МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ

СЕВЕРО-КАВКАЗСКАЯ ГОСУДАРСТВЕННАЯ АКАДЕМИЯ

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Ф.У. Айбазова
А.Х. Батчаева
Л.Т. Кубанова

МЕДИЦИНСКАЯ ПАРАЗИТОЛОГИЯ

(Medical parasitology)

Учебно-методическое пособие
для студентов I курса обучающихся по специальности
31.05.01. «Лечебное дело»
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CONTENTS

INTRODUCTION TO PARASYTOLOGY

1. Origin of parasitism. Criteria of parasitism.

According to E. N. Pavlovsky, «parasites are animals that live at the cost of individuals of other species, being biologically and ecologically closely con–nected with them in their life cycle at its longer or shorter duration».

Criteria of parasitism:

1) special relations with the host;

2) feeding at cost of the host;

3) pathogenic action on the host (inflicted harm).

The host of the parasite is an organism that provides it with inhabitation and food and suffers a definite harm from it.

A specific habitation is characteristic of the parasite. The habitation of the 1st order is the host's organism. This environment actively reacts to the pres–ence of a parasite. The habitation of the 2nd order is an external environment. The host is a link between the parasite and the environment.

Parasitism is a most common form of symbiosis. Parasites are all viruses, many bacteria, some kinds of mushrooms and higher plants. 10 000 species of protists, 7000 species of arthropoda, 20 000 species of helminthes are referred to parasites. Some classes are presented completely by parasites – cryptogamers, Suckers and Tapeworms.

Diseases caused by viruses and bacteria are infections (the flue, hepatitis, tuberculosis, etc.). Protists and helminthes cause invasions (ascariasis, teniasis, enterobiasis, etc.). Diseases caused by arthropoda (ticks and insects) are infesta–tions (pediculosis, myiasis, scabby, etc.).

Age of parasitism: Theoretically, one can presume that parasites appeared simultaneously with protists, because parasitizing bacteria were revealed in the body of amoeba. Multicellular parasites existed already in the paleozoic era. Imprints of sea lilies (echinodermata), the stems of which had gall–like growths caused by nematodes, prove it.

Parasitism origin:

1. **Predator → ectoparasite**. Medicinal leeches are temporal ectoparasites for the human, for small animals it may be a predator, as it sucks out a great amount of blood and the animal dies.

2. **Free way of life → attached way of life → ectoparasitism.** Independently living cirripedia may pass to an attached way of life fixing themselves to underwater parts of wooden buildings or bottoms of ships. They pass to ectoparasitism if they attach themselves to living objects –mollusks' shells or fish bodies.

3. **Commensalism → ectoparasitism.** If a commensal settles on coverings of its partner's body, it may become an ectoparasite. It becomes an endoparasite, when gets inside the organism in body cavities connected with an external environment. The enteric amoeba is an endocommensal in the human organism.

4. **Transit through the digestive tract** (larva of a filth fly).

Parasitism is an ecological event. **Ecological Parasitology** studies interre–lations of parasites and their populations with each other, with the host organism and the environment.

The «parasite–host» system. This system includes one individual of the host and one or a group of parasites of a definite species.

For the formation of this system, the following conditions are necessary:

a) a contact between the parasite and the host;

b) providing conditions for the development of the parasite by the host;

c) the ability of the parasite to withstand the host's reactions.

The basic direction of evolution is to achieve the equilibrium, smoothing the antagonism between partners and improving the reliability of the system.

Smoothing of the antagonism is achieved due to co–adaptation:

– in the parasite – morphologic and biologic adaptations;

– in the host – complication of defense mechanisms. Directions of evolution are also different (co–evolution):

– in the parasite – complication of adaptation mechanisms to the host;

– in the host – improving defense reactions at all levels (for destroying the parasite).

Parasitic diseases (parasitism): *protozoosis* (causative agents are protists); *helminthosis* (causative agents are helminthes); *acariasis* (causative agents are ticks); *insectosis* (causative agents are insects).

Transmissible diseases – causative agents are transmitted through the blood by a carrier – an arthropod (ticks and insects).

2. Classification of parasites and their hosts.Classification of parasites:

1. According to relation with the host:

– *true* – a parasitic way of life is a species character (ascarids, lice);

– *false* (pseudo–parasites) – free living, but when they get into a living organism, they may exist there and produce harm (larvae of the filth fly);

– *hyperparasites* or *super–parasites* – are parasites of parasites (bacteria in parasitizing protists).

2. According to localization in the host:

– ectoparasites inhabit body coverings of the host (lice, fleas);

– endoparasites live inside the host's organism:

a) intracellular (toxoplasm);

b) intracavital (ascarids);

c) tissue (liver sucker);

d) intradermal (scabby tick).

3. According to duration of the relation with the host:

– constant – they spend the whole life cycle in the host (an ascarids);

– temporal – they spend a part of their life cycle in the host: larval parasitism (larvae of the horse fly); immarginal parasitism –sexually mature individuals parasitize (mosquitoes, fleas).

Classification of hosts:

1. According the parasite's development stage:

a) *definitive or final* – the parasite reaches its sexual maturation and undergoes its sexual reproduction in his organism (the human for tenias);

b) *alternate or intermediate* –parasite's larvae inhabit his organism, here their asexual reproduction occurs (the human for malaria plasmodia);

c) *supplementary or secondary (*predatory fish for larvae of Diphyllobothrium).

2. According to the parasite's development conditions:

a) *obligatory or natural* – they provide optimal conditions for parasite development in the presence of biocenotic links (natural ways of infection) – the human for the ascarids;

b) *optional or permissive* – the presence of biocenotic links, but the absence of biochemical conditions for the parasite's development (the human for the pig's ascarids);

c) *potential* – the presence of biochemical conditions for the development but the absence of biocenotic links (Guiney pig for trichinella).

3. Ways of infecting the human with parasites.

Permeation ways into the host organism:

1) *alimentary* –with food and water orally (helminthes eggs, protists cysts);

2) *air–drop (respiratory)* – through the respiratory tract (cysts of soil amoebas, some viruses and bacteria);

3) *percutant* –through the intact skin (larvae of suckers);

4) *transplacental* – intrauterally from mother to fetus (toxoplasm, malaria plasmodia);

5) *transfusional* – in transfusion of infected blood (trypanosomes, malaria plasmodia);

6) *contact–household* – in contact with a sick person or animal, through utensils (scabby tick);

7) *transmissive* –with participation of an arthropod (trypanosomes, malaria plasmodia);

8) *sexual* – in sexual contacts (vaginal trichomonade).

Morphophysiological adaptations of parasites. Parasites are highly specialized organisms, maximally adapted to their inhabitation:

a) **progressive**:

– *enlargement of body sizes* (up to 20 m in tape worms);

– *the sexual system reaches its most development* as compared to others;

– *hermaphrodism*;

– *diversity of fixation organs* (sucking discs of lamblii, suckers of sucking insects, botria, hooks of tape worms; claws of lice, etc);

– *external coverings* –tegument, cuticle protect from the action of host's enzymes;

– *«molecular mimicry»* –similarity of proteins of the parasite and the host;

– *excretion of anti*–enzymes, histolysines, by parasites;

b) **regressive**:

– *simplification of sense organs* –endoparasites have only tactile organs and chemical senses;

– *simplification of the organ system structure* – absence of the alimentary tract in tape worms.

Biological adaptations are associated with peculiarities of the sexual system structure, reproduction and development cycles of parasites:

a) *high fertility* (Taenia solium excretes 100 thousand eggs with every mature segment, an ascarid –250 thousand eggs per day);

b) *various forms of asexual reproduction* (Schizogony in malaria plasmodia, polyembryony in suckers);

c) *migrations over the host organism (larvae of taenia solium and ascarids)*;

d) *complex development cycles* with changing of hosts.

The «results» of interactions of the parasite and the host on an organism level may be different: *death of a parasite, death of a host and pathogenicity*.

4. **Pathogenic action and specificity of parasites. Pathogenicity** is the ability to cause a disease, it depends on:

– *parasite's genotype*, its species;

– *host's age*(children and old people are more vulnerable to infection);

– *diet regimen* (improper diet increases the number of parasites in the organism and their sizes, reduces the terms of their development);

– *dose and degree of invasion (*the more eggs or larva are introduced into the organism, the more severe will be a course of the disease);

– *resistance degree of the host's organism;*

– *presence of other parasites and diseases.*

Specificity is manifestation of a historically formed adaptation degree of the parasite to the host. Specificity is manifested in the following forms:

a) *hostal* (that of a host's): monohostal – the parasite has one speciesof the host (ascarids), polyhostal – the parasite has hosts of various species (trichinella);

b) *topical* (a site of parasitizing): ascarids (intestines);

c) *age* enterobiasis in children);

d) *seasonal* (outbursts of amoebic dysentery – the end of spring – summer).

Pathogenic action of parasites:

1. *Mechanic action*: parasites produce it by their body mass (a ball of ascarids in the intestines, an echinococcus vesicle in the brain), by fixation organs (incarceration of the intestinal mucous membrane by suckers), impairment of the skin coverings integrity, etc. This action is revealed due to a pain syndrome.

2. *Toxic– allergic action*: is produced by metabolites of parasites that are antigens; histolyzins and decay products of dead parasites. Manifestations of this action: skin eruptions, dermatitis, eosinophilia, allergic reactions.

3. *Absorption of nutrients and vitamins* in the host's organism results in avitaminosis (mainly A and C), loss of weight, exhaustion.

4. *Impairment of the metabolic process* in the host's organism reduces resistance and increases sensitivity to pathogens of other diseases.

5. Biologically active substances produce an *immune–depressive action*.

6. Some *parasites stimulate* the formation of malignant tumors: schistosomes – cancer of the bladder and rectum.

7. Parasites produce an *unfavorable effect on the course of pregnancy and fetus development* (malaria plasmodia, toxoplasm, cat's sucker, etc.).

5. Host's response to parasitic invasion.

The basis of all reactions – is **the host's immune defense**. Allergy is a kind of immune reactivity. *The first reaction to a parasite* – is an attempt to kill it with enzymes, then –to neutralize factors of its «aggression» by proteases, inhibitors of enzymes.

Reactions on a cellular level: hypertrophy and modification of the shape of affected cells (erythrocytes in malaria).

Tissue defense reactions: isolation of the parasite from a healthy tissue – the formation of a capsule in trichinellosis, formation of pseudocysts of toxoplasms.

On an organism level: humoral reactions (production of antibodies) and various forms of immunity: absolute –relative, active –passive, congenital – acquired.

6. Biological prophylaxis bases of parasitic diseases.

K. I. Skriabin developed **biological prophylaxis bases** for fighting against parasites. It is «a complex of prophylactic measures based on detailed studying of the pathogen's biology, migration ways, stages of its development, biology of intermediate hosts. Al these give a possibility to interrupt any link of the parasite development cycle». The final practical aim of Parasitology is protection of the human, animals and plants from parasites' action and elimination of parasitic diseases.

Basic terms and concepts:

1. Anthroponoses – are diseases, pathogens of which are transmitted from a human to human.

2. Invasive diseases – are diseases caused by protists and helminthes.

3. Infectious diseases – are diseases caused by viruses and bacteria.

4. Hyper–parasitism – is parasitizing of parasites on parasites.

5. Zoonoses – are diseases, pathogens of which are transmitted from an animal to animal, sometimes they may affect the humans too.

6. True parasites –this style of life is characteristic of all representatives of this species.

7. Criteria of parasitism –basic characteristics of parasitism.

8. Pathogenicity – is the ability of the parasite to cause a disease.

9. Parasite – is an organism living at the cost of a host and inflicting harm to him.

10. Parasitism – is an antagonistic symbiosis, when the parasite used the host as a source of food and environment and does harm to him.

11. Specificity of the parasite – a historically formed adaptation degreeof the parasite to its host.

12. Invasive stage – a stage, when the parasite, having got into the host, continues its development.

ANSWERS TO THE OPEN TESTS

1. Free–living organisms, which can be parasites in case of invadingthe organism of other species, are called ... .

2. Hosts providing optimal biochemical conditions for the development of the parasite and which have biocoenotic relations with it, are called ... .

3. Hosts providing biochemical conditions for the development of the parasite, but which don't have biocoenotic relations with it, are called ... .

4. Hosts characterized by the presence of biocoenotic relations with pa–rasites, but have no optimal biochemical conditions for their development, are called ... .

5. Way of parasite invasion in to the host organism with water and foodstuffs is called ... .

6. Way of parasite invasion in to the host organism through mucous membranes of respiratory pipes is called ... .

7. Way of parasite invasion in to the host organism by immediate contact with a sick person or animal and with household objects is called ... .

8. Way of parasite invasion in to the host organism when transfusing un–sterile donor blood is called ... .

CLOSE TESTS

1. The Parasitism – such a cohabitation of different kinds of organisms, at which: a) organisms receive mutual benefit; b) the individual of one species uses the individual of other species only as habitation; c) the individual of one species uses the individual of other species as habitation and the source ofnutrition, not causing any harm; d) the individual of one species uses the individual of other species as dwelling and the source of nutrition and harms her;

e) none of the organisms receive any benefit.

2. Examples of parasites progressive morpho–physiological adaptation are: a) the presence of organs of bracing and special integuments of a body (the cuticle, tegument); b) simplification of the nervous system a constitution and sense organs; c) molecular «mimicry» and anti–enzymes discharge; d) a reduction of the tape worms alimentary system; e) a high fertility and intricit development of cycles.

3. Examples of biological acclimatization of parasites: a) presence of organs of bracing and anti–enzymes; b) simplification of the nervous system and sense organs constitution; c) perfection of various forms of an asexual reproduction and a high fertility; d) complex cycles of development, change of host and larvae migration over an organism of the host; e) immunosuppressive action.

4. Pathogenic action of the parasite: a) mechanical damage of organs and tissues and toxic–allergic; b) supply of the host by vitamins; c) supply of the host by nutrients; d) absorption of nutrients and vitamins from the organism of the host; e) opening a gate for a secondary infection.

5. Pathogenicity of a parasite does not depend on: a) the host genotype and factors of the environment; b) the genotype and virulence of a parasite;

c) the host age and a feeding schedule; d) body height and a sex of the host;

e) presence of other parasites in the host.

6. Levels of defense reactions in host organism are: a) subcellular and cellular; b) cellular and organism; c) both specific and histic; d) cellular and histic; e) population–specific.

7. Adaptation of parasites at the population level: a) presence of cyst and active search of host's; b) simplification of the nervous system constitution and the reduction of the alimentary system in tape worms; c) molecular «mimicry» and anti–enzymes discharge; d) involving of intermediate and reservoir hosts in to the development cycle; e) synchronization parasite development cycles and hosts behavior.

PHYLUM SARCOMASTIGOPHORA, CLASSESSARCODINA, ZOOMASTIGOTA

1. General characteristic of the Protist kingdom.

Inhabitance: water pools, damp soil, organisms of plants, animals and humans. Over 10 000 of 65 000 species are parasites.

A cell of protists performs functions of the whole organism. The membrane consists of a *plasmatic membrane*, elastic membrane – *pellicle* or a denser *cuticle*. The shape is constant (zoomasticota and infusorians) or changeable (sar– codina). The sizes are from 3 to 150 μm. There are 2 layers in the cytoplasm: *ectoplasm* – an external layer and *endoplasm* – an internal one. There are organoids of general purpose (mitochondria, EPR, ribosomes, Golgi's complex, etc.) and of special purpose (pulsing and digestive vacuoles, cilia, filaments, etc.). *Organoids of movement*: pseudopodia (pseudostems), filaments and cilia.

The majority of protists are *heterotrophers*. Substances come by endocytosis, an active transport, osmotically or through a cellular mouth. Around a food particle a *digestive vacuole* is formed and lyzosomal enzymes come there. Digested substances are absorbed by the cytoplasm, and undigested remains are removed from the cell through a plasmolemma in any part of it or through a special opening – cytoproct. Protists have *contractive vacuoles* performing osmoregulation and excretion of dissimilation products, they also stimulate gas exchange.

Cells of protists contain one or several *nuclei*. Reproduction is asexual: division into two or schizogony. There is a sexual process (conjugation or copulation). In unfavorable conditions *cysts* are formed. When they get in

favorable conditions excysting and formation of a vegetative form (trophozoit) occurs. *Irritability* has a form of taxises.

Classification: phulum Sarcomastigophora (classes Sarcodina and Zoomastigota), phulum Apicomplexa (class Sporozoa) and phulum Infusoria (class Ciliata).

2. Parasitic Sarcodina (phulum Sarcomastigophora, class Sarcodina).

10 000 species of Sarcodina are the most primitive representatives of Sarcfomastigophora. The cellular membrane consists of a cytoplasmatic membrane, no pellicle, the body shape is changeable. The cell contains one nucleus. Pseudostems are organoids of movement. In unfavorable conditions cysts are formed. Organoids in parasitic forms are poorly developed. Nutrition is accomplished by endocytosis (bacteria, organic substances, enteric cells, erythrocytes).

Dysentery amoeba, Entamoeba histolytica – a pathogen of amoebiasis (amoebic dysentery). The disease is common everywhere, more often in countries with a hot climate.

Morphological peculiarities: 2 stages – a vegetative (trophozoit) and a cyst. Cysts (8–16 μm in size) contain 4 nuclei (fig. 1).

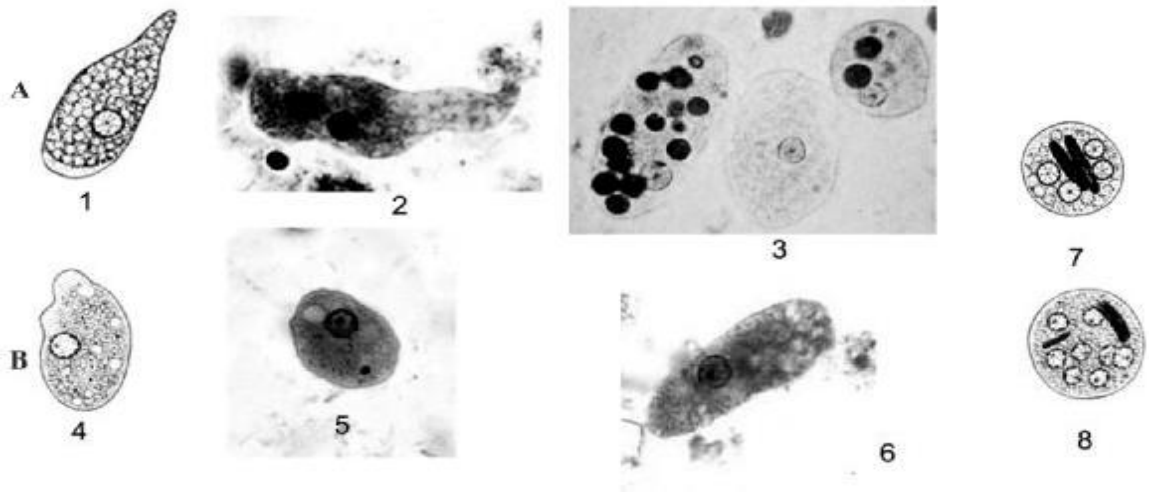

Fig. 1. Morphology of vegetative forms and cysts E. histolytica and E. coli:
A –E. histolytica, B –E. coli: 1, 4 –sketches of trophozoits; 2, 5, 6 –trophozoits (7×40); 3 –f. magna with swallowed erythrocytes (7×40); 7, 8 – cysts (7×40)

Trophozoits exist in 3 forms: a small vegetative (forma minuta), great vegetative (forma magna) and that of tissue. Small vegetative forms (12–20 μm in diameter) are capable of moving, feed on bacteria, are not pathogenic. Forma magna (with sizes of 30–40 μm) swallows erythrocytes, excretes proteolythic enzymes. A tissue form (sizes of 20–25 μm) can move fast. A great vegetative and tissue form is pathogenic.

Life cycle: infection of the human occurs alimentally on swallowing cysts. Factors of transmitting cysts: contaminated vegetables, fruit and water. Mechanical carriers of cysts are flies and cockroaches. 4 small vegetative forms develop from a cyst in the intestinal lumen. They can exist for a long time (eat, multiply) and transform into cysts (cystic pathogenicity) (fig. 2).

