АНГЛИЙСКИЙ ЯЗЫК

шпаргалка

СОДЕРЖАНИЕ

1a 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. At that time 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 ethic 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 15-th century in Oriental countries and later in Europe. Another advance of the Middle Ages was the foundation of universities during 13—14-th centuries. Among other disciplines students could study medicine. During 18-th 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,

2a 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 beeing 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 kidney, 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 molecules is called the cytoplasm. Cytoplasm contains a variety of organelles that have different functions.

3a 3. Tissue

A tissue is a group of cells working together to do a special job. A histologist 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 materials in which the tissues are bathed is slightly salty. It must be mentioned that an insufficiency of tissues fluid is called dehydration and an abnormal accumulation of this fluid caused a condition called edema.

Tissue classification: The 4 main groups of tissues are:

1) epithelial tissue forms elands, covers surfaces and lines cavities;
2) connective tissue holds all parts of the body in Place. This can be fat, cartilage, bone or blood. Blood sometimes is considered a sort of tissue, since it contains cells and performs many of the functions of tissues. However; the blood has many other unique characteristics;
3) nerve tissue conducts nerve impulses all over the body;
4) the muscle tissue is designed for power-producing contractions.

The surface of the body and of the tubes or passages leading to the exterior and the surface of the various cavities in the body are lined by cells which are closely approximated to each other; thus have a small amount of intercellular substance. This lining cellular layer is called epithelium. The nature and consistency of intercellular substance, the matrix, and the amount and arrangement of fibers furnish the basis for the subdivision of connective tissue into three main groups: connective tissue proper, cartilage and bone. In connective tissue the intercellular substance is soft; in cartilage it is firm, yet flexible and ela-

4a 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, excretion, 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 germinativum) is a proliferative basal layer of columnar-like cells that contain 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 basophilic keratohyalin granules. Viewed at the electron microscopic level, these cells also contain numerous mem brane-coating granules. Stratum corneum is the superficial stratum of dead cells and consists of several to many layers of flat, anucleated, and cornified (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: keratinocytes are the most numerous and are responsible for the production of the family of keratin proteins that provide the barrier function of the epidermis.

1б 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 20-th 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.

New words

medicine — медицина
human — человеческий
occupation — занятие
to develop — развивать
science — наука
civilization — цивилизация
Middle ages — Средние века
modern — современный
animal — животное
illness — заболевание
death — смерть
discovery — открытие
blood — кровь

2б

New words

cell — клетка
independent — независимый
unit — единица
body — тело
all — все
lipid — жир
microenvironment — микровооружение
muscle — мышечный
nervous — нервный
digestive — пищеварительный
life — жизнь
human — человеческий
together — вместе
tissue — ткань
organ systems — системы органов
to function — функционировать
to contain — содержать
membranes — мембраны
protein — протеин
nucleus — ядро
cytoplasm — цитоплазм
different — различный

3б 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 intes tines of blood vessels. The cells forming this tissue are long spin dles with a central oval nucleus.

Striated muscle tissue is composed of cylindrical fibres often of great at 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.

New words

liquid — жидкость
epithelial — эпителиальный
layer — слой
muscle — мышца
body — тело
flexible — гибкий
elastic — эластичный
nucleus — ядро
smooth — гладкий
fibre — волокно
cardiac — сердечный

4б 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

epidermis — эпидермис
dermis — дерма
weight — вес
to protect — защищать
injury — рана
cytoplasmic — цитоплазматический
level — уровень
flat — плоский
palm — ладонь
thick — толстый
pigment — пигмент
melanin — меланин
nerve — нерв

5a

5. Dermis

Dermis is a connective tissue layer of mesodermal origin subjacent 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 in closer proximity to the epidermal cells. The epidemis, like epithelia in general, is devoid of blood vessel. Histologically, dermis consists of two identifiable regions.

Papillary layer, associated principally with the dermal papillae, is the most superficial layer. 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 intertwined with elastic fibers in a gel matrix. This layer is a typical dense irregular connective 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 contains the deepest portions of the cutaneous glands and hairs, it is also an important part of the skin. The hypodermis fastens the skin to underlying muscles and other structures.

New words

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

6a

6. Cutaneous appendages

Cutaneous appendages are all derivatives of the epidermis.

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 single 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 innervation 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, areolar, and anal regions.

Secretory portions of these glands are composed of a single 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 basement 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 epidermal 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 (cerumen). 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 acinar glands. They usually discharge their secretions onto the hair shaft within hair follicles. These glands are found

7a

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 inter convertible physical states: solids, liquids and gases. For instance, ice, water and steam are respectively the solid, liquid and gaseous states of water. Things in the physical world are made up of a relatively small number of basic materials combined in various 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. There are two kinds of properties: physical — colour, taste, odour, 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 chemical change the composition of the substance is changed and new products are formed. Chemical properties are permanent.

It is useful to classify 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 described by the terms solidify (freeze), liquify (melt), vapourise (evaporate) and condense are examples of physical changes. After physical change there is still the same

8a

8. Skeletal system

The components of the skeletal system are derived from mesenchymal elements that arise from mesoderm and neural crest. Mesenchymal cells differentiate into fibroblasts, chondroblasts, and osteoblasts, which produce connective tissue, cartilage, and bone tissue, respectively. Bone organs either develop directly in mesenchymal connective tissue (intramembranous ossification) or from preformed cartilage models (endochondral ossification). The splanch nic mesoderm 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 embryonic connective tissue, known as mesenchyme. Mesenchyme cells migrate and differentiate to form fibroblasts, chondroblasts, or osteoblasts.

Bone organs are formed by two methods.

Flat bones are formed by a process known as intramembinous ossification, in which bones develop directly within mesenchyme.

Long bones are formed by a process known as endochondral 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 appose 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.

6б in the dermis throught the skin, except on the palms and soles.

Secretory portions consist of peripherally located, flattened 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 cat 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 the acini occurs at puberty.

Hairs are long, filamentous projections consisting of dead keratini-zed epidermal cells. Each hair derives from an epidermal invagination called the hair follicle, which possesses a terminal hair bulb, located in the dermis or hypodermis, from which the hair shaft grows. Contraction of smooth muscles raise the hairs and dimple 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.

New words

cutaneous — кожный
appendace — покров
tubular — трубчатый
pyramidal — пирамидальный
surface — поверхность
thermal — тепловой
innervation — иннервация

5б to increase — увеличивать
surface — поверхность
area — площадь
epidermal — эпидермальный
thick — толстый
skin — кожа
papillary — папиллярный
devoid — происходить
meshwork — ячеистая сеть
coarse — грубый
bundle — связка
interwine — сплетаться
bring — приносить
to consists of — состоять из
to contain — содержать
collagen — коллагеновый
adipocyte — жировая клетка

8б Viscerocranium arises primarily from the first two pharynge 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 end chondral. 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.

Vertebral column.

During the fourth week, sclerotome cells migrate medially to surround the spinal cord and notochord. After proliferation of the caudal portion of the sclerotomes, the 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 bod ies, it degenerates between them, forming the nucleus pulposus. The latter, together with surrounding circular fibers of the annulus fibrosis, forms the intervertebral disc.

New words

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

7б 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
steam — пар
to undergo — подвергать
variety — разнообрзие
change — перемена
physical — физический
chemical — химический
natural — природный
transformation — трансформация
colour — цвет
taste — вкус
odour — запах
density — плотность
hardness — твердость
solubility — растворимость
ability — возможность
to conduct — проводить
permanent — постоянный

9a

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.

Myofibrils appear in the cytoplasm, and, by the third month, cross-striations appear. Individual muscle fibers increase in diameter as myofibrils multiply and become arranged in groups 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 ramus of the spinal nerve, and a ventral hypomere, supplied by the ventral primary ramus.

Epimere muscles form the extensor muscles of the vertebral column, and hypomere muscles give rise to lateral and ven tral 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 abdomii 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 preoptic myotomes that originally surround the prochordal plate.

10a

10. Skeleton

The bones of our body make up a skeleton. The skeleton forms about 18% of the weight of the human body.

The skeleton of the trunk mainly consists of spinal column made of a number of bony segments called vertebrae to which the head, the thoracic cavity and the pelvic bones are connected. The spinal column consists of 26 spinal column bones.

The human vertebrae are divided into differentiated groups. The seven most superior of them are the vertebrae called 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 vertebrae, making 12 pairs of ribs. Most of the rib pairs come together ventrally and join a flat bone called the sternum.

The first pairs or ribs are short. All seven pairs join the sternum directly and are sometimes called the «true ribs». Pairs 8, 9, 10 are «false ribs». The eleventh and twelfth pairs of ribs are the «floating ribs».

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 together the coccyx.

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

New words

skeleton — скелет
make up — составлять
weight — вес
trunk — туловище

11a

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 cells, which arc called muscle fibres, and which are bound into bundles by connective tissue.

There are three varieties of muscle fibres:

1) striated muscle fibres, which occur in voluntary muscles;
2) unstriated muscles which bring about movements in the internal organs;
3) cardiac or heart fibres, which are striated like (1), but are otherwise different.

Muscle consists of threads, or muscle fibers, supported by connective tissue, which act by fiber contraction. There are two types of muscles smooth and striated. Smooth, muscles are found in the walls of all the hollow organs and tubes of the body, such as blood vessels and intestines. These react slowly to stimuli from the autonomic nervous system. The striated, muscles of the body mostly attach to the bones and move the skeleton. Under the microscope their fibres have a cross — striped appearance. Striated muscle is capable of fast contractions. The heart wall is made up of special type of striated muscle fibres called cardiac muscle. The body is composed of about 600 skeletal muscles. In the adult about 35—40% of the body

12a

12. Bones

Bone is the type of connective tissue that forms the body's supporting framework, the skeleton. Serve 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.

The bones of women are generally lighter than those of men, while children's bones are more resilient than those of adults. Bones also respond to certain physical physiological changes: atrophy, or waste away.

Bones are generally classified in two ways. When classified on the basis of their shape, they fall into four categories: flat bones, such as the ribs; long bones, such as the thigh bone; short bones, such as the wrist bones; and irregular bones, such as the vertebrae. When classified on the basis of how they develop, bones are divided into two groups: endochondral bones and intramembraneous bones. Endochondral bones, such as the long bones and the bones at the base of the skull, develop from cartilage tissue. Intramembraneous 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 intramembraneous 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: anouter layer of compact bone and an inner layer of spongy bone. Compact bone is strong and dense. Spongy 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 com-

10б vertebrae — позвоночник
thoracic cavity — грудная клетка
pelvic — тазовый
cervical — шейный
atlas — 1 шейный позвонок
sternum — грудина
mainly — главным образом
axis — ось
spinal column — позвоночник
inferior — нижний
rib — ребро
pair — пара
sacral — сакральный
coccyx — копчик
floating — плавающий
forming — формирующий
cartilage — хрящ
lumbar — поясничный
adult — взрослый

9б 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 soma mesoderm that migrates into the limb bud. With time, the limb musculature splits into ventral flexor and dorsal extern 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 a 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, trachtea, 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
ivertebral — позвоночный
arche — дуга
abdomen — живот
facial — лицевой
branch — ветвь

12б 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.

