine aci- nar glands. They usually discharge their secretions onto the hair shaft within hair follicles. These glands are found

7. Matter

Matter is anything that occupies space, possesses mass and can be perceived by our sense organs. It exists in nature in three, usually interconvertible physical states: solids, liquids and gases. For instance, ice, water and ste- am are respectively the solid, liquid and gaseous states of water. Things in the physical world are made up of a rela- tively small number of basic materials combined in vari- ous ways. The physical material of which everything that we can see or touch is made is matter. Matter exists in three different states: solid, liquid and gaseous. Human senses with the help of tools allow us to determine the properties of matter. Matter can undergo a variety of changes — physical and chemical, natural and controlled.

Chemistry and physics deal with the study of matter, its properties, changes and transformation with energy. The- re are two kinds of properties: physical — colour, taste, odor, density, hardness, solubility and ability to conduct electricity and heat; in solids the shape of their crystals is significant, freezing and boiling points of liquids.

Chemical properties are the changes in composition undergone by a substance when it is subjected to various conditions. The various changes may be physical and chemical. The physical properties are temporary. In a che- mical change the composition of the substance is chan- ged and new products are formed. Chemical properties are permanent.

It is useful to sort materials as solid, liquid or gas (though water, for example, exists as solid (ice), as liquid (water) and as gas (water vapour). The changes of state can be classified by the terms solidity (frozen), liquid (melt), va- pourise (evaporate) and condense are examples of phys- ical changes. After physical change there is still the same

8. Skeletal system

The components of the skeletal system are derived from mesenchymal elements that are primarily of mesodermal and neu- ral crest. Mesenchymal cells differentiate into fibroblasts, chordroblasts, and osteoblasts, which produce connective tissue, cartilage, and bone tissue, respectively. Bone organs either develop directly in mesenchymal connective tissue (endochondral ossification) or from preformed cartilage models (endochondral ossification). The splanchnic meso- derm gives rise to cardiac and smooth muscle. The skeletal system develops from paraxial mesoderm. By the end of the fourth week, the sclerotome cells form striated connective tissue, known as mesenchyme. Mesenchyme cells migrate and differentiate to form fibre- blasts, chordroblasts, or osteoblasts. Bone organs are formed by two methods. Flat bones are formed by a process known as intra- membranous ossification, in which bones develop directly within mesenchyme. Long bones are formed by a process known as en- dendochondral ossification, in which mesenchymal cells give rise hyaline cartilage models that subsequently become ossified. Skull formation.

Neurocranium is divided into two portions. The membranous neurocranium consists of flat bones that surround the brain as a vault. The bones oppose one another at sutures and fontanelles, which allow overlap of bones during birth and remain membranous until adulthood. The cartilaginous neurocranium (chondro-cranium) of the base of the skull is formed by fusion and ossification of number of separate cartilages along the median plate.
In the dermis through the skin, except on the palms and soles. Secretory portions consist of peripherally located, flat-toned stem cells that resemble basal keratinocytes. Toward the center of the acini, enlarged differentiated cells are engorged with lipid. Death and fragmentation of cells nearest the duct portion result in the holocrine mechanism of secretion. Duct portions of sebaceous glands are composed of stratified squamous epithelium that is continuous with the hair and epidermal surface. Functions involve the lubrication of both hairs and cornified layers of the skin, as well as resistance to desiccation. Control of sebaceous glands is hormonal. Enlargement of smooth muscles raise the hairs and dilate the epidermis (“goose flesh”). Nails, like hair, are a modified stratum corneum of the epidermis. They contain hard keratin that forms in a manner similar to the formation of hair. Cells continually proliferate and keratinize from the stratum basale of the nail matrix.

Viscerocranium arises primarily from the first two pharyngeal arches. Appendicular system: The pectoral and pelvic girdles and the limbs comprise the appendicular system. Except for the clavicle, most bones of the system are endochondral. The limbs begin as mesenchymal buds with an apical ectodermal ridge covering, which exerts an inductive influence over the mesenchyme. Bone formation occurs by ossification of hyaline cartilage models. The cartilage that remains between the diaphysis and the epiphyses of a long bone is known as the epiphysial plate. It is the site of growth of long bones until they attain their final size and the epiphysial plate disappears. Vertebrae are formed, each consisting of the caudal part of one sclerotome and cephalic part of the next. While the notochord persists in the areas of the vertebral bodies, it degenerates between them, forming the nucleus pulposus. The latter, together with surrounding circular fibers of the annulus fibrosus, forms the intervertebral disc.

Material. Water is water whether it is solid, liquid or gas. Also, there is still the same mass of material. It is usually easy to reverse a physical change.

New words
- matter — материя
- mass — масса
- sense — чувство
- organ — орган
- variety — разнообразие
- change — перемена
- color — цвет
- taste — вкус
- odour — запах
- density — плотность
- hardness — твердость
- solubility — растворимость
- ability — возможность
- to conduct — проводить
- to consist of — состоять из
- to contain — содержать
- collagen — коллагеновый
- adipocyte — жировая клетка
- to increase — увеличивать
- area — площадь
- epidermal — эпидермальный
- thick — толстый
- skin — кожа
- papillary — папиллярный
- devoid — происходить
- to undergo — подвергать
- to consist of — состоять из
- to contain — содержать
- collagen — коллагеновый
- adipocyte — жировая клетка

New words
- cutaneous — кожный
- appendage — покров
- tubular — трубчатый
- pyramidal — пирамидальный
- surface — поверхность
- thermal — тепловой
- innervation — иннервация

New words
- skeletal — скелетный
- mesoderm — мезодерма
- cartilage — хрящ
- fibroblasts — фибробласты
- chondroblasts — хондробласты
- osteoblasts — остеобласты
- paraxial — параксиальный
- flat — плоский
- bone — кость

New words
- to undergo — подвергать
- to contain — содержать
9. Muskular system

Skeletal (voluntary) system. The dermomyotome further differentiates into the myotome and the dermatome. Cells of the myotome migrate ventrally to surround the intraembryonic coelom and the somatic mesoderm of the ventrolateral body wall. These myoblasts elongate, become spindle-shaped, and fuse to form multinucleated muscle fibers. Myotubules appear in the cytoplasm, and, by the third month, cross-striations appear. Individual muscle fibers increase in diameter as myoblasts multiply and become surrounded by mesenchyme.

Individual muscles form, as well as tendons that connect muscle to bone.

Trunk musculature. By the end of the fifth week, body-wall musculature divides into a dorsal epimere, supplied by the dorsal primary rami of the spinal nerve, and a ventral hypomere, supplied by the ventral primary rami.

Epimere muscles form the extensor muscles of the vertebral column, and hypomere muscles give rise to lateral and ventral flexor musculature.

The hypomere splits into three layers. In the thorax, the three layers form the external costal, internal intercostal, and transverse thoracic muscle.

In the abdomen, the three layers form the external oblique, internal oblique, and transverse abdominal muscles. Head musculature.

The extrinsic and intrinsic muscles of the tongue are thought to be derived from occipital myotomes that migrate forward.

The extrinsic muscles of the eye may derive from preoptalic myotomes that originally surround the optic vesicle.

10. Skeleton

The bodies of our body make up a skeleton. The skeletal system is the framework of the body. The skeleton is composed of a number of bony segments called vertebrae, which make up the spine. The vertebrae make up the spinal column. The spinal column consists of 12 vertebrae. The human vertebrae are divided into differentiated groups. The seven most superior are the cervical vertebrae. The first cervical vertebra is the atlas. The second vertebra is called the axis. Inferior to the cervical vertebrae are twelve thoracic vertebrae. There is one rib connected to each thoracic vertebra, making 12 pairs of ribs. Most of the rib pairs come together ventrally to form the rib cage. The first pairs or ribs are short. All seven pairs join the sternum directly and are sometimes called the "false ribs." Pairs 8, 9, 10 are "false ribs." The eleventh and twelfth pairs are the "floating ribs."

Trunk vertebrae. Inferior to the thoracic vertebrae are five lumbar vertebrae. The lumbar vertebrae are the largest and the heaviest of the spinal column. Inferior to the lumbar vertebrae are five sacral vertebrae forming a strong bone in adults. The most inferior group of vertebrae are four small vertebrae forming the coccyx.

The vertebral column is not made up of bone alone. It also has cartilages.

11. Muscles

Muscles are the active part of the motor apparatus; their contraction produces various movements. The muscles may be divided from a physiological standpoint into two classes: the voluntary muscles, which are under the control of the will, and the involuntary muscles, which are not.

All muscular tissues are controlled by the nervous system. When muscular tissue is examined under the microscope, it is seen to be made up of small, elongated threadlike muscle fibers. These react slowly to stimuli from the autonomic nervous system. These may be divided into groups surrounded by mesenchyme. The striated muscle fibers are attached to the bone. The unstriated muscles bring about movements in the human body. The heart is composed of about 600 skeletal muscle fibers. In the adult about 35–40% of the body weight is made up of muscle.

New words

Muscle — мышца
Weight — вес
Trunk — туловище

12. Bones

Bone is the type of connective tissue that forms the body’s supporting framework, the skeleton. It serves to protect the internal organs from injury. The bone marrow inside the bones is the body’s major producer of both red and white blood cells.

Bones are generally classified in two ways. When classified by the basis of their shape, they fall into four categories: flat bones, such as the skull; long bones, such as the thigh bone; short bones, such as the wrist bones; and irregular bones, such as the vertebrae. When classified by the basis of how they develop, bones are divided into two groups: endochondral bones and intramembranous bones. Endochondral bones, such as the long bones and the bones of the base of the skull, develop from cartilage tissue. Intramembranous bones, such as the flat bones of the roof of the skull, are not formed from cartilage but develop under or within a connective tissue membrane. Although endochondral bones and intramembranous bones form in different ways, they have the same structure.

The formation of bone tissue (ossification) begins early in embryological development. The bones reach their full size when the person is about 25.

Most adult bone is composed of two types of tissue: another layer of compact bone and an inner layer of spongy bone. The bone in the body is hard and dense and the bone in the end of bone is light and porous and contains bone marrow. The amount of each type of tissue varies in different bones. The flat bones of the skull consist almost entirely of compact bone, while other bones have less compact bone and more spongy bone.
Pact bone, with very little spongy tissue. In a long bone, such as the thigh bone, the shaft, called the diaphysis, is made up largely of compact bone. While the ends, called epyphyses, consist mostly of spongy bone. In a long bone, marrow is also present inside the shaft, in a cavity called the medullary cavity.

Surrounding every bone, except at the surface where it meets another bone, is a fibrous membrane called the periosteum. The outer layer of the periosteum consists of a network of densely packed collagen fibres and blood vessels. This layer serves for the attachment of tendons, ligaments, and muscles to the bone and is also important in bone repair.