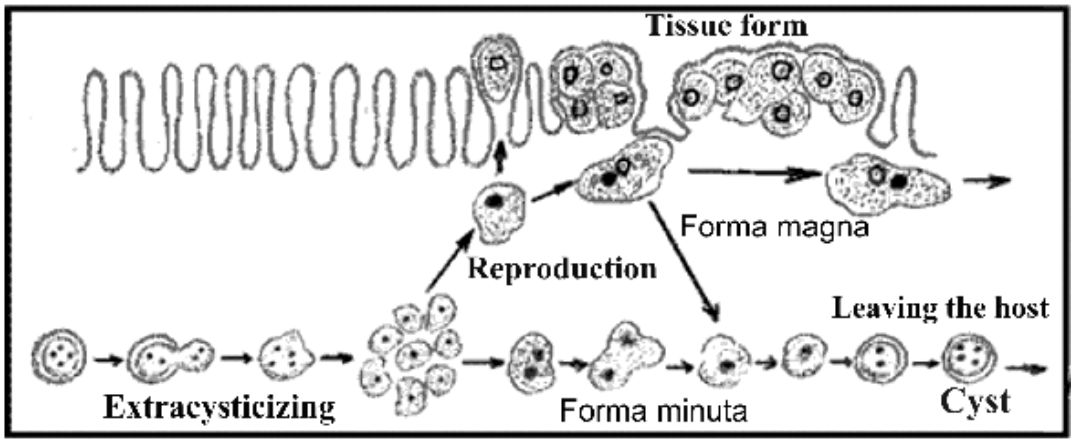

Fig. 2. Life cycle of a dysentery amoeba. (Entamoeba histolytica)

When the host's organism is weakened (by suffered infections, using spicy food, fasting, hyperthermia, etc.) forma minuta passes into forma magna that de stroys the mucous membrane epithelium of a large intestine. In the intestinal wall this form transforms into a tissue form, it may get into the liver, brain and other organs through vessels. In remission, pathogenic forms in the intestinal lumen transform into small vegetative forms and then into cysts.

Pathogenic action:

1. *Mechanic* (destruction of the large intestine mucous membrane with formation of bleeding ulcers from some mm to 2–2,5 cm in diameter).

2. **Toxic– allergic** (poisoning by waste products).

3. Feeding on the host's organism and impairment of metabolic processes (absorption of erythrocytes and vitamins, impairment of water–salt exchange).

Characteristic symptoms: bloody diarrhea up to 10 times a day and more, pains in the abdomen in the large intestine area (the right hypochondrium). Intoxication may be marked in various degrees.

Complication of amebiasis: amoebic processes in the liver and lungs, suppurative peritonitis, inflammatory processes of the skin in the perineal area.

Laboratory diagnosis: microscopic investigation of feces smears, the content of ulcers bottom and revealing a tissue and a large vegetative form in it. It ispossible to reveal cysts during remissions and cystic pathogenicity.

Prophylaxis: personal –observing hygienic rules (washing hands and vegetables, fruit with hot water, protection of food from flies and cockroaches). Social prophylaxis: revealing and treating sick persons; control over the sanitary condition of water wells, food enterprises, shops and markets; prophylactic examination of workers of catering enterprises; killing flies and cockroaches; sani tary–popularization activity.

Intestinal amoeba, Entamoeba coli is similar in morphology with a dysenteric amoeba. Its localization is in the lumen of a large intestine of the human. It forms trophozoits and cysts. Mature cysts of an intestinal amoeba (its sizes are 13–25 μm) contain 8 nuclei. Trophozoits do not excrete proteolythic enzymes and do not injure the intestinal wall. It is not pathogenic.

Oral amoeba, Entamoeba gingivalis occurs in carious teeth and in dental deposits, on palatal tonsils. The body size is from 6 to 30 μm. It feeds on bacteria

and leukocytes, sometimes erythrocytes. It does not form any cysts. The pathogenic action is not revealed.

3. Amoebas of Limax group.

They are free living amoebas inhabiting water reservoirs and soil. Having got into the human organism they are capable to cause severe inflammatory processes in CNS (meningoencephalytis). The most dangerous are representatives of two genera: Naegleria and Acanthamoeba (fig. 3).

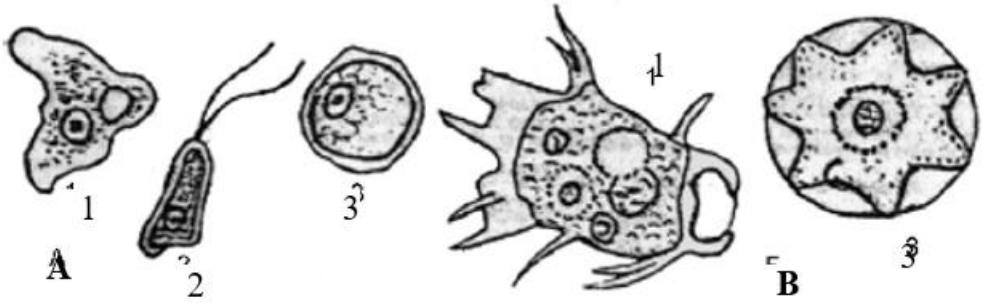

Fig. 3. Amoebas of Limax group: A –Naegleria, B – acanthamoeba:
1 – an amoebic stage; 2 – a filament stage; 3 – a cyst

Morphological peculiarities: vegetative forms of g. Naegleria (20–30 μm in size) have short broad pseudopodia (am amoebic stage). In sharp changes of temperature amoebas form 2 filaments (a filament stage) and pass to active motion. Representatives of g. Acanthamoeba have no filament stage. Amoebic stages have multiple narrow sharpened pseudopodia. Cysts may not form in tissues.

Life cycle: amoebas of Limax group may parasitize on the human, apes and rodents. The most virulent is Naegleria. Infection occurs through the mucous membrane of the nasopharynx while bathing in open water reservoirs and swimming pools, through water while washing up (Naegleria), by cysts with dust (Acanthamoeba). From the nasal cavity amoebas permeate into the brain along an olfactory nerve.

Pathogenic action:

1. *Mechanic* (destroys the cortical grey matter of the cerebral hemispheres and its membrane).

2. *Toxic– allergic* (poisoning by waste products).

3. Due to the integrity impairment of cells and cerebral membranes the inflammatory process develops.

Clinical manifestations. *The incubation period lasts 4–7 days*. A running nose, malaise, conjunctivitis, cough, elevation of temperature. Then appear symptoms of affecting cerebral membranes and the brain substance (high temperature, vomiting, loss of consciousness, etc.), in the absence of treatment deathoccurs in 3–5 days.

Laboratory diagnosis: revealing vegetative forms in the cerebrospinal fluid (liquor).

Prophylaxis: not to bathe in open water reservoirs, sanitary control over the water condition, sanitary–popularization activity.

4. Parasitizing filamentous protists (phulum Sarcomastigophora, class Zoomastigota).

There are 8 000 species of Sarcomastigophora. Many representatives are parasites of animals and humans. They have a constant body shape (they have pellicules). Contrain one nucleus. Organoids of movement *filaments and an unduling membrane*, representing a cytoplasmatic protuberance. Parasitic species –heterotrophs, the way of feeding – osmotic. They multiply by a longitudinal division into two. Some species have a sexual process – c*opulation*.

Leischmania. Leischmaniasis – a natural–focal disease. Visceral leisch–maniasis is common in the area of the Mediterranean Sea, Middle and South Asia, Africa and South America. American leischmaniasis occurs in South Europe, North and West Africa, Near East, Central and South Asia. The focus of mucocutaneous leischmaniosis is in South and Central America.

Morphological peculiarities: there are 2 forms – a promastigota (a non–filament rounded or an oval form, 3–5 μm in size). Leischmaniasis pathogens are morphologically similar but have biochemical and antigenic differences (fig. 4).

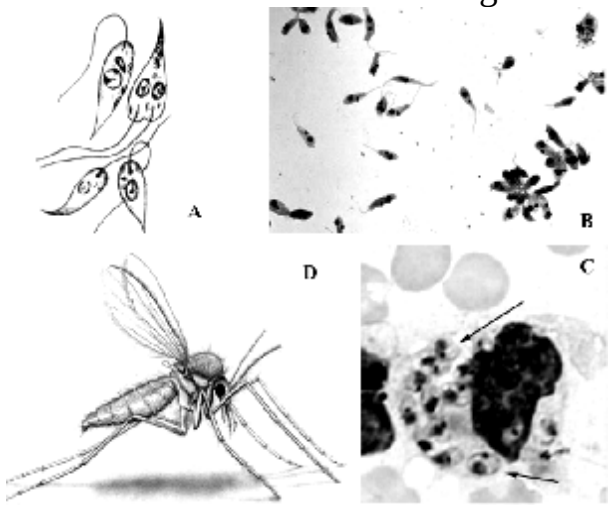

Fig. 4. Morphology of leschmaniasis pathogens and their transmitter:
A – a sketch; B – a filament form (7×40); C – a non–filament form inside the macrphage (7×40); D – a mosquito

Life cycle: specific transmitters –mosquitoes of g. Phlebotomus that have a filament stage –promastigota (fig. 5).

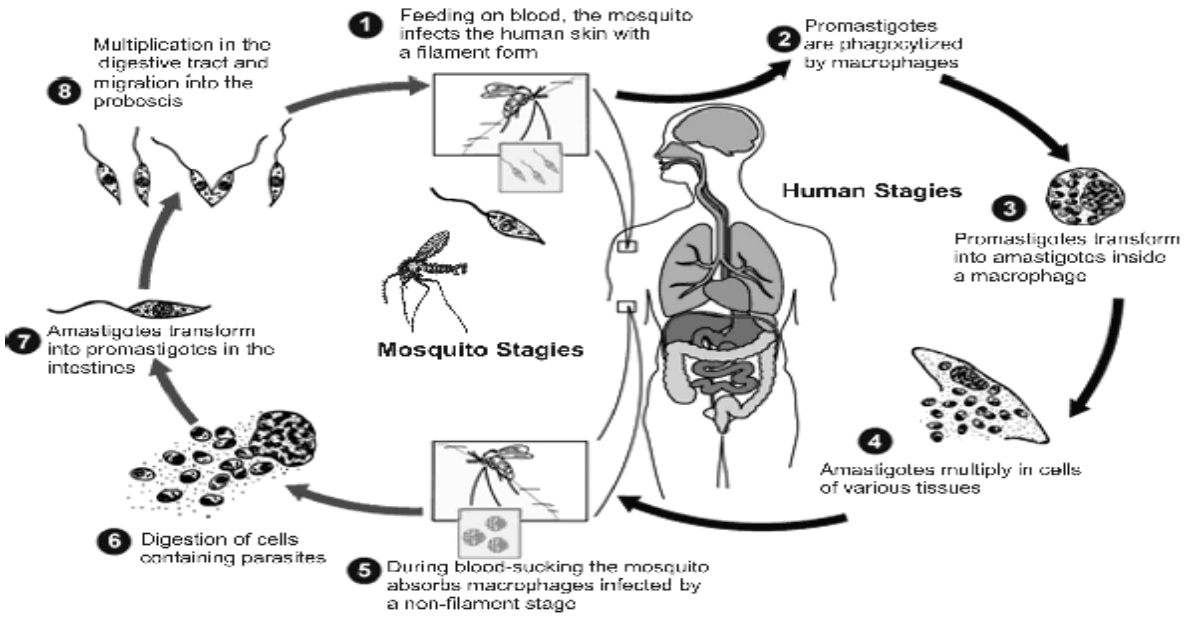

Fig. 5. Life cycle of leischmaniasis pathogens

Infecting of the human occurs in mosquito bites (a transmissible way). Leischmania lose their filament in the human organism, transform into amastigotes, pass to intracellular parasitizing and intensively multiply.

Natural reservoirs of L. donovani may be coyotes, dogs, rodents, of L. tropica–rodents, of L. braziliens–rodents, apes and slothes. L. donovani and L. infantum cause visceral leischmaniasis, dumdum fever, visceral leisch–maniasis, infantile leischmaniasis.

Pathogenic action:

1. *Mechanic* (destruction of hepatic cells, lymphatic nodes, red marrow).

2. *Toxic– allergic* (poisoning by waste products). Incubation period – from several weeks to 6–8 months.

L. donovani and L. infantum are called visceral leischmaniasis (black dis ease, dumdum fever, kalaazar, infantile leischmaniasis).

Characteristic symptoms: irregular fever, weakness, headache, exhaustion, rash, enlargement of the liver and spleen, anemia.

Children fall ill more often.

After leischmaniasis they acquire a persistent immunity.

Laboratory diagnosis: revealing leischmania in punctuates of red marrow (breastbone), lymphatic nodes.

L. tropica major and L. tropica minor cause cutaneous leischmaniasis (oriental ulcer).

Pathogenic action:

1. *Mechanic* (destruction of cutaneous cells).

2. *Toxic– allergic* (poisoning by waste products).

Characteristic symptoms: Small erythematic protuberances on the skin in 2–6 weeks after a mosquito bite. Later on forms an ulcer with elevated edges (leischmanioma). The whole process from the first manifestations to heeling of the ulcer takes from 3–4 months to 2 years. After healing of ulcers ugly scars stay.

Laboratory diagnosis: revealing leischmania in smears from ulcers content.

L. brasiliensis, L. mexicana and L. peruviana cause **cutanomucous leischmaniasis** (espundia).

Pathogenic action:

1. *Mechanic* (cell destruction of the skin, mucous membranes, cartilages).

2. *Toxic– allergic* (poisoning by waste products). Incubation period from 2–3 weeks to 1–3 months.

Characteristic symptoms: Ulcers gradually destroying all soft tissues. Overgrowing of the tissues of the nose, lips, pharynx, larynx. The disease is difficult to treat and it often ends with death.

Laboratory diagnosis: revealing leischmania in smears from the ulcers content.

Prophylaxis: protection from mosquito bites (repellents, nets against mosquitoes) and vaccination, revealing and treating sick persons, killing mosquitoesand animals–reservoirs of the diseases, sanitary–popularization activity.

Trypanosomes. Pathogens of African sleeping disease (African trypanosomosis) are *Trypanosoma brucei gambiense* (West Africa) and *Trypanosoma brucei rhodesiense* (East Africa).American trypanosomaisis (Chagas' disease) caused by *Trypanosoma cruzi* is spread in South Africa. They are transmissible diseases with a natural focal origin.

There are the following stages in the development cycle of trypanosomes (fig. 6):

– a *trypomastigote* has an elongated shape, a long filament, an undulating membrane; it parasitizes on the organism of vertebrate hosts (the human, animals) and is an invasion stage for them;

– an *epimastigote* resembles a trypomastigote, but its filament is shorter and an undulating membrane is poorly expressed; it exists only in the organism of the transmitter and can transform into a trypomastigote;

– *an amastigote* is immobile, parasitizes on the organism of vertebrate hosts, it is an intracellular parasite; can transform into a trypomastigote.

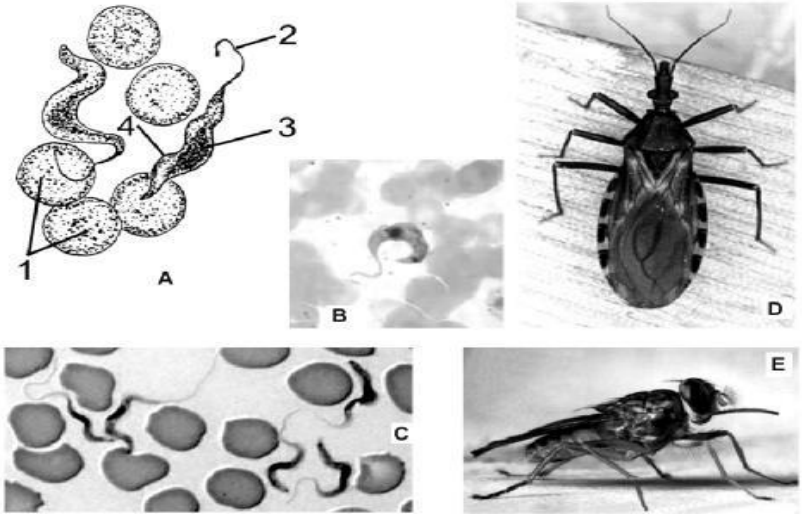

Fig. 6. Morphologhical peculiarities of pathogens of African trypanosomaisis:
A – a sketch: 1 –erythrocytes; 2 – a filament; 3 – a nucleus; 4 – an undulating mem– brane; B – T. cruzi (7×40); C –T. brucei (7×40); D –Triatoma infestans; E –Glossina palpalis

The body is curved, has a filament going along the edge of an undulating membrane. The body length is 13–40 μm. They feed osmotically, multiply by division into two.

Life cycle: 2 stages of the development: a trypomastigote and an epimastigote (fig. 7). Tsetse flies (g. Glossina) are specific transmitters. When the fly sucks blood of a sick person, trypomastigotes get into its stomach. Here they transform into epimastigotes, multiply and accumulate in salivary glands (the development duration is 20 days). When healthy people are bitten by flies (a transmissible way), infection occurs. Infection is possible in blood transfusion and while using unsterilized syringes. A transplacental way is possible.

The second part of the cycle undergoes in the organism of the human and reservoir hosts (for a gambiense trypanosome –pigs, for a rhodesiense one – antelopes and the cattle). At first trypomastigotes inhabit the hypodermal cellular tissue, then the lymphatic system, they multiply and in 20–25 days enter the blood and are carried to all tissues and organs. The predominant localization – the cerebrospinal fluid, then they get into the brain and spinal cord.

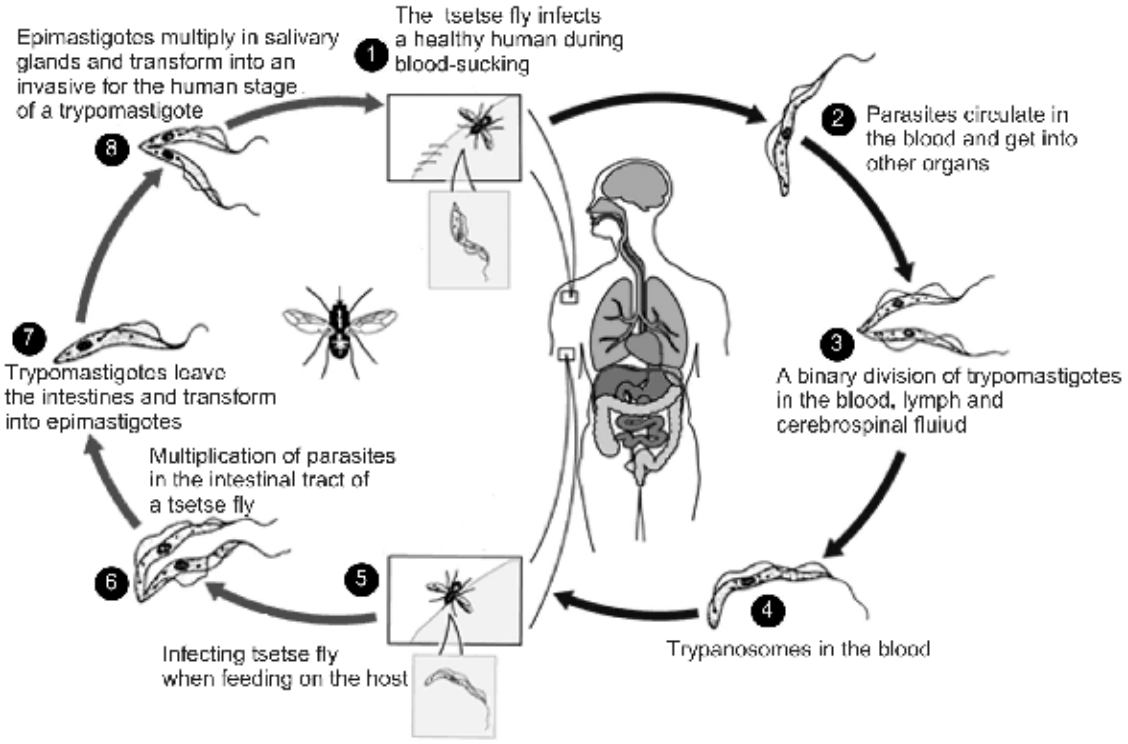

Fig. 7. Life cycle of pathogens of African trypanosomasis

Pathogenic action:

1. *Mechanic* (destruction of cells and tissues of affected organs).