11б 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

13a 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 intramembraneous 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 fibers and an intercellular substance. This substance, together with the collagen fibers and the connective tissue fibers 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 plares, 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

14a 14. Skull

Bones of the skull: the neurocranium (the portion of the skull that surrounds and protects the brain) or the viscerocranium (i. e., the skeleton of the face). Bones of the neurocranium: Frontal, Parietal, Temporal, Occipital, Ethmoid, Sphenoid.

Bones of the viscerocranium (surface): Maxilla, Nasal, Zygomatic, Mandible. Bones of the viscerocranium (deep): Ethmoid, Sphenoid, Vomer, Lacrimal, Palatine, Inferior nasal concha. Articulations: Most skull bones meet at immovable joints called sutures. The coronal suture is between the frontal and the parietal bones. The sagittal suture is between two parietal bones. The lambdoid suture is between the parietal and the occipital bones. The bregma is the point at which the coronal suture intersects the sagittal suture.

The lambda is the point at which the sagittal suture intersects the lambdoid suture. The pterion is the point on the lateral aspect of the skull where the greater wing of the sphenoid, parietal, frontal, and temporal bones converge. The temporomandibular joint is between the mandibular fossa of the temporal bone and the condylar process of the mandible.

The parotid gland is the largest of the salivary glands. Structures found within the substance of this gland include the following: Motor branches of the facial nerve. CN VII enters the parotid gland after emerging from the stylomastoid foramen at the base of the skull. Superficial temporal artery and vein. The artery is a terminal branch of the external carotid artery.

Retromandibular vein, which is formed from the maxillary and superficial temporal veins.

Great auricular nerve, which is a cutaneous branch of the cer vical plexus. Auriculotemporal nerve, which is a sensory branch of V3. It supplies the TMJ and conveys postganglionic parasympathetic fibers from the otic ganglion to the parotid gland. Parotid (Stensen's) duct, which enters the oral cavity at

15a 15. Neck. Cervical vertebrae, cartilages, triangels

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 vertbral 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 articulates 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 arterior triangle by the sternocleidomastoid muscle. These triangles are subdivided by smaller muscles into six smaller triangles. Posterior triangle is bound by the sternocleidomastoid, the clavicle, and the trapezius. Occipital triangle is located above the inferior belly 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 supaclavicular nerves.

Subclavian (omoclavicular, supraclavicular) triangle is located below the inferior belly of the omohyoid. Its contents include the following: Brachial plexus supraclavicular portion The branches include the dorsal scapular, long thoracic, subclavius, and suprascapular nerves.

16a 16. Neck. Root, fascies of the neck

Root of neck: This area communicates with the superior medi astinum through the thoracic inlet. Structures of the region include the following: subclavian artery and vein. The subclavian artery passes poste rior to the scalenus anterior muscle, and the vein passes ante rior 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.

Phrenic nerve is a branch of the cervical plexus, which arises from C3, C4, and C5. It is the sole motor nerve to the diaphragm. It crosses the anterior scalene muscle from lateral to medial to enter the thoracic inlet.

Recurrent laryngeal nerve is a branch of the vagus nerve. This mixed nerve conveys sensory information from the laryngeal; mucosa below the level of the vocal folds and provides motor innervation to all the intrinsic muscles of the larynx except the cricothyroid muscle.

Thoracic duct terminates at the junction of the left subclavian and the left internal jugular veins. On the right side of the body, the right lymphatic duct terminates in a similar fashion.

Fascias of the neck: Superficial investing fascia encloses the platysma, a muscle of facial expression, which has migrated to the neck.

Deep investing fascia surrounds the trapezius and sternoclei — domastoid muscles.

Retropharyngeal (visceral) fascia surrounds the pharynx.

Prevertebral fascia invests the prevertebral muscles of the nee (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

14б the level of the maxillary second molar. The facial artery is a branch of the external carotid artery in the neck. It terminates as the angular artery near the bridge of the nose.

The muscles of face

Muscles of the scalps	Muscels of the mouth
Frontalis	Levator labii superioris alaeque nasi
Occipitalis	Levator labii superioris
Muscles of the ear	Zygomaticus minor
Anterior auricular	Zygomaticus major
Superior auricular	Levator anguli oris (caninus)
Posterior auricular	Risorius
Muscles of the rim of the orbit	Depressor anguli oris (triangularis)
Orbicularis oculi	Depressor labii inferioris
Corrugator supercilii	Mentalis (quadratus labii inferioris)
Muscles of the nose	Buccinator
Procerus	Orbicularis oris
Nasalis	Muscle of the neck
Platysma	Nasalis

New words

brain — мозг
frontal — лобная
parietal — теменная
temporal — височная
occipital — затылочная
ethmoid — решетчатая
maxilla — верхняя челюсть
zygomatic — скуловой
mandible — нижняя челюсть
sphenoid — клиновидная
vomer — сошник
lacrimal — слезная
palatine — небная
nasal concha — носовая раковина

13б are removed. In all bones, the matrix is arranged in layers called lamellae. In compact bone, the lamellae are arranged concentrically around blood vessels, and the space containing each blood vessel is called a Haversian canal. The osteocytes are located between the lamellae, and the canaliculi containing their cellular extensions connect with the Haversian canals, allowing the passage of nutrients and other materials between the cells and the blood vessels. Bone tissue contains also many smaller blood vessels that extend from the periosteum and enter the bone through small openings. In long bones there is an additional blood supply, the nutrient artery, which represents the chief blood supply to the marrow. The structure of spongy is similar to that of compact bone. However, there are fewer Haversian canals, and the lamellae are arranged in a less regular fashion, forming spicules and strands known as trabeculae.

New words

bone — кость
internal — внешний
phosphorus — фосфор
atrophy — атрофия
spongy — губчатый
tendon — сухожилие
ligament — связка
flexible — гибкий
periosteum — надкостница
osteoblast — остеобласт (клетка, образующая кость)
rigidity — неподвижность
shape — форма
to crumble — крошиться
to congregate — собираться
epiphyseal — относящийся к эпифизу
shaft — ствол, тело (длинной) кости, диафиз

16б in a group share common innervation with one exception in each group.

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 one 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.

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 stylopharyngeus muscle, which is supplied by CN IX.

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 CN V3.

Group 5: Infrahyoid muscles. All but one of the infrahyoid muscles are supplied by the ansa cervicalis of the cervical olexus (C1, C2, and C3). The exception is the thyrohyoid, which is supplied by a branch of C1. (This branch of C1 also supplies the geniohyoid muscle).

New words

neck — шея
cervical — цервикальный
vertebrae — позвоночник
cricoid cartilage — перстневидный хрящ гортани
scapulae — лопатка
scalene — лестничная мышца
brachial plexus — плечевое сплетение
vagus nerve — блуждающий нерв
hypoglossal nerve — подъязычный нерв
laryngeal branches — гортанные ветви

15б 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.

Anterior triangle is bound by the sternocleidomastoid muse 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 midline of the neck. Carotid (vascular) 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, bifurcates and form the internal and external carotid arteries. The external carotid artery has six branches (i. e., the superior thyroid; the ascending pharyngeal, the lingual, the facial, the occipital, and the posterior auricular arteries). Vagus nerve; hypoglossal nerve; internal and external laryngeal branches of the superior laryngeal branch of the vagus nerve. Digastric (submandibular) triangle is bound by the anterior and posterior bellies of the digastric muscle and the inferi or border of the body of the mandible. It contains the submandibular salivary gland. Submental triangle is bound by the anterior belly of the digastric muscle, the hyoid bone, and the midline of the neck. It contains the submental lymph nodes.

17a

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 angel an important clinical landmark.

The body articulates directly with ribs 2—7; it articulates interiorly 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.

Subcostalis 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

Intercostal 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.

18a

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 (fibrinogen), 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 trans porting oxygen from the lungs to tissues and in returning carbon dioxide to the lungs. Oxygen and carbon dioxide carried in the RBC combine with hemoglobin to form oxyhemoglobin and carbaminohemoglobin, respectively.

Mature erythrocytes are denucleated, biconcave disks with a diameter of 7—8 mm. The biconcave shape results in a 20—30% increase in sur face area compared to 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/mm^3 in women and 4,3—5,9 million/mm^3 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

19a

19. Blood. Formed elements of the blood. Leukocytes

Leukocytes, or white blood cells, are primarily with the cellular and humoral defense of the organism foreign materials. Leukocytes are classified as granulocytes (neutrophils, eosinophils, basophils) and agranulocytes (lympmonocytes).

Granulocytes are named according to the staining properties of their specific granules. Neutrophils sare 10—16 mm in diameter.

They have 3—5 nuclear lobes and contain azurophilic granules (lysosomes), which contain hydrolytic enzymes for bacterial destruction, in their cytoplasm. Neutrophils are phagocytes 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 a discharged into phagocytic vacuoles.

Eosinophils are more numerous 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 reacting substance 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

20a

20. Plasma

Plasma is the extracellular component of blood. It is an aqueous solution containing proteins, inorganic salts, and organic com pounds. 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 capil lary 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 com position as plasma, but lacks the clotting factors (especially fib rinogen).

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 sys tem 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 lymphocytes and antibodies produced in lymph nodes into the blood circulation.

Lymphatic capillaries consist of vessels lined with endothelial cells, which begin as blind-ended tubules or saccules in most tis sues of the body. Endothelium is attenuated and usually lacks a continuous basal lamina. Lymphatic vessels of large diameter resemble veins in their

18б to certain tissues, where it combines with apoferritin to form ferritin. The heme is catabolized into 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 hyalomere that sends out fine cytoplasmic processes, and a central, dark-staining granulomere that con tains 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 mem brane permits them to agglutinate and adhere to surfaces.

Platelets aggregate to set up the cascade of enzymatic reac tions that convert fibrinogen into the fibrin fibers that make up the clot.