The inner layer of the periosteum has many fibres, called fibres of Sharpey, which penetrate the bone tissue, anchoring the periosteum to the bone. The inner layer also has many bone-forming cells, or osteoblasts, which are responsible for the bone’s growth in diameter and the production of new bone tissue in cases of fracture, infection.

In addition to the periosteum, all bones have another membrane, the endosteum. It lines the marrow cavity as well as the smaller cavities within the bone. This membrane, like the inner layer of the periosteum, contains osteoblasts, and is important in the formation of new bone tissue.

The muscles of mastication, facial expression, the pharynx, and the larynx are derived from different pharyngeal arches and maintain their innervation by the nerve of the arch of origin.

Limb musculature originates in the seventh week from some mesoderm that migrates into the limb bud. With time, the limb musculature splits into ventral flexor and dorsal extem groups.

The limb is innervated by spinal nerves, which penetrate the limb bud mesodermal condensations. Segmental branches of the spinal nerves fuse to form large dorsal and ventral nerves.

The cutaneous innervation of the limbs is also derived from spinal nerves and reflects the level at which the limbs arise.

Smooth muscle: the smooth muscle coats of the gut, trachea, bronchi, and blood vessels of the associated mesenteries are derived from splanchnic mesoderm surrounding the gastrointestinal tract. Vessels elsewhere in the body obtain their coat from local mesenchyme.

Cardiac muscle, like smooth muscle, is derived from splanchnic mesoderm.

New words
- ventral — брюшной
- somatic — соматический
- cytoplasm — цитоплазма
- cross-striations — поперечные бороздчатости
- extensor — разгибающая мышца
- dorsal — спинной
- arch — дуга
- abdomen — живот
- facial — лицевой
- branch — ветвь

The weight is formed by the muscles. According to the basic part of the skeleton all the muscles are divided into the muscles of the trunk, head and extremities.

According to the form all the muscles are traditionally divided into three basic groups: long, short and wide muscles. Long muscles compose the free parts of the extremities. The wide muscles form the walls of the body cavities. Some short muscles, of which stapedus is the smallest muscle in the human body, form facial musculature.

Some muscles are called according to the structure of their fibres, for example radiated muscles; others according to their uses, for example extensors or according to their directions, for example, — oblique.

Great research work was carried out by many scientists to determine the functions of the muscles. Their work helped to establish that the muscles were the active agents of motion and contraction.

New words
- muscles — мышцы
- active — активный
- motor apparatus — двигательный аппарат
- various — различный
- movement — движение
- elongated — удлиненный
- threadlike — нитевидный
- be bound — быть связанным
- ability — возможность
- capable — способность
- scientist — ученый
- basic — основной
13. Bones. Chemical structure

Bone tissue consists largely of a hard substance called the matrix. Embedded in the matrix are the bone cells, or osteocytes. Bone matrix consists of both organic and inorganic materials. The organic portion is made up chiefly of collagen fibres. The inorganic portion of matrix constitutes about two thirds of a bone’s total weight. The chief inorganic substance is calcium phosphate, which is responsible for the bone’s hardness. If the organic portion were burned out the bone would crumble under the slightest pressure. In the formation of intramembranous bone, certain cells of the embryonic connective tissue congregate in the area where the bone is to form. Small blood vessels soon invade the area, and the cells, which have clustered in strands, undergo certain changes to become osteoblasts. The cells then begin secreting collagen fibres and an intercellular substance. This substance, together with the collagen fibres and the connective tissue fibres already present, is called osteoid. Osteoid is very soft and flexible, but as mineral salts are deposited it becomes hard matrix. The formation of endochondral bone is preceded by the formation of a cartilaginous structure similar in shape to the resulting bone. In a long bone, ossification begins in the area that becomes the center of the shaft. In this area, cartilage cells become osteoblasts and start forming bone tissue. This process spreads toward either end of the bone. The only areas where cartilage is not soon replaced by bone tissue are the regions where the shaft joins the two epiphyses. These areas, called epiphyseal plates, are responsible for the bone’s continuing growth in length. The bone’s growth in diameter is due to the addition of layers of bone around the outside of the shaft. As they are formed, layers of bone on the inside of the shaft are formed, layers of bone on the outside of the shaft.

14. Skull

Root of neck: This area communicates with the superior mediastinum through the thoracic inlet. Structures of this region include the following: subclavian artery and vein. The subclavian artery passes posterio r to the scalene anterior muscle, and the vein passes anterior to it. Branches of the artery include: vertebral artery; thyrocervical trunk, which gives rise to the inferior thyroid, the transverse cervical, and the suprascapular arteries; Internal thoracic artery. The artery is a terminal branch of the external carotid artery. The vertebral artery and vein. The artery is a terminal branch of the external carotid artery. The internal thoracic artery and vein. The artery is a terminal branch of the external carotid artery.

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15. Neck. Cervical vertebrae, cartilages, triangles

Cervical vertebrae: There are seven cervical vertebrae of which the first two are atypical. All cervical vertebrae have the foramina transversaria which produce a canal that transmits the vertebral artery and vein.

Atlas: This is the first cervical vertebra (C1). It has no body and leaves a space to accommodate the dens of the second cervical vertebra. Axis: This is the second cervical vertebra (C2). It has odontoid process, which articulate with the atlas as a pivot joint. Hyoid bone is a small U-shaped bone, which is suspended by muscles and ligaments at the level of vertebra C3. Laryngeal prominence is formed by the lamina of the thyroid cartilage.

Cricoid cartilage. The arch of the cricoid is palpable below the thyroid cartilage and superior to the first tracheal ring (vertebral level C6). Triangles of the neck: The neck is divided into a posterior and an anterior triangle by the sternocleidomastoid muscle. These triangles are subdivided by smaller muscles into six smaller triangles. Posterior triangle is formed by the sternocleidomastoid, the clavicle, and the trapezius. Occipital triangle is located above the inferior border of the omohyoid muscle. Its contents include the following: CN XI Cutaneous branches of the cervical plexus are the lesser occipital, great auricular, transverse cervical, and suprascapular nerves. Subclavian (omoclavicular, supraclavicular) triangle is located below the anterior border of the scapular neck. Its contents include the following: Brachial plexus suprascapular portion. The branches include the dorsal scapular, long thoracic, subclavian, and suprascapular nerves.

16. Neck. Root, fascias of the neck

Retropharyngeal (visceral) fascia surrounds the pharynx. Retropharyngeal (visceral) fascia surrounds the pharynx. Prevertebral fascia invests the prevertebral muscles of the neck (i.e., longus colli, longus capitis). This layer gives rise to a derivative known as the alar fascia. The major muscle groups and their innervations. A simple method of organizing the muscles of the neck is based on two basic principles: (1) The muscles may be arranged in group according to their functions; and (2) all muscles...
The muscles of the mouth

Muskels of the mouth

Mentalis (quadratus labii inferioris)
Muscle of the neck

Buccinator

Levator labii superioris

Orbicularis oris

Zygomaticus minor

Nasalis

Depressor labii inferioris

Levator labii superioris alaeque nasi

Zygomaticus major

The muscles of the face

Group 1: Muscles of the tongue. All intrinsic muscles plus all but one of the extrinsic muscles (i.e., those containing the suffix, glossus) of the tongue are supplied by CN XII. The exception is palatoglossus, which is supplied by CN X.

Group 2: Muscles of the larynx. All but one of the intrinsic muscles of the larynx are supplied by the recurrent laryngeal branch of the vagus nerve. The sole exception is the cricothyroid muscle, which is supplied by the external laryngeal branch of the vagus nerve.

Group 3: Muscles of the pharynx. All but one of the longitudinal and circular muscles of the pharynx are supplied by CNs X and XI (cranial portion). The sole exception is the tensor veli palatini, which is supplied by CN V3.

Group 4: Muscles of the soft palate. All but one of the muscles of the palate are supplied by CNs X and XI (cranial portion). The sole exception is the tensor veli palatini, which is supplied by CN V3.

Group 5: Infrahzyoid muscles. All but one of the infrathyroid muscles are supplied by the ansa cervicale of the cervical Plexus (C1, C2, and C3). The exception is the thyrohyoid, which is supplied by a branch of C1. (This branch of C1 also supplies the genioglossal muscle).

The subclavian artery enters the subclavian triangle. The subclavian vein passes superficial to scalenus anterior muscle. It receives the external jugular vein.

Anterior triangle is bound by the sternocleidomastoid muscle of the midline of the neck, and the inferior border of the body of the mandible. Muscular triangle is bound by the sternocleidomastoid muscle, the superior belly of the omohyoid muscle and the posterior belly of the digastric muscle. The carotid triangle contains the following: internal jugular vein; Common carotid artery; carotid and accessory nerve; Vagus nerve; hypoglossal nerve; External carotid and ascending pharyngeal arteries.

The third part of the subclavian artery enters the subclavian triangle. The subclavian vein passes superficial to scalenus anterior muscle. It receives the external jugular vein.

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17. Thoracic wall

There are 12 thoracic vertebrae. Each rib articulates with the body of the numerically corresponding vertebra and the one below it. Sternum: the manubrium articulates with the clavicle and the first rib. It meets the body of the sternum at the sternal angle, an important clinical landmark. The body articulates directly with ribs 2—7; it articulates inferiorly with the xiphoid process. Ribs and costal cartilages: there are 12 pairs of ribs, which are attached posteriorly to thoracic vertebrae. Ribs 1—7 attach directly to the sternum by costal cartilages. Ribs 8—10 attach to the costal cartilage of the rib above. Ribs 11 and 12 have no anterior attachments. The costal groove is located along the inferior border of each rib and provides protection for the intercostal nerve artery, and vein. There are 11 pairs of external intercostal muscles. These muscles fill the intercostal spaces from the tubercles of ribs posteriorly to the costochondral junctions anteriorly. There are 11 pairs of internal intercostal muscles. These muscles fill the intercostal spaces anteriorly from the sternum to the angles of the ribs posteriorly. Innermost intercostal muscles: the deep layers of the internal intercostal muscles are the innermost intercostal muscles. Subcostal portion: Fibers extend from the inner surface of the angle of one rib to the rib that is inferior to it. Internal thoracic vessels: branches of the subclavian arteries, run anterior to these fibers. Intercostal structures: internal thoracic nerves: there are 12 pairs of thoracic nerves, 11 intercostal pairs, and 1 subcostal pair. Intercostal nerves are the ventral primary rami of thoracic spinal nerves. These nerves supply the skin and musculature of the thoracic and abdominal walls.