2. *Toxic– allergic* (poisoning by waste products). Incubation period is from 1–3 weeks to 2 and more years.

Characteristic symptoms: a tryposomal chancre at a bite site, enlargement of lymphatic nodes on the back surface of the neck, elevation of temperature, weakness, exhaustion. Later symptoms of the CNS affection appear: sleepiness, progressing imbecility, soporose (inhibited); and then a comatose state (loss of

consciousness). In gambiense variant a progressing encephalitis is noted, it is characterized by sleepiness (a sleeping disease). In the absence of treatment a fatal outcome is observed.

Laboratory diagnosis: revealing trypanosomes in smears of peripheral blood, punctuates from lymphatic nodes, cerebrospinal fluid; immunological reactions (determination of anti–bodies in the blood serum of patients).

Prophylaxis: protection from bites of the tsetse fly, revealing and treatment of sick persons and parasitic pathogens, sanitary popularization activity.

Morphological peculiarities of a pathogen of **American trypanosomiasis** are similar to that of African trypanosomiasis.

Life cycle: The pathogen of Chagas' disease parasitizes on the human and animals (armadillos, ants, etc.) that are natural reservoirs of pathogens. Specific transmitters are kissing bugs of g. Triatoma. In sucking the blood of a sick person or animals trypomastigotes get into the intestine of bugs, transform into epimastigotes, multiply, transform into trypomastigotes and some time later are excreted with their excrements. Infecting of the human (a transmissible way) occurs, when excrements with pathogens get on the injured skin (wounds from bites, scratches). Infecting is also possible in transfusing blood, transplacentally. In the human organism trypomastigotes transform into amastigotes and multiply. In 1–2 weeks amastigotes transform into trypomastigotes inside the injured cells and enter the blood flow, circulate throughout the organism, invade the cells (of the cardio–vascular and skeletal musculature, nervous system, etc.), where the cycle repeats.

Pathogenic action:

1. *Mechanic* (destruction of cells and tissues of organs, tissue edema).
2. *Toxic– allergic* (poisoning by waste products).

Incubation period lasts 4–14 days.

Characteristic symptoms: at the site of trypanosomes permeation into the skin appears hyperemia and edema (chagoma). In 1–2 weeks (when parasites enter the blood) appears fever, headache, face edema, pains in the heart area and signs of cardiac insufficiency. Complications: meningoencephalitis, impairment of the vegetative nervous system, the heart, liver, kidneys and other organs; the mortality reaches 14 %.

Laboratory diagnosis: revealing trypanosomes in blood smears, cerebrospinal fluid, punctuates from lymphatic nodes, spinal cord; immunological reactions (revealing anti–bodies in the blood serum of sick persons).

Prophylaxis: revealing and treating sick persons, killing and protection from bites of kissing bugs (repellents, etc.), sanitary popularization activity.

Lamblia. Lamblia (Giardia) intestinealis – a pathogen of lambliasis. Parasitizes only on the human. The disease is spread everywhere.

Morphological peculiarities: a pear–like shape (fig. 8), the body size is 10–18 μm. 4 pairs of filaments, 2 supporting cores (axostyles) dividing the body into two symmetrical halves having per 1 nucleus and a sucking disc. Cysts have an oval shape.

Life cycle: 2 stages: a vegetative (a trophozoit) and a cyst. Infecting occurs by an alimentary way, when cysts are swallowed with unwashed vegetables and fruit, with water. Excysting occurs in the duodenum. Localization – the upper part of a small intestine and bile ducts.

Pathogenic action.

1. *Mechanic* (irritation of the duodenum mucous membrane, impairment of wall digestion and absorption).

2. *Toxic– allergic* (poisoning by waste products).

3. *Feeding on the host organism and impairment of metabolic processes* (absorption of nutrients and vitamins).

Characteristic symptoms: general malaise, poor appetite, nausea, pains in the epigastric region and right hypochondrium, unstable stool (diarrhea, constipation). Lambliosis aggravates the course of other diseases of the digestive system.

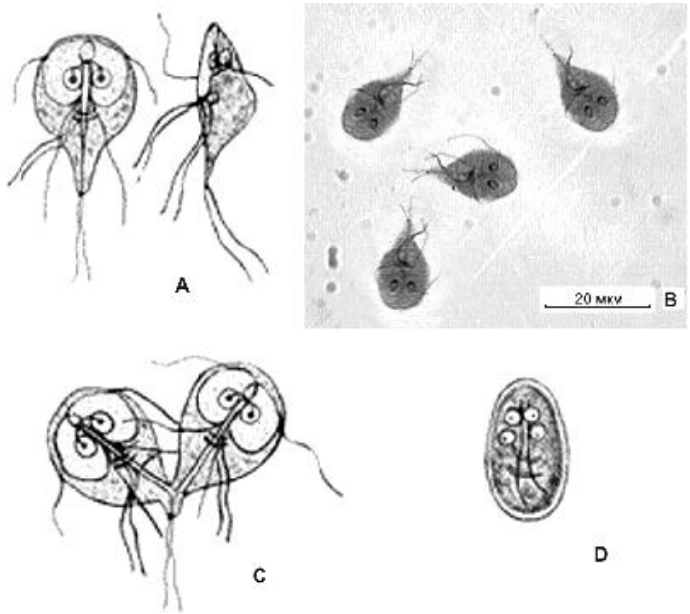

Fig.8. Morphology of lamblias (Lamblia intestinalis):
A – asketch of a trophozoit; B –Trtophozoits (7×40); C –division into two; D – a cyst

Laboratory diagnosis: revealing vegetative forms (trophozoits) in feces or duodenal content.

Prophylaxis: observing rules of personal hygiene, revealing and treating patients, sanitary popularization activity.

Trichomonas. Trichomonas vaginalis – a pathogen of urogenital trichomoniasis. The disease is common everywhere.

Morphological peculiarities (fig. 9): an oval shape with a sharpened long thorn at the back end. Body sizes up to 30 μm. Has 5 filaments. One filament goes along an undulating membrane. A supporting core (axostyle) is in the middle of the body. There is a nucleus and digestive vacuoles in the cytoplasm.

Life cycle: infection occurs in sexual contacts, also through insterile gynecological instruments. Affects urinary ways. Does not form cysts.

Pathogenic action.

1. *Mechanic* (destruction of the urinary mucous membranes).

2. *Toxic– allergic* (poisoning by waste products).

Characteristic symptoms: in acute form – itching, a burning sensation in urogenital ways, a local inflammatory process, plentiful fluid discharge of a greenish color with unpleasant smell.

Laboratory diagnosis: revealing trophozoits in native smears of the content from urogenital ways.

Prophylaxis: revealing and treating sick persons, excluding accidental sexual contacts, observing instruments sterility in examination rooms, sanitary–popularization activity.

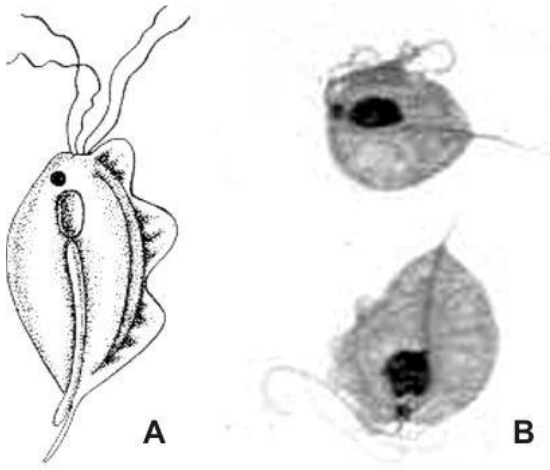

Fig.9. Trichomonas morphology:
A – a sketch; *B* – a trophozoit (7×40)

Basic terms and concepts:

1. Axostyle – a supporting core, which goes in the middle of a protist cell.

2. Amoebiasis – a disease caused by Entamoeba histolytica.

3. Chagas' disease – a disease caused by Trypanosoma cruzi.

4. Dermato–mucous leischmaniasis –this disease is caused by Leischmania brasiliensis, Leischmania mexicana and Leischmania peruviana.

5. Lambliasis – a disease caused by Lamblia intestinalis.

6. Amoebic meningoencephalitis –severe inflammatory processes ofCNS that may be caused by amoebas of the Limax group.

7. Pellicle – an elastic membrane covering a protist cell.

8. Sleeping disease (trypanosomiasis) – a disease caused by Trypano soma bruceli.

9. Trichomonaisis – a disease caused by Trichomonas vaginalis.

10. Trophozoit – a vegetative form of protists.

OPEN TESTS

1. Vegetative form of protista is called ... .

2. «Melting» of mucous membrane of the large intestine with formation of bleeding ulcers 2,5 cm in diameter is a pathogenic effect of ... .

3. Amoeba Limax cause inflammatory processes in the cerebrum and its

membranes; the disease is called ... .

4. Supporting centre, which some representatives of class Zoomastigota can have, is called ... .

5. Specific carrier of African surra agent is ... .

6. Trypanosoma has flagellar and non–flagellar forms in its life cycle.

7. Hyperemia and edema 10–15 cm in diameter, which develop on the site of Trypanosoma cruzi iinvasion nto the derm, are called ... .

8. Stage of life cycle of Leischmania donovani, which parasitizes in the carrier, is called ... .

9. Trichomonas vaginalis has flagella.

CLOSE TESTS

1. Sequence of stages of dysenteric ameba development cycle is:

a) forma minuta → forma magna → tissue → cyst → forma magna ;b) forma magna → forma minuta → tissue → cyst → forma magna; c) the cyst → forma minuta → forma magna → tissue → forma magna; d) cyst → forma minuta → forma magna → tissue → forma minuta → cyst; e) histic → forma magna → forma minuta → the cyst.

2. Laboratory diagnosis of the American trypanosomiasis is based on: a) detection of trypanosomes in excrements and duodenal contents; b) immunological methods; c) detection of trypanosomes in blood smears; d) trypanosome detection in a neurolymph and in puncture specimens of the lymph nodes;

e) trypanosome detection in skin sections and hypodermic tissues.

3. Diagnostic features of a visceral leishmaniasis are: a) fever, asthenia, a headache; b) a water bloody stool; c) anemia and an cachexia; d) enlargement of the liver and the spleen; e) pains along the small intestine.

4. Characteristic features of Acanthamoeba are: a) narrow long pseudopodia; b) short wide pseudopodia; c) do not form cysts in unfavorable conditions; d) trophozoite with two flagellum; e) have no flagellate form, in unfavorable conditions form cysts.

5. Reservoir hosts of African trypanosomiasis originators are: a) sick people and monkeys; b) cattle stock; c) dogs and wolves; d) opossums and armadillos; e) pigs and antelopes.

6. Diagnostic features of the African trypanosomiasis are: a) drowsiness, fever, an cachexia; b) a bloody diarrhea; c) a cardio muscular lesion;

d) the liver and spleen enlargement; e) trypanosomic chancre on the skin, lymph nodes enlargement on the back of the head occiput.

7. Characteristic features of pathogenic action of cutanomucous leishmaniasis agent are: a) a skin lesion only; b) a skin, mucosa and cartilage lesion; c) a lesion of internals; d) involving a secondary infection; e) vision and hearing impairment.

8. Diagnostic features of lambliasis are: a) decrease of appetite and nausea; b) a headache and drowsiness; c) pains in epigastrium and in dextral subcostal area; d) pains in left subcostal area; e) a unstable stool.

PHYLUM INFUSORIA, CLASS CILIATA PHYLUM APICOMPLEXA, CLASS SPOROZOA

1. Balantidium.

Balantidium coli – is a human parasite of the Ciliata class, it causes balantidiasis (infusoric dysentery). The disease is common everywhere.

Morphological peculiarities (fig. 10): the body is of oval shape, sixes –30–150 × 40–70 μm. There is a peristome at the frontal end, which passes into a cystome and a funnel–like cytopharynx. At the back side is cytoproct. The macronucleus has a bean–like or rod–like shape. There are 2 contractive vacuoles. It can form cysts.

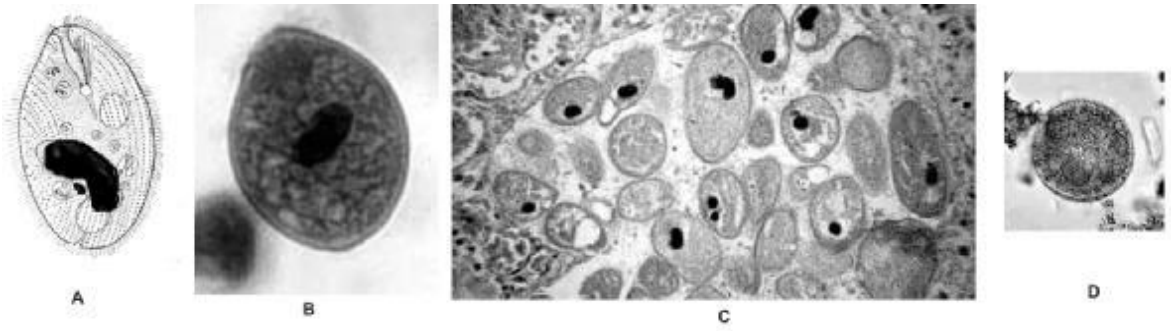

Fig. 10. Balantidium coli morphology: *A* – a sketch; *B* – a trophozoit (7×40); *C* – accumulation of parasites in tissue (7×40); *D* – a cyst (7×40)

Development cycle: a vegetative form parasitizes in a thick part of the intestines (caecum). Infection occurs alimentally on swallowing cysts (invasive stage) with contaminated vegetables, fruit, drinking water. Workers of pigbreeding farms are affected more often, because pigs are a source of invasion. Trophozoits are formed in the alimentary tract from cysts.

Pathogenic action:

1. *Mechanic* (impairment of the intestinal mucous membrane and formation of deep ulcers).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding on the host's organism* (with food particles, sometimes erythrocytes and leukocytes are found in its cytoplasm).

Characteristic symptoms: diarrhea with blood, pains in the abdomen, vomiting, malaise, weakness, headache.

Complications: perforation of ulcers and liver abscesses.

Laboratory diagnosis: revealing vegetative forms of the parasite in feces smears.

Prophylaxis: observing rules of personal hygiene, revealing and treating sick persons. Protection of the environment from contamination by feces of pigs and sick people, sanitary–popularization activity.

2. Life cycle of a human malaria pathogen. Types of malaria plasmodia, their morphological characteristic in a thin blood smear.

Human malaria pathogens (fig. 11) are referred to order of Haemosporidia, genus of Plasmodium.

They are of 4 types:

1. Plasmodium vivax – a 3–day malaria pathogen.
2. Plasmodium ovale – an ovale malaria pathogen (kind of a 3–day variety).
3. Plasmodium malaria – a 4–day malaria pathogen.
4. Plasmodium falciparum – a tropic malaria pathogen.

Malaria occurs predominantly in countries with a subtropic and tropic climate.

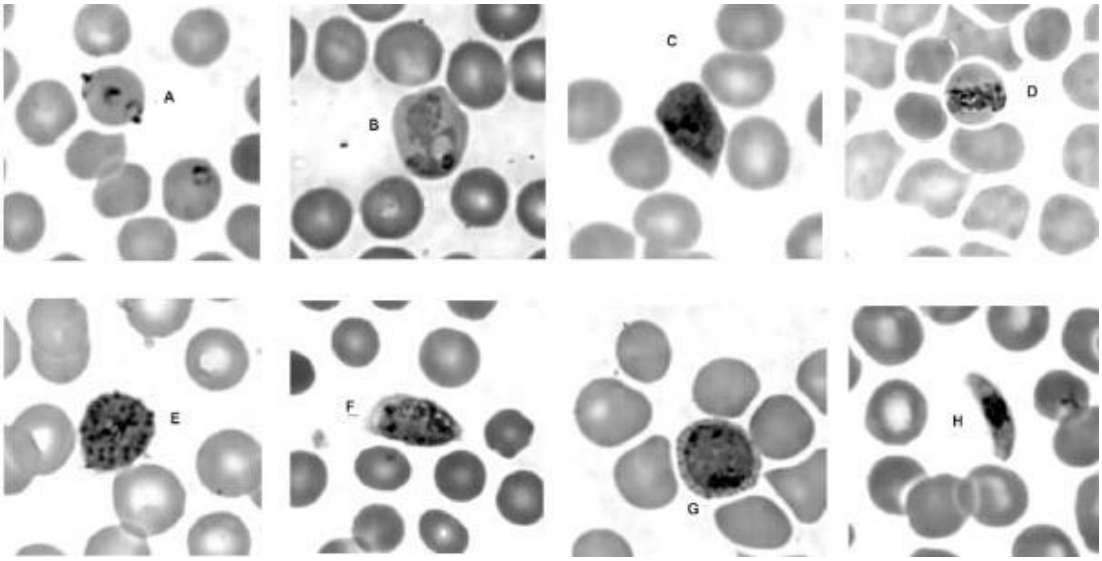

Fig. 11. Malaria pathogens morphology:
A – a ring of Pl. falciparum; B – an amoeba–like shizont of Pl. vivax; C –shizont ofPl. ovale; D – a tape–like shizont of Pl. malaria; E –morula of Pl. vivax; F – a morula of Pl. ovale; G – a gametocyte of Pl. vivax; H – a gametocyte of Pl. falciparum.

Life cycle. The human is an intermediate host for a malaria pathogen, and mosquito females are principal hosts (fig. 12).

Contamination of the human occurs on bite by a female mosquito of Anopheles g.; it injects plasmodium *sporozoits* into the blood together with saliva. Sporozoits are carried by the blood flow into cells of the liver, spleen, endothelium of blood capillaries, where they transform into tissue shizonts. Shizonts grow and in 5–16 days schizogony passes and *tissue merozoits* form. All these development stages are called tissue (pre–erythrocytic) schizogony corresponding to an incubation period of the disease.

Tissue merozoits destroy cells, enter the blood and settle in erythrocytes. The cycle of erythrocytic schizogony starts. The merzoit that permeatedthe erythrocyte, is an *erythrocytic shizont, undergoes the stages of a ring and amoebic shizont*. Their nucleus is divided many times (into 6–24 parts), and segments of the cytoplasm are isolated around the nucleus. Such stage is calleda *morula*. The cells formed as a result of erythrocytic schizogony are *blood merozoits*. The erythrocyte membrane destroys, and merozoits and their metabolites enter the blood (*merulation*). And at this moment a malaria attack starts.