New words

mesodermal — мезодермальный
erythrocytes — эритроциты
platelets — тромбоциты
carbon — углерод
dioxid — диоксид
span — промежуток
light-staining — легкое окрашивание
to aggregate — соединяться

17б 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 subcla vian artery.

Nine pairs of intercostal and one pair of subcostal arter ies 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 azygos 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 poste rior mediastinum.

New words

thoracic — грудной
wall — стенка
clavicle — ключица
xiphisternal — грудинный
groove — углубление
intercostal — межреберный
subcostal — подкостный
transversus — поперечный
musculophrenic — мышечный грудобрюшной
paraaortic — парааортальный
mediastinum — средостение

20б struc ture but lack a clear-cut separation between layers. Valves are more numerous in lymphatic vessels. Smooth muscle cells in the media layer engage in rhythmic contraction, pumping lymph toward the venous system. Smooth muscle is well-developed in large lymphatic ducts.

Circulation of lymph is slower than that of blood, but it is nonetheless an essential process. It has been estimated that in a single day, 50% or more of the total circulating protein leaves the blood circulation at the capillary level and is recaptured by the lymphatics.

Distribution of lymphatics is ubiquitous with some notable excep tions, including epithelium, cartilage, bone, central nervous sys tem, and thymus.

New words

plasma — плазма
extracellular — внеклеточный
aqueous — водный
solution — раствор
proteins — белки
inorganic — неорганический
salts — соли
organic — органический
albumin — альбумин
globulins — глобулины
alpha — альфа
beta — бета
gamma — гамма
fibrinogen — фибриноген
lymphatic — лимфатический
vessel — сосуд
endothelium — эндотелий
circulation — кровообращение
lymph — лимфа
ubiquitous — вездесущий
notable — известный

19б leukocytes. They con tain circular dark-stained nuclei and scanty clear blue cyto plasm. 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 effec tors of cell-mediated immunity. They also function as helper and suppressor cells, by modulating the immune response through their effect on B cells, plasma cells, macrophages, and other T Cells.

B cells differentiate in bone marrow. Once activated by contact with an antigen, they differentiate into plasma cells, which synthesize antibodies that are secreted into the blood, intercellular fluid, and lymph. B lymphocytes also give rise to memory cells, which differentiate into plas ma 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
humoral — гуморальный
to contain — содержать
nuclei — ядра

21a

21. Hematopoietic tissue. Erythropoiesis

Hematopoietic tissue is composed of reticular fibers and cells, blood vessels, and sinusoids (thin-walled blood channels). Myeloid, or blood cell-forming tissue, is found in the bone marrow and provides the stem cells that develop into erythrocytes, granulocytes, agranulocytes, and platelets. Red marrow is characterized by active hematopoiesis; yellow bone marrow is inactive and contains mostly fat cells. In the human adult, hematopoiesis takes place in the mar row of the flat bones of the skull, ribs and sternum, the vertebral column, the pelvis, and the proximal ends of some long bones. Erythropoiesis is the process of 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 undergoes mitotic divisions. Its nucleus comprises approximately 50% of its mass and contains condensed chromatin which appears in a «checkerboard» pattern. The polychnsia of the cytoplasm is due to the increased quantity of acidophilic hemoglobin combined with the basophilia of cytoplasmic polyribosomes.

Normoblast (orthochromatophilic erythroblast) is a cell with a small heterochromatic nucleus that comprises ap-

22a

22. Hematopoietic tissue. Granulopoiesis, thrombopoiesis

Granulopoiesis is the process of granulocyte formation. Bone marrow stem cells differentiate into all three types of granulocytes.

Myeloblast is a cell that has a large spherical nucleus containing delicate euchromatin and several nucleoli. It has a basophilic cytoplasm and no granules. Myeloblasts divide differentiate to form smaller promyelocytes.

Promyelocyte is a cell that contains a large spherical indented nucleus with coarse condensed chromatin. The cytoplasm is basophilic and contains peripheral azurophilic granules.

Myelocyte is the last cell in this series capable of division. The nucleus becomes increasingly heterochromatic with subsequent divisions. Specific granules arise from the Golgi apparatus, resulting in neutrophilic, eosinophilic, and basophilic myelocytes.

Metamyelocyte is a cell whose indented nucleus exhibits lobe formation that is characteristic of the neutrophil, eosinophil, or basophil. The cytoplasm contains azurophilic granules and increasing numbers of specific granules. This cell does not divide. 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—2% of peripheral WBCs; they subsequently mature into definitive neutrophils.

Agranulopoiesis is the process of lymphocyte and monocyte for mation. Lymphocytes develop from bone marrow stem cells (lymphoblasts). Cells develop in bone marrow and seed the secondary lymphoid organs (e. g., tonsils,

23a

23. Arteries

Arteries are classified according to their size, the appearance of their tunica media, or their major function.

Large elastic conducting arteries include the aorta and its large branches. Unstained, they appear yellow due to their high con tent of elastin.

The tunica intima is composed of endothelium and a thin sub jacent connective tissue layer. An internal elastic membrane marks the boundary between the intima and media.

The tunica media is extremely thick in large arteries and con sists of circularly organized, fenestrated sheets of elastic tissue with interspersed smooth muscle cells. These cells are responsi ble for producing elastin and other extracellular matrix com ponents. The outermost elastin sheet is considered as the external elastic membrane, which marks the boundary between the media and the tunica adventitia.

The tunica adventitia is a longitudinally oriented collection of collagenous bundles and delicate elastic fibers with associated fibroblasts. Large blood vessels have their own blood supply (vasa vasorum), which consists of small vessels that branch profusely in the walls of larger arteries and veins. Muscular distributing arteries are medium-sized vessels that are characterized by their predominance of circularly arranged smooth muscle cells in the media interspersed with a few elastin compo nents. Up to 40 layers of smooth muscle may occur. Both internal and external elastic limiting membranes are clearly demonstrated. The intima is thinner than that of the large arteries.

Arterioles are the smallest components of the arterial tree. Generally, any artery less than 0,5 mm in diameter is considered to be a small artery or arteriole. A subendothelial layer and the inter nal elastic membrane may be

24a

24. Capillaries

Capillaries are thin-walled, narrow-diameter, low-pressure vessels that generally permit easy diffusion across their walls. Most capillar ies have a cross-sectional diameter of 7—12 mm. They are composed of a simple layer of endothelium, which is the lining of the entire vas cular system, and an underlying basal lamina. They are attached to the surrounding tissues by a delicate reticulum of collagen. Associated with these vessels at various points along their length are specialized cells called pericytes. 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 diame ter than other capillaries (up to 40 mm), exhibit irregular cross-sec tional profiles, have more tortuous paths, and often lack a con tinuous basal

22б lymph nodes, spleen). Stem cells for T cells come from bone marrow, develop in the thymus and, subsequently, seed the secondary lym phoid 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 divi sions without concomitant cytoplasmic division. As a result, the megakaryocyte is a cell with polylobulated, polyploid nucleus and abundant granules in its cytoplasm. As megakaryocyte maturation proceeds, «curtains» of platelet demarcation vesicles form in the cytoplasm. These vesicles coalesce, become tubular, and eventually form platelet demarcation membranes. 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

21б proximately 25% of its mass. It contains acidophilic cytoplasm because the large amount of hemoglobin and degenerating organelles. The pyknotic nucleus, which is no longer capable of division, is extruded from the cell.

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
sinusoids — синусоиды
granulocytes — гранулоциты
agranulocytes — агранулоциты
active — активный
yellow — желтый
glycoprotein — гликопротеин
erythropoietin — эритропоэтин
amount — количество
hemoglobin — гемоглобин
degenerating — дегенерирующие
condensed — сжатый

24б lamina. Cells with phagocytic activity (macrophages) are present within, or just subjacent to, the endothelium.

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
vas cular — сосудистый
underlying — лежащий в основе
basal — основной
lamina — тонкая пластинка

23б present in the largest of these vessels but are absent in the smaller ones. The media is composed of sev eral smooth muscle cell layers, and the adventitia is poorly devel oped. An external elastic membrane is absent.

New words

endothelium — эндотелий
media — средняя
arteries — артерии
to be classified — классифицированный
according — соответственно
their — их
size — размер
appearance — вид
tunica — оболочка
major — главный
elastic — эластичный
conducting — проведение
arteries — артерии
to include — включать
aorta — аорта
branches — ветви
up to — до
layers — слои
smooth — гладкий
may — может
infima — внутренняя полость артерии

25a

25. Veins

Veins are low-pressure vessels that have larger lumina and thinner walls than arteries. In general, veins have more collagenous connec tive tissue and less muscle and elastic tissue than their arterial coun terparts. Although the walls of veins usually exhibit the three layers, they are much less distinct than those of the arter ies. 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 approxi mately 15—20 mm (post-capillary venules) up to 1—2 mm (small veins). The walls of the smaller of these are structurally and func tionally 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, affect ing 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

26a

26. Heart

The heart is a muscular organ, composed primarily of 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 conduc-ting system are present in the subendocardial connective tissue layer.

Myocardium is composed of branching, anastomotic 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 skeleton is composed mainly of dense connective tissue and consists of the annuli fibrosi, the trigonum fibrosum, and the septum membranaceum.

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

27a

27. 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 pri mary bronchi.

Bronchioles do not possess cartilage, glands, or lymphatic nodules; however, they contain the highest proportion of smooth r 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 nonciliated 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 (cupola) 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, lym phatics, and nerves. Lobes and fissures.

28a

28. Respiratory system

The respiratory system is structurally and functionally adapt ed for the efficient transfer of gases between the ambient air and the bloodstream as well as between the bloodstream and the tissues. The major functional components of the res piratory system are: the airways, alveoli, and blood vessels of the lungs; the tissues of the chest wall and diaphragm; the systemic blood vessels; red blood cells and plasma; and respi ratory control neurons in the brainstem and their sensory and motor connections. LUNG FUNCTION: provision of O_2 for tissue metabolism occurs via four mechanisms. Ventilation — the transport of air from the environment to the gas exchange surface in the alveoli. O_2 diffusion from the alveolar air space across the alveolar-capillary membranes to the blood.

Transport of O_2 by the blood to the tissues: O_2 diffusion from the blood to the tissues.

Removal of CO_2 produced by tissue metabolism occurs via four mechanisms. CO_2 diffusion from the tissues to the blood.

Transport by the blood to the pulmonary capillary-alveolar membrane.

CO_2 diffusion across the capillary-alveolar membrane to the air spaces of the alveoli. Ventilation — the transport of alveolar gas to the air. Functional components: Conducting airways (conducting zone; anatomical dead space).

These airways are concerned only with the transport of gas, not with gas exchange with the blood.