18. Blood. Formed elements of the blood. Erythrocytes and platelets

Blood is considered a modified type of connective tissue. Mesodermal is composed of cells and cell frag ments (erythrocytes, leukocytes, platelets), fibrous proteins (fibronectin), and an extracellular fluid and proteins (plasma). It also contains cellular elements of the immune system as well as humoral factors. The formed elements of the blood include erythrocytes, leukocytes, and platelets. Erythrocytes, or red blood cells, are important in transporting oxygen from the lungs to tissues and in returning carbon dioxide to the lungs. Oxygen and carbon dioxide is carried in the RBC in combination with hemoglobin to form oxyhemoglobin and carbaminohemoglobin, respectively. Mature erythrocytes are encrusted, biconcave discs with a diameter of 7—8 mm. The biconcave shape results in a 20—30% increase in surface area and thus has the shape of a sphere. Erythrocytes have a very large surface area: volume ratio that allows for efficient gas transfer. Erythrocyte membranes are remarkably pliable, enabling the cells to squeeze through the narrowest capillaries. In sickle cell anemia, this plasticity is lost, and the subsequent clogging of capillaries leads to sickle crisis. The normal concentration of erythrocytes in blood is 3.5—5.5 million/mm³ in women and 4.3—5.9 million/mm³ in men. The packed volume of blood cells per total volume of known as the hematocrit. Normal hematocrit values are 46% for women and 41—53% for men. When aging RBCs develop subtle changes, macrophages in the bone marrow, spleen, and liver engulf and digest them. The iron is carried by transferring in the blood system as well as humoral factors.


Leukocytes, or white blood cells, are primarily the cellular and humoral defense of the organism from foreign materials. Leukocytes are classified as granulocytes (neutrophils, eosinophils, basophils) and agranulocytes (lymphocytes). Granulocytes are named according to the staining properties of their specific granules. Neutrophils have 3—5 nuclear lobes and contain azurophilic granules, which contain hydrolytic enzymes for bacterial destruction, in their cytoplasm. Neutrophils are polymorphonuclear cells that are drawn (chemotaxis) to bacterial chemoattractants. They are the primary cells involved in the acute inflammatory response and represent 54—62% of leukocytes. Neutrophils have 3—5 nuclear lobes and contain azurophilic granules (lysosomes), which contain hydrolytic enzymes for bacterial destruction, in their cytoplasm. Neutrophils are polymorphonuclear cells that are drawn (chemotaxis) to bacterial chemoattractants. They are the primary cells involved in the acute inflammatory response and represent 54—62% of leukocytes. Eosinophils: they have a bilobed nucleus and possess acid granulations in their cytoplasm. These granules contain hydrolytic enzymes and peroxidase, which is discharged into phagocytic vacuoles. Eosinophils are found in the blood during allergic diseases; they norma asent only — 3% of leukocytes. Basophils: they possess large spheroid granules, which are basophilic and metachromatic. Basophils degranulate in certain immune reaction, releasing heparin and histamine into their surroundings. They also release additional vasoactive amines and slow reaction substances of anaphylaxis (SRS-a) consisting of leukotrienes LTC4, LTD4, and LTE4. They represent less than 1% — of leukocytes. Agranulocytes are named according to their lack of specific granules. Lymphocytes are generally small cells measuring 7—10 mm in diameter and constitute 25—33% of total blood cells. There are three types of lymphocytes: B, T, and natural killer (NK) cells. Neutrophils have 3—5 nuclear lobes and contain azurophilic granules (lysosomes), which contain hydrolytic enzymes for bacterial destruction, in their cytoplasm. Neutrophils are polymorphonuclear cells that are drawn (chemotaxis) to bacterial chemoattractants. They are the primary cells involved in the acute inflammatory response and represent 54—62% of leukocytes.

20. Plasma

Plasma is the extracellular component of blood. It is an aqueous solution containing proteins, inorganic salts, and organic compounds. Albumin is the major plasma protein that maintains the osmotic pressure of blood. Other plasma proteins include the globulins (alpha, beta, gamma) and fibrinogen, which is necessary for the formation of fibrin in the final step of blood coagulation. Plasma is in equilibrium with tissue interstitial fluid through capillary walls; therefore, the composition of plasma may be used to judge the mean composition of the extracellular fluids. Large blood proteins remain in the intravascular compartment and do not equilibrate with the interstitial fluid. Serum is a clear yellow fluid that is separated from the coagulum during the process of blood clot formation. It has the same composition as plasma, but lacks the clotting factors (especially fibrinogen). Lymphatic vessels: Lymphatic vessels consist of a fine network of thin-walled vessels that drain into progressively larger and progressively thicker-walled collecting trunks. These ultimately drain, via the thoracic duct and right lymphatic duct, into the left and right subclavian veins at their angles of junction with the internal jugular veins, respectively. The lymphatics serve as a one-way (i.e., toward the heart) drainage system for the return of tissue fluid and other diffusible substances, including plasma proteins, which constantly escape from the blood through capillaries. They are also important in serving as a conduit for channeling leukocytes and antibodies produced in lymph nodes into the bloodstream. Lymphatic capillaries consist of vessels lined with endothelial cells, which begin as blind-ended tubules or sacs in most tissues of the body. Endothelium is attenuated and usually lacks a continuous basal lamina. Lymphatic vessels of large diameter resemble veins in their configuration.
to certain tissues, where it combines with apoterritin to form territin. The latter is converted to biliverdin, which is converted to bilirubin. The latter is secreted with bile salts.

Platelets (thromboplastids) are 2–3 mm in diameter. They are a nuclear, membrane-bound cellular fragments derived by cytoplasmic fragmentation of giant cells, called megakaryocytes, in the bone marrow. They have a short life span of approximately 10 days. There are normally 150 000—400 000 platelets per mm3 of blood. Ultrastructurally, platelets contain two portions: a peripheral, light-staining hypolamella that sends out fine cytoplasmic processes, and a central, dark-staining granouline that contains mitochondria, vacuoles, glycogen granules, and granules. Platelets seal minute breaks in blood vessels and maintain endothelial integrity by adhering to the damaged vessel in a process known as platelet aggregation. Platelets are able to form a plug at the rupture site of a vessel because their membrane permits them to aggregate and adhere to surfaces. Platelet aggregation is mediated by the clot.

New words
mesodermal — мезодермальный
erythrocytes — эритроциты
platelets — тромбоциты
carbon — углерод
divid — дивид
span — промежуток
light-staining — легкое окрашивание to aggregate — соединяться

205 Intercostal arteries: there are 12 pairs of posterior and anterior arteries. 11 intercostal pairs, and 1 subcostal pair.

Anterior intercostal arteries.
Pairs 1—6 are derived from the internal thoracic arteries. Pairs 7—9 are derived from the musculophrenic arteries. Posterior intercostal arteries: the first two pairs arise from the superior intercostal artery, a branch of the costocervical trunk of the subclavian artery.
Nine pairs of intercostal and one pair of subcostal arteries arise from the thoracic aorta:
Intercostal veins: Anterior branches of the intercostal veins drain to the internal thoracic and musculophrenic veins.
Posterior branches drain to the aygos system of veins.
Lymphatic drainage of intercostal spaces: anterior drainage is to the internal thoracic (parasternal) nodes.
Posterior drainage is to the paraaortic nodes of the posterior mediastinum.

New words
thoracic — грудной
clavicle — ключица
xiphisternal — грудинный
costal — подкостный
intercostal — межреберный
transversus — поперечный
musculophrenic — мышечно-грудобрюшной
mediastinum — средостение

Intercostal and subcostal arteries.

New words
plasma — плазма
extracellular — внеклеточный
aqueous — водный
solution — раствор
proteins — белки
organic — органический
salts — соли
globulins — глобулины
alpha — альфа
beta — бета
gamma — гамма
fibrogen — фиброген
lymphatic — лимфатический
endothelium — эндотелий
circulation — кровообращение
ubiquitous — вездесущий
notable — известный

Leukocytes. They contain circular dark-stained nuclei and scanty clear blue cytoplasm. Circulating lymphocytes enter the blood from the lymphatic tissues. Two principal types of immunocompetent lymphocytes can be identified T lymphocytes and B lymphocytes. T cells differentiate in the thymus and then circulate in the peripheral blood, where they are the principal effectors of cell-mediated immunity. They also function as helper and suppressor cells. They differentiate into plasma cells only after the second exposure to the antigen. Monocytes vary in diameter from 15–18 mm and are the largest of the peripheral blood cells. They constitute 3–7% of leukocytes. Monocytes possess an eccentric nucleus. The cytoplasm has a ground-glass appearance and fine azurophilic granules. Monocytes are the precursors for members of the mononuclear phagocyte system, including tissue macrophages (histiocytes), osteoclasts, alveolar macrophages, and Kupffer cells of the liver.

New words
mesodermal — мезодермальный
erythrocytes — эритроциты
leukocytes — лейкоциты
fibrous proteins — волокнистые белки
immune — иммунный
tumoral — туморальный
ubiquitous — вездесущий
to contain — содержать
nucllei — ядра
lychnsia of the cytoplasm is due to the increased quantity in which appears in a "checkerboard" pattern. The approximately 50% of its mass and contains condensed chroma...ndergoes mitotic divisions. Its nucleus comprises appro...nucleus that comprises approximately 75% of its mass. Reduced by the kidney.

Numerous cytoplasmic polyribosomes, condensed chromatin, no visible nucleoli, and continued hemoglobin

RBC formation. Bone marrow stem cells (colony-forming units, CFUs) differentiate into proerythroblasts under the influence of the glycoprotein erythropoietin, which is produced by the kidney.

Proerythroblast is a large basophilic cell containing a large spherical euchromatic nucleus with prominent nucleoli. Basophilic erythroblast is a strongly basophilic cell with nucleus that comprises approximately 75% of its mass. Numerous cytoplasmic polyribosomes, condensed chromatin, no visible nucleoli, and continued hemoglobin synthesis characteristics of this cell.

Polychromatophilic erythroblast is the last cell in this line undergoing mitotic divisions. Its nucleus comprises approximately 50% of its mass and contains condensed chromatin which appears in a "checkerboard" pattern. The polychromasia of the cytoplasm is due to the increased quantity of acidophilic hemoglobin combined with the basophilic of cytoplasmic polyribosomes.

Normoblast (orthochromatophilic erythroblast) is a cell with a small heterochromatic nucleus that comprises ap...nterface to the blood. Neutrophilic granulocytes are the definitive cells that enter the blood. Neutrophilic granulocytes exhibit an intermediate stage called the band neutrophil. This is the first cell of this series to appear in the peripheral blood.

It has a nucleus shaped like a curved rod or band. Bands normally constitute 0.5—3% of peripheral WBCs; they subsequently mature into definitive neutrophils.

Agranulopoiesis is the process of lymphocyte and monocyte formation. Lymphocytes develop from bone marrow stem cells (lymphoblasts). Cells develop in bone marrow and seed the secondary lymphoid organs (e.g., tonsils, spleen). Arteries are classified according to their size, the appe...arteries that generally exhibit easy diffusion across their walls. Most capillaries have a cross-sectional diameter of 7—12 mm. They are composed of a simple layer of endothelium, which is the lining of the enter...s. These cells, enclosed within their own basal lamina, which is continuous with that of the endothelium, contain contractile proteins and thus may be involved in the control of capillary dynamics. They may also serve as stem cells at times of vascular repair. Capillaries are generally divided into three types, according to the structure of their endothelial cell walls.