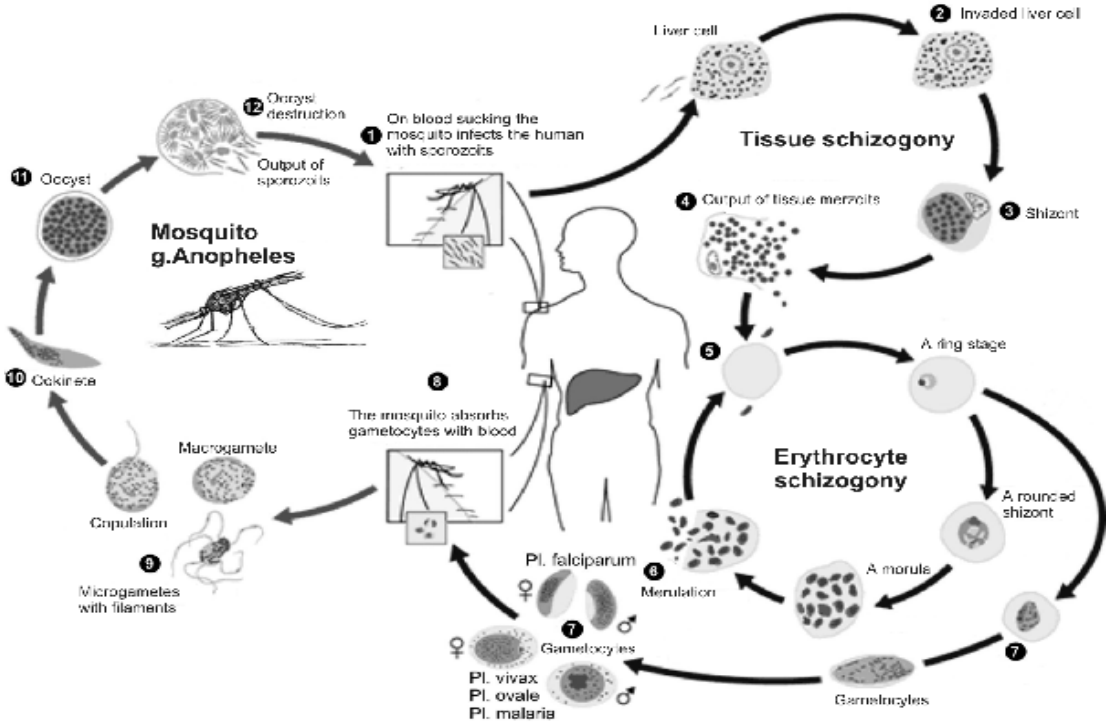

Fig. 12. Life cycle of malaria pathogens

A part of merozoits permeate erythrocytes again and repeat the cycle of erythrocytic schizogony (it may be repeated many times). The other part of merozoits, having got into erythrocytes, transform into *gamonts* (*micro– and macrogametocytes*), further development of which (*gametogony*) occurs inthe mosquito body. On getting into the human blood microgametocytes and macrogametocytes get into the mosquito female's stomach, where *micro– and macrogamets* form. They fuse forming a mobile zygote (*ookinete*), which actively implants into the stomach wall, permeates to its surface, covers itself with a pro tective membrane and transforms into an *oocyst*. The oocyst enlarges in size, its content divides repeatedly and a great number (up to 10 000) of *sporozoits* are formed (*sporogony*).The membrane of a mature oocyst breaks, sporozoits get into a cavity of the mosquito body and are carried to all organs with the hemolymph, accumulating predominantly in salivary glands.

3. Ways of infecting the human with malaria, pathogenic action of pathogens; symptoms and diagnosis of malaria.

Infecting of the human occurs in a bite by a female mosquito p. Anopheles that injects sporozoits of malaria plasmodium into the blood with saliva(a transmission way). Infection is also possible in blood transfusion and transplacentally. In this case an invasive stage for the human is an erythrocyte shizont,and such malaria is shizont.

Pathogenic action:

1. *Mechanic* (destruction of erythrocytes and hepatocytes).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding on the host* (absorption of hemoglobin) *and impairment of metabolic processes*.

Characteristic symptoms: intermittent fever attacks. An attack lasts 6–12 hours, it has 3 phases: chill, fever and perspiration. The attack starts with chills lasting from 0,5 to 2–3 hours. Then a sharp elevation of temperature up to 40–41 °C is noted. Patients develop a severe fever and intoxication symptoms. In 6–8 hours (in tropical malaria it occurs later) the body temperature suddenly drops to 35–36 °C and a profuse perspiration starts, intoxication decreases, patients feel better. In a 3–day malaria the attacks are repeated in 48 hours, and in a 4–day malaria – in 72 hours. It is due to the fact that the duration of erythrocyte schizogony for *Plasmodium vivax, Plasmodium ovale and Plasmodium falciparum* is 48 hours, and for *Plasmodium malaria* –72 hours.

Enlargement of the liver, spleen is observed (here affected erythrocytes are destroyed). The disease is accompanied by anemia.

Tropical malaria has a more severe course and results in lethal outcomes. Basic causes of complications (malaria coma, acute renal insufficiency, etc.): all age forms of erythrocytes are affected; a great number of blood merozoits; erythrocyte schizogony occurs not in large blood vessels, as in other types of plasmodia, but in capillaries of internal organs (the brain).

Laboratory diagnosis: revealing of parasites in the blood (a thick blood smear). It is necessary to take blood during an attack or immediately after it. To determine the specious belonging of plasmodia one should pay attention to the following signs:

1. In *Plasmodium vivax* the stage of an amoeba–like shizont is marked.
2. Erythrocytes affected by *Plasmodium ovale* are enlarged and have an irregular shape with torn fringed edges.
3. For *Plasmodium falciparum* the stage of a semi–lunar gamont is characteristic.
4. For *Plasmodium malaria* the stage of a tape–like shizont is characteristic.

Immunological methods are also used for diagnosis (determination of antibodies in the patients' blood).

4. Biological bases of malaria prophylaxis.

Personal prophylaxis: defense from mosquitoes' bites (using repellents) and chemical prophylaxis. **Social** –revealing and treating sick persons and parasites carriers, sanitary–popularization activity, destruction of mosquitoes of g. Anopheles.

Fighting mosquitoes includes the following directions:

1. *Immediate defense from mosquitoes' attacks* (wearing covering–up clothes, repellents, setting nets on windows of dwelling houses, zooprophylax– is –making biologic barriers (cattle–breeding farms) between places of mosqui–toes' reproduction and dwelling houses, etc.).
2. *Fighting against winged mosquitoes* – dispersion of insecticides in places of wintering and sleeping of mosquitoes (basements, garrets, cattle yards).
3. *Fighting against larvae:*

d) drainage of small water reservoirs having no economic significance;

e) using toxic chemicals;

f) shading water reservoirs with trees;

g) drainage of mashes, deepening of reservoirs, straightening of riverbeds;

h) dispersion of mineral oils over the surface of water reservoirs; they block stigmas;

i) growing gambusia fish (a biological way).

Toxoplasm. Toxoplasma gondii – is a representative of the Sporozoa class, Coccidia order. It is a pathogen of toxoplasmosis. The disease is common everywhere, 30 % of the Earth population are infected.

Morphological peculiarities (fig. 13): a trophozoit has a semi–lunar shape, sizes of 4–7–2–4 μm.

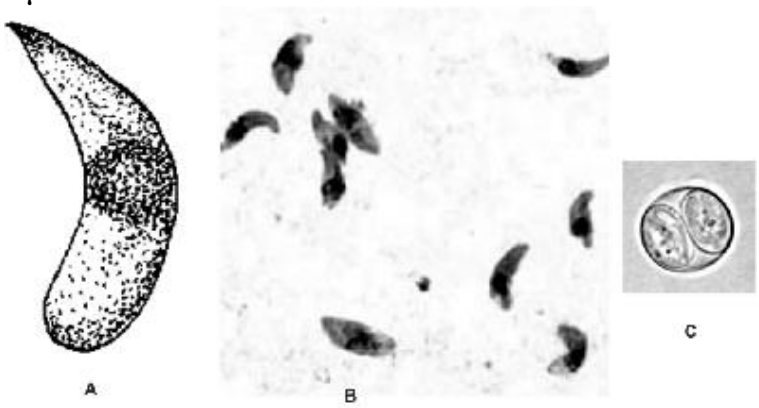

Fig. 13. Morphology of T. gondii:
A – a sketch; B – a trophozoit (7×40); C – an oocyst (7×40)

One of its ends is sharpened, the other is rounded. The body is covered with 2 membranes. The nucleus is large. There is a *conoid* on the sharpened end;it serves for attachment of the parasite to a host's cell.

Development cycle: principal hosts – are representatives of the Feline species (cat, lynx, etc.) (fig. 14).

Intermediate hostsall annimammals, birds and reptiles. Invasion sources: 1) cats, excreting oocysts with sporozoits into the environment; 2) wild and domestic animals, birds and humans excreting tissue cysts with trophozoits in saliva, nose mucus, sperm, feces and milk; 3) meat of domestic animals and wildanimals and birds.

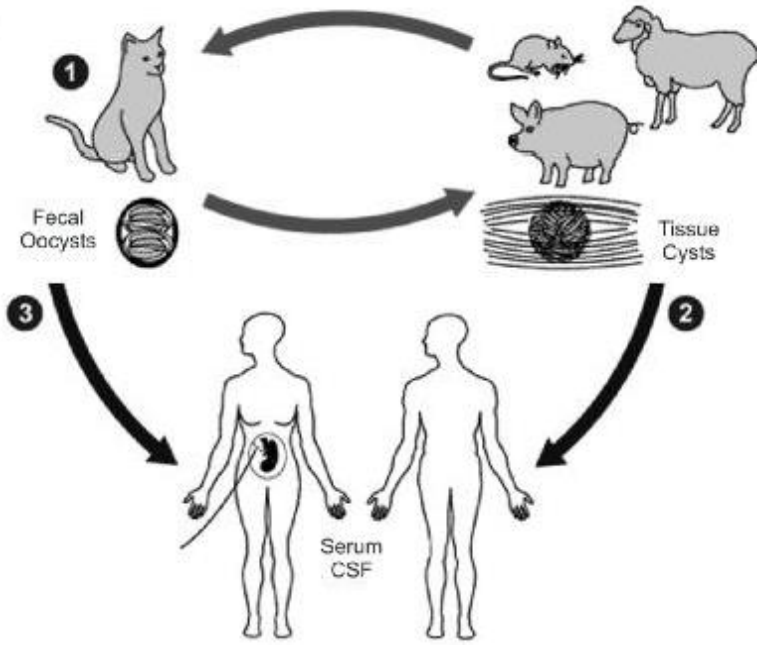

Fig. 14. Life cycle of T. gondii

Mechanisms and ways of transmission:

1) alimentary –through contaminated food of animal origin (meat, milk and eggs);

2) contact – in contact with cats (contamination with oocysts), through the broken skin during processing skins of affected animals;

3) transplacental.

Pathogenic action:

1. *Mechanical* (impairment of cells, hemorrhages in serous membranes, necrotic foci in the liver, spleen, brain).

2. *Toxic– allergic* (poisoning by waste products).

Characteristic symptoms. *Acquired toxoplasmosis* has no symptoms. In people with weakened immunity the disease has symptoms of chronic intoxication: prolonged elevation of temperature to 37,3–37,5 °C, weakness, listlessness, poor appetite, headache, worsening of memory, etc., lymphatic glands are enlarged (cervical, occipital, inguinal).

Congenital toxoplasmosis. If infection occurs during the first months of pregnancy, miscarriages or still–birth may be observed. When infection occurs ata later term of pregnancy, the development of the fetus's brain may be impaired (hydrocephaly), meningoencephylitis develops, sometimes – inflammation of ocular membranes, jaundice, enlargement of the liver and spleen.

Laboratory diagnosis: Immune methods (revealing anti–bodies in the blood of sick people). Sometimes one can reveal parasites in blood smears, punctuates of lymphatic nodes and cerebrospinal fluid.

Prophylaxis: personal – observing rules of hygiene after contacts with cats, eating cooked meat, boiled milk, observing rules of cutting and cooking an imal carcasses. **Social** – protection of the environment and water sources from contamination by animal feces, sanitary–popularization activity. Timely

examination of pregnant women is necessary for prophylaxis of congenital toxoplasmosis.

Basic terms and concepts:

1. Gametogony – development of gametes in a female mosquito body.

2. Gamont (gametocyte) – an ovule of a malaria plasmodium.

3. Shizont malaria – malaria, when the invasive stage is an erythrocyte shizont.

4. Merozoit – a vegetative stage in the Sporozoa development cycle.

5. Merulation – outcome of merozoits from erythrocytes into the blood plasma.

6. Ookinete – a movable zygote of malaria plasmodia.

7. Oocyst – a stage formed from an ookinete on an external surface ofthe female malaria mosquito stomach; it contains sporozoits.

8. Pseudocyst – a tissue cyst that is formed as a result of accumulation of trophopzoits covered with a cellular membrane.

9. Shizont – a life stage of the Sporozoa that is capable of repeated division (*schizogonies*).

10. True cyst – is formed as a result of gametes fusion (copulation).

OPEN TESTS

1. Pathogenic agent of tropical malaria is Pl. ... .

2. Pathogenic agent of quartan is Pl. ... .

3. Stage of the life cycle of malarial plasmodium, invasive for interme–diate host in transmitting way of infection, is called … .

4. Final stage of development of malaria pathogenic agent in the human organism is called ... .

5. Tape–like shizont are characteristic of Pl. ... .

6. Semi–lunar gamonts are characteristic of Pl. ... .

7. Specific formation on the arrow–headed end of toxoplasma, providingthe parasite fixation to the host's cell, is called ... .

8. Main hosts of toxoplasma are representatives of the family ... .

9. Invasive stage of toxoplasma for the main host is ... and ... .

10. Invasive stage of toxoplasma for intermediate hosts are ... and ... .

CLOSE TESTS

1. Sequence of stages of the malaria development in preerythrocyte schizogonies is: a) sporozoits → blood schizonts → tissue schizonts → tissue merozoites; b) sporozoits → tissue schizonts → blood schizonts → tissue merozoites; c) sporozoits → tissue schizonts → tissue merozoites;

d) blood schizonts→ sporozoits → gametocytes; e) sporozoits → blood schizonts → tissue schizonts → gametocytes.

2. Sequence of stages of the development in erythrocytic schizogonies is: a) ring–shaped schizont → amoeboid schizont → gametocyte → rounded schizont → blood merozoite; b) rounded schizont → blood merozoite → game– tocyte → ring–shaped schizont → amoeboid schizont; c) amoeboid schizont → ring–shaped schizont → rounded schizont → gametocytes → blood merozoite; d) ring–shaped schizont → amoeboid schizont → rounded schizont → blood me–rozoite → gametocyte; e) gamentocyte → rounded schizont → ring–shaped schizont → amoeboid schizont → blood merozoite.

3. Sequence of gametogonium stages in man malaria agent is: oocytes → gametocyte → macro– and microgametes → zygote → ookinete gametocytes→ macro– and microgametes → zygote → ookinete; c) macro– and microgametes → ookinete → zygote → gametocytes; d) macro– and micro–gametes → zygote →ookinete → gametocytes; e) gametocytes → zygote → ookinete → macro– and microgametes.

4. Sequence of sporogonium stages of malaria agent in man is:

a) micro– and macrogamete → ookinete → oocyte → sporozoites → tissue mero–zoites; b) ookinete → oocyte → sporozoites → tissue merozoites; c) oocyte → sporozoites →tissue merozoites; d) oocyte → ookinete → sporozoites e) oocyte → sporozoites.

5. Sequence of symptoms exhibiting during an malaria attack is: abundant perspiration → chill → fever; b) chill → abundant perspiration → a fever; c) fever → chill → abundant perspiration; d) chill → fever → abundant perspiration; e) fever → abundant perspiration → chill.

PHYLUM PLATHELMINTHES, CLASS TREMATODA

1. General characteristic and classification of the phylum.

The number of species: 15 000. Style of life: free living and parasites (suckers, tape–like).Characteristic features of the **phylum**: 1) 3–layers (the development of 3 germinal layers); 2) double–sided (bilateral) symmetry of the body); 3) elongated, flattened body; 4) dermato–muscular sac; 5) absence of a body cavity; 6) organ systems: digestive, excretory, nervous and genital.

The dermato–muscular

sac consists of a dermal epithelium (tegument), 3 layers of smooth muscles (ring, longitudinal and diagonal) are beneath it. **The digestive system:** 2 departments – a front intestine (mouth, pharynx) and a middle intestine locked blindly. Tape worms have no digestive system. The excretory system is of a pronephric type. The nervous system: a paralymphoid nervous ring, supra–pharyngeal and sub–pharyngeal ganglia, longitudinal nervous trunks, the lateral ones being most developed. The tactile organs and organs of chemical senses are developed. The majority of species are **hermaphrodites**. Interspaces between organs are filled with the parenchyma. The phulum includes 3 classes: Cilia worms (*Turbellaria*), Flukers (*Trematoda*) and Tape worms (*Cestoidea*).

2. Progressive organization features of suckers and features of adaptability to a parasitic style of life.

The body of flukers is leaf–like from 2 to 80 mm long. Fixation organs are located on the abdominal side – a mouth and abdominal sucker. The tegument defends the parasite from digestion in the host's organism. The majority of flukers are hermaphrodites. A male sexual system: branching or compact testicles, semen ducts, ejaculating canal, cirrus. A female sexual system: an unpaired ovary, uterus, vitelline gland, ootype, special glands (Mellis' bodies). Flukers have complex development cycles; produce thousands and tens of thousands of eggs daily. An asexual reproduction of larval stages is called polyembryony.

3. Peculiarities of development cycles in trematodas.

Principal hosts: vertebrate animals and humans, **intermediate hosts** – fresh–water mollusks (1st host), fish, cancroids, crabs (2nd host).A sex–mature stage of suckers – *marita* – lays eggs in the organism of the principal host (fig. 15).

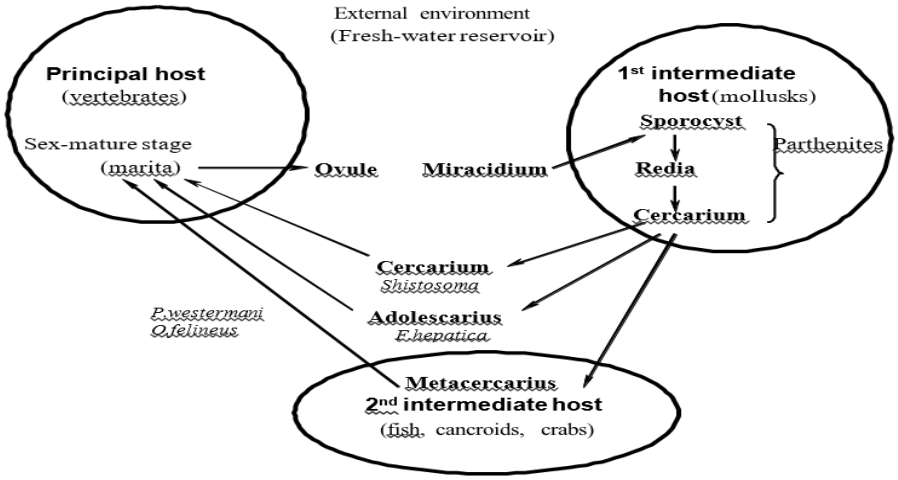

Fig. 15. Diagram of the flukers' life cycle

The egg should get into water for further development. The egg givesa larva – a miracidium. The miracidium swims in water and permeates the intermediate host's body – a mollusk, where it undergoes sporocyst stages during which a redia generation develops; and in redia – a generation of cercaria. They leave the mollusk's body and freely swim in water. A dormant stage of cercaria on water plants is adolescercarium. The majority of species of trematodas have the **2nd supplementary host** (fish, craw–fish and crabs). Cercaria permeate its body by a sharp style and transforms into *metacercaria*. For a principal host (a human) invasive stages can be *metacercaria, adolescercaria or cercaria*.

Diseases caused by flukers are called **trematodoses**.

4. Liver fluker.

Fasciola hepatica – a biohelminth, pathogen of fasciolasis. The disease is common everywhere.

Morphological peculiarities: the shape is leaf–like; 3–5 cm in length,2 suckers – a mouth and abdominal one. Intestinal canals are rather branched. Behind the abdominal sucker is a uterus, and beneath it – a branches ovary, on the body sides –viteline gland, in the middle part –testicles (fig. 16).

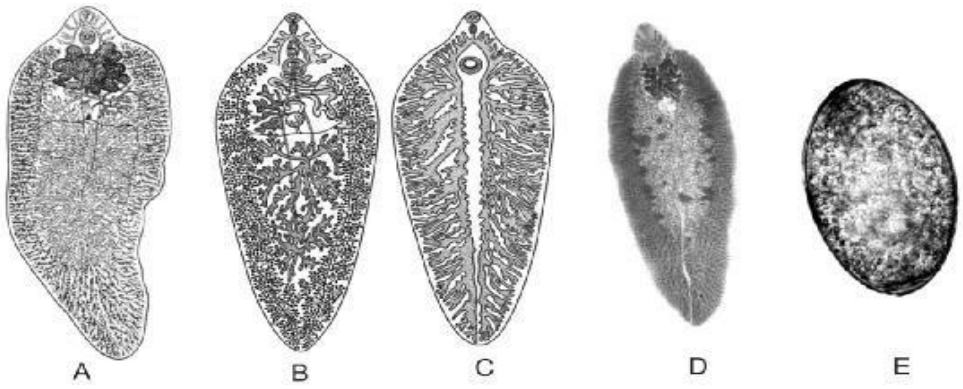

Fig. 16. Morphological peculiarities of F. hepatica:

A – a sketch of the parasite's structure; *B* – the genital system structure; *C* – the digestive system structure; *D* –F. hepatica (magnifier); *E* – an egg of F. hepatica (7×40)

Development cycle: principal hosts –herbivorous animals, sometimes a human. An intermediate host – a mollusk (Limnea truncatula). Life cycle stages: marita – egg – miracidium – sporocyct – redium – cercarium – adolesca–rium. The human is infected while drinking water from stagnant water reservoirs or eating improperly washed vegetables and greenery, which may have adolescercaria on them. In the intestines the membrane of adolescertcaria is dissolved, parasites permeate into the liver through the portal vein or through the intestinal wall into the abdomen, and then – into the liver.