They are thick-walled, branching, cylindrical structures with ciliated epithelial cells, goblet cells, smooth muscle cells. Clara cells, mucous glands, and (sometimes) cartilage.

26б 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), intern-odal 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 conduct ing myocytes are in electrical contact with each other and with normal contractile 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.

New words

heart — сердце
muscular — мышечный
cardiac — сердечный
to pump — качать
endocardium — эндокардиум
innermost — самый внутренний
conducting system — проведение системы
subendocardial — внутрисердечный
impulse — импульс
fibrosi — фиброзные кольца

25б adventitia (usually the thickest layer) composed of collagen bundles, elastic fibers, and smooth muscle cells oriented along the longitudinal axis of the vessel. Venous valves are sheet-like outfoldings of endothelium and underlying connective tissue that form flaps to permit unidi rectional flow of blood.

Large veins, such as the external iliac, hepatic portal, and vena cavae, are the major conduits of return toward the heart. The intima is similar to that of medium veins. Although a network of elastic fibers may occur at the boundary between the intima andmedia, a typical internal elastic membrane as seen in arteries is not present. A tunica media may or may not be present. If pre sent, smooth muscle cells are most often circularly arranged. The adventitia is the thickest layer of the wall and consists of elastic fibers and longitudinal bundles of collagen. In the vena cava, this layer also contains well-developed bundles of longitudinally oriented smooth muscle.

New words

vein — вена
low-pressure — низкое давление
collagenous — коллагеновый
intima — интима
reflux — рефлюкс
inflammation — воспаление
longitudinal — продольный
flaps — створки
iliac — подвздошный
hepatic — печеночный

28б Alveoli and alveolar septa (respiratory zone; lung parenchyma).

These are the sites of gas exchange.

Cell types include: Type I and II epithelial cells, alveolar macrophages.

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 m^2). It consists of alveolar epithelium, basement membrane interstitium, and capillary endothelium.

New words

respiratory — дыхательный
air — воздух
bloodstream — кровоток
airways — воздушные пути
alveoli — альвеолы
blood vessels — кровеносные сосуды
lungs — легкие
chest — грудь
diaphragm — диафрагма
the systemic blood vessels — системные кровеносные сосуды
red blood cells — красные кровяные клетки
plasma — плазма
respi ratory control neurons — дыхательные нейроны контроля
brainstem — ствол мозга
sensory — сенсорный
motor connections — моторные связи
ventilation — вентиляция
transport — транспортировка
environment exchange — окружающая среда
surface — поверхность

27б The right lung has three lobes: superior, middle and inferior.

The left lung has upper and lower lobes.

Bronchopulmonary segments of the lung are supplied by the segmental (tertiary) bronchus, artery, and vein. There are 10 on the right and 8 on the left.

Arterial supply: Right and left pulmonary arteries arise from the pulmonary trunk. The pulmonary arteries deliver deoxygenated blood to the lungs from the right side of the heart.

Bronchial arteries supply the bronchi and nonrespiratory por tions of the lung. They are usually branches of the thoracic aorta.

Venous drainage. There are four pulmonary veins: superior right and left and inferior right and left. Pulmonary veins carry oxygenated blood to the left atrium of the heart.

The bronchial veins drain to the azygos system.

Bronchomediastinal lymph trunks drain to the right lymphatic duct and the thoracic duct.

Innervation of Lungs: Anterior and posterior pulmonary plexuses are formed by vagal (parasympathetic) and sympathetic fibers. Parasympathetic stimulation has a bronchoconstrictive effect. Sympathetic stimulation has a bronchodilator effect.

New words

lungs — легкие
intrapulmonary bronchi — внутрилегочные бронхи
the primary bronchi — первичные бронхи
lobar bronchi — долевые бронхи
submucosa — подслизистая оболочка

29a 29. Lung volumes and capacities

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 an 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 con tained within the maximally inflated lungs (average human = 6 L).

Vital capacity is the maximal volume 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 luman = 2,2 L).

Inspiratory 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 approximate 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 us-

30a 30. Ventilation

Total ventilation (VT, minute ventilation) is the total gas flow into the lungs per minute. It is equal to the tidal volume (VT) x the respiratory rate (n). Total ventilation is the sum of dead space ventilation and alveolar ventilation.

Anatomic dead space is equivalent to the volume of the conducting airways (150 mL in normal individuals), i. e., the trachea and bronchi up to and including the terminal bronchioles. Gas exchange does not occur here. Physiologic dead space is the volume of the respiratory tract that does not participate in gas exchange. It includes the anatomic dead space and partially functional or nonfunctional alveoli (e. g., because of a pulmonan embolus preventing blood supply to a region of alveoli). In normal individuals, anatomic and physiologic dead space are approximately equal. Physiologic dead space can greatly exceed anatomic dead space in individuals with lung disease.

Dead space ventilation is the gas flow into dead space per minute. Alveolar ventilation is the gas flow entering functional alveoli per minute.

Alveolar ventilation: It is the single most important parameter of lung function. It cannot be measured directly. It must be adequate for removal of the CO_2 produced by tissue metabolism whereas the partial pressure of inspired O_2 is 150 mmHg, the partial pressure of O_2 in the alveoli is typically 100 mmHg because of the displacement of O_2 with CO_2. PAo2 cannot be measured directly.

New words

total — общее количество
ventilation — вентиляция
flow — поток
per minute — в минуту
equal — равный

31a 31. Air flow

Air moves from areas of higher pressure to areas of lower pres sure just as fluids do. A pressure gradient needs to be established to move air.

Alveolar pressure becomes less than atmospheric pressure when the muscles of inspiration enlarge the chest cavity, thus lowering the intrathoracic pressure. Intrapleural pressure decreases, caus ing expansion of the alveoli and reduction of intra-alveolar pressure. The pressure gradient between the atmosphere and the alveoli drives air into the airways. The opposite occurs with expiration.

Air travels in the conducting airways via bulk flow (mL/min). Bulk flow may be turbulent or laminar, depending on its velocity. Velocity represents the speed of movement of a single particle in the bulk flow. At high velocities, the flow may be turbulent. At lower velocities transitional flow is likely to occur. At still lower velocities, flow may be laminar (streamlined). Reynold's number predicts the air flow. The higher the number, the more likely the air will be turbulent. The velocity of particle movement slows as air moves deeper into the lungs because of the enormous increase in cross-sectional area due to branching. Diffusion is the primary mechanism by which gas moves between terminal bronchioles and alveoli (the respiratory zone).

Airway resistance: The pressure difference necessary to produce gas flow is directly related to the resistance caused by friction at the airway walls. Medium-sized airways (> 2 mm diameter) are the major site of airway resistance. Small airways have a high individual resis tance. However, their total resistance is much less because resistances in parallel add as reciprocals.

32a 32. Mechanics of breathing

Muscles of respiration: inspiration is always an active process. The following muscles are involved: The diaphragm is the most important muscle of inspiration. It is convex at rest, and flattens during contraction, thus elongating the thoracic cavity. Contraction of the external intercostals lifts 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 breath ing, but become more important in exercise. Expiration is normally a passive process. The lung and chest wall are elastic and naturally return to their resting positions after being actively expanded during inspiration. Expiratory muscles are used during exercise, forced expiration and cer tain disease states. Abdominal muscles (rectus abdominis, internal and exter nal obliques, and transversus abdominis) increase intra-abdominal pressure, which pushes the diaphragm up, forc ing air out of the lungs. The internal intercostal muscles pull the ribs downward and inward, decreasing the thoracic volume. Elastic properties of the lungs: the lungs collapse if force is not applied to expand them. Elastin in the alveolar walls aids the passive deflation of the lungs. Collagen within the pulmonary interstitium resists further expansion at high lung volumes. Compliance is defined as the change in volume per unit change in pressure (AV/AP). In vivo, compliance is measured by esophageal balloon pres sure vs. lung volume at many points during inspiration and expiration. Each measurement is made after the pressure and volume have equilibrated and so this is called static compli ance. The

30б the conducting — проведение
airways — воздушные пути
exchange — обмен
tract — трактат
to be measured — быть измеренным
directly — непосредственно
displacement — смещение

29б ed to determine the partial pressure of oxygen in the atmosphere. Assuming that the total pressure (or barometric pressure, PB) is atmospheric pressure at sea level (760 mmHg) and the fractional concentration of O_2 is 21%, or 0,21 : P02 = 760 mmHg × 0,21 = 160 mmHg. As air moves into the airways, the partial pressures of the vari ous gases in atmospheric air are reduced because of the addi tion of water vapor (47 mmHg). Henry's Law states that the concentration of a gas dissolved in liquid is proportional to its partial pressure and its solubility coef ficient (Ks). Thus, for gas X, [X] = Ks × Px

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

$$Vgas = Y \times D \times (P1 - P2)$$

where A and T are the area and thickness of the barrier, P1 and P2 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

32б compliance is the slope of the pressure-volume curve. Several observations can be made from the pressure-volumecurve.

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:

$$QO_2 = CO \times 1{,}34\ (ml/g) \times [Hg] \times SaO_2 + \\ + 0{,}003\ (ml/ml\ per\ mm\ Hg) \times PaO_2,$$

where QO_2 is oxygen delivery (ml/min), CO is cardiac output (L/min). Hg is hemoglobin concentration (g/L), SaO_2 is the fraction of hemoglobin saturated with oxygen, and PaO_2 is the partial pressure of the oxygen dissolved in plasma and is trivial compare 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 be insuring adequate fluid resuscitation (cardiac preload) and manipulating contractility and after load pharmacologically (usually catecholamines).

New words

Equation — уравнение
Delivery — доставка
Cardiac output — сердечный выброс
Fraction — фракция
Contractility — сократимость

31б 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 vol umes 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 vol umes, bronchioles may collapse. The viscosity or density of inspired gases can affect airway resistance. The density of gas increases with deep sea div ing, leading to increased resistance and work of breathing. Low-density gases like helium can lower airway resistance During a forced expiration, the airways are compressed by increased intrathoracic pressure. Regardless of how forceful the expiratory effort is, the flow rate plateaus and cannot be exceeded. Therefore, the air flow is effort-independent; the collapse of the airways is called dynamic compression. Whereas this phenomenon is seen only upon forced expira tion in normal subjects, this limited flow can be seen dur ing normal expiration in patients with lung diseases where there is increased resistance (e. g., asthma) or increased compliance (e. g., emphysema).