Continuous (muscular, somatic) capillaries are formed by a single uninterrupted layer of endothelial cells rolled up into the shape of a tube and can be found in locations such as connective tissue, muscle, and nerve. Fenestrated (visceral) capillaries are characterized by the presence of pores in the endothelial cell wall. The pores are covered by a thin diaphragm (except in the glomeruli of the kidney) and are usually encountered in tissues where rapid substance interchange occurs (e.g., kidney, intestine, endocrine glands).

Sinusoidal capillaries can be found in the liver, hematopoietic and lymphopoietic organs, and in certain endocrine glands. These tubes with discontinuous endothelial walls have a larger diameter than other capillaries (up to 40 mm), exhibit irregular cross-sectional profiles, have more tortuous paths, and often lack a continuous basal...
lymph nodes, spleen). Stem cells for T cells come from bone marrow, develop in the thymus and, subsequently, seed the secondary lymphoid organs.

Promonocytes differentiate from bone marrow stem cells (monoblasts) and multiply to give rise to monocytes. Monocytes spend only a short period of time in the marrow before being released into the bloodstream. Monocytes are transported in the blood but are also found in connective tissues, body cavities and organs.

Outside the blood vessel wall, they are transformed into macrophages of the mononuclear phagocyte system. Thrombopoiesis, or the formation of platelets, occurs in the red bone marrow.

Megakaryoblast is a large basophilic cell that contains a U-shaped or ovoid nucleus with prominent nucleoli. It is the last cell that undergoes mitosis. Megakaryocytes are the largest of bone marrow cells, with diameters of 50 mm or greater. They undergo 4—5 nuclear divisions without concomitant cytoplasmic division. As a result, the megakaryocyte is a cell with polycellular, polykaryon nucleus and abundant granules in its cytoplasm. As megakaryocyte maturation proceeds, «curtains» of platelet demarcation vesicles form in the cytoplasm. These membranes fuse to give rise to the membranes of the platelets. A single megakaryocyte can shed (i.e., produce) up to 3,500 platelets.

New words
- capable — способный
- spherical — сферический
- indented — зазубренный
- chromatin — хроматин

Reticulocyte (polychromatophilic erythrocyte) is an immature acidophilic denucleated RBC, which still contains some ribosomes and mitochondria involved in the synthesis of a small quantity of hemoglobin. Approximately 1% of the circulating RBCs are reticulocytes. Erythrocyte is the mature acidophilic and denucleated RBC. Erythrocytes remain in the circulation approximately 120 days and are then recycled by the spleen, liver, and bone marrow.

New words
- reticular — сетчатый
- sinuosity — синусоид
- granulocytes — гранулоциты
- agranulocytes — агранулоциты

Erythrocyte is the mature acidophilic and denucleated RBC. Erythrocytes remain in the circulation approximately 120 days and are then recycled by the spleen, liver, and bone marrow.

New words
- capillaries — капилляры
- to thin-walled — окруженный тонкой стеной
- narrow-diameter — узкий диаметр
- low-pressure — низкое давление
- that — тот
- generally — главным образом
- permit — разрешение
- easy — легкий
- diffusion — распространение
- cross-sectional — поперечный
- to be composed — быть сложным
- simple — простой
- endothelium — эндотелий
- lining — выравнивание
- entire — весь
- vascula — сосудистый
- underlying — лежащий в основе
- basal — основной
- lamina — тонкая пластинка

New words
- endotothelium — эндотелий
- media — средняя
- arteries — артерии
- to include — включать
- aorta — аорта
- branches — ветви
- up to — до
- layers — слои
- smooth — гладкий
- may — может
- infima — внутренняя полость артерии
Veins are low-pressure vessels that have larger lumina and thinner walls than arteries. In general, veins have fewer collagenous connective tissue and less muscle and elastic tissue than their arterial counterparts. Although the walls of veins usually exhibit the three layers, they are much less distinct than those of the arterial tree. Unlike arteries, veins contain one-way valves composed of exten sions of the intima that prevent reflux of blood away from the heart. Veins can be divided into small veins or venules, medium veins, and large veins.

Venules are the smallest veins, ranging in diameter from approximately 15—20 μm (post-capillary venules) up to 1—2 mm (small veins). The walls of the smaller of these are structurally and functionally like those of the capillaries; they consist of an endothelium surrounded by delicate collagen fibers and some pericytes. In those vessels of increased diameter, circularly arranged smooth muscle cells occur surrounding the intima layer, but unlike in the small arteries, these cells are loosely woven and widely spaced. Venules are important in inflammation because their endothelial cells are sensitive to histamine released by local mast cells. This causes endothelial cells to contract and separate from each other, exposing a naked basement membrane. Neutrophils stick to the exposed collagen and extravasate (i.e., move out into the connective tissue). Histamine also causes local arterioles to relax, affecting a rise in venous pressure and increased leaking of fluid. This produces the classic signs of inflammation: redness, heat, and swelling.

Medium veins in the range of 1—9 mm in diameter have a well-developed intima, a media consisting of connective tissue and loosely organized smooth muscle, and an adventitia composed of collagenous connective tissue and some pericytes. Medium veins in the range of 1—9 mm in diameter have a well-developed intima, a media consisting of connective tissue and loosely organized smooth muscle, and an adventitia composed of collagenous connective tissue and some pericytes.

Lungs

Intrapulmonary bronchi: the primary bronchi give rise to three main branches in the right lung and two branches in the left lung, each of which supply a pulmonary lobe. These lobar bronchi divide repeatedly to give rise to bronchioles.

Mucosa consists of the typical respiratory epithelium. Submucosa consists of elastic tissue with fewer mixed glands than seen in the trachea. Anastomosing cartilage plates replace the C-shaped rings found in the trachea and extra pulmonary portions of the primary bronchi. Bronchioles do not possess cartilage, glands, or lymphatic nodules; however, they contain the highest proportion of smooth muscle in the bronchial tree. Bronchioles branch up to 12 times to supply lobules in the lung. Bronchioles are lined by ciliated, simple columnar epithelium with ciliated bronchiolar cells. The musculature of the bronchi and bronchioles con tracts following stimulation by parasympathetic fibers (vagus nerve) and relaxes in response to sympathetic fibers. Terminal bronchioles consist of low-ciliated epithelium with bronchiolar cells.

The costal surface is a large convex area related to the inner surface of the ribs. The mediastinal surface is a concave medial surface, contains the root, or hilus, of the lung. The diaphragmatic surface (base) is related to the convex sur face of the diaphragm. The apex (cuppula) protrudes into the root of the neck. The hilus is the point of attachment for the root of the lung. It contains the bronchi, pulmonary and bronchial vessels, lymphatics, and nerves. Lobes and fissures.

Cardiac muscle tissue, which contracts rhythmically to pump blood throughout the body. Structure of the heart wall: the walls of the heart are constructed in layers that are similar to those of the major blood vessels. Endocardium is the innermost layer of the heart and is lined with endothelium. Veins, nerves, and components of the impulse conduction system are present in the subendocardial connective tissue layer.

Myocardium is composed of branching, anastomosing cardiac myocytes attached to one another by intercalated disks. Most of these cells are involved in the pumping function of the heart; others are specialized for the control of rhythmicity (impulse conducting system) or secretion (myocardial endocrine cells).

Epicardium is a serous membrane that forms the visceral lining of the pericardium. Its external mesothelium is supported by a loose connective tissue subepicardial layer.

Cardiac valves are composed of dense fibrous tissue covered by endothelium. Unidirectional flow is maintained from the:

- Right atrium to the right ventricle (tricuspid valve).
- Right ventricle to the pulmonary artery (pulmonic semilunar valve).
- Left atrium to the left ventricle (mitral/bicuspid valve).
- Left ventricle to the aorta (aortic semilunar valve).

Tricuspid and mitral valves are attached to papillary muscles by cords of fibrous connective tissue (chordae tendineae) and prevent reflux of blood into the atria during diastole.
ventricular con traction (systole). Semilunar valves (aortic and pulmonic) prevent reflux of blood back into the ventricles during ventricular relaxation (diastole). Impulse conducting system of the heart consists of specialized cardiac myocytes that are characterized by automaticity and rhythmicity (i. e., they are independent of nervous stimulation and possess the ability to initiate heart beats). These specialized cells are located in the sinoatrial (SA) node (pacemaker), internodal tracts, atrioventricular (AV) node, AV bundle (of His), left and right bundle branches, and numerous smaller branches to the left and right ventricular walls. Impulse conducting myocytes are in electrical contact with each other and with normal contracting myocytes via communicating (gap) junctions. Specialized wide-diameter impulse conducting cells (Purkinje myocytes), with greatly reduced myofilament components, are well-adapted to increase conduction velocity. They rapidly deliver the wave of depolarization to ventricular myocytes.

The blood-gas barrier (pulmonary capillary-alveolar membrane) is ideal for gas exchange because it is very thin (< 0.5 mm) and has a very large surface area (50—100 m²). It consists of alveolar epithelium, basement membrane in intrapulmonary bronchi — долевые бронхи

Innervation of Lungs: Anterior and posterior pulmonary nerve plexuses are formed by vagal (parasympathetic) and sympathetic fibers. Parasympathetic stimulation has a bronchoconstrictive effect. Sympathetic stimulation has a bronchodilator effect.
Lung volumes — there are four lung volumes, which when added together, equal the maximal volume of the lungs. Tidal volume is the volume of one inspired or expected normal breath (average human = 0.5 L per breath). Inspiratory reserve volume is the volume of air that can be inspired in excess of the tidal volume. Expiratory reserve volume is the extra air that can be expired after a normal tidal expiration.

Residual volume is the volume of gas that re-lungs after maximal expiration (average human = 1.2 L).

Total lung capacity is the volume of gas that can be expelled after maximal inspiration (average human = 4.8 L).

Functional residual capacity is the volume remaining in the lungs at the end of a normal tidal expiration (average human = 2.2 L).

Respiratory capacity is the volume that can be taken into the lungs after maximal inspiration following expiration of a normal breath. Helium dilution techniques are used to determine residual volume, FRC and TLC. A forced vital capacity is obtained when a subject inspires maximally and then exhales as forcefully and as completely as possible. The forced expiratory volume (FEV1) is the volume of air exhaled in the first second. Typically, the FEV1 is approximately 80% of the FVC.

Gas laws as applied to respiratory physiology: Dalton’s Law: In a gas mixture, the pressure exerted by each gas is independent of the pressure exerted by the other gases.

A consequence of this is as follows: partial pressure = total pressure x fractional concentration. This equation can be used for other gases.

Alveolar pressure becomes less than atmospheric pressure when the muscles of inspiration enlarge the chest cavity, thus lowering the intrathoracic pressure. Alveolar pressure is measured by esophageal balloon pressure vs. lung volume at a number of different lung volumes. The pressure gradient between the atmosphere and the alveoli drives air into the airways. The opposite occurs with expiration.