Pathogenic action:

1. *Mechanic* (destruction of hepatic cells and obstruction of bile ducts). Liver cirrhosis develops in intensive invasion.

2. *Toxic– allergic* (poisoning by waste products).

3. *Feeding on the host and metabolic impairments* (absorption of nutrients and vitamins).

Characteristic symptoms: pains in the right hypochondrium, nausea, vomiting, jaundice of scleras, indigestion, weakness, headache, skin itching, rash and fever. The liver is enlarged, dense and painful. Complications: inflammation of bile ducts, liver abscess, jaundice.

Laboratory diagnosis: revealing of eggs in feces or duodenal content. Eggs are large (135 × 80 μm), oval and yellowish–brown, there is a lid on one of the poles. Eggs (transit) may be revealed in healthy people after eating liver of animal sick with fasciolasis. Immune examination is effective.

Prophylaxis: not to use water for drinking and watering vegetable gardens from open reservoirs; to wash vegetables thoroughly; to reveal and treat sick persons, sanitary popularization activity, sanitize animals, provide protection of water reservoirs from contamination with feces of sick animals and people.

5. Cat liver fluke.

Opisthorchis felineus – a biohelminth, pathogen of opisthorchiasis. The disease is common in Siberia along the banks of large rivers. Some foci occur in Belarus and other countries.

Morphological peculiarities: the body length is 10 mm. There is a uterus in its middle part, then – a rounded ovary and a bean–like semen–receiver.

There are 2 rosette–like testicles in the back part of the body, and between them is an S–shaped canal of the excretory system. The middle intestine canals do not branch; viteline glands are located on both sides of the body (fig. 17).

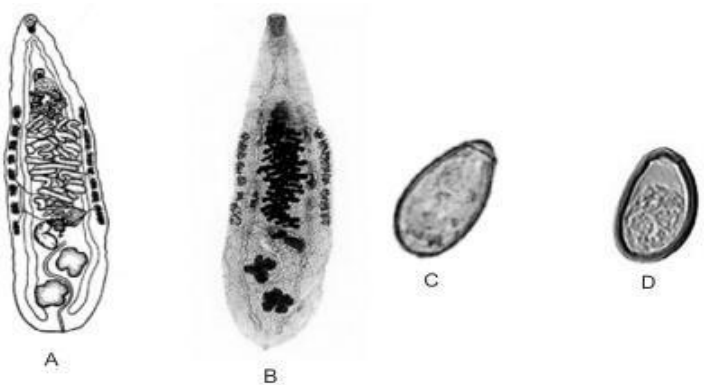

Fig. 17. Morphological peculiarities of O. felineus:
A – a sketch of the marita's structure; B – a marita (×20); C – a sketch of the egg structure; D – an egg (7×40)

Development cycle: principal hosts – the human, cat, dog and other fisheating animals. The first intermediate host –fresh water mollusks (Bithynia leachi), the 2nd –fresh water fish, of Life cycle stages: marita – egg – miracidium – sporocyst – redium – cercarium – metacercarium. Infecting of the humanoccurs in eating undercooked fish, containing metacercaria. Maritas are localized in the liver and pancreas of a principal host.

Pathogenic action:

1. *Mechanic* (injury of the walls of bile ducts and their obstruction by suckers, impairment of the liver and pancreas).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding at cost of the host and impairment of metabolic processes.*
4. *Mutagenic* (The primary liver cancer is often the case).

Characteristic symptoms: severe pains in the right hypochondrium (in the liver area), worsening of appetite, nausea, vomiting, indigestion, weakness, headache. The liver is enlarged.

Laboratory diagnosis: revealing of eggs in feces or duodenal content. Eggs are 26–30 × 10–15 μm in size, of yellowish–brown color, oval, there isa lid on one pole. Immunological methods –revealing anti–bodies in the blood serum.

Prophylaxis: eating properly boiled, fried or salted fish; observing the rules of salting fish, revealing and treating sick persons, protection of water from contamination with feces of animals and people, sanitary–popularization activity.

6. Lung fluke.

Paragoniums westermani – a biohelminth, pathogen of paragonimosis. The disease is common in the South–Eastern Asia and South Asia, Central Africa and South America.

Morphological peculiarities: the body shape is egg–like, a bit flattened ina dorsal–ventral department; the length is 7,5–12 mm (fig. 18).On the sides froman abdominal sucker a lobular ovary is on one side, and the uterus –on the other.

Viteline glandsare located in lateral parts of the body. Backward from the uterus and ovary are 2–blade testicles.

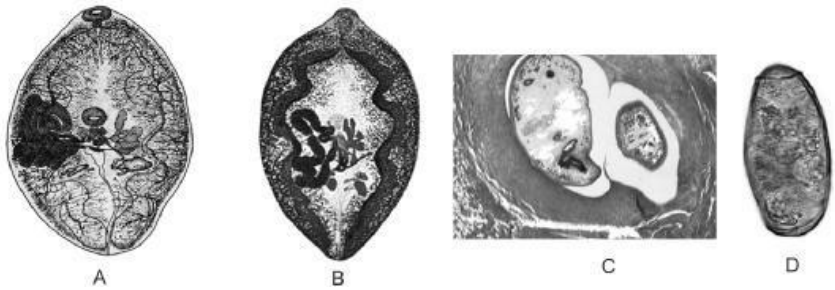

Fig. 18. Peculiarities of P. westermani morphology:
A – a marita structure sketch; *B* – a marita (×20); *C* –parasites in the lung tissue; *D* – an egg (7×40)

Development cycle: principal hosts – a human, dog, cat, pig and other mammals. The 1st intermediate host –fresh water mollusks of g. Melania, the 2nd – craw–fish and crabs. *Life cycle stages*: marita – egg – miracidium – sporocyst – redium – cercarium – metacercarium. Infecting of the human occurs while eating craw–fish and crabs having metacercaria. In the gastro – intestinal tract of the host parasites are released of their membranes, permeate into the abdomen through the intestinal wall, and then through the diaphragm – into the pleura and lungs. Localization of a marita –small bronchi, where cavities are formed around parasites; they are filled with exchange products and tissue decay. Eggs are excreted into the environment with mucous discharge or feces.

Pathogenic action:

1. *Mechanic* (injury of the intestinal wall, diaphragm, pleura and lungs).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding on the host's organism and impairment of metabolic processes.*

Characteristic symptoms: chest pains, breathlessness, cough with purulent sputum and sometimes with blood, elevation of temperature, headache. Complications: cardio–pulmonary insufficiency, brain abscesses, meningoencephalitis.

Laboratory diagnosis: revealing eggs in the sputum or feces. Eggs are large (up to 100 μm), oval, of yellowing color, with a lid and a thick membrane.

Prophylaxis: not to eat craw–fish and crabs improperly cooked; sanitary–popularization activity, protection of water reservoirs from contamination by feces of humans and animals, revealing and treating sick persons.

7. Blood flukers.

Schistosomes (blood flukers) inhabit countries with a tropical and sub–tropical climate. In humans one can meet: Schistosoma haematobium; S. japonicum: S. ***Mansoni. S. haematobium*** – is a pathogen of a urogenital schistosomosis (bilgariasis). ***S. Mansoni*** – is a pathogen of an enteric schistosomosis.

S. japonica – is a pathogen of a Japanese schistosomosis (Katayama disease) – a variety of an enteric schistosomosis with severe affections of the intestines, liver, sometimes CNS.

Morphological peculiarities: have separate sexes, a male's body is short and broad (10–15 mm), a female's one up to 20 mm (fig. 19). The female takes place in the gynecofornous canal on the abdominal side of the male. Males have a developed abdominal sucker, which ensures a reliable fixation to the walls of blood vessels.

Development cycle: principal hosts – the human and various mammals, intermediate hosts –fresh–water mollusks. Life cycle stages: marita – egg – miracidium – sporocyst I – sporocyst II – cercarium. Maritas are localized in veins of the abdominal cavity and human urogenital system. Females lay eggs in the vascular lumen of the bladder walls, intestines. Eggs have sharp thorns, which help them get into the organ lumen and then into water, and develop in the mollusk's body. Cercaria leaves mollusks and actively implant into the human skin during bathing, working in water, drinking water from open reservoirs. Clothes do not protect from permeation of cercarias. In the organism cercarias migrate through lymphatic and blood vessels into the right atrium, right ventricle and then to the lungs, further – into veins of mesentery, intestines, urogenital system.

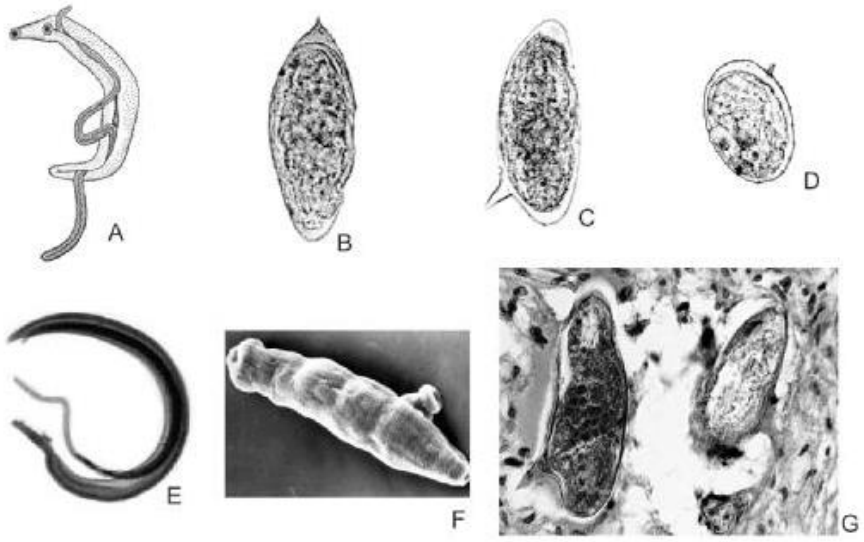

Fig. 19. Morphology peculiarities of schistosomosis pathogens:
A – a sketch of the marita structure; B – an egg of S. haematobium (7×40); C – an egg of S. Mansoni (7×40); D – an egg of S. japonicum (7×40); E –maritas (×20); F – a schisto–somule (7×40); G – an egg of S. Mansoni in the wall of the in testiness (7×40)

Pathogenic action:

1. *Mechanic* (walls injury of the urogenital system and intestines by eggs).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding on the host's organism and impairment of metabolic processes* (absorption of nutrients, vitamins, corpuscular elements of blood).
4. *Mutagenic* (provoke cancerous diseases of the bladder, urinary ducts and intestines).

Characteristic symptoms: dermatitis, itching at the site of cercaria invasion. In the migration period of young schistosomes there appears cough with mucus and hemoptysis, symptoms of bronchial asthma on the background of general malaise, headache, weakness and lowered appetite.

Characteristic signs of a urogenital schistosomosis are: disuria (impairment of urination) hematuria (excretion of blood at the end of urination), painful urination.

Characteristic signs of an **enteric** schiostosomosis are: pains in the abdomen, irregular stool, the presence of blood and mucus in feces, diarrhea, edema of lower extremities and the abdomen.

Laboratory diagnosis: revealing eggs of S. Mansoni and S. japonicum in feces and bioptates of the intestinal mucous membrane; eggs of S. haematobium in urine and bioptates of the bladder mucous membrane. Immunological methods are used.

Prophylaxis: not to bathe, wash, not to drink, not to use water for domestic needs, which contains cercaria; revealing and treating sick persons, protection of water reservoirs from contamination with urine and feces, sanitary–popularization activity.

8. Biological bases of prophylaxis of trematodosis.

It is a complex of measures that are based on studying biology of the pathogen, migration ways, development stages, biology of intermediate hosts that give a possibility to interrupt some link of the parasite development cycle.

Basic terms and concepts:

1. Adolescarium – a dormant larval stage of the liver sucker.

2. Dermo–muscular sac – a body wall of flat worms that is formed by tegument and 3 layers of smooth muscles.

3. Marita – a sexually mature stage of flukers.

4. Metacercarium – an invasive stage for a final host in the development cycle of flukers.

5. Miracidium – the 1st larval stage in the flukers development cycle.

6. Redium – a larval stage of flukers in the organism of the 1st interme diate host.

7. Sporocyst – a larval stage of flukers. That develops in the organism of the 1st intermediate host from a miracidium.

8. Tegument – an external layer of a dermato–muscular sac of flukers.

9. Cercaria – a mobile larva of the fluker that is excreted from the mol lusk's organism into water.

OPEN TESTS

1. Metacercaria, adolescaria or cercaria of flukes for the final host are ... .

2. Fluke, in the hindquarter of which 2 rosette–like testicles are situated, between which an shaped curved secretory channel passes, is called ... .

3. Life cycle of Cat liver fluke includes stages: egg □ miracidium □ sporocysts □ redia □ ... □ metacercarium.

4. Fluke, which is egg–shaped and has an abdominal sucker somewherein the middle of the body, is called ... .

5. Larva of Paragonimus westermani, which is an invasive stage forthe final host, is called ... .

6. Special fillet for the localization of a female schistosome in a male schistosome is called ... .

7. Life cycle of schistosomes includes stages: egg miracidium spo–rocysts I ... cercarium.

8. Larva of schistosomes, invasive for the final host, is called ... .

CLOSE TESTS

1**. The Female sexual system of fluks includes:** a) spermaries, ovaries and uterus; b) ovaries, yolk glands and cirrus; c) ovaries, uterus, yolk glands and spermatheca; d) ovaries, spermatic vessels and uterus; e) an ootype, cirrus and yolk glands.

2. The First mediate hosts of flukes are: a) man and monkeys; b) cattle stock; c) cats and dogs; d) molluscums; fish, e) fishes, shrimps and crabs.

3. The Second mediate hosts of flukes are: a) may not be present;

a) cattle stock; c) wild boars and house pigs; d) molluscums; e) fish, shrimps and crabs.

4. Laboratory diagnostics of fascioliasis is based on: a) detection of eggs in the phlegm and urine; b) detection of eggs in duodenal contents and excrements; c) immunoligical methods; d) radiological examination of the liver and pancreas; e) detection of maritas in excrements and duodenal content.

5. Methods of laboratory opistorchosis diagnosis are: a) Fulleborn and Kalantarjan; b) Gorachev; c) twistings by Schulman; d) native and thick blood film with cellophane; e) a sticky tape.

6. Laboratory diagnosis of a paragonimiasis is based on: a) detection of eggs in excrements and urine; b) detection of eggs in excrements and sputum;

b) detection of larvas in excrements and sputum; d) detection of marits in the lung and liver; e) immunologic methods and roentgenoscopic examination of the lungs.

7. In urinogenital schistosomosis: a) the mesentery veins and the wall of the small intestine; b) veins of the uterus and the top third of the vagina; veins of the bladder and prostate; d) veins of the large intestine; e) veins of the lungs – are damaged.

8. In Menson schistosomosis: a) veins of the mesentery and the intestine; b) veins of the uterus and the vagina; c) veins of the bladder; d) the system of the portal vein of the liver and the liver itself; e) the brain – are damaged.

PHYLUM PLATHELMINTHES, CLASS CESTOIDEA

1. Characteristic of the class of tape worms, adaptability features to parasitism.

There are 1800 species of endoparasites, their body is flattened in a dorsal–ventral direction, looks like a tape. Sizes from 1 mm to 10–18 m in length. At the front end is a head (*scolex*) with fixation organs: *suckers, a proboscis with hooks, bothria*; then goes a neck, then a body (*strobila*) consisting of segments

(*proglottid*). New proglottids detach themselves and come outside. An external layer of the dermato–muscular sack, *tegument*, has hair–like growths (*microthrichia*) that absorb nutrients from the host's intestines. The digestive, circulation and respiratory systems are absent. The excretory system is presented by protonephridia. The nervous system and sense organs are poorly developed. Cestodes are hermaphrodites. In proglottids, beginning with the neck, there develops a male sex system at first, then a female one (hermaphroditic segments in the middle of the strobila); in mature segments (at the end of the body) there stays a uterus filled with eggs. In tenia the uterus is closed, in Diphyllobothria –open.

2. Peculiarities of development cycles in tenia and Diphyllobothria.

Types of finnas. The larva of an oncosphere (a 6–hooked round–shaped germ) develops in the egg. In the intestines of an intermediate host the oncosphere comes out of membranes, permeates into blood vessels using hooks, is carried to tissues and organs and transformed in to a *finna* (fig. 20).

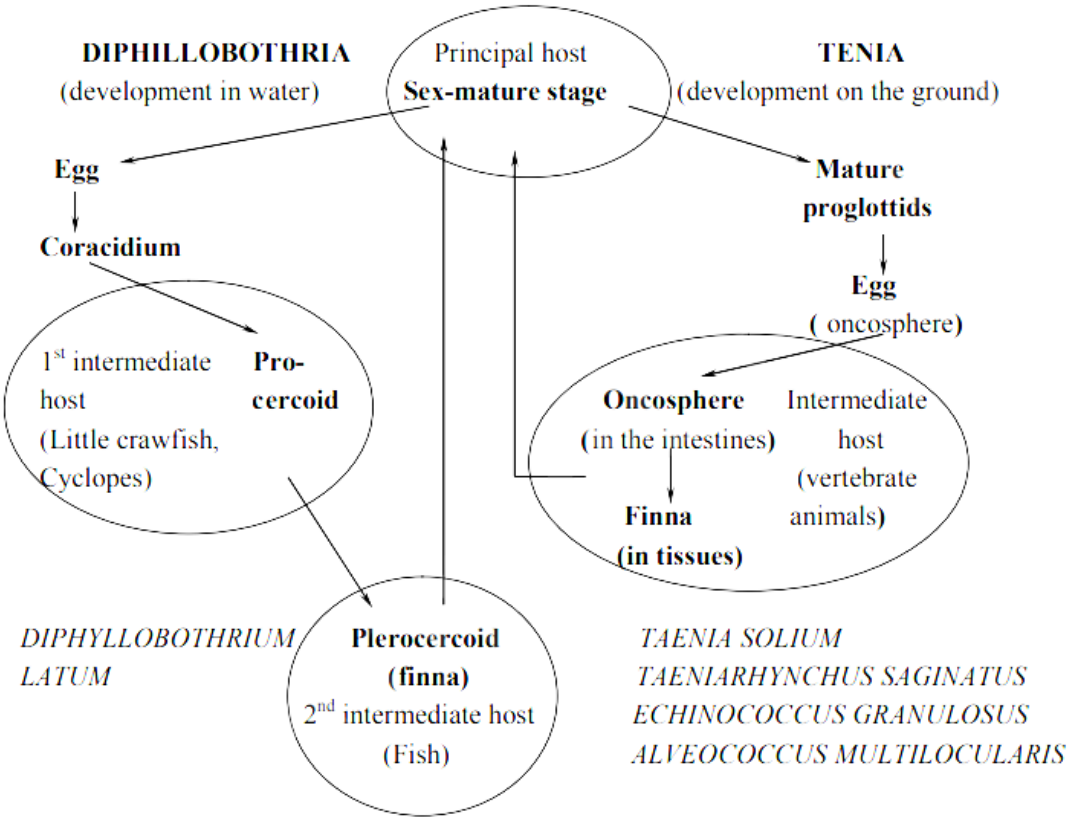

Fig. 20. Diagram of development cycles of cestodes

A cysticerc is a bladder–like finna filled with fluid, inside of which one scolex is screwed. The *coenurus* is a bladder with several screwed heads *A cysticer– coid* has a widened part with a screwed skolex, and behind – a caudal appendix.An *echinococcus* – is a finna as a large mother bladder with daughter and granddaughter bladders, inside of which are skolexes. A *plerocercoid* is a worm–like larva with two bothria. Finnas develop into an adult individual in the intestiness of final hosts. Under the action of digestive juices the skolex

screws outside, attaches to the intestinal wall, and proglottids start detaching themselves from the neck. Diseases caused by cestodes are *cestodoses*.