New words

intrapleural — внутриплевральный
intra-alveolar — внутриальвеолярный
collapse — коллапс
viscosity — вязкость
density — плотность

33a

33. Surface tension forces

In a liquid, the proximity of adjacent molecules results large, intermolecular, attractive (Van der Waals) 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 causes the surface to maintain as small an area as possible. In alveoli, the result a spherically-curved, liquid lining layer that tends to be pulled inward toward the center of curvature of the alveolus. The spherical surface of the alveolar liquid lining behaves in manner similar to a soap bubble. The inner and outer surface of a bubble exert an inward force that creates a greater pressure inside than outside the bubble. Interconnected alveoli of different sizes could lead to collapse of smaller alveoli (atelectasis) into larger alveoli, because of surface tension, the pressure inside the small alveolus (smaller radius of curvature) is greater than that of the larger alveolus. Without surfactant, gas would therefore move from smaller to larger alveoli, eventually producing or giant alveolus.

Pulmonary surfactant: Pulmonary surfactant is a phospholipid (comprised primari ly of dipalmitoyl phosphatidylcholine) synthesized by type II alveolar epithelial cells. Surfactant reduces surface tension, thereby preventing the collapse of small alveoli. Surfactant increases the compliance of the lung and reduces the work of breathing.

Surfactant keeps the alveoli dry because alveolar collapse tends to draw fluid into the alveolar space. Surfactant can be produced in the fetus as early as gestational week 24, but is synthesized most abundantly by the 35 th week of gestation. Neonatal respiratory distress syn drome can occur with premature infants, and results in areas

34a

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 conduct ing 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.

The nose contains the paired nasal cavities separated by the nasal septum. Anteriorly, each cavity opens to the outside at a nostril (naris), and posteriorly, each cavity opens into the nasopharynx. Each cavity contains a vestibule, a respiratory area, and an olfactory area, and each cavity communicates with the paranasal sinuses.

Vestibule is located behind the nares and is continuous with the skin.

Epithelium is composed of stratified squamous cells that are similar to the contiguous skin.

Hairs and glands that extend into the underlying connective tissue constitute the first barrier to foreign particles entering the respiratory tract.

Posteriorly, the vestibular epithelium becomes pseudostratified, ciliated, and columnar with goblet cells (respiratory epithelium).

Respiratory area is the major portion of the nasal cavity.

Mucosa is composed of a pseudostratified, ciliated, columnar epithelium with numerous goblet cells and a subjacent fibrous lamina propria that contains mixed mucous and serous glands.

Mucus produced by the goblet cells and the glands is carried toward the pharynx by ciliary motion.

The lateral wall of each nasal cavity contains three bony pro jections, the conchae, which increase the surface area

35a

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.

The cilia beat towards the oropharynx, which is composed of a stratified, squamous, nonkeratinized epithelium.

The pharyngeal tonsil, an aggregate of nodular and diffuse lymphatic tissue, is located on the posterior wall of the nasopharynx subjacent to the epithelium. Hypertrophy of this tissue as a result of chronic inflammation results in a condition known as adenoiditis. Larynx is a passageway that connects the pharynx to the trachea and contains the voicebox. Its walls are composed of cartilage held together by fibroelastic connective tissue.

The mucous layer of the larynx forms two pairs of elastic tissue folds that extend into the lumen. The upper pair are called the vestibular folds (or false vocal cords), and the lower pair con stitute the true vocal cords. The epithelium of the ventral side of the epiglottis and of the vocal cords is composed of stratified, squamous, nonkeratinized cells. The remainder of the larynx is lined with ciliated, pseudostratified, columnar epithelium. All cilia, from the larynx to the lungs, beat upward toward the nasopharynx.

New words

nasopharynx — носоглотка
first — сначала
pseudostratified — псевдомногослойный
ciliated — снабженный ресничками
columnar — колоночный
epithelium — эпителий
goblet cells — кубические клетки

36a

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 epitheli um, an unusually thick basement membrane, and an underlying lamina propria that is rich in elastin. The lamina propria contains loose elastic tissue with blood vessels, lymphatics, and defensive cells. The outer edge of the lamina propria is defined by a dense network of elastic fibers.

Submucosa consists of dense elastic connective tissue with seroriltfcous glands whose ducts open onto the surface of the epithe lium.

Cartilage rings are C-shaped hyaline cartilage pieces whose free extremities point dorsally (posteriorly). They are covered by a perichondrium of fibrous connective tissue that surrounds each of the cartilages. Smooth muscle bundles (trachealis muscle) and ligaments span the dorsal part of each cartilage.

Adventita a consists of peripheral dense connective tissue that binds the trachea to surrounding tissues.

Primary bronchi

The trachea branches at its distal end into the two primary bronchi. Short extrapulmonary segments of the primary bronchi exist before they enter the lungs at the hilus and then branch further. The histologic structure of the walls of the extrapulmonary segment of the primary bronchi is similar to that of the tracheal wall.

New words

hollow — пустота
cylinder — цилиндр
supported — поддержанный
cartilaginous rings — хрящевые кольца

33б of atelectasis, filling of alveoli with transudate, reduced lung compliance, and V/Q mismatch leading to hypoxia and CO_2 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

34б and pro mote warming of the inspired air. This region is richly vascularized and innervated.

Olfactory area is located superiorly and posteriorly in each of the nasal cavities.

The pseudostratified epithelium is composed of bipolar neu rons (olfactory cells), supporting cells, brush cells, and basalcells. The receptor portions of the bipolar neurons are modi fied 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 cavi ties 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
trachea — трахея
bronchi — бронхи
bronchioles — бронхиолы
nasal septum — носовая перегородка
nostril — ноздря
vestibule — вестибулярный
respiratory area — дыхательная область
olfactory area — обонятельная область
paranasal sinuses — параназальные пазухи

35б 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 — некеритизированный
somewhere — где-нибудь, куда-нибудь, где-то, куда-то

36б larynx — гортань
above — выше
branching — переход
primary bronchi — первичные бронхи
below — ниже
mucosa — слизистая оболочка
typical — типичный
respiratory epitheli um — дыхательный эпителий
an unusually — нетипитчно
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

37a

37. Respiratory bronchioles

Respiratory bronchioles are areas of transition (hybrids) between the conducting and respiratory portions of the airways. In addi tion to the typical bronchiolar epithelium of the terminal bron chioles, these passageways contain outpouchings 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 alveolar ducts, which are long sinuous tubes.

Alveolar sacs are spaces formed by two or more conjoined alveoli. They are lined by the simple squamous alveolar epithe lium. 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 (api cal and basal membranes) and its basal lamina, the basal lami na 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 (lamel

38a

38. Pleura

Visceral pleura is a thin serous membrane that covers the outer surface of the lungs. A delicate connective tissue layer of collagen and elastin, containing lymphatic channels, vessels, and nerves, supports the membrane. Its surface is covered by simple squamous mesothelium with microvilli.

Parietal pleura is that portion of the pleura that continues onto the inner aspect of the thoracic wall. It is continuous with the visceral pleura and is lined by the same mesothelium.

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; visceral pleura follows the contours of the lung itself.

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

It normally contains a small amount of serous fluid elaborated by mesothelial cells of the pleural membrane.

Pleural reflections are areas where the pleura changes direction from one wall to the other. The sternal line of reflection is where the costal pleura is con tinuous with the mediastinal pleura behind the sternum (from costal cartilages 2—4). The pleural margin then passes inferiorly to the level of the sixth costal cartilage. The costal line of reflection is where the costal pleura becomes continuous

39a

39. Nasal cavities

The anatomical structures that play a central role in the res piratory system are located in the head and neck as well as the thorax.

Nasal cavities are separated by the nasal septum, which consists of the vomer, the perpendicular plate of the ethmoid bone, and the septal cartilage. The lateral wall of each nasal cavity features three scroll-shaped bony structures called the nasal conchae. The nasal cavities communicate posteriorly with the nasopharynx through the choanae. The spaces inferior to each concha are called meatus. The paranasal sinu-ses and the nasolacrimal duct open to the meati. The inferior concha is a separate bone, and the superior and middle conchae are parts of the ethmoid bone.

Inferior meatus. The only structure that opens to the inferior meatus is the nasolacrimal duct. This duct drains lacrimal fluid (i. e., tears) from theTneaTaraspect of the orbit to the nasal cavity.

Middle meatus: the hiatus semilumaris contains openings of frontal and maxillary sinuses and americy ethmoidal air cells. The bulla ethmoidalis contains the opening for'the middle ethmoidal air cells.

Superior meatus contains an opening for thff'posterior ethmoidal air cells.

Sphenoethmoidal recess is located above the superior concha and contains an opening for the sphenoid sinus.

Innervation: Somatic innervation. General sensory information from the lateral wall and septum of the nasal cavity is conveyed to the CNS by branches of V, and V2.

Autonomic innervation. Preganglionic parasympathetic fibers destined to supply the glands of the nasal mucosa and the lacrimal gland travel in the nervus intermedius and

40a

40. Pharynx and related areas

The pharynx is a passageway shared by the digestive and respira tory systems. It has lateral, posterior, and medial walls through out, but is open interiorly in its upper regions, communicating with the nasal cavity and the oral cavity. The anterior wall of the laryngopharynx is formed by the larynx. The pharyngeal wall con sists of a mucosa, a fibrous layer, and a muscularis, which is com posed of an inner longitudinal layer and an outer circular layer.

Nasopharynx is the region of the pharynx located directly poste rior to the nasal cavity. It communicates with the nasal cavity through the choanae.

The torus tubarius is the cartilaginous rim of the auditory The pharyngeal recess is the space located directly above and behind the torus tubarius; it contains the nasopharyngeal tonsil. The salpingopharyngeal fold is a ridge consisting of mucosa and the underlying salpingopharyngeus muscle.

Oropharynx is the region of the pharynx located directly posterior to the oral cavity. It communicates with the oral cavity through a space called the fauces. The fauces are bounded by two folds, consisting of mucosa and muscle, known as the anterior and posterior pillars.

The tonsillar bed is the space between the pillars that houses the palatine tonsil.

Laryngopharynx is the region of the pharynx that surrounds the larynx. It extends from the tip of the epiglottis to the cricoid car tilage. Its lateral extensions are known as the piriform recess.

Oral cavity: the portion of the oral cavity that is posterior to the lips and anterior to the teeth is called the vestibule. The oral cavi ty proper has a floor formed by the mylohyoid and geniohyoid muscles, which support the tongue. It has lateral walls, consisting of the buccinator muscles and buccal mucosa, and a roof formed by the hard palate an-

38б 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 pleu ra are supplied by intercostal nerves.