Air moves from areas of higher pressure to areas of lower pressure. Thus, gases diffuse. A pressure gradient needs to be established to move air.

The lungs are elastic and naturally reinflate at rest. Deflation occurs during exercise, forced expiration and certain disease states. Accessory muscles of inspiration, including the scalene (elevate the first two ribs) and sternocleidomastoid (elevate the sternum) muscles, are not active during quiet breathing, but become more important in exercise. Inspiration is normally a passive process. The lungs and chest wall are elastic and naturally return to their resting positions after being actively expanded during inspiration. Inspiratory muscles are used during exercise, forced inspiration and certain disease states. Abdominal muscles (rectus abdominis, internal and external obliques, and transversus abdominis) increase intra-abdominal pressure, which pushes the diaphragm up, forcing air out of the lungs. The internal intercostals lift the rib cage upward and outward, expanding the thoracic cavity. These muscles are more important for deep inhalations. Accessory muscles of inspiration, including the scalene (elevate the first two ribs) and sternocleidomastoid (elevate the sternum) muscles, are not active during quiet breathing, but become more important in exercise. Inspiration is normally a passive process. The lungs and chest wall are elastic and naturally return to their resting positions after being actively expanded during inspiration. Inspiratory muscles are used during exercise, forced inspiration and certain disease states. Abdominal muscles (rectus abdominis, internal and external obliques, and transversus abdominis) increase intra-abdominal pressure, which pushes the diaphragm up, forcing air out of the lungs. The internal intercostals lift the rib cage upward and outward, expanding the thoracic cavity. These muscles are more important for deep inhalations.
the conducting — проведение
airways — воздушные пути
exchange — обмен
tract — тракт

to be measured — быть измеренным
directly — непосредственно

displacement — смещение
compliance is the slope of the pressure-volume curve. Several observations can be made from the pressure-volume curve. Note that the pressure-volume relationship is different with deflation than with inflation of air (hysteresis). The compliance of the lungs is greater (the lungs are more distensible) in the middle volume and pressure ranges. The equation for oxygen is:

\[ Q_{O_2} = C_O \times 1.34 \text{ (ml/g)} \times [Hg] \times S_aO_2 + 0.003 \text{ (ml/ml per mm Hg)} \times P_{aO_2} \]

where \( Q_{O_2} \) is oxygen delivery (ml/min), \( C_O \) is cardiac output (L/min), \( Hg \) is hemoglobin concentration (g/L), \( S_aO_2 \) is the fraction of hemoglobin saturated with oxygen, and \( P_{aO_2} \) is the partial pressure of the oxygen dissolved in plasma and is trivial compared to the amount of oxygen carried by hemoglobin. Examination of this equation reveals that increasing hemoglobin concentration and increasing cardiac output can enhance oxygen delivery. Saturation is normally greater than 92% and usually is easily maintained through supplemental oxygen and mechanical ventilation. Cardiac output is supported by insuring adequate fluid resuscitation (cardiac preload) and manipulating contractility and afterload pharmacologically (usually catecholamines).

Factors affecting airway resistance: Bronchoconstriction (increased resistance) can be caused by parasympathetic stimulation, histamine (immediate hypersensitivity reaction), slow-reacting substance of anaphylaxis (SRS-A = leukotrienes C4, D4, E4, mediator of asthma), and irritants. Bronchodilation (decreased resistance) can be caused by sympathetic stimulation (via beta-2 receptors). Lung volume also affects airway resistance. High lung volumes lower airway resistance because the surrounding lung parenchyma pulls airways open by radial traction. Low lung volumes lead to increased airway resistance because there is less traction on the airways. At very low lung volumes, bronchioles may collapse. The viscosity or density of inspired gases can affect airway resistance. The density of gas increases with deep sea diving, leading to increased resistance and work of breathing. Low-density gases like helium can lower airway resistance.

Fick's Law states that the volume of gas that diffuses across a barrier per unit time is given by:

\[ V_{gas} = Y \times D \times (P_1 - P_2) \]

where \( A \) and \( T \) are the area and thickness of the barrier, \( P_1 \) and \( P_2 \) are the partial pressures of the gas on either side of the barrier and \( D \) is the diffusion constant of the gas. \( D \) is directly proportional to the solubility of the gas and inversely proportional to the square root of its molecular weight.

New words
- lung — легкое
- tidal — вдыхаемый и выдыхаемый
- inspired — вдохновленный
- breath — дыхание
- human — человек
- residual — остаточный
- helium — гелий
- dilution — растворение
- techniques — методы
33. Surface tension forces

In a liquid, the proximity of adjacent molecules results in large, intermolecular, attractive (Van der Waal's) forces that serve to stabilize the liquid. The liquid-air surface produces inequality of forces that are strong on the liquid side and weak on the gas side because of the greater distance between molecules in the gas phase. Surface tension is the force of adhesion between the surface of the liquid and the surrounding air. Surface tension is caused by the attraction between molecules on the surface of the liquid and those below. It is what prevents a liquid from spreading out on a solid surface.

34. The nose

The respiratory system permits the exchange of oxygen and carbon dioxide between air and blood by providing a thin cellular membrane deep in the lung that separates capillary blood from alveolar air. The system is divided into a conducting portion (nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles) that carries the gases during inspiration and expiration, and a respiratory portion (alveoli) that provides for gas exchange between air and blood.

35. Nasopharynx and larynx

Nasopharynx is the first part of the pharynx. It is lined by a pseudostratified, ciliated, columnar epithelium with goblet cells: under the epithelium, a gland-containing connective tissue layer rests directly on the periosteum of the bone.

36. Trachea

The trachea, a hollow cylinder supported by 16–20 cartilaginous rings, is continuous with the larynx above and the branching primary bronchi below. Mucosa of the trachea consists of the typical respiratory epithelium that forms the lining mucous membrane. The only secretory cells are goblet cells. These goblet cells secrete mucus, which lubricates the respiratory tract and traps inhaled particulate matter. The tracheal wall is composed of the mucous membrane, the submucosa, the adventitia, and the perichondrium. The epithelial lining of the trachea is pseudostratified ciliated columnar.
and promote warming of the inspired air. This region is richly vascularized and innervated.

The pseudostratified epithelium is composed of bipolar neurons (olfactory cells), supporting cells, brush cells, and basal cells. The receptor portions of the bipolar neurons are modified dendrites with long, nonmotile cilia. Under the epithelium, Bowman’s glands produce serous fluid, which dissolves odorous substances. Paranasal sinuses are cavities in the frontal, maxillary, ethmoid and sphenoid bones that communicate with the nasal cavities. The respiratory epithelium is similar to that of the nasal cavities except that it is thinner. Numerous goblet cells produce mucus, which drains to the nasal passages. Few glands are found in the thin lamina propria.

New words

respiratory system — дыхательный аппарат
oxygen — кислород
carbon — углерод
dioxide — диоксид
nasal cavity — носовая впадина
pharynx — зев
larynx — гортань
tracea — трахея
bronchi — бронхи
bronchioles — бронхиолы
nasal septum — носовая перегородка
nostril — ноздря
vestibule — вестибулярная область
respiratory area — дыхательная область
paranasal sinuses — параназальные пазухи

of atelectasis, filling of alveoli with transudate, reduced lung compliance, and V/Q mismatch leading to hypoxia and CO2 retention.

New words

surface tension forces — поверхностные силы напряжения
liquid — жидкость
proximity — близость
adjacent — смежный
intermolecular — межмолекулярный
to stabilize — стабилизироваться
surface — поверхность
distance — расстояние
phase — фаза
tension — напряжение
spherically-curved — сферически-кривой
lining — выравнивание
inward — внутрь
toward — к
curvature — искривление
spherical — сферический
soap bubble — мыльный пузырь
inner — внутренний
to exert — проявить
interconnected — связанный

larynx — гортань
above — выше
branching — переход
primary bronchi — первичные бронхи
below — ниже
mucosa — слизистая оболочка
typical — типичный
respiratory epithelium — дыхательный эпителий
unusual — нетипичный
thick — толстый
basement — основание
underlying — основной
lamina — тонкая пластинка
rich — богатый
elastin — эластин
loose — свободный
vessel — сосуд
lymphatics — лимфатический
defensive cells — защитные клетки
outer — внешний
edge — край

gland-containing — содержащий железу
connective tissue — соединительная ткань
layer — слой
directly — непосредственно
periosteum — надкостница
bone — кость
cilia — ресница
oropharynx — верхняя часть глотки
stratified — стратифицированный
squamous — чешуйчатый
nonkeratinized — некератинизированный
somewhere — где-нибудь, куда-нибудь, где-то, куда-то
37. Respiratory bronchioles

Respiratory bronchioles are areas of transition (hybrids) between the conducting and respiratory portions of the airways. In add tion to the typical broncholar epithelium of the terminal bronchioles, these passageways contain outp ockings of alveoli, which comprise the respiratory portion of this system.

Terminal bronchioles give rise to respiratory bronchioles. Respiratory bronchioles branch to form two to three al veolar ducts, which are long sinuous tubes.

Alveolar sacs are spaces formed by two or more conjo ned alveoli. They are lined by the simple squamous al veolar epithelium. Alveoli are the terminal, thin-walled sacs of the respiratory tree that are responsible for gas exchange. There are approximately 300 million alveoli per lung, each one 200—300 mm in diameter. Blood-air interface. Oxygen in the alveoli is separated from hemoglobin in the red blood cells of alveolar capillaries by five layers of membrane and cells: the alveolar epithelial cell (apical and basal membranes) and its basal lamina, the basa l lamina of the capillary and its endothelial cell (basal and apical membranes), and the erythrocyte membrane. The total thick ness of all these layers can be as thin as 0.5 mm.

Alveolar epithelium contains two cell types. Type I cells completely cover the alveolar luminal surface and provide a thin surface for gas exchange. This simple squamous epithelium is so thin (~25 nm) that its details are beyond the resolution of the light microscope.

Type II cells are rounded, plump, cuboidal-like cells that sit on the basal lamina of the epithelium and contain mem brane-bound granules of phospholipid and protein (lamell ae.

Type II cells produce the lamellae that cover Type I cells and provide the phospholipid bilayer of the surf ace of the alveoli.

38. Pleura

Pleural cavity: The pleural cavity is a potential space between the parietal and visceral pleura that allows the lungs to move in the chest cavity. It contains a thin layer of serous fluid that lubricates the pleura and prevents friction when the lungs expand and contract with respiration. Pleural reflection is where the parietal pleura reflects onto the parietal peritoneum.

Parietal pleura is the part of the pleura that lines the chest wall and organ surfaces internally. It is a serous mem brane that lines the surface of the thoracic cavity. The visceral pleura is the part of the pleura that lines the surface of the lungs. It is also a serous membrane that lines the surface of the lungs. The parietal pleura and the visceral pleura are connected by the diaphragm.