3. Taenia solium and Taeniarhynchus saginatus.

Taeniarhynchus saginatus – is a biohelminth, a pathogen of teniarhynchosis. The disease is common everywhere.

Morphological peculiarities: the length of a sexually mature parasite is 4–10 m. There are 4 suckers on the skolex. Hermaphrodite progottids have a double–lobular ovary, viteline glands are located under it; vesicle–like testicles – in lateral parts of a proglottid. The uterus in sexually mature segments contains 17–35 side branches and contains up to 175 000 eggs (fig. 21). Mature segments may crawl out of an anal opening and move along the human body andlinen.

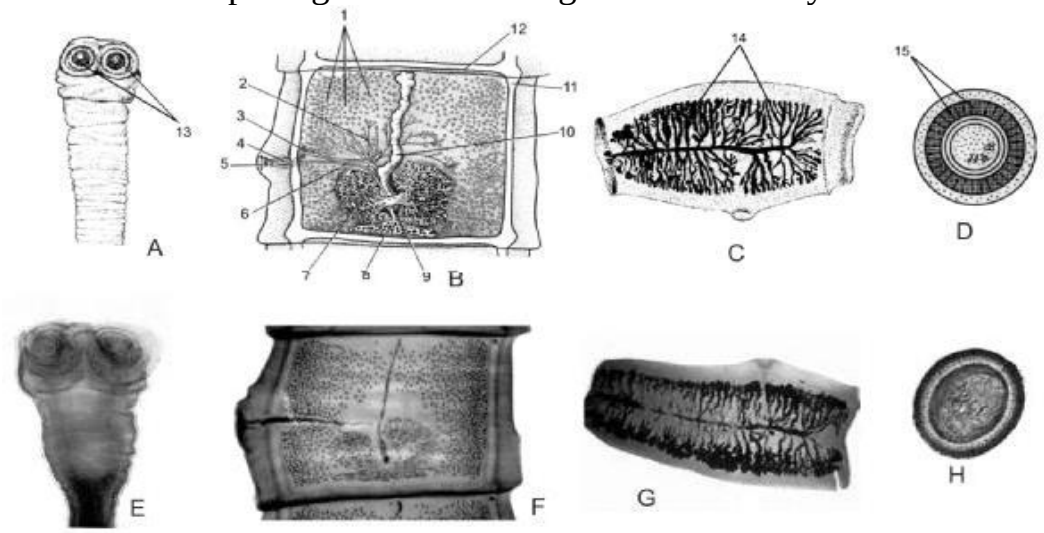

Fig. 21. **Morphology of Taeniarhynchus saginatus:**
A–D –sketches, *E–H* – microphotographs: *A, E* –skolexes, *B, F* – hermaphrodite progloditts, *C, G* – mature proglottids, *D, H* – eggs: *1* – testicles; *2, 3* – semen ducts; *4* – cirrus; *5* – sexual cloaca; *6* – vagina; *7* – ovary; *8* – viteline gland; *9* – ootype; *10, 14* – uterus; *11, 12* –excretory canals; *13* – suckers; *15* – radial banding

Development cycle: a principle host is a human, an intermediate one – cattle that get infected while swallowing eggs of tenia with grass. The human gets infected while eating undercooked beef with finnas (cysticercs). The life span of tenia in the human organism is up to 25 years.

Pathogenic action:

1. *Mechanic* (by irritation of the intestinal mucous membrane by suckers).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding on the host's organism and impairment of metabolic processes.*

Characteristic symptoms: itching around the anus, pains in the abdomen, unstable stool, weakness, impairment of appetite, loss of weight.

Laboratory diagnosis: revealing segments or eggs in feces. Eggs are rounded, have a double– contour lined thick membrane, inside they contain a 6–hooked oncosphere.

Prophylaxis: personal – not to eat untested beef. **Social** – making a veterinary expertise of cattle carcasses, revealing and treating sick persons,

protecting pastures from contamination with human feces, building sanitary facilities in settlements (closed toilets in rural areas), sanitary–popularization activity.

Taenia solium – a biohelminth, causes teniasis in the human (a sexually mature form) and cysticercosis (a larval form).

Morphological peculiarities: the length of a sexually mature form is 2–3 m, there are 4 suckers and a proboscis with 2 rows of hooks on the skolex (fig. 22).

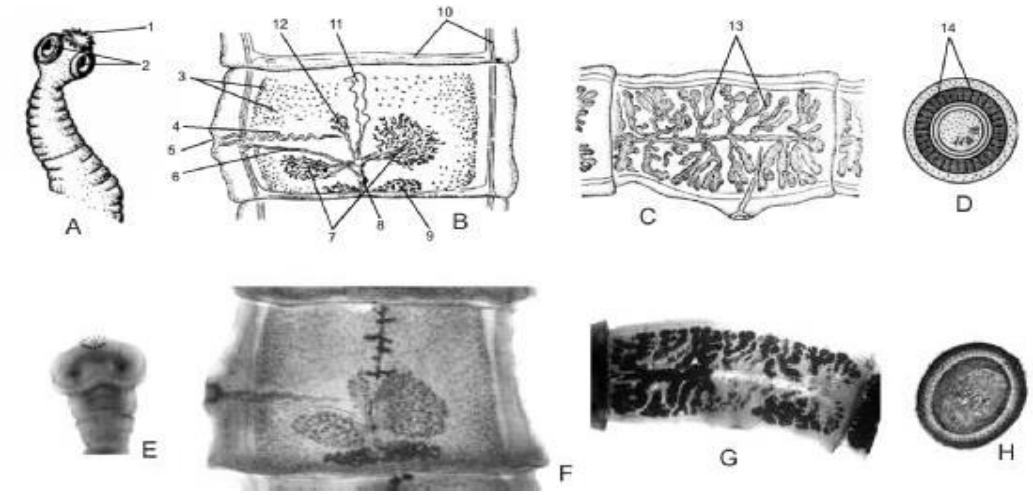

Fig. 22. Morphology peculiarities of Taenia solium:
A–D – sketches, E–H – microphotographs: A, E –skolexes, B, F – hermaphrodite proglottids, C, G – mature proglottids, D, H – eggs: 1 – hooks; 2 – suckers; 3 – testicles; 4 – a semen duct; 5 – a sexual cloaca; 6 – a vagina; 7 – an ovary; 8 – an ootype; 9 –viteline glan; 10 – excretory canals; 11, 13 – uterus; 12 – additional lobe of the pvary;14 – radial lining

A hermaphrodite proglottid contains a 3–lobal ovary. A mature proglottid contains a uterus with 7–12 lateral branches. Mature segments are immobile.

Development cycle: a principal host is a human, an intermediate – domestic or wild pigs, sometimes a human. Getting infected by teniasis occurs while eating undercooked pork with cysticercs. In the intestines under the action of digestive juices a scolex cysterca screws out, fixes itself to the intestinal wall,and proglottids begin detach themselves. In 2–3 months a helminth reaches its sexual maturity. The life span of a tenia is several years.

Pathogenic action is similar to that of Taenia solium.

Characteristic symptoms: pains in the abdomen, nausea, vomiting, indigestion, headache, dizziness.

Laboratory diagnosis: revealing segments or eggs in feces. Eggs of Taeniarhynchus saginatus and Taenia lolium are similar.

Prophylaxis: personal –not to eat untested pork. **Social** – veterinary expertise of carcasses of pigs and wild pigs, revealing and treating sick persons, protection of the environment from contamination with human feces, building sanitary facilities in settlements (closed toilets), sanitary–popularization activity.

Cystercosis. The pathogen of cystercosis is a larval stage of an armed – cysticerc. **The human gets infected with cystercosis**:

1) when neglecting rules of personal hygiene and swallowing eggs which can be on hands and food;

2) in autoinvasion: if a person is ill with teniasis, proglottids may get into the stomach during vomiting, under the action of digestive juice oncospheres are released and in various organs (subcutaneous cellular tissue, muscles, eyes, brain) finnas develop;

3) in treating teniasis with preparations that dissolve proglottids.

Pathogenic action:

1. *Mechanic* (pressure on tissues).

2. *Toxic– allergic* (poisoning by waste products).

Symptoms depend on intensity of infection and localization of cysticercs. Their presence in CNS is accompanied by headaches, convulsion attacks, paralysis of extremities and may even end with a fatal outcome. Intra–ocular cystercosis may cause a complete loss of vision.

Laboratory diagnosis: immunological methods.

Prophylaxis: personal –observing rules of hygiene, **social** –sanitary–popularization activity, revealing and treating sick persons.

4. Dwarf tenia.

Hymenolepis nana – is a contact helminth, a pathogen of hymenolepidosis. Pre–school children fall ill more often.

Morphological peculiarities: the length of a tenia is 1–5 cm, contains about 200 proglottids, there are 4 suckers and a proboscis with a double corolla of hooks on a scolex. The uterus is closed, but a thin wall of proglottids is easily destroyed and eggs come outside into the intestinal lumen (fig. 23).

Development cycle: the human and a principal and intermediate host. Infection occurs in neglecting rules of personal hygiene and swallowing eggs of tenia, from which oncospheres come out in the small intestine. They implant into cilia of the intestinal mucous membrane and transform into cysticercoids. Finnas destroy a cilia, fall into the intestinal lumen, attach to the mucous membrane and in 2 weeks form sexually mature forms. The parasite's life span is 1–2 months. The development of oncospheres is possible without passing into the environment and it leads to autoreinvasion.

Pathogenic action:

1. *Mechanic* (destruction of cilia of a thin intestine, irritation of the mucous membrane by fixation organs of the parasite).

2. *Toxic– allergic* (poisoning by waste products).

3. Feeding on the host's organism and impairment of metabolic processes.

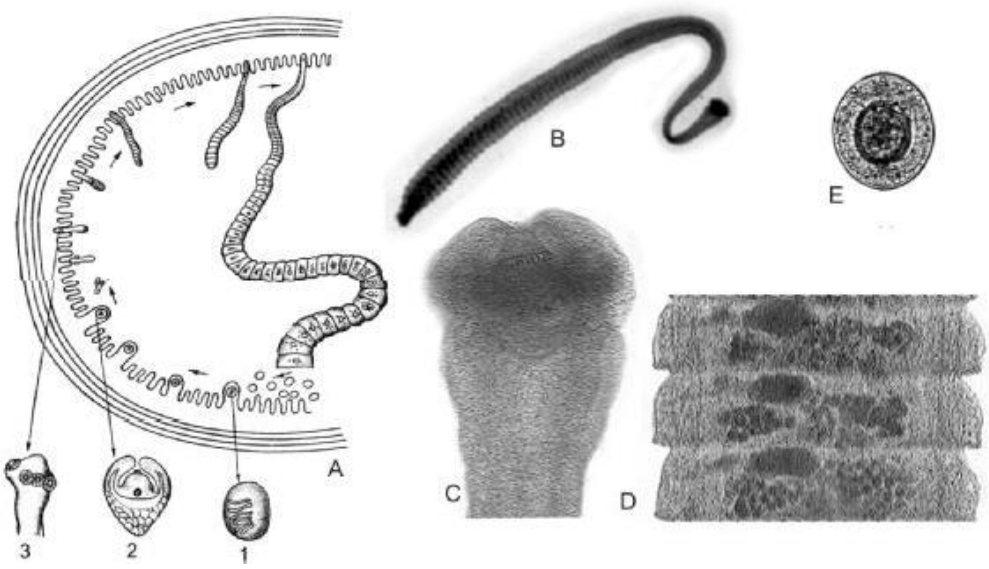

Fig. 23. Morphology of Hymenolepis nana:
A – a development sketch in a small intestine: 1 – an oncosphere; 2 – a cysticercoid; 3 – a skolex; B – a tape form (×20); C – a skolex (7×8); D – mature proglottids (7×8); E – an egg (7×40)

Characteristic symptoms: pain in the abdomen, worsening of appetite, nausea, indigestion, general weakness, irritability; in intensive invasions – vomiting, dizziness, seizures, fainting. Children retard in mental and physical development.

Laboratory diagnosis: revealing eggs in feces. Eggs are rounded with2 translucent membranes, between which pass twisting filaments.

Prophylaxis: personal – observing rules of hygiene. **Social**:

1) cultivating hygienic skills in children;

2) revealing, isolating and treating sick persons;

3) thorough wet cleaning of children's rooms and sanitary treatment of toys;

4) sanitary–popularization activity.

5. Tenia echinococcus and alveococcus.

Echinococcus granulosus – is a biohelminth, a pathogen of echinococcosis.

Morphological peculiarities: the length is 3–5 mm. The skolex has suckers and a proboscis with 2 rows of hooks. The strobila consists of 3–4 proglottids. The last but one proglottid is hermaphrodite, the last one – mature. The uterus is branched, closed (fig.24).

Development cycle: principal hosts – carnivorous animals (dogs, wolfs, coyotes), intermediate ones – the human, herbivorous and omnivorous animals (large and small cattle, pigs, camels, deer, etc.).

Infection of final hosts occurs in eating organs of affected animals. Finnas in the intestines give a great number of sexually mature forms. Mature proglottids of tenia are capable of crawling from the anus and moving on the animal hair scattering eggs. Eggs and proglottids, having got on the grass, are swallowed by intermediate hosts. In the intestines, oncospheres come out of eggs, get into the

blood stream and are carried to various organs (liver, lungs), where a finna develops. The human gets infected from sick dogs while neglecting rules of personal hygiene. There is a possibility to get infected from sheep and other animals, the hair of which contains eggs that have got there from grass or soil.In the human echinococcus affects the liver, lungs, brain, muscles and bones.

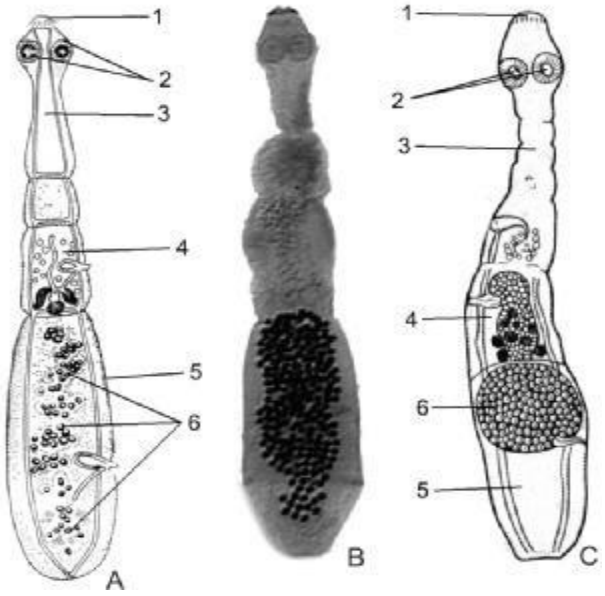

Fig. 24. Morphology of Echinococcus granulosus and Alveococcus multilocularis:
A, B – Echinococcus granulosus; C – alveococcus multilocularis: 1 – a proboscis with2 corollas of hooks; 2 – a sucker; 3 – a neck; 4 – a hermaphrodite proglottid; 5 – a mature proglottid; 6 – a uterus; A, C –sketches; B – a microphotograph (7×8)

Pathogenic action:

1. *Mechanic* (pressure on tissues and destruction of affected organs).

2. Toxic– allergic (poisoning by waste products).

Characteristic symptoms: skin itching and rash, pain and pressure in the right hypochondrium. If a left lung is affected, the patient suffers from pains in the chest, cough, breathlessness, sometimes hemoptysis. The echinococcus bladder may burst into a bronchus, abdominal and thoracic cavity or become purulent. These complications may result in a fatal outcome.

Laboratory diagnosis: is based on an X–ray and immune examination (revealing antibodies in the blood serum).

Prophylaxis: personal –observing rules of hygiene, washing hands after dealing with dogs, sheep, the hair of which can contain eggs of echinococcus. **Social** – dehelminthization of service dogs, never feed them with animals organs affected by echinococcus, killing stray dogs, sanitary–popularization activity.

Alveococcus, Alveococcus multilocularis – a biohelminth, pathogen of aleveococcosis.

Morphological peculiarities: sexually mature forms of echinococcus and alveococcus are similar, but an alvelcoccus has a ball–like uterus; a finna of alveococcus is filled with a jelly–like mass; daughter bladders detach themselves only outside (fig. 41). Alveococcus is called a multichamber echinococcus.

Development cycle: final hosts are carnivorous animals (foxes, dogs, cats, polar foxes). Intermediate hosts – are mice–like rodents, sometimes – the human. The human may get infected through dirty hands after contact with skins of foxes and wolfs, from dogs, while eating contaminated vegetables, forest berries and water.

Pathogenic action is similar to the action of echinicoccus. Alveococcosis has a malignant course: daughter bladders detach themselves outside, proliferate into adjacent tissues (growth as in malignant tumors).

Characteristic symptoms: are similar to those of echinococcus and depend on localization of the parasite.

Laboratory diagnosis: an immunological and X–ray methods.

Prophylaxis is the same as in echinococcosis.

6. Dyphyllobothrium latum – a biohelminth, pathogen of diphyllobothriosis.

Morphological peculiarities: the body length is 10–18 m. There are 2 sucking slots on the skolex –bothria. The size of proglottids in width is larger than in length (fig. 25). Mature proglottids contain an open rosette–like uterus.

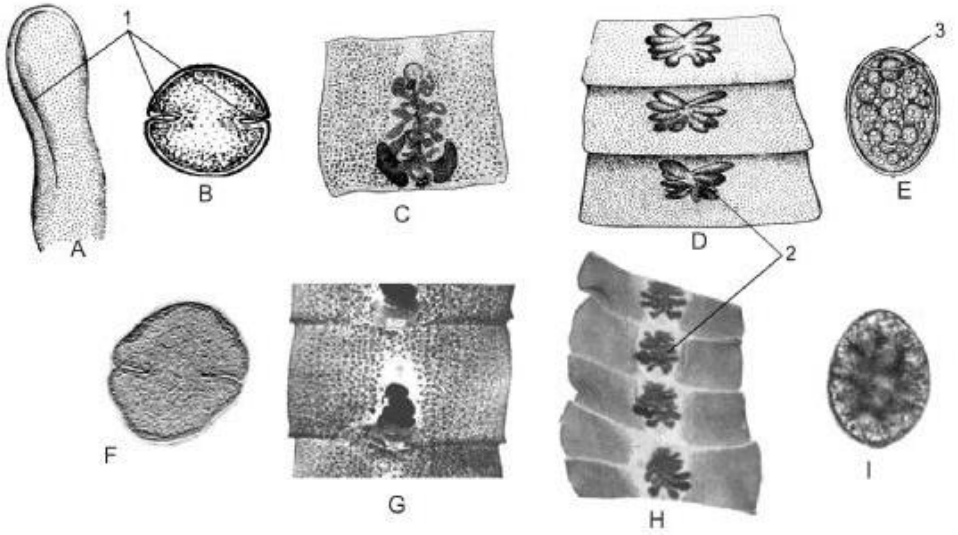

Fig. 25. **Morphology of Diphyllobothrium latum:**
A–E –sketches; *F–I* – microphotographs; *A* – a skolex, *B*, *F* – a transverse section ofthe skolex, *C*, *G* – a hermaphrodite proglottid, *D*, *H* – a mature proglottid, *E*, *I* – an egg:*1* –bothria; *2* – a uterus; *3* – an egg

Development cycle: principal hosts – the human and fish–eating mammals (cats, dogs, polar foxes, bears), the 1st intermediate host – small craw–fish (Cyclops, daphnia), the 2nd –fish, a reservoir host –predator fish. Eggs are excreted with feces out of the organism of a final host. They get into water, where in 3–5 weeks they excrete a larva, *coracidium*. The coracidium is swal– lowed by the 1st intermediate host. The coracidium transforms into a larva in its intestines, a *procercoid*. When a fish swallows a small craw–fish, the procercoid transforms in its muscles and sexual organs into a *plerocercoid*. Principal hosts get infected while eating fish or caviar containing plerocercoids. The life span of Diphyllobothrium in the human organism is up to 25 years. The localization of the parasite is a small intestine.