The central portion of the diaphragmatic pleura and the medi astinal 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

37б lar bodies). The contents of these lamellar bodies are secreted onto the alveolar surface to provide a coating of surfactant that reduces alveolar surface tension.

Alveolar macrophages (dust cells) are found on the surface of the alveoli.

Derived from monocytes that extravasate from alveolar capillaries, alveotar macrophages are part of the mononu — clear phagocyte system. Dust cells, as their name implies, continuously remove parti cles and other irritants in the alveoli by phagocytosis.

New words

respiratory bronchioles — дыхательные бронхиолы
hybrids — гибриды
respiratory portions — дыхательные части
airways — воздушные трассы
bronchiolar — бронхиолярный
terminal bron chioles — предельные бронхиолы
passageway — проходы
tocomprise — включить
ducts — трубочки
sinuous tubes — извилистые трубы
thin-walled — окруженный тонкой стеной
sacs — мешочки
respiratory tree — дыхательное дерево
hemoglobin — гемоглобин
apical — апикальный

40б teriorly 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.

The tongue is a mobile, muscular organ necessary for speech. It is divisible into an anterior two-thirds and a posterior one-third by the sulcus terminalis.

Muscles of the tongue. These include the intrinsic and extrinsic muscles (i. e., palatoglossus, stylogiossus, hyoglos — sus, 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 branch of the external carotid aitery.

Venous drainage. 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 cervi cal nodes.

New words

digestive — пищеварительный
pharyngeal — глоточный
mucosa — слизистая оболочка
fibrous layer — волокнистый слой
posterior nasal apertures — задние носовые апертуры
nasopharyngeal tonsil — миндалина

39б 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.

New words

anatomical — анатомический
respiratory system — дыхательная система
head — голова
neck — шея
nasal cavities — носовые впадины
the perpendicular plate — перпендикулярная пластина
ethmoid — решетчатый
septal — относящийся к перегородке
nasal conchae — носовой раковина
paranasal — параносовой
sinuses — пазухи
nasolacrimal — назолакримальный
duct — трубочка
drain — проток
tears — слезы
orbit — орбита
maxillary — верхнечелюстной
bulla — булла

41a

41. Oral cavity

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 pharynx, or throat, and to the hyoid bone in the neck.

The posterior limit of the oral cavity is marked by the fauces, an apperture 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. Hiese 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 maxil-

42a

42. 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 viscid fluid containing a mixture of all the oral secretions. It contains mucus, 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 starchy food. Other uses of saliva include the moistening of food for easier manipulation by the tongue, the consequent 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 tonsilses, called the tonsillitis.

The tongue, a muscular organ in the mouth, provides the sense of taste and assists in chewing, swallowing, and

43a

43. The 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 function the particular part performs. The tract has a very good blood sup ply, because food, once it is broken down, has to be absorbed into the bloodstream. The mouth contains the tongue and the teeth and communicates with the salivary glands situated round it. Behind the nose and mouth is the pharynx. Leading from the pharynx is a mus cular 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 ca vity. It is divided into three parts; the duodenum, the jejunum, and the ilium. 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, the ascending colon, the transverse colon, the descending colon, the 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

44a

44. The 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 mucus, 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 in testine. Absorption of the products of digestion taken 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.

42б speaking. It is firmly anchored by connective tissues to the front and side walls of the pharynx, or throat, and to the hyoid bone in the neck.

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 teeth and gums by a deep groove. A midline fold, the frenulum, is near he 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.

New words

buccal — относящийся ко рту или щеке
palatine — небный
salivary glands — слюнные железы
parotid gland — околоушная железа
sublingual — подязыковой

41б lary bones, and posteriorly by the horizontal part of each palate bone. The oral surface of the hard palate is a mucous membrane covered with a stratified squamous epithelium. A submucosal layer contains mucous glands and binds the membrane firmly to the periosteum of the bony component. Above the bone is the mucous membrane that forms the floor of the nasal cavity.

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 tonsil. 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.

New words

mouth — рот
lips — губы
junction — соединение
distensible — растяжимый
cheeks — щеки
tongue — язык
taste — вкус
chewing — жевание
swallowing — глотание

44б Having been rendered suitable for swallowing the food is pushed back into the pharynx by the tongue, and enters the esopha gus to be transported rapidly down the neck and thorax, through the diaphragm to the stomach. The mucous membrane of the stomach is equipped with millions of glands secreting mucus, digestive enzymes and hydrochloric acid.

The small intestine is the region within which the process of digestion is completed and its products are absorbed. Although its epithelial lining forms many small glands, they mainly produce mucus. Most of the enzymes present are secreted by the pancreas, whose duct, opens into the duodenum. Bile from the liver also enters the duodenum.

The absorption of the product's of digestion also takes place in the small intestine, although water, salts, and glucose are ab sorbed from the stomach and the large intestine.

The large intestine is chiefly concerned with the preparation, storage and evacuation of undigestible and unabsorbable food residue.

New words

process of digestion — процесс переваривания
chewing — жевание
saliva — слюна
to moisten — увлажнять
enzyme — фермент
carbohydrates — углеводы
stomach — живот
tongue — язык
hydrochloric acid — соляная кислота
absorption — поглощение

43б fundus; the distal portion is the pyloric part; and the body is between the fundus and the pyloric part.

The coats of the stomach are four: an outer, peritoneal or serous coat; a muscular coat, made up of longitudinal, oblique, and circular fibres; a submucous coat; and tine mucous coat or membrane forming the inner lining.

Gastric glands, which are in mucous coat, secrete gastric juice containing hydrochloric acid and other digestive enzymes into the cavity of the stomach. The glands of the fundus and body moot important in the secretion of gastric juice.

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-built 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.

New words

gastrointestinal tract — желудочно-кишечный тракт
food — пища (еда)
enzymes — ферменты
intestinal tract — кишечный тракт
anus — задний проход
esophagus — пищевод
diaphragm — диафрагма
abdominal — брюшной
pyloric sphincter — пилорический сфинктер

45a 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 are threefold.

First, complex food material which is taken into the mouth must be digested mechanically and chemically, as it travels through, the gastrointestinal tract.

Second, the digested food must be absorbed by passage through the walls of the small intestine into the blood stream so that the valuable energy-carrying nutrients can travel to all cells of the body.

The third function of the gastrointestinal tract is to eliminate the solid waste materials which are unable to be absorbed by the small intestine.

In the man the food in the mouth is masticated, that is to say it is bitten and broken up by the teeth and rolled into the bolus by the tongue.

The act of swallowing is divided into three stages.

The first stage is under voluntary control. The food which has been transformed into a soft, mass by the act of mastication is brought into position upon the root of the tongue, and by the action of the lingual muscles is rolled backwards towards the base of the tongue.

The second stage is brief and is occupied in guiding the food through the pharynx and past the openings that lead from it. The muscular movements during this stage are purely reflex in nature. The third stage involves the passage of the food down the eso phagus. The food is seized by peristaltic wave which, traveling along the esophagus, carries the material before it into the stomach. The cardiac sphincter which guards the lower end of the esophagus and which at other times is kept tonically closed re laxes upon the ap-

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

Liver, the pancreas and the kidneys are the organs primarily engaged in the intermediary metabolism of the materials resorbed from the gasro — intestinal tract and in the excretion of metabolic waste products. Of these 3 organs the liver performs the most diverse func tions. It acts as the receiving depot and distributing center for the majority of the products of intestinal digestion and plays a major role in the intermediary metabolism of carbohydrates, fats, proteins and purines.

It controls the concentration of cholesterol esters in the blood and utilizes the sterol in the formation of bile acid. The liver takes in the regulation of the blood volume and in water metabolism and distribution. Its secretion, the bile, is necessary for fat diges tion.

The liver is a site for the formation of the proteins of the blood plasma, especially for fibrinogen, and also forms heparin, also forms heparin, carbohydrate which prevents the clotting of the blood. It has important detoxicating functions and guards the organism against toxins of in testinal origin as well as other harmful substances. The liver in its detoxicating functions and manifold metabolic activities may well be considered the most important gland of the body.

The normal position of the empty human stomach is not hori zontal, as used to be thought before the development of rentgenology. This method of examination has revealed the stomach to be either somewhat J-shaped of comparable in outline to a reversed L. The majority of normal stomachs are J-shaped. In the J-shaped type the pylorus lies at a higher level than the lowest part of the greater curvature and the body of the stomach is nearly verti cal.

The stomach docs not empty itself by gravity, but through the contraction of its muscular wall like any other part of the diges tive tube, of which it is merely a segment.

47a 47. The urinary system: embriogenesis

The urinary system is formed mainly from mesodermal and endodermal derivatives. Three separate systems form sequentially. The pronephros is vestigial; the mesonephros may function transiently, but then mainly disappears; the metanephros develops into the definitive kidney. The permanent excre tory ducts are derived from the metanephric ducts, the uro-genital sinus, and surface ectoderm.

Pronephros: Segmented nephrotomes appear in the cervical intermediate mesoderm of the embryo in the fourth week. These structures grow laterally and canalize to form nephric tubules. Successive tubules grow caudally and unite to form the pronephric duct, which empties into the cloaca. The first tubules formed regress before the last ones are formed.

Mesonephros: In the fifth week, the mesonephros appears as «S-shaped» tubules in the intermediate mesoderm of the thoracic and lumbar regions of the embryo.

The medial end of each tubule enlarges to form a Bowman's capsule into which a tuft of capillaries, or glomerulus, invaginates.

The lateral end of each tubule opens into the mesonephric (Wolffian) duct.

Mesonephric tubules function temporarily and degenerate by the beginning of the third month. The mesonephric duct pesists in the male as the ductus epididymidis, ductus deferens, and the ejaculatory duct.

Metanephros: During the fifth week, the metanephros, or permanent kidney, develops from two sources: the ureteric bud, a diverticulum of the mesonephric duct, and the metanephric mas, from intermediate mesoderrn of the lumbar and sacral regions. The ureteric bud penetrates the metanephric mass, which cordenses around the diverticulum to form the metanephrogen cap. The bud dilates to form the renal pelvis. One-to-three million collecting tubules develop from the mi-

48a 48. The urinary system: kidneys

The urinary system is the major system involved in the excre tion of metabolic waste products and excess water from the body. It is also important in maintaining a homeostatic bal ance of fluids and electrolytes. The urinary system consists of two kidneys, two ureters, the urinary bladder, and the ure thra. Urine is produced by the kidneys and is then transmit ted via the ureters to the bladder for temporary storage. The urethra is the final pathway that conveys urine to the exteri or. This system also has an important endocrine function in the production of renin and erythropoietin, which influence blood pressure and red blood cell (RBC) formation, respec tively.