Pleural fluid is a thin serous membrane that covers the outer surface of the lungs. A delicate connective tissue layer separates the parietal pleura from the visceral pleura.

Visceral pleura is the part of the pleura that continues onto the inner aspect of the thoracic wall. It is continuous with the parietal pleura and is lined by the same mesothelial cells.

Pleural cavity is a very narrow fluid-filled space that contains monocytes located between the two pleural membranes. It contains no gases and becomes a true cavity only in disease (e.g., in pleural infection, fluid and pus may accumulate in the pleural space). If the chest wall is punctured, air may enter the pleural space (pneumothorax), breaking the vacuum, and allowing the lung to recoil. Parietal pleura lines the inner surface of the thoracic cavity, while visceral pleura follows the contours of the lung itself.

Pleural cavity: The pleural cavity is the space between the parietal and visceral al layers of the pleura. It is a sealed, blind space. The introduction of air into the pleural cavity may cause the lung to col late (pneumothorax).

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Visci...
with the diaphragmatic pleura from rib 8 in the midclavicular line, to rib 10 in the midaxillary line, and to rib 12 lateral to the vertebral column. Pleural recesses are potential spaces not occupied by lung tissue except during deep inspiration. Costodiaphragmatic recesses are spaces below the inferior borders of the lungs where costal and diaphragmatic pleura are in contact. Costomediastinal recess is a space where the left costal and mediastinal parietal pleura meet, leaving a space due to the cardiac notch of the left lung. This space is occupied by the lingula of the left lung during inspiration.

In nervation of the parietal pleura: The costal and peripheral portions of the diaphragmatic pleura are supplied by intercostal nerves. The central portion of the diaphragmatic pleura and the mediastinal pleura are supplied by the phrenic nerve.

New words
- visceral — висцеральный
- pleura — плевра
- dcollagen — коллаген
- elastin — эластин
- lymphatic channels — лимфатические сосуды
- nerves — нервы
- squamous — чешуйчатый
- microvilli — микроворсинки
- parietal pleura — париетальная плевра
- visceral pleura — висцеральная плевра
- costal — реберный
- posteriorly and the soft palate posteriorly. Its posterior wall is absent and is replaced by an opening to the oropharynx, which is flanked by the pillars of the fauces. The palate separates the nasal and oral cavities. Hard palate is formed by the palatine process of the maxilla and the horizontal palate of the palatine bone. Its mucosa is supplied with sensory fibers from CN V2.

Soft palate consists of a fibrous membrane, the palatine aponeurosis, covered with mucosa. The portion that hangs down in the midline is the uvula.

Muscles of the tongue. These include the intrinsic and extrinsic muscles (i.e., palatoglossus, styloglossus, hyoglossus — суст. genioglossus). All of the muscles are innervated by CN XII except the palatoglossus, which is supplied by CN X. Arterial supply: The tongue is supplied by the lingual veins, which lie on the under-surface of the tongue, drain to the internal jugular veins.

Lymphatic drainage: The tip of the tongue drains to the submental nodes, and the remainder of the anterior two-thirds drains first to submandibular, then to deep cervical nodes. The posterior one-third drains directly to deep cervical nodes.

New words
- digestive — пищеварительный
- pharyngeal — глоточный
- mucosa — слизистая оболочка
- fibrous layer — волокнистый слой
- posterior nasal apertures — задние носовые апертуры
- nasopharyngeal (tissue) — носоглотка

the greater superficial petrosal branches of the facial nerve (CN VII). These fibers synapse in the pterygopalatine ganglion, which is located in the pterygopalatine fossa. Postganglionic fibers traveling to the mucous glands of the nasal cavity, paranasal air sinuses, hard and soft palate, and the lacrimal gland follow branches of V2 and in some cases V1, to reach their destinations.
The oral cavity forms in the embryo from an in-pocketing of the skin, stomodeum; it is, thus, lined by ectoderm. Functionally, the mouth forms the first portion of both the digestive and respiratory systems.

In humans, the margins of the lips mark the junction between the outer skin and the inner mucous lining of the oral cavity. The roof of the mouth consists of the hard palate and, behind this, the soft palate which merges into the oropharynx. The lateral walls consist of the distensible cheeks. The floor of the mouth is formed principally by the tongue and the soft tissues that lie between the two sides of the lower jaw, or mandible.

The tongue, a muscular organ in the mouth, provides the sense of taste and assists in chewing, swallowing, and speaking. It is firmly anchored by connective tissues to the front and side walls of the oropharynx, or throat, and to the hyoid bone in the neck.

The posterior limit of the oral cavity is marked by the fauces, an aperture which leads to the pharynx. On either side of the fauces are two muscular arches covered by mucosa, the glossopalatine and pharyngopalatine arches; between them lie masses of lymphoid tissue, the tonsils. These are spongy lymphoid tissues composed mainly of lymphocytic cells held together by fibrous connective tissue. Suspended from the posterior portion of the soft palate is the soft retractable uvula. The palate develops from lateral folds of the primitive upper jaw. The hard palate, more anterior in position, underlies the nasal cavity. The soft palate hangs like a curtain between the mouth and nasal pharynx.

The hard palate has an intermediate layer of bone, supplied anteriorly by paired palatine processes of the maxilla.

**Digestive Tract Structure**

The gastrointestinal tract and associated organs are collectively called the digestive system. This system is responsible for receiving food and breaking it down by using enzymes from the glands and by the movement of the various parts of the intestinal tract; for absorption of these components into the blood; and for eliminating undigested food and certain metabolic wastes from the body. The alimentary canal extends from the mouth to the anus. It is a long tube varying in size and shape depending on what part of the particular part performs. The tract has a very good blood supply, because food, once it is broken down, has to be absorbed into the bloodstream. The mouth contains the tongue and the teeth and communicated with the salivary glands situated around it. Behind the nose and mouth is the pharynx. Leading from the pharynx is a muscular tube called the esophagus which passes down the thoracic cavity to the stomach. The stomach lies below the diaphragm in the upper left side, of the abdominal cavity. The opening into the small intestine is called the pylorus and is closed by the pyloric sphincter. The small intestine is a muscular tube coiled up in the abdominal cavity. It is divided into three parts; the duodenum, the jejunum, and the ileum. The large intestine, also a muscular tube but with wider lumen than the small intestine, is often called the colon. It is divided into several different parts; the, cecum, ascending colon, descending colon, transverse colon, and rectum and the anal canal. The glands belonging to the digestive system are the salivary glands, the liver and the pancreas.

- Stomach is probably the most distensible of any in the human body. The proximal portion is the cardiac portion; the portion above the entrance of the esophagus is the

**Oral Glands**

All mammals are well supplied with oral glands. There are labial glands of the lips, buccal glands of the cheeks, lingual glands of the tongue, and palatine glands of the palate. Besides these, there are larger paired salivary glands. The parotid gland, near each ear, discharges into the vestibule. The submaxillary or submandibular gland lies along the posterior part of the lower jaw; its duct opens well forward under the tongue. The sublingual gland lies in the floor of the mouth. Saliva is a viscous fluid containing a mixture of all the oral secretions. It contains mucous, proteins, salts, and the enzymes ptyalin and maltase. Most of the ptyalin in human saliva is furnished by the parotid gland. The digestive action of saliva is limited to starch food. Other uses of saliva include the moistening of food for easier manipulation by the teeth, the facilitation of swallowing, and a lubrication by mucus that ensures a smoother passage of food down the esophagus to the stomach. Tonsils are spongy lymphoid tissues at the back of the throat, composed mainly of lymphocytic cells held together by fibrous connective tissue. There are three types of tonsils. The palatine tonsils, usually referred to as the tonsils, are visible between the arches that extend from the uvula to the floor of the mouth. The pharyngeal tonsils, usually referred to as the adenoids, lie at the back of the throat. The lingual tonsils are on the upper surface of each side of the back of the tongue. The tonsils function to protect the pharynx and the remainder of the body from infectious organisms that become trapped in the mucous membrane lining the mouth, nose and throat. Chronic or acute inflammation of the tonsils, called the tonsillitis.

The tongue, a muscular organ in the mouth, provides the sense of taste and assists in chewing, swallowing, and speaking. It is firmly anchored by connective tissues to the front and side walls of the oropharynx, or throat, and to the hyoid bone in the neck. The tongue and the cheeks, lips and lower jaw break down food, mix it with saliva and roll it into a moist, soft mass called a bolus, suitable for swallowing.

**Digestion**

The process of digestion begins when food is taken into the mouth. Chewing breaks the food into smaller pieces, thereby exposing more surfaces to the saliva. Saliva moistens the food, so facilitating swallowing, and it contains the enzyme which begins the conversion of carbohydrates into simple sugars. The major processes of digestion do not occur until the food passes down through the esophagus into the stomach. The stomach has both a chemical and a physical function. The walls of the stomach, which are protected by a layer of mucous, secrete gastric juices composed of several enzymes and hydrochloric acid. The most powerful enzyme is pepsin, which begins the process of converting proteins into amino acids. In addition, waves of contraction and relaxation, known as peristalsis, move the walls of the stomach. They turn the food particles into a semi-solid mass known as chyme.

From the stomach, the chyme passes into the small intestine through the pyloric sphincter. Proteins have not been completely broken down, carbohydrates are still being converted into simple sugars, and fats remain in large globules. In the small intestine the process of digestion is completed by the action of the bile, which is secreted by the liver and released by the gallbladder; and by the action of various enzymes which are secreted by the pancreas and walls of the small intestine. Absorption of the products of digestion take place mainly through the wall of the small intestine.

**Digestion**

Chewing movements of the teeth, tongue, cheeks, lips and lower jaw break down food, mix it with saliva and roll it into a moist, soft mass called a bolus, suitable for swallowing.
The mammalian tongue is divided into two parts by a V-shaped groove, the terminal sulcus. At the apex of this V is a small blind pit, the foramen cecum. The larger part, or body, of the tongue belongs to the floor of the mouth, whereas the root forms the front wall of the oral pharynx. The body of the tongue is separated from the throat and gums by a deep groove. A midline fold, the frenulum, is near the tip on the undersurface. The upper surface of the body, called the dorsum, has a velvety appearance because of filiform papillae. Distributed among these are occasional larger, rounded fungiform papillae and some large conical papillae. Immediately in front of the groove separating the body of the tongue from the root is a series of still larger vallate papillae arranged in a V-shaped row. The apex of the V points down the throat. Posteriorly along each side of the body of the tongue and near the root, is a series of parallel folds constituting the foliate papillae. The surface of the root of the tongue, which belongs to the pharynx, has no papillae but bears nodules containing lymphoid tissue. The soft palate is a backward continuation from the hard palate, its free margin connects on each side with two folds of mucous membrane, the palatine arches, enclosing a palatine tonsils. In the midline the margin extends into a fingerlike projection called uvula. The oral side of the soft palate continues as the covering of the hard palate, and the submucosa contains mucous glands. The intermediate layer is a sheet of voluntary muscle. Besides separating the nasal passages from the mouth, the hard palate is a firm plate, against which the tongue manipulates food. In swallowing and vomiting the soft palate is raised to separate the oral from the nasal portion of the pharynx. This closure prevents food from passing upward into the nasopharynx and nose.