Pathogenic action:

1. *Mechanic* (injures a mucous membrane of the intestines by bothria).

2. *Toxic– allergic (*poisoning by waste products).

3. *Feeding on the host's organism and impairment of metabolic processes* (selectively absorbs vitamin B_{12}, which results in the development of malignant anemia).

Characteristic symptoms: weakness, nausea, pain in the abdomen, meteorism, subfebrile temperature. Signs of anemia appear: sharp general weakness, sleepiness, dizziness, dyspeptic events. Bright–red spots and fissures appear on the tongue, atrophy of nipples occurs. The skin is pale with a yellowish shade; the liver and spleen are enlarged.

Laboratory diagnosis: revealing eggs and proglottids in feces. Eggs are oval, there is a lid on one pole, on the other – a protuberance.

Prophylaxis: personal –exclusion of raw, half–raw, improperly cooked fish and caviar. **Social** –protection of water reservoirs from contamination with human feces, revealing and treating sick persons, sanitary–popularization activity.

7. Biological bases of cestodoses prophylaxis.

It is a complex of preventive measures that are based on studying the pathogens biology, ways of migration, development stages, biology of intermediate hosts, which gives a possibility to interrupt some link of the parasite development and prevent its further development.

Basic terms and concepts:

1. Biohelminths – worms, the development cycle of which occurs while changing hosts.

2. Bothria – fixation organs of Diphyllobothria.

3. Contact helminthes – worms, whose eggs are transmitted in contact ofa healthy person with a sick one or through domestic objects.

4. Plerocercoid – a finna of a Diphyllobothria latum.

5. A prglottid – a segment of tape worms.

6. Scolex – a head of tape worms.

7. Strobila – a body of tape worms consisting of segments.

8. Cisticerc – a finna of Taeniarhynchus saginatus and Taenia solium.

9. Cysticercoid – a finna of a dwarf tenia.

10. Echinococcus – a tape worm, pathogen of echinococcosis.

OPEN TESTS

1. From class of Tape worms contact helminth is … .

2. Hermaphrodite progottids of Taeniarhynchus saginatus have an ovary, consisting of sections.

3. Mature proglottid of Taeniarhynchus saginatus have. side branches.

4. Taenia solium is characterized by the finna of type.

5. Hermaphrodite progottids of Taenia solium have an ovary consisting of sections.

6. Mature proglottid of Taenia solium have. side branches.

7. Finna of Hymenolepis nana is called ... .

8. Strobilus of Hyminolepis nana contains approximately proglottids.

9. Man is a … host for Echinococcus and alveococcus.

10. Life cycle of Diphylobotrium latum includes the following stages: ovum ... procercoid … plerocercoid … adult individual.

CLOSE TESTS

1. Sequence of tapeworm life cycle stages is: a) ovum → coraci– dium → procercoid → oncosphere → plerocercoid; b) ovum → oncosphere → the Finn; c) ovum → coracidium → procercoid → plerocercoid; d) cercarium →coracidium → procercoid → the Finn; e) procercoid → metacercaria → plero– cercoid.

2. Means of teniasis infestation of man are: a) personal hygiene neglect; b) contacts with teniasis and cysticercosis patients; c) the usage of thermal ly insufficient beef; d) the usage thermally insufficient pork; e) the usage ther– mally insufficient processed fish, shrimps and crabs.

3. Means of cystiercosis infestation of man are: a) swallowing of armed tapeworm eggs neglecting personal hygiene; b) the usage of thermally insufficient pork and beef; c) the usage of thermally insufficient shrimps and crabs; contact with house pigs; e) autoinvasion in teniasis.

4. Pathogenic action of Taeniarchynchus saginatus is: a) brain and a spinal cord lesion; b) toxi– allergic; c) large intestine mucosa irritation; d) small intestine mucosa irritation; e) absorption of nutrients from the host intestine.

5. Diagnostic signs of Taeniarchynchus invasion are: a) bloody fluid stool; b) fever and gastric pains; c) gastric pains, nausea, vomiting; d) difficulty of respiration, a pains in the thorasic cavity; e) liver and spleen enlargement.

6. Invasion alveococci stage for man is: a) ovum; b) oncosphere; c) plerocercoid; d) cysticercoid; e) cysticercus.

7. Means of alveococcosis infestation of man are: a) neglect of person–al hygiene after contacts with sick people; b) neglect of personal hygiene after contacts with carnivores; c) the usage of thermally insufficient pork and beef; d) transmissible; e) the usage of thermally insufficient fish.

PHYLUM NEMATHELMINTHES, CLASS NEMATODA

CLASSES I

1. General characteristic of the phulum of ring worms and the class of ring worms proper.

Over 15 000 species inhabit water, soil, decaying organic substances; many of them have adapted to a parasitic style of life.

Characteristic features of the phulum:

1) they have three layers;

2) a bilateral symmetry of the body;

3) a cylindrical or spindle–like shape of the body;

4) the presence of a dermato–muscular sac and the body primary cavity;

5) the presence of organ systems – nervous, digestive, excretory and genital;

6) they have separate sexes; 7) a posterior intestine and the anus have appeared. The type includes 5 classes. The class of ring worms proper has a medical significance.

Class of ring worms proper (Nematoda). The body is spindle–like, its length is from a mm to 1,5 m, a transverse section presents a circle. The body wall is a *dermato–muscular sac*, consisting of a cuticle, hypoderm and the 1st layer of smooth muscles. The body cavity is primary (*pseudocele*). It contains internal organs. *The digestive system* is divided into 3 departments: anterior, middle and posterior. *The excretory system* is presented by 1–2 cutaneous glands. The function of excretion is also performed by phagocytes. The nervous system consists of a supra–pharyngeal and sub–pharyngeal ganglia, a para–pharyngeal ring and longitudinal trunks. *Sense organs*: tactile and chemical senses.

Nematodas have separate sexes, a sexual dimorphism is marked: males are smaller than females and their back end of the body is spirally screwed on the abdominal side. *The genital system* is tubular. In females it starts with paired ovaries that pass into egg–ducts, then into the uterus and vagina. The sexual sys–tem of males consists of an unpaired testicle, semen duct, ejaculation canal that opens into the posterior intestine. Some species are viviparous. The majority of nematodas are geohelminthes.

Diseases caused by ring worms are called *nematodoses*.

2. Human ascarides.

Ascaris lumbricoides – is a geohelminth, pathogen of ascariasis. The disease is spread everywhere, excluding arctic areas, deserts and semi–deserts.

Morphological peculiarities: the length of a female is 40 cm, of a male –25 cm. The body is cylindrical, sharpened at the ends; on the anterior end of the body are cuticular lips (fig. 26).

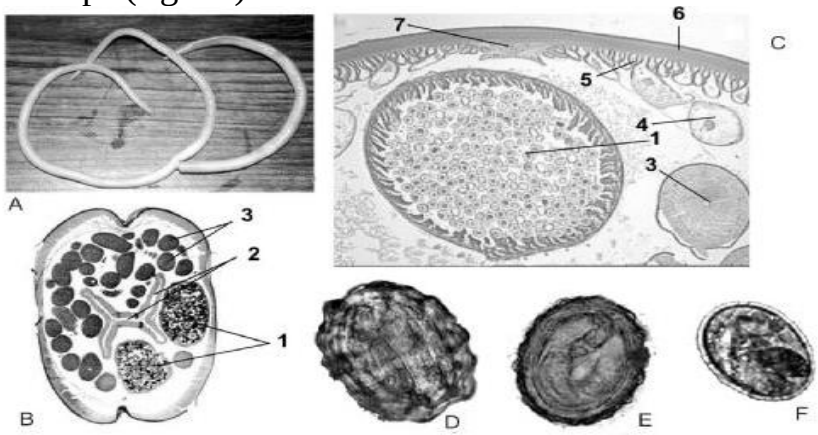

Fig. 26. Morphology of Ascaris lumbricoides:

A – sexually mature helminthes (photograph), B – a transverse section (7×8), C – a fragment of the transverse section in the uterus area (7×40): 1 – the uterus filled with eggs; 2 – a middle intestine; 3, 4 – an ovary; 5 – muscular fibers; 6 – a cuticle; 7 – a hypodermic cylinder; D, E –

fertilized eggs with a larva (7×40); F – an unfertilized egg (7×40)

Development cycle: a sexually mature form is localized in a thing intestine. A fertilized female lays up to 240 000 eggs a day, they are excreted into the environment with feces. In soil, when an optimal temperature is 20–25 °C, humidity is sufficient and oxygen is available, infectiom larva develop in eggs in 21–24 days. Such eggs get into the human organism with unwashed vegetables, fruit and water. In a thin intestine larvae come out of eggs, perforate its wall, get into blood vessels and accomplish a *migration*: They pass through the liver, right atrium, right ventricle with a flow of blood; then they are carried into the pulmonary trunk and alveolar capillaries. Through the capillary walls larvae get into alveoli, ascend into bronchioles, bronchi, trachea and get into the pharynx, are swallowed. In 2,5–3 months they transform into sexually mature forms in a thin intestine. Larval migration lasts about 2 weeks. The life span of mature ascarides is 1 year.

In the human organism larvae of other ascarid species may also migrate (those of the pig, dog, etc.), they cause a syndrome of Larva migrans.

Pathogenic action of ascarid larvae:

1. *Toxic– allergic* (poisoning by waste products).

2. *Mechanic* (injury of the liver, rupture of capillaries, injury of alveoli, eosinophylic infiltrates in the lungs).

3. Feeding on the host's organism and impairment of metabolic processes (absorption of nutrients and vitamins).

4. Mutagenic.

Characteristic symptoms of migrational ascariasis: general weakness, fever, headaches, perspiration, a persistent spastic cough especially at night, itching, skin rash, edema of lids and face.

Characteristic symptoms of enteric ascariasis: pains in the abdomen, nausea, vomiting, diarrhea, worsening of appetite, weakness, irritability, worsening of memory, loss of weight.

Complications of enteric ascariasis: mechanic jaundice, purulent pancreatitis, purulent cholangitis, appendicitis, peritonitis, spastic and mechanic intestinal obstruction. Sometimes ascarides are found in frontal sinuses, cranial cavity, middle ear and ovaries.

Prophylaxis: personal – observing rules of hygiene, thorough washing of vegetables, fruit and berries with hot water. It is necessary to protect food from flies and cockroaches – mechanic transmitters of ascarid eggs. **Social** – revealing and treating sick persons, protection of the environment from contamination with ascarid eggs, sanitary–popularization activity.

3. Human vlasoglav (whipworm).

Trichocephalus trichiurus – a geohelminth, pathogen of trichocephaliasis. The disease is common everywhere.

Morphological peculiarities: the length of a female is up to 5 sm, males are a bit shorter. The anterior end of the body is filament–like, the posterior – is thickened. The esophagous is in the anterior department is, in the posterior one – all other organs (fig. 27).

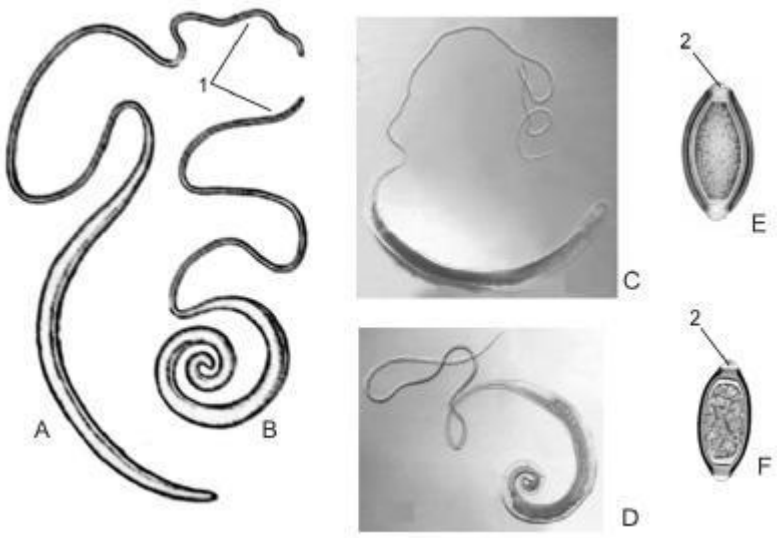

Fig. 27. Morphology of Trichocephalus trichiurus:
A, B, E – sketches; C, D, F – microphotographs; A, C – sexually mature females, B, D – males, E, F – eggs: 1 – an anterior end of the body; 2 – a plug on the pole

Development cycle. A fertilized female lays up to 60 000 eggs a day; they are excreted to the environment with feces. The development of eggs occursin soil. In optimal conditions, when the temperature is 25–30 °C, the humidity is high and oxygen is available, an invasion larva develops in 25–30 days. The human gets infected eating vegetables, fruit and water contaminated with parasite's eggs. In the intestine larvae come out of eggs that in 1–1,5 months transform into sexually mature forms without migration. The vlasoglavs' life span in the human is about 5 years. Parasites are localized in the upper department of a large intestine (mainly in the caecum).

Pathogenic action:

1. *Mechanic* (injury of the mucous membrane of the intestine).
2. *Toxic– allergic* (poisoning by waste products).
3. *Feeding on the host's organism and impairment of metabolic processes* (they «sew» the intestinal mucous membrane by an anterior end and feed on blood).
4. *Mutagenic*.

Characteristic symptoms: pains along a large intestine, irregular stool, meteorism, poor appetite, nausea, vomiting, weakness, headache. *Complications*: anemia, appendicitis and convulsive attacks.

Laboratory diagnosis: revealing vlasoglav's eggs in feces. Eggs havea lemon shape with plugs on the poles.

Prophylaxis: the same as in ascariasis.

4. Seat worms.

Seat worm, Enterobius vermicularis – a contact helminth, a pathogen of enterobiosis. The disease is common everywhere.

Morphological peculiarities: the length of a female is about 10 mm, that of a male – 2–5 mm (fig. 28). There are cuticular swellings – vesicles, and on the posterior part of the esophagus – a ball–like dilation – a bulbus, that take part in fixation of the parasite to intestinal walls.

Development cycle: they are localized in the lower department of a small and in the initial department of a large intestine. After fertilization females crawl out of the anus, excrete an irritating fluid and lay eggs on the skin of the perineum. If the temperature is 34–36 °C and humidity is high (70–90 %), the eggs become infectious in 4–6 hours. The patients scratch itching sites and eggs get under nails, which in the morning are brought into the mouth and scattered on surrounding objects. In the intestines larvae come out of eggs and in 2 weeks reach their sexual maturity. The life span of a seat worm is about a month. Pre–school and junior school children fall ill more often.

Pathogenic action:

1. *Mechanic* (injury of the intestinal mucous membrane).
2. *Toxic–allergic* (poisoning by waste products).
3. *Feeding on the host's organism and impairment of metabolic processes*.

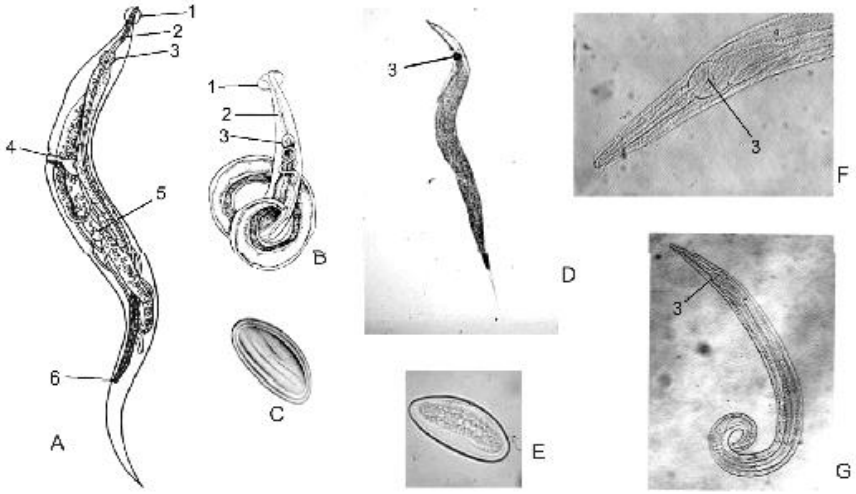

Fig. 28. Morphology of Enterobius vermicularis: A– c –sketches; D–G –microphotographs; A, D, F – a female, B, G – a male: 1 – a vesicle; 2 – the esophagus; 3 – a bulbus; 4 – a genital opening; *5* – the uterus; *6* – the anus; C, *E* – an egg

Characteristic symptoms: itching and a burning sensation around the anus. Itching troubles day and night, becomes unbearable, spreads to the perineum, sexual organs and abdomen. The well–being and sleep of patients becomesworse, there appears irritability, nervous break–downs, diarrhea with mucus, nausea, vomiting, grumbling and flatulence, the progress in studies becomes worse.

Laboratory diagnosis: revealing eggs by a sticky tape. Eggs are colorless, asymmetric, flattened from one side.

Prophylaxis: observing personal hygiene, clean hands and linen. **Social** – cultivating hygienic skills in children, examination of the personnel of pediatric establishments, isolation and treatment of sick persons, systemic wet cleaning of rooms, sanitary treatment of toys, sanitary–popularization work with parents and educators of pre–school establishments.

5. Trichinella.

Trichinella spiralis – a biohelminth, a pathogen of trichinellosis.

Morphological peculiarities: females have sizes of 3–4 mm, males –1,5–2,0 mm. There is an unpaired sexual tube in females. Larvae are screwed like a spiral and encapsulated with a connective tissue (fig. 29).

Development cycle: they parasitize carnivorous and omnivorous animals (pigs, wild boars, cats, dogs, mice, rats, bears, etc.). One and the same organism is at first a principal (sexually mature forms in the intestines) and then an intermediate host (larvae in muscles). Getting infected occurs while eating meat contaminated with larvae (of pork, meat of wild boars, bears, etc.). In a small intestine capsules of larvae are digested, larvae transform in sexually mature forms. After fertilization females implant into the mucous membrane of a small intes– tine and produce living larvae. The larvae are carried over the organism by a flow of blood and lymph, stop in the skeletal musculature. The diaphragm, in– tercostal and masticatory muscles are affected most severely. Larvae get into a muscular fiber and become spiralized. A capsule is formed round larvae, which is calcified in a year. Larvae preserve their vitality in the capsule up to 20–25 years. To transform larvae into sexually mature forms they must get into the intestines of another host. The human is a biological dead end for them.

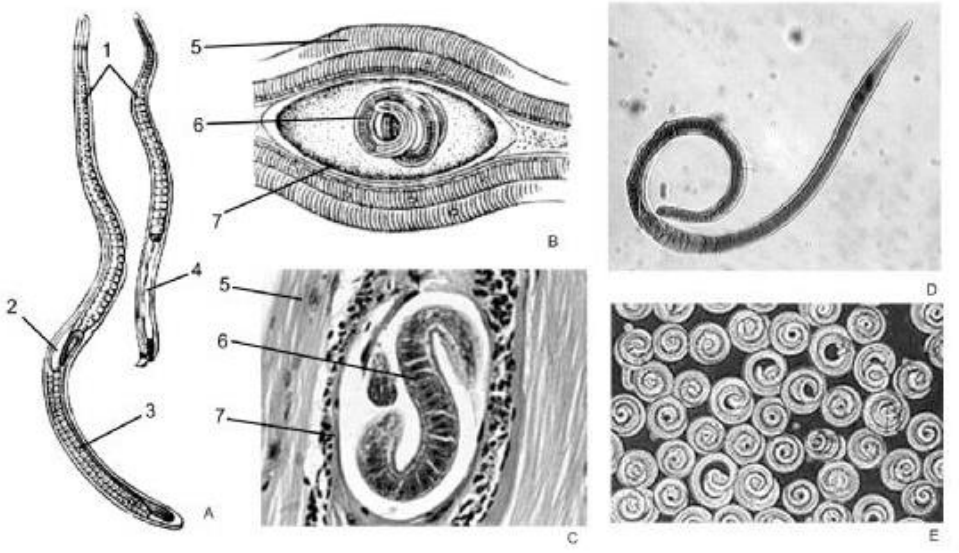

Fig. 29. Morphology of Trichinella spiralis:
A –sexually mature forms (a sketch), B – an encapsulated larva (a sketch), C – an encapsulated larva (7×8): 1 – the esophagus; 2 – the uterus; 3 – an ovary; 4 – a testicle; 5 – a muscular fiber; 6 – a larva; 7 – a capsule; D – a male (7×40); E – decapsulated larvae (7×8)

Pathogenic action:

1.*Toxic– allergic* (poisoning of the organism by waste products and dead bodies decay).