Each kidney is composed of stroma and parenchyma. The stroma consists of a tough fibrous connective tissue capsule and a delicate interstitial connective tissue com posed of fibroblasts, wandering cells, collagen fibrils, and a hydrated proteoglycan extracellular matrix, which is collec tively called the renal interstitium. The parenchyma consists of more than one million elaborate uriniferous tubules that represent the functional units of the kidney.

The kidney contains a hilum, a cortex, and a medula. The hilum is located medially and serves entrance as the point of entrance and exit for the renal artery, renal veins, and ureter. The renal pelvis, the expanded upper, divides into two or three entrance into the kidney. These, in turn, divide into eight minor calyces.

The cortex forms the outer zone of the kidney.

The medulla appears as a series of medullary pyramids. Two or three pyramids may unite to form a papilla. Uriniferous tubules consist of two functionally related portions called the nephron and the collecting tubule.

Glomerulus is made up of several anastomotic capillary loops interposed between an afferent and an efferent arteriole. Plasma filtration occurs in the glomerulus.

46б Gastric motility shows great individual variation; in some types of stomach the wave travels very rapidly, completing its journey in from 10 to 15 seconds. In others the wave takes 30 seconds or go to pass from its origin to the pylorus. The slow waves are the more common.

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 glu cose. Glucose not needed for immediate use is converted into glycogen and stored in the liver. When the blood sugar concentra tion goes down, the liver reconverts some of its stored glycogen into glucose.

Pats make up the second largest source of energy in most diets. They are stored in adipose tissue and round the principal internal organs. If excess carbohydrate is taken in, this can be converted into fat and stored. The stored fat is utilized when the liver is empty of glycogen.

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 Eskimo, 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 — животный жир
amino acids — аминокислоты

45б proach of the bolus which is then swept into the stomach by the wave of constriction which follows.

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.

In the stomach the food is thoroughly mixed by the series of contractions, three or four a minute, the contraction waves pass ing from the middle of the stomach to the pylorus. These tend to drive the food in the same direction, but the pylorus being closed, there is axial reflex, owing to which the food is well mixed. After a time — a bout a minute when water has been swallowed — the pylorus relaxes at each wave, allowing some of the stomach contents to enter the duodenum. Fat stays in the stomach longer than carbo hydrate, but all food leaves generally in three or four hours. In the small intestine the food continues to be moved by peristalsis, the latter controlled by the deep nerve plexus. The small intestine undergoes segmentation movements, the food contents being thoroughly mired The wall becomes constricted into a number of segments and then about five seconds later the constrictions disappear, there being another set exactly out of phase with the first. The large intestine undergoes infrequent powerful contractions, food having entered it. From the large intestine the food enters the rectum.

New words

voluntary control — добровольный контроль
soft — мягкий
mastication — перетирание
position — положение
root — корень

48б Bowman's capsule consists of an inner visceral layer and an outer parietal layer. The space between these layers, the uri nary space, is continuous with the renal tubule.

Visceral layer is apposed to the glomerulus and closely fol lows 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, call podocytes.

Cytoplasmic extensions of podocytes 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, or the descend ing thick segment, is a direct medullary continuation of the cortical proximal convoluted tubule.

The thick distal portion of the loop of Henle, the ascending thick segment, ascends to the cortex and is continuous with distal convoluted tubule. The major function of the distal tubule is to reabsorb soduim and chloride from the tubular filtrate. Collecting tubules consist of arched and straight segments.

New words

urea — моча
stroma — строма
parenchyma — паренхима
fibrous capsule — волокнистая капсула
delicate — тонкий
interstitial — промежуточный

47б nor calyces, thus forming the renal pyramids. Penetration of collecting tubules into the metanephric mass induces cells of the tissue cap to form nephrons, or excretory units. The proximal nephron forms Bowman's capsule, whereа the distal nephron connects to a collecting tubule.

Lengtheningy of the excretory tubule gives rise to the proximal convoluted tubule, loop of Henle, and the distal convoluted tubule.

The kidneys 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 mucosa of the trigone of the bladder is formed by the incorporation of the caudal mesonephric ducts into the dorsal bladder wall. This mesodermal tissue is eventually replaced by endodermal epithelium so that the entire lining of the blad der 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 spongy (penile).

The prostatic urethra, membranous urethra, and proximal penile urethra develop from the narrow portion of the uro genital sinus below the urinary bladder. The distal spongy urethra is derived from the ectodermal cells of the glans penis.

Fimale urethra: The upper two-thirds develops from the esonephric ducts, and the lower portion is derived from the ogenital sinus.

New words

urinary system — мочевая система
kidneys — почки
bladder — мочевой пузырь
excretory ducts — выделительные трубочки
pronephros — первичная почка
urogenital — мочеполовой

49a

49. The urinary system: kidney vascular sypply

Vascular supply begins with the renal artery, enters the kidney the hilum, and immediately divides into interlobar arteries. The arteries supply the pelvis and capsule before passing direct between the medullary pyramids to the corticomedullary junction. The interlobar arteries bend almost 90 degrees to form shoarching, arcuate arteries, which run along the corticomedullary junction. The arcuate arteries subdivide into numerous fine interlobul arteries, which ascend perpendicularly to the arcuate arteries through the cortical labyrinths to the surface of the kidney. Each interlobular artery passes midway between two adjacent medullary rays.

The interlobular arteries then give off branches that become the afferent arterioles of the glomeruli.

As the afferent arteriole approaches the glomerulus, some its smooth muscle cells are replaced by myoepithelioid cells, which are part of the juxtaglomerular apparatus. The juxtaglomerular apparatus consists of juxtaglomerular cells, polkissen cells, and the macula densa.

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

The juxtaglomerular cells secrete an enzyme called renin, which enters the bloodstream and converts the circulating 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 appear darker under the light microscope. The macula densa is

50a

50. The urinary system: ureters, uretra

The calyces, renal pelves, and ureters 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 is lined by a transitional epithelium, which varies in thickness with the distention 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 generally disappear when the organ dilates during urine transport. 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 organ for urine. The structure of the wall of the bladder is similar to but thicker than of the ureter. Mucosa of the urinary 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 abundant 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

51a

51. The kidney`s function

The kidneys are filters which remove waste products from the blood. In the human each is a bean-shaped organ, some four inches long and about two inches wide. The two are situated high up on the posterior abdominal wall behind the peritoneum and in front of the lats ribs and the upper two lunbar transverse processes. Each is invested by a fibrous capsule surrounded by more or less perinephric fat. On the upper pole of each is a supra-renal gland. On the medical side is a notch called the hilum where the vessels and the ureter are attached.

Vertical selections through a kidney discloses three more or less concentric zones. The other light-colored zone is the renal cortex, within this is the darker renal medulla and within this again is a space — the renal sinus which is normally occurred by a fibrous bag called the renal pelvis. The pelvis opens below into the ureter. The cortex extends inwards in a series of renal columns which divide the medulla into a number of renal pyramids. Each pyramid has a free rounded projection — a renal papilla — which lies in a cap — like extension, of the pelvis cal led a renal calyx. The pelvis is lined by transitioual epithelium, which extends the calyces and covers the papillae.

Within the cortex each minute artery presents along its course a convoluted knot, called a glomerulus; the branch which enters the knot is the afferent vessel, that which leaves is she efferent vessel. Each glomerulus project into the dilated end of its corresponding renal tubule, from which it is separated by a thin layer of cells called glomerular (Bowman` s) capsule; glomerulus plus capsule form a renal (Nalpighian) corpuscle. The cortex contains multitudes of such corpuscles, each giving rise to a tubule which passes down into the medul la and back again in the

52a

52. Acute renal failure

The two major mechanisms may participate in association between intratubular hemorrage and nephron damage in acute renal failure. The first mechanism is direct nephrotoxicity from hemoglobin, because intratubular degradation of erythrocytes releases heme and iron which are toxic to cells. The second mechanism is hypoxic damage induced by regional vasoconstriction because heme avidly binds the potent vasodilator nitric oxide.

Intratubular degradation of hemoglobin releases heme containing molecules and eventually free iron. These breakdown products, also elaborated from myoglobin, probably play an important role in the pathogenesis of acute tubular necrosis. Endocytic reabsorption from the tubular him en of filtered free hemoglobin or myoglobin may be a major pathway to proximal tubular damage in pigment nephropathy. In addition, free iron promotes the formation of oxygen free radicals, lipid peroxidation and cell death Another source of toxic iron is from the breakdown of intracellular cytochrom P-450 under hypoxic condition. One of the most potent intrarenal vasodilator system is nitric oxide, produced from L-arginine in vascular endothelium. smooth muscle and tubular calls, causing Vascular smooth muscle relaxation through the induction of intracellular cyclic GMP. Blocking nitric oxide synthesis causes profound vascular constriction, systemic hypertension and a marked decline in renal blood flow. Endothelial dysfunction with reduced nitric oxid production may underlie the defective regional vasodilation in diabetes and atherosclerosis,, predisposing to renal ischemia and nephrotoxic insult.

Hemoglobin avidly binds nitric oxide and ingibits nitrovasodilation. The presence of large pool of hemoglo-

50б serves as an excretory duct for both urine and semen. It is approximately 20 cm in length and has three anatom ic 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 glans. At this point, it becomes stratified squamous and is continuous with the epidermis of the external part of the penis. 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 surrounded and supported by the cylindrical erectile mass of corpus spongiosum tissue. 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 epithelium begins at the bladder as a transitional variety and becomes stratified squamous with small areas of a pseudostratified columnar epithelium. The muscularis is rather indefinite but does contain both circu lar 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
renal pelvis — почечная лоханка
calyces — чашечки
urethra — уретра

49б thought to sense sodium concentration in the tubular fluid.

Polkissen cells are located between the afferent and effer ent arterioles at the vascular pole of the glomerulus, adja cent to the macula densa.

Their function is unknown. Efferent glomerular arteriole divides into a second system of capillaries, the peritubufar plexus, which forms a dense net work of blood vessels around the tubules of the cortex.

Arterial supply of the medulla is provided by the efferent arte rioles of the glomeruli near the medulla. The arteriolae rectae and the corresponding venae rectae with their respective capillary networks comprise the vasa recta, which supplies the medulla. The endothelium of the venae rectae is fenestrated and plays an important role in maintaining the osmotic gradi ent required for concentrating urine in the kidney tubules.