Food is pushed back into the pharynx by the tongue, and enters the esophagus to be transported rapidly down the neck and thorax, through the diaphragm to the stomach. The mammalian tongue is divided into two parts by a V-shaped groove, the terminal sulcus. At the apex of this V is a small blind pit, the foramen cecum. The larger part, or body, of the tongue belongs to the floor of the mouth, whereas the root forms the front wall of the oral pharynx. The body of the tongue is separated from the throat and gums by a deep groove. A midline fold, the frenulum, is near the tip on the undersurface. The upper surface of the body, called the dorsum, has a velvety appearance because of filiform papillae. Distributed among these are occasional larger, rounded fungiform papillae and some large conical papillae. Immediately in front of the groove separating the body of the tongue from the root is a series of still larger vallate papillae arranged in a V-shaped row. The apex of the V points down the throat. Posteriorly along each side of the body of the tongue and near the root, is a series of parallel folds constituting the foliate papillae. The surface of the root of the tongue, which belongs to the pharynx, has no papillae but bears nodules containing lymphoid tissue. The soft palate is a backward continuation from the hard palate, its free margin connects on each side with two folds of mucous membrane, the palatine arches, enclosing a palatine tonsils. In the midline the margin extends into a fingerlike projection called uvula. The oral side of the soft palate continues as the covering of the hard palate, and the submucosa contains mucous glands. The intermediate layer is a sheet of voluntary muscle. Besides separating the nasal passages from the mouth, the hard palate is a firm plate, against which the tongue manipulates food. In swallowing and vomiting the soft palate is raised to separate the oral from the nasal portion of the pharynx. This closure prevents food from passing upward into the nasopharynx and nose.

Having been rendered suitable for swallowing the food is pushed back into the pharynx by the tongue, and enters the esophagus to be transported rapidly down the neck and thorax, through the diaphragm to the stomach. The mammalian tongue is divided into two parts by a V-shaped groove, the terminal sulcus. At the apex of this V is a small blind pit, the foramen cecum. The larger part, or body, of the tongue belongs to the floor of the mouth, whereas the root forms the front wall of the oral pharynx. The body of the tongue is separated from the throat and gums by a deep groove. A midline fold, the frenulum, is near the tip on the undersurface. The upper surface of the body, called the dorsum, has a velvety appearance because of filiform papillae. Distributed among these are occasional larger, rounded fungiform papillae and some large conical papillae. Immediately in front of the groove separating the body of the tongue from the root is a series of still larger vallate papillae arranged in a V-shaped row. The apex of the V points down the throat. Posteriorly along each side of the body of the tongue and near the root, is a series of parallel folds constituting the foliate papillae. The surface of the root of the tongue, which belongs to the pharynx, has no papillae but bears nodules containing lymphoid tissue. The soft palate is a backward continuation from the hard palate, its free margin connects on each side with two folds of mucous membrane, the palatine arches, enclosing a palatine tonsils. In the midline the margin extends into a fingerlike projection called uvula. The oral side of the soft palate continues as the covering of the hard palate, and the submucosa contains mucous glands. The intermediate layer is a sheet of voluntary muscle. Besides separating the nasal passages from the mouth, the hard palate is a firm plate, against which the tongue manipulates food. In swallowing and vomiting the soft palate is raised to separate the oral from the nasal portion of the pharynx. This closure prevents food from passing upward into the nasopharynx and nose.

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The shape of the stomach varies from individual to individual and from time to time in the same individual depending upon the degree of digestion, degree of contraction, and the age and the body build of the individual. Frequently in more J-shaped than U-shaped so that its greater curvature can even lie in the greater pelvis. Cardia and fundus are relatively fixed and, hence, tend to move only with the respiratory excursions of the diaphragm.
45. The digestive system: the function

The digestive system, or gastrointestinal tract, begins with the mouth, where food enters the body, and ends with the anus, where solid waste material leaves the body. The primary function of the organs of the digestive system is to break down food into smaller components, absorb the nutrients, and eliminate waste material.

First, complex food material is taken into the mouth and the food is broken down physically and chemically by the teeth and tongue. The food is then swallowed and travels down the esophagus to the stomach.

Second, the food is mixed with gastric juices in the stomach. The food is then moved into the small intestine where it is mixed with the bile and pancreatic juices. The digestive enzymes in the small intestine break down the food into its elemental components.

Third, the digested food is absorbed by the villi and folds of the small intestine. The nutrients are then transported into the bloodstream via the capillaries of the villi. The undigested waste material is then eliminated through the rectum.

46. The digestive system: liver and stomach. Sources of energy

The liver is a vital organ that plays a crucial role in the digestive process. It is responsible for the production of bile, which aids in the digestion of fats. The liver also detoxifies harmful substances and produces certain hormones.

The stomach is a muscular organ that plays a key role in the digestive process. It receives food from the esophagus and stores it temporarily. The stomach also churns the food, breaking it down into smaller particles and mixing it with gastric juices, which begin the process of protein digestion.

47. The urinary system: embriogenesis

The urinary system is formed mainly from mesodermal and endodermal derivatives. These separate systems form sequentially. The pronephros is vestigial; the mesonephros provides the main kidneys. The metanephros develops into the definitive kidney. The mesonephric ducts descend into the bladder, and the metanephric ducts, which carry the excretory ducts, regress before the last ones are formed.

48. The urinary system: kidneys

The urinary system is the major system involved in the excretion of metabolic waste products. The kidneys remove excess water and waste from the body. It is also important in maintaining a homeostatic balance of fluids and electrolytes.

The kidneys consist of two kidneys, two ureters, the urinary bladder, and the urethra. The kidneys are responsible for the production of urine, which is passed to the bladder for temporary storage. The urachus is the final pathway that conveys urine to the exterior of the body. The liver is responsible for the formation of bile, which is necessary for fat digestion.

The liver is a vital organ that plays a crucial role in the digestive process. It is responsible for the production of bile, which aids in the digestion of fats. The liver also detoxifies harmful substances and produces certain hormones.
Sources of energy

The fuels of the body are carbohydrates, fats and proteins. These are taken in the diet. Carbohydrates are the principal source of energy in most diets. They are absorbed into the blood stream in the form of glucose and stored in the liver. When the blood sugar concentration goes down, the liver releases glucose, which is converted into glycogen and stored in the liver. If excess carbohydrate is taken in, this can be converted into fat and stored. The storage of fat is utilized when the liver is empty of glycogen. When the blood sugar concentration goes down, the liver releases glucose, which is converted into glycogen and stored in the liver. When excess carbohydrate is taken in, this can be converted into fat and stored. The storage of fat is utilized when the liver is empty of glycogen.

Fats make up the second largest source of energy in most diets. They are stored in adipose tissue and around the principal internal organs. If excess carbohydrate is taken in, this can be converted into fat and stored. Adipose tissue is a direct medullary continuation of the cortical proximal convoluted tubule. The major function of the cortical proximal convoluted tubule is to reabsorb sodium and chloride from the filtrate. The thick distal portion of the loop of Henle, the ascending thick segment, ascends to the cortex and is continuous with the distal convoluted tubule.

Proteins are essential for the growth and rebuilding of tissue, but they can also be utilized as a source of energy. In some diets, such as the diet of the Eskamo, they form the main source of energy. Proteins are first broken down into amino acids. Then they are absorbed into the blood and pass round the body. Amino acids not used by the body are eventually excreted in the urine in the form of urea. Proteins, unlike carbohydrates and fats, cannot be stored for future use.

New words

- fuels — топливо
- principal source — основной источник
- energy — энергия
- glucose — глюкоза
- glycogen — гликоген
- stored — сохраненный
- adipose — жировой
- amino acids — аминокислоты

Bowman’s capsule consists of an inner visceral layer and an outer parietal layer. The space between these layers, the urinary space, is continuous with the renal tubule. The visceral layer is apposed to the glomerulus and closely follows the branches of the glomerular capillaries. The visceral layer is composed of a single layer of epithelial cells resting on a basal lamina, which is fused with the basal lamina of the capillary endothelium. The cells of the visceral layer, called podocytes, have cytoplasmic extensions that rest on the basal lamina.

Between adjacent pedicles, a thin slit diaphragm assists in preventing large plasma proteins from escaping from the vascular system. In fact, most of the components of the glomerular filtrate are reabsorbed in the proximal tubule. Loop of Henle is a hairpin loop of the nephron that extends into the medulla and consists of thick and thin segments. The thick proximal portion of Henle’s loop is the descending thick segment, and the thick convoluted tubule. The thick distal portion of the loop of Henle, the ascending thick segment, ascends to the cortex and is continuous with the distal convoluted tubule. The major function of the distal tubule is to reabsorb sodium and chloride from the tubular filtrate. Collecting tubules consist of arched and straight segments.

New words

- loop — колено
- proximal — проксимальный
- distal — дистальный
- convoluted — волокнистый
- renal — почечный
- tubule — тубулус
- collecting — собирательный
- interstitium — межуточная ткань
- interlobular — межlobулярный
- hilum — верхушка
- interlobar — межlobулярный
- papilla — сосочка
- medullary — медулярный
- pyramids — пирамиды
- parietal — париетальный
- visceral — висцеральный

New words

- voluntary control — добровольный контроль
- position — положение
- root — корень

Peristalsis is a type of muscular contraction characteristic of the gut and consists in waves of contraction, these running along the muscles, both circular and longitudinal, towards the anus. If the food is fluid it enters the stomach six seconds after the beginning of the act, but if it is solid it takes much longer, up to fifteen minutes, to pass down the esophagus. The distal nephron connects to a collecting tubule. The kidney tubules develop in the pelvis but appear to ascend into the abdomen as a result of fetal growth of the lumbar and sacral regions.

The upper and largest part of the urogenital sinus becomes the urinary bladder, which is initially continuous with the allantois. Later the lumen of the allantois becomes obliterated. The urothelium of the trigone of the bladder is formed by the incorporation of the caudal mesonephric ducts into the dorsal bladder wall. This mesonephric duct is eventually replaced by endodermal epithelium so that the entire lining of the bladder is of endodermal origin. The smooth muscle of the bladder is derived from splanchnic mesoderm.

Mile urethra is anatomically divided into three portions: prostatic, membranous, and spongious (penile). The prostatic urethra, membranous urethra, and spongious urethra develop from the narrow portion of the urogenital sinus below the urogenital membrane. The spongious urethra is derived from the urogenital membrane of the glans penis. Female urethra: The upper two-thirds develops from the esonephric ducts, and the lower portion is derived from the urogenital sinus.
Vascular supply begins with the renal artery, enters the kid- 
ney the hilum, and immediately divides into interlobar arte-
ries. The arteries supply the pelvis and capsule before pas-
ing direct between the medullary pyramids to the 
corticomediastinal junction. The interlobar arteries bend 
at almost 90 degrees to form branching, arculate arteries, 
which run along the corticomediastinal junction. The arculate 
arteries subdivide into numerous fine interlobar arteries, 
which ascend perpendicularly to the arculate arteries 
through the cortical labyrinths to the surface of the kidney. 
Each interlobar artery passes midway between two adja-
cent medullary rays.

The interlobar arteries then give off branches that be-
come the arterioles and capillaries of the glomeruli.

As the arteriole approaches the glomerulus, some of its 
smooth muscle cells are replaced by myoepithelio-
lar cells, which are part of the juxtagonal apparatus.

The juxtagonal apparatus consists of juxtagonal-
lar cells, podkissen cells, and the macula densa.

Cells of the distal convoluted tubule near the arteriole 
are taller and more slender than elsewhere in the 
distal tubule.

The juxtagonal cells secrete an enzyme called re-
nin, which enters the bloodstream and converts the circu-
lating polypeptide angiotensinogen into angiotensin I. 
Angiotensin I is converted to angiotensin II, a potent vaso-
constrictor that stimulates aldosterone secretion from the 
adrenal cortex. Aldosterone increases sodium and water
reabsorption in the distal portion of the nephron.

Their nuclei are packed closely, so the region appears 
darker under the light microscope. The macula densa is

The two major mechanisms may participate in associa-
tion between intratubular or- 
gan, some four inches long and about two inches wide.

The two are situated high up on the posterior abdominal 
wall, behind the peritoneum and the 
upper two lumbar transverse processes. Each is inves-
ted by a fibrous capsule surrounded by more or less peri-
nephric fat. On the upper pole of each is a supra-
renal gland. On the medical side is a notch called the hilum

from the blood. In the human each is a bean-
shaped or-

hemoglobin, because intratubular degradation of erythrocytes released in the lats ribs and the upper two lumbar transverse processes. Each is inves-
ted by a fibrous capsule surrounded by more or less peri-
nephric fat. On the upper pole of each is a supra-
renal gland. On the medical side is a notch called the hilum

The kidneys are filters which remove waste products 
from the blood. In the human each is a bean-shaped or-

endothelium. smooth muscle and tubular cells, caus-
ing Vascular smooth muscle relaxation through the induc-

The calyces, renal pelvies, and ureteres constitute the 
main excretory ducts of the kidneys. The walls of these 
structures, in particular the renal pelvis and ureter, consist 
of three coats: an inner mucosa, middle muscularis, and 
an outer adventitia.

Mucosa of the calyces and ureter are lined by a 
transitional epithelium, which varies in thickness with the disten-
tion of the ureter. In the collapsed state, the cells are cuboidal 
with larger c-shaped cells in the superficial layer. In the relaxed 
state, the lumen of the ureter is thrown into folds that gen-
erally disappear when the organ dilates during urine trans-
port. Muscularis consists of an inner longitudinal and an outer 
circular layer of smooth muscle. In the distal ureter, an 
additional discontinuous outer longitudinal layer is present.

Adventitia consists of loose connective tissue with many 
large blood vessels. It blends with the connective tissue of the 
surrounding structures and anchors the ureter to the 
renal pelvis. The urinary bladder functions as a strong or-
gan for urine. The structure of the wall of the bladder is si-
nilar to but thicker than that of the ureter. Mucosa of the urina-
ry bladder is usually folded, depending the degree of the 
bladder distention. The epithelium is transitional and the 
number of apparent layers depends on the fullness of the 
bladder. As the organ becomes distended, the superficial 
epithelial layer and the mucosa become flattened, and the 
entire epithelium becomes thinner. At its fullest distention, 
the bladder epithelium maybe only two or three cells thick.
Lamina propria consists of connective tissue with abun-
dant elastic fibers. Muscularis consists of prominent and 
thick bundles of smooth muscle that are loosely organized 
into three layers. Adventitia covers the bladder except on 
its superior part, where serosa is present. Male urethra


Hemoglobin avidly binds nitric oxide and inhibits 
endothelial dysfunction with reduced nitric oxide pro-
duction may underlie the defective regional vasodilation in 
diabetes and atherosclerosis., predisposing to renal 
ischemia and nephrotoxic insult.

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endothelial dysfunction with reduced nitric oxide pro-
duction may underlie the defective regional vasodilation in 
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ischemia and nephrotoxic insult.
Female urethra is considerably shorter than that of the male urethra. It serves as the terminal urinary passage, conducting urine from the bladder to the vestibule of the female urethra. The urethral muscularis is rather indefinite but does contain both circular and longitudinal smooth muscle fibers. A urethral sphincter is formed by skeletal muscle as the female urethra passes through the urogenital diaphragm.

New words

ureter — мочеточник
calyces — чашечки
urethra — уретра

The epithelium begins at the bladder as a transitional epithelium similar to that of the bladder. The membranous urethra is encircled by a sphincter of skeletal muscle fibers from the deep transverse perineal muscle of the urogenital diaphragm, which also keeps the urethral lumen closed. The wall of the penile urethra contains little muscle but is supported by the erectile mass of corpus spongiosum tissue. The urethral lumen is closed. In the membranous and penile portions, the urethral epithelium becomes stratified squamous and is continuous with the epidermis of the external part of the penis. Female urethra is considerably shorter than that of the male urethra. It serves as the terminal urinary passage, conducting urine from the bladder to the vestibule of the vulva. The cylindrical erectile mass of corpus spongiosum tissue. The epithelium begins at the bladder as a transitional variety and becomes stratified squamous with small areas of a pseudostratified columnar epithelium. The posterior urethra is fenestrated and plays an important role in maintaining the osmotic gradient required for concentrating tubular fluid.

New words

renal pelvis — почечная лоханка
renal veins — почечные вены
expanded — расширенный
minor calyces — незначительные чашечки
interlobar — междолевой
tubules — тонкие трубы

The medulla is divided by its own septa into three anatomical divisions. The prostatic portion is lined by transitional epithelium similar to that of the bladder. The prostatic urethra is surrounded by the fibromuscular tissue of the prostate, which normally keeps the urethral lumen closed. In the membranous and penile portions, the epithelium is pseudostratified up to the level of the prostatic urethra. Back in, the cortex loop of Henle. The efferent vessel from the glomerulus accompanies the loop of Henle, supplying the tubule on the way and finally ends in a small vein. A renal corpuscle plus its complement of tubules and blood vessels is called a renal unit, or nefron. The renal corpuscle is a bean-shaped organ. It is approximately 20 cm in length and has three anatomic divisions. The prostatic portion is lined by transitional epithelium similar to that of the bladder. The prostatic urethra is surrounded by the fibromuscular tissue of the prostate, which normally keeps the urethral lumen closed. In the membranous and penile portions, the epithelium is pseudostratified up to the level of the prostatic urethra. Back in, the cortex loop of Henle. The efferent vessel from the glomerulus accompanies the loop of Henle, supplying the tubule on the way and finally ends in a small vein. A renal corpuscle plus its complement of tubules and blood vessels is called a renal unit, or nefron. The renal corpuscle is a bean-shaped organ.
It is accepted that the total amount of iron in the body is between 2 and 5 g, varying with body-weight and hemoglobin level; about two-thirds of this is in the form of hemoglobin and about 30% is storage iron; iron in myoglobin and enzymes makes up the small remaining fraction together with iron in transport, which is only 0.12%. There is a big difference between the sexes: in the adult male the total iron is about 50 mg per kg body-weight, but in the adult female the figure is only 35 mg per kg, mainly because the normal blood-level of hemoglobin is lower than in the male. Iron exists in the blood mainly in two forms: firstly, as hemin in hemoglobin, and cytochrome concerned with the utilization of oxygen; and secondly, bound to a protein without heme formation, as storage and transport iron. Iron in the body has a very rapid turnover; since some 3 million red blood cells are broken down per second and the greater part of the iron released is reutilized by the bone marrow and re-formed into fresh hemoglobin; some 6.3 g of hemoglobin containing 21 mg of iron is handled this way every 24 hours.

The amount of iron in the body is regulated by control of absorption, since excretion is very small. The amount of iron absorbed from food differs with different foodstuffs, so the iron composition of the diet is important. Absorption can be increased in the normal individual when the blood-hemoglobin is lower than normal and is the iron stores are low. Iron stores are normally lower in women than men and so they tend to absorb more iron. Iron absorption can decrease in older persons, especially in those over 60. Many estimates have agreed that the average Western diet provides between 10 and 15 mg of iron daily, of which only 5—10% is absorbed.

53. Iron in the body

54. Artificial oxygen carries

Artificial oxygen (O2) carries aim at improving O2 delivery. Artificial O2 carries thus may be used as an alternative to allogeneic blood transfusions or to improve tissue oxygenation and function of organs with marginal O2 supply. Artificial O2 carries can be grouped into modified human Hb (Hb) solutions and perfluorocarbon (PFC) emulsions. The native human Hb molecule needs to be modified in order to decrease O2 affinity and to prevent rapid dissociation of the native tetramer into dimers. The O2 transport characteristics of modified Hb solutions and PFC emulsions are fundamentally different. The Hb solutions exhibit a sigmoidal O2 dissociation curve similar to blood. In contrast, the PFC emulsions are characterised by a linear relationship between O2 partial pressure and O2 content. Hb solutions thus provide O2 transport and unloading capacity similar to blood. This means that already at a relatively low arterial O2 partial pressure substantial amounts of O2 are being transported. In contrast, relatively high arterial O2 partial pressures are necessary to maximize the O2 transport capacity of PFC emulsions. Modified Hb solutions are very promising in improving O2 transport and tissue oxygenation to a physiologically relevant degree. Because cross-matching is unnecessary, these solutions hold great promise as an alternative to allogeneic blood transfusions and as O2 therapies, which might be of great value also in the prehospital resuscitation of trauma victims or in specific situations in intensive care medicine. In patients with a reduced cardiac contractility and normal or elevated mean arterial pressure, Hb infusion may increase pulmonary vascular resistances with consequent reduction in cardiac output. In contrast, in a previously healthy trauma
Iron absorption takes place mainly in the upper jejunum, although some is absorbed in all parts of the small intestine and even in the colon. Iron in food is mostly in ferric form and must be reduced to the ferrous form before it can be absorbed; this reduction begins in the stomach — though very little is absorbed there — and continues in the small intestine. The iron is absorbed via the brush-border of the intestine and then may take one of two paths: it is either passed into the blood, where it combines with a globulin, and passes to the marrow or to storage sites; or it combines with the protein, which is then deposited in the intestinal cells.

Iron is lost mostly through the gastrointestinal tract by way of red cells and intestinal cells containing iron lost in the constant desquamation from the intestinal mucosa.

New words

iron — железо
varying — изменение
storage — хранение
fraction — фракция
together — вместе
body-weight — масса тела
desquamation — десквамация