New words

renal artery — почечная артерия
renal veins — почечные вены
expanded upper — расширенный верхний
minor calyces — незначительные чашечки
to supply — снабжать
arcuate arteries — дугообразные артерии
to subdivide — подразделять
numerous — многочисленный
interlobul — междолевой
to ascend — поднимать
perpendicularly — перпендикулярно
arcuate arteries — дугообразные артерии

52б bin in the tubular lumen could therefore affect the vasomotor balance of kidney circulation: intrarenal vasoconstriction is likely to be most pronounced and most significant in the medulla., because the ratio of tubular mass to vessels surface may be particularly high in this region. The medulla normally functions at low oxygen tension, because of limited medulla blood flow and countercurrent exchange of oxygen. Inhibinion of nitric oxide synthesis induces severe and prolonged outer medullary hypoxia and predisposes to tubular necrosis Unfortunately, biopsy specimens of glomerulonephritis associated with acute tubular necrosis do not provide the precise distribution of the tubular lesions.

In chronic glomerulonephritis tubulo-interstitiaJ damage has often been reported as correlate of kidney function and also its best prognostic marker. Glomerular obsolescence deprives the renal parenchyma from nutritional blood flow, leading to tubule-interstitial fibrosis in medullary rays and outer medulla. Proteinuria imposes to the proximal tubules a constant burden of reabsorption and catabolism of albumin and other proteins from the tubular lumen, which have been suggested to cause cellular injury.

New words

nephron — нефрон
intratubular — внутриканальцевый
heme — гем
tubular necrosis — канапьцевый некроз
reabsorption — реабсорбция
proteinuria — протеннурия

51б so-called loop of Henle. Back in, the cortex loop ends in a functional tubule which joins a larger collecting tube. Ultimately, a number of collecting tubes combine to form an excretory tube, which opens at the apex of a papilla into a renal calyx. The efferent vessel from the glomerulus accompanies the loop of Henle, supply ing the tubule on the way and finally ends in a small vein. A renal corpuscule plus its complement of tubules and blood vessels is called a renal unit, or nephron; there are said to be one million such units in each kidney, their tubing totaling a length of some twenty miles.

New words

bean-shaped organ — орган в форме боба
four inches long — 4 дюйма в длину
two inches wide — 2 дюйма в ширину
peritoneum — брюшина
lumbar — поясничный
renal cortex — корковый слой
renal medulla — мозговой слой
fibrous — волокнистая
dilated — расширенный
to be separated — быть разделенным
loop of henle — петля Генле

53a

53. Iron in the body

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 be cause the normal blood-level of hemoglobin is lower than in the male. Iron exists in the body mainly in two forms: firstly, as heme 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 returned to 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 com position 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 pro vides between 10 and 15 mg. of iron daily, of which only 5—10% is absorbed.

54a

54. Atherosclerotic mechanisms

Pivotal mechanisms involved in atherogenesis include.

1. Focal intimal influx and accumulation of plasma lipoproteins at lesion-prone sites.
2. Focal intimal monocyte-macrophage recruitment.
3. Generation within the intima of reactive oxygen species of free radicals by smooth muscle cells, macrophages and endothelial cells.
4. Oxidative modification of intimal lipoproteins by these reactive oxygen species to produce such oxidatively modified lipoproteins species as oxidized LDL and Lp(a).
5. Foam cell formation due to the uptake of oxidatively modified lipoproteins by the non-down-regulating macrophage scavenger receptors.
6. Foam cell necrosis, most likely due to the cytotoxic effects of oxidatively modified LDL. This process gives rise to the extracellular lipid core, and is an important event in the transition from the reversible fatty streak to the less readily reversible, more advanced atherosclerotic lesion.
7. Smooth muscle cell migration to and proliferation in the arterial intima, a process in which platelet-derived growth factor is believed to act as a chemo oattractant. Fibroblast growth factors likely regulate smooth muscle cell proliferation.
8. Plaque rupture, primarily at sites of greatest macrophage density. Proteolytic enzymes released by macrophages may stimulate plaque rupture, which ultimately leads to mural or occlusive thrombosis. Thrombosis contributes significantly to the stages of plaque growth.
9. Autoimmune inflammation, likely the result of antigenic epitopes of oxidized LDL. Lipoproteins, such as LDL and Lp(a), enter the subendothelial space and intercept free radicals generated by endothelial cells. Following oxi-

55a

55. Advances in blood component separation and plasma treatment for therapeutics

The separation of blood cells from plasma is done routinely by centrifugal techniques.

Membranes for plasma separation.

Membrane modules vary in surface area from about 0,15 to 0,8 m^2. Membrane plasma separation is a relatively simple process. At relatively low transmembrane pressure (generally less than 50 mm Hg), adequate plasma fluxes can be achieved. Equipment requirements are only minimal and the operation is much akin to that for other extracorporeal treatment technologies as hemodialysis, hemofiltration and hemoperfusion.

Membrane of on-line plasma treatment.

Plasma exchange whether by centrifugal or membrane techniques requires that the plasma discarded be replaced by physiological solution, which in most cases is en albumin solution. Because essential plasma components as well as pathological ones, are removed during plasma exchange, techniques designed to remove only the pathological components would be highly desirable. Review of the disease states treated by plasma exchange reveals that mane of the marker solutes ere of f molecular weight larger (generally greater than 100 000 daltons) than albumin, suggesting membrane filtration as physical separation techniques for their removal.

With presently available membranes, selective passage of albumin (near 70 000 daltons) and lower molecular weight solutes with complete retention of larger molecular weight solutes is difficult to achieve. However, such a complete separation may not be desirable since many higher molecular weight solutes are normal components

56a

56. Artificial oxygen carries

Artificial oxygen (O_2) carries aim at improving O_2 delivery. Artificial O_2 carries thus may be used as alternative to allogeneic blood transfusions or to improve tissue oxygenation and function of organs with marginal O_2 supply. Artificial O_2 carries can be grouped into modified hemoglobin (Hb) solutions and perfluorocarbon (PFC) emulsions. The native human Hg molecule needs to be modified in order to decrease O_2 affinity and to prevent rapid dissociation of the native tetramer into dimers. The O_2 transport characteristics of modified Hb solutions and PFC emulsions are fundamentally different. The Hb solutions exhibit a sigmoidal O_2 dissociation curve similar to blood. In contrast, the PFC emulsions are characterised by a linear relationship between O_2 partial pressure and O_2 content. Hb solutions thus provide O_2 transport and unloading capacity similar to blood. This means that already at a relatively low arterial O_2 partial pressure substantial amounts of O_2 are being transported. In contrast, relatively high arterial O_2 partial pressures are necessary to maximize the O_2 transport capacity of PFC emulsions.

Modified Hb solutions are very promising in improving O_2 transport and tissure oxygenation to a physiologically relevant degree. Because cross-matching is unnecessary, these solutions hold great promise as alternative to allogeneic blood transfusions and as O_2 therapeutics, 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 systemic and pulmonary vascular resistances with consequent reduction in cardiac output. In contrast, in a previously healthy trauma

54б dation, these charge-modified lipoproteins are taken up by the non-down-regulating macrophage scavenger receptors pathway, resulting in lipid-rich, cholesteryl ester rich foam cells. Concurrently, circulating monocytes continue to attach to the endothelium, attracted by the chem oattractant MCP-1, and oxidized LDL. The expression and synthesis of MCP-1 by endothelial and smooth muscle cells is augmented by oxidatively modified lipoproteins, allowing the process to continue.

The next phase in atherogenesis is the development of the classic fatty streak as result of the continued uptake of oxidatively modified LDL by the macrophage scavenger receptors with continuing foam cell formation. A few smooth muscle cells can also be seen apparently entering the subendothelial space and proliferating within the intima during this phase. The transitional phase of atherogenesis is characterized by necrosis of the foam cells and the formation of an extracellular lipid core. In this stage, there is an increase in both smooth muscle cells proliferation and collagen synthesis, and lesions continue to grow. As long as elevated low density lipoproteins are present in the circulation, the atherosclerosis process continues. Among the additional changes taking place is the influx of Tlymphocytes. The involvenment of an autoimmune inflammatory component becomes obvious in the late stages of lesion development and is reflected by a prominent lymphocytic infiltration of the adventitia.

New words

atherogenesis — атерогенез
plaque — атеросклеротическая бляшка
lymphocytic — лимфотический
inflammatory — воспалительный
low density lipoproteins — липопротеины низкой плотности

53б Iron absorption takes place mainly in the upper jejunum, though 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 intes tinal 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
hemoglobin — гемоглобин
storage — хранение
myoglobin — миоглобин
fraction — фракция
together — вместе
body-weight — масса тела
desquamation — десквамация

56б victim, suffering from severe hypovolaemia due to massive haemorrhage, the combined effects of volume replacement, added O_2 transport capacity, and mild vasoconstriction due to the infusion of a modified Hb solution may be beneficial.

PFC are carbonfluorine compounds characterised by a high gas-dissolving capacity, low viscosity, and chemical and biological inertness. Manufacturing an emulsion with very specific characteristics is a great technologic challenge. After intravenous application, the droplets of the emulsion are being taken up by the reticular-endothelial system, droplets are slowly broken down, the PFC molecules are being taken up in the blood again and transported to the lungs, where the unaltered PFC molecules are finally excreted via exhalation. The ability of PFC emulsions to transport and efficiently unload O_2 is undisputed. With the application of perflubron emulsion, cardiac output tender to increase.

New words

saturation — насыщение гемоглобина кислородом
emulsion — эмульсия
oxygen — кислород
solution — раствор
O_2 transport — транспорт кислорода
tissure oxygenation — оксигенация тканей
physiological — физиологический

55б of plasma To apply some selectivity in the separation of the marker solutes with a high return to the normal constituents of plasma and thus no requirement for plasma product infusion, the technique of cryofiltration was applied.

Cryofiltration is the on-line technique of plasma treatment consisting of plasma cooling followed by membrane filtration. By cooling the plasma, cryogel is deposited on the membrane during the Filtration process. The cryogel has been shown to contain concentrated quantities of the marker solutes. Response to therapy in the majority of patients with rheumatoid arthritis has been from good to excellent. In treatments, decreases in marker solutes have been noted coupled with improvement in clinical symptomology.

Membrane technology appears very promising in the separation and treatment of plasma on-line. Chronic treatment therapies appear safe and well tolerated by the patients.

New words

centrifugal technique — центрифужные технологии
plasma exchange — плазмообмен
therapeutic — терапевтический
metabolic — метаболический
multiple — множественный
extracorporeal — экстракорпоральный

Беликова Елена Владимировна

АНГЛИЙСКИЙ ЯЗЫК

Шпаргалки

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