2.*Mechanic* (injury of intestinal walls and muscular fibers).

3.Feeding on the host's organism and impairment of metabolic processes.

4.*Mutagenic*.

Characteristic symptoms: pains in the abdomen, nausea, vomiting, diarrhea. Then allergic rash appears and pain in muscles (ocular, masticatory musclesand muscles of calves, waist and shoulder girdle), the temperature elevates to 40–41 °C, edema of lids and face is noted. Complications: myocarditis, pneumonia, meningoencephalitis, polyneuritis, thromboembolia, etc.

Diagnosis: the clinical picture of the disease (edema of the lids and the face, muscular pains), taking case history (eating untested meat of pigs, wild boars). *Laboratory investigations*: general blood analysis (eosinophilia) and immunological methods, microscopic investigation of bioptates of calves muscles and acromiohumeral muscles.

Prophylaxis: personal – exclusion of untested meat from the diet (thermal preparation of meat does not kill larvae). **Social** –killing rodents being reservoirs of invasion, veterinary control over meat products, zoohygienic keeping of pigs (not allowing them to eat rats), deratization and sanitary–popularization activity.

6. Biological bases of prophylaxis of nematodosis.

It is a complex of prophylactic measures that are based on studying biology of the pathogen, ways of migration, development stages and biology of interme diate hosts, which gives a possibility to interrupt some link of the parasite's development cycle.

Basic terms and concepts:

1. Migration ascariasis – a disease caused by ascarides' larvae.

2. Bulbus – dilation of the esophagus.

3. Vesicule – swelling of a cuticle around the oral opening of a seat worm.

4. Geohelminthes – worms the larvae of which develop in soil.

5. Dehelmithization – a complex of measures to destroy parasitizing worms in the human organism.

6. A capsule is formed by a connective tissue, it protects a trichinella larva from being digested by the host's organism.

7. Migration –movement of a larval stage of ring worms in the human organism.

8. Nematodoses – diseases caused by ring worms.

9. Larva migrans – a syndrome that occurs in migration of larvae of animal ascarides (of pigs, dogs, etc.) in the human organism.

10. Muscular tremor – convulsive trembling of muscles.

CLASSES II

1. Medina.

Dracunculus medinensis – a biohelminth, a pathogen of dracunculesis. Foci of the disease are in Africa, the Near East, South–Western Asia and South America.

Morphological peculiarities: the length of a filament female is 30–150 cm. Viviparous. Larvae come out through ruptures of the uterus and cuticle onthe anterior end of the body. The length of a male is 12–29 cm.

Development cycle: a principal host is the human, sometimes dogs and monkeys. Intermediate hosts – are small craw–fish– cyclops. Sexually mature females are localized in subcutaneous adipose cellular tissue of lower extremi– ties. After fertilization larvae develop (microfilaria). A female approaches with its anterior end to the skin surface, where a bladder 2–7 cm in diameter is

formed and filled with fluid. Then the bladder bursts out. When water gets into a wound, a medina protrudes its anterior end and produces up to 3 million larvae, while it itself undergoes dissolution. Larvae are swallowed by a cyclop. The human gets infected while drinking water from open reservoirs. In the intes–tines cyclops are digested, and microfilaria migrate through its wall and by blood and lymphatic vessels into the subcutaneous cellular tissue of lower extremities. They reach their sexual maturation in 10–14 months after infection.

Pathogenic action:

1. *Mechanic* (larvae injure intestinal walls, females –subcutaneous cellular tissue).

2. Toxic– allergic (poisoning the organism by waste products and decay of dead parasites).

Characteristic symptoms: erythema, thickening of the skin, pains in the extremities, movement impairment, vesicles and ulcers at the site, where the helminth comes out on surface. When vesicles burst, fever, diarrhea, urticaria and vomiting are noted.

Laboratory diagnosis: is not needed (the parasite is well seen as twisted subcutaneous rollers).

Prophylaxis: personal –usage of unboiled and unfiltered water should be excluded in foci of dracunculesis. **Social** –revealing and treating sick persons, protection of water sources from contamination, sanitary–popularization activity.

2. Duodenal assassin worm.

Ancylostoma duodenale – a geohelminth, a pathogen of ankylostomiasis.

The disease is spread in countries with a subtropical and tropical climate.

Morphological peculiarities: a female is 10–13 mm in length, a male –8–10 mm. There is a funnel–like mouth capsule with 4 cuticular teeth on the head part (fig. 30).

Development cycle: adult forms are localized in the duodenum. After ferti lization the female lays eggs that get into the environment with feces. Under op timal conditions in a day, non– infectious (rabdit) larvae come out of eggs in the soil. After several sloughing they transform into infectious (filarial–like) larvae (fig. 31).

Infecting of the human occurs: 1) in active permeation of larvae through the skin, 2) through the mouth with contaminated food and water, 3) intrauterinely by a hematogenic way through the placenta. Having permeated through the skin larvae accomplish a migration: they are carried to the heart, lungs with blood, pass through alveolar walls and get into the respiratory tract, ascend to the pharynx, are swallowed and reach the duodenum. If a larva gets to the human organism through the mouth, no migration occurs. In the intestines larvae of an assessin worm transform into sexually mature forms. The life span of sexually mature parasites reaches 5–6 years.

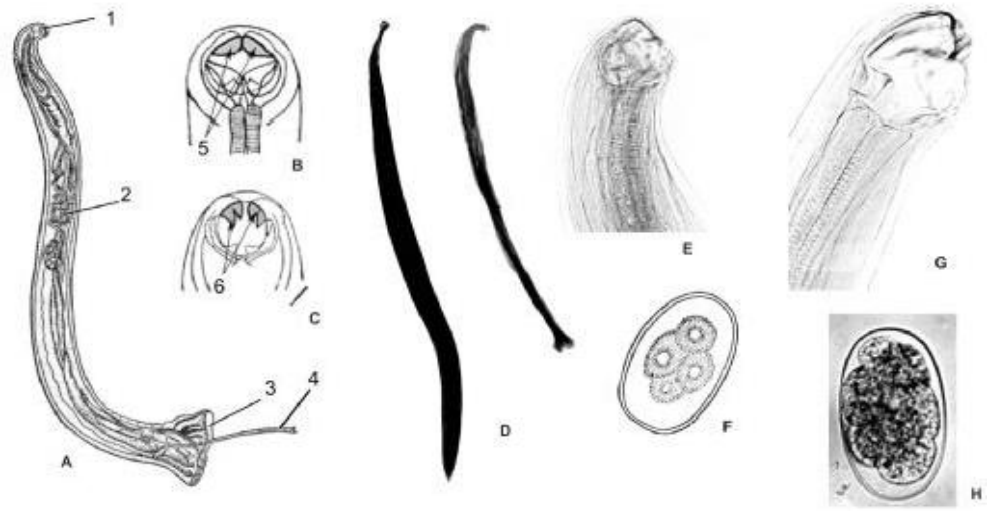

Fig. 30. Morphology of duodenal assassin worms: A– c, F –sketches; D, E, G, H – microphotographs; A, D –sexually mature forms, B, E – a mouth capsule of a necator, C, G – a mouth capsule of an assassin worm: 1 – a mouth capsule; 2 – a testicle; 3 – a sexual bag; 4 – spicules; F, H – an egg

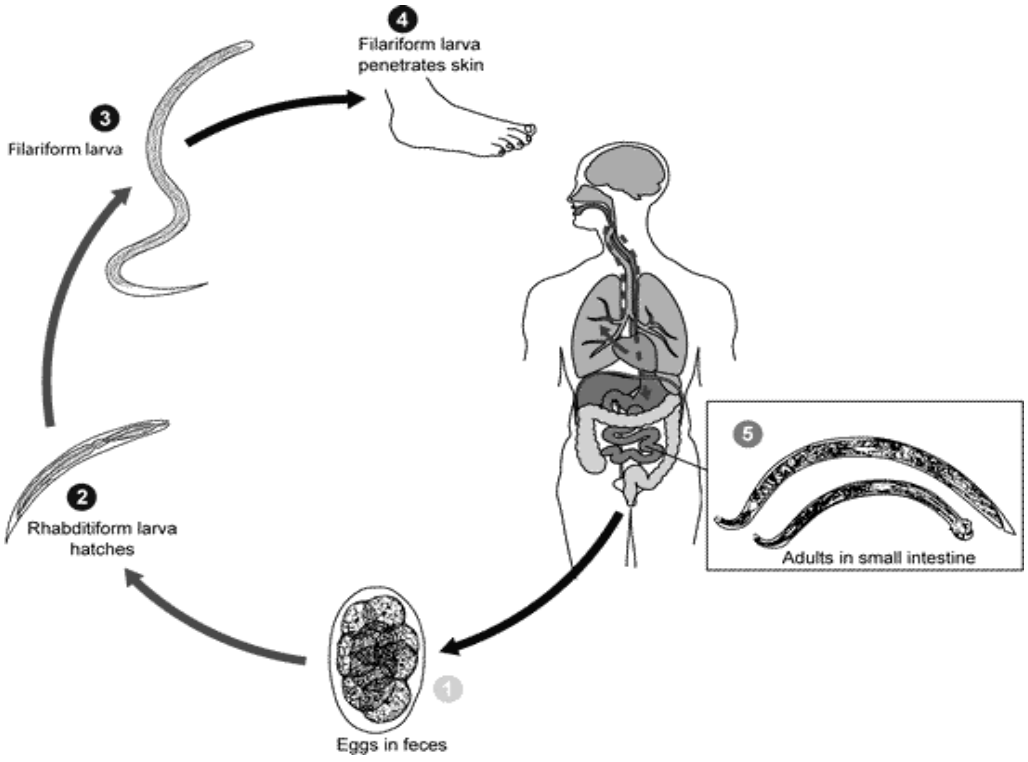

Fig. 31. Life cycle of assessin worms

Pathogenic action:

1. *Mechanic* (rupture of capillaries, injury of alveoli, the mucous membrane of the intestines by larvae, cuticular teeth of sexually mature forms).

2. *Toxic–allergic* (poisoning by waste products).

3. *Feeding on the host's organism* (each assessin worm consumes from 0,36 to 0,7 ml of blood a day) *and impairment of metabolic processes*.

Characteristic symptoms: painfulness at the sites of larvae permeation**,** lateritching, erythema with red papules, pains in the epygastic area, nausea and diarrhea. Development retardation is noted in children. In a chronic course one can observe edemas, headaches, breathlessness, memory and workability become worse.

Laboratory diagnosis: revealing eggs or larvae in feces.

Prophylaxis: personal –observing rules of hygiene. In foci of ankylostomosis one should not go bare–footed or lie on the ground. **Social** – revealing and treating sick persons, building sanitary facilities in settlements (running water, sewage systems), sanitary–popularization activity.

3. Necator, necator americanus – a geohelminth, a pathogen of necatorosis. The disease is common in tropical and subtropical regions of Asia and South America.

Morphological peculiarities: unlike the assassin worm it has 2 sharp cutting plates in the mouth capsule. **The development cycle, pathogenic action, characteristic symptoms, laboratory diagnosis and prophylaxis** are the same as in ankylostomosis.

4. Dwarf treadworm.

Strongiloides stercoralis – a geohelminth, pathogen of strongyloidosis. The disease is common in the South–East Asia, East and South Africa and South America.

Morphological peculiarities: colorless filament–like nematodas from 1 to 2–3 mm in size.

Development cycle: localization – the duodenum, bile and pancreatic ducts. After fertilization females lay eggs and males die. Rabdit (non– infectious) larvae come out of eggs, which are excreted into the environment with feces. The further development of rabdit larvae goes in soil **in two ways**:1) if the conditions are unfavorable, they turn into filarial–like (infectious) larvae that actively get into the human skin and migrate around the organism (as assessin worm larvae); 2) if the conditions are favorable, the rabdit larvae transform into free living males and females. After fertilization free living females lay eggs produc– ing rabdit larvae that transform either into sexually mature forms or in filarial– like larvae. There is also a possibility of a development way without leaving the intestines for the environment: after a slough rabdit larvae transform into filarial–like ones in the intestines, accomplish a migration and reach their sexual maturity. Migrating larvae may transform into sexually mature forms already inthe lungs.

Pathogenic action:

3. *Mechanic* (rupture of capillaries, breaking of alveoli by larvae, injury of the mucous membrane of a small intestine).

4. *Toxic– allergic* (poisoning by waste products).

5. Feeding on the host's organism (content of the intestines) *and impair–ment of metabolic processes.*

Characteristic symptoms: skin inflammation, weakness, irritability, headaches, skin itching, symptoms of bronchitis, pneumonia. Then appear signs of enteritis, gastroenteritis. Complications: perforation of the intestines with perito nitis, pancreatitis.

Laboratory diagnosis: revealing rabdit larvae in fresh warm feces, sometimes – in duodenal content, sputum, vomit masses. A high eosinophilia is noted in the blood, it reaching 70–80 %.

Prophylaxis is the same as in ankylostomoses.

5. Filarias.

Filaria –biohelminthes, pathopgens of filariatoses, is widely spread in countries with a tropical and subtropical climate.

They have a filamentous shape, localized in tissues and cavities of the human body, and larvae (microfilarias) – in the blood or tissues. Filarias are viviparous. *A final host* is the human and mammals. *Intermediate hosts and carriers* are 2–winged blood–sucking insects.

Wuchereria bancrofti – a pathogen of wucheriosis.

Morphological peculiarities: a female has a filamentous body of white color 8–10 cm in length, a male – 4 cm.

Development cycle: a principal host is the human, intermediate hosts and transmitters are mosquitoes of g. Culex, Anopheles, Aedes and Mansonia. Loca lization of sexually mature forms is lymphatic vessels and nodes. Females produce larvae that migrate into blood vessels (at day they are in deep vessels of in ternal organs, at night – in peripheral ones). When a sick person is bitten bya mosquito female, it gets infected with microfilarias. Microfilarias develop in the mosquito organism, and when it bites a human – they migrate into the lymphatic system and reach their sexual maturity (fig. 32).

Pathogenic action:

1. *Mechanic*: obstruction of lymphatic vessels, impairment of the lymphat ic off–flow, a sharp increase of the affected organ.

2. *Toxic– allergic action of the parasite's metabolite products.*

Characteristic symptoms: at an early stage –fever, conjunctivitis, enlargement of lymphatic nodes, attacks of bronchial asthma. At the 2 nd stage – inflammation of lymphatic nodes and vessels, microfilarias appear in the blood. At the 3rd stage – the presence of lymph in the urine, testicle dropsy, diarrhea with lymph, elephanthiasis of lower extremities, mammary glands, sexualorgans.

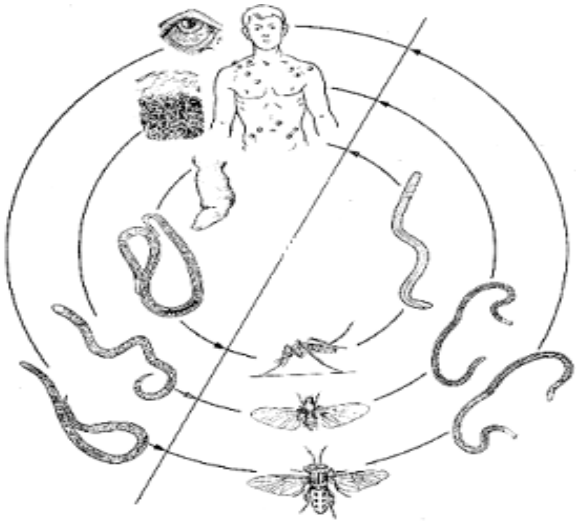

Fig. 32. Diagram of filarial development cycles

Diagnosis: revealing microfilaria in blood.

Prophylaxis: personal –protection from mosquito bites and chemoprophylaxis. **Social**: revealing and treating sick persons, killing transmitters, sanita–rypopularization activity.

Brugia malaji – a pathogen of *brugiosis*. *The morphology is similar to* that of W. bancrofti. The life cycle does not differ from the cycle of wuchereria. *A final host* is the human, monkeys, cats and dogs. *Intermediate hosts* and transmitters – mosquitoes of g. Mansonia. It is extremities that are mainly affected. Pathogenic action, symptoms and diagnosis are the same as in wuchereriosis.

Onchocerca volvulus – a pathogen of *onchocercosis*.

Morphological peculiarities: a principal host is the human, an intermediate host and transmitter –midges of g. Simulium. Sexually mature forms are localized in the superficial layers of the skin. After fertilization females produce microfilarias that permeate into the skin, eyes and lymphatic nodes. In bitinga sick person larvae that become infectious get into the stomach of a midge together with blood. When this midge bites a healthy person, larvae get into the skin, migrate into the subcutaneous adipose cellular tissue, where they reach their sexual maturity.

Pathogenic action:

1. *Toxic– allergic* (poisoning by waste products).
2. *Mechanic* (injury of the skin, lymphatic vessels).

Characteristic symptoms: onchocercotic dermatitis (itching, skin eruptions, its thinning, loss of elasticity, formation of small wrinkles – an «orange skin» or «crocodile skin», «elephant skin», elephantiasis of the face («lion's muzzle»). Complications – eye injuries, loss of vision.

Laboratory diagnosis: revealing microfilarias in section of superficialparts of the skin or of sexually mature forms – in onchocercomes.

Prophylaxis: personal –protection from midges' bites. **Social** – revealing and treating sick persons, killing midges, sanitary–popularization activity.

Loa loa – a pathogen of loaiasis.

Morphological peculiarities: a filamentous body is up to 5 cm in length in females and to 3 cm in males.

Development cycle: a final host is the human, monkeys, an intermediate host and transmitter –horse flies. Localization of sexually mature forms – the subcutaneous cellular tissue, eye serous cavities, while larvae are localizedin the circulation system. Larvae (microfiilarias) are characterized by a day periodicity of migrations in the human organism. After a horse fly bite microfilarias become infectious in its organism. The human gets infected througha horse fly bite.

Pathogenic action:

1. *Toxic– allergic* (poisoning by waste products).
2. *Mechanic* (injury of tissues).

Characteristic symptoms: pains in the extremities, paresthesia (impair ment of sensitivity), edemas, eye affection – edemas and hyperemia of lids, pains,

worsening of eyesight. Abscesses develop as a result of a secondary infection in muscles and lymphatic nodes.

Laboratory diagnosis: revealing microfilarias in smears and in a thick drop of blood. Parasites are seen beneath the conjunctiva.

Prophylaxis: personal – protection from attacks of horse flies. **Social** – revealing and treating sick persons, killing transmitters, sanitary–popularization activity.

6. Diagnostic methods of helminthes.Macroscopic methods:

1. **Examination of excrements.** Small portions of excrements are mixed with water in a flat bath or a Petri's plate. They are looked through under good illumination on a dark background, if necessary using a magnifying glass. One can reveal integral helminthes, their skolexes, tears of a strobila, proglottids.

2. **Settling method.** Excrements are mixed with water and left in a glass cylinder, then the upper layer of the fluid is pored off. This is repeated several times. After the fluid becomes translucent, it is pored off, and settlings are looked through in a glass bath of a Petri's plate. The method allows to reveal helminthes, their skolexes, scraps of a strobila, proglottids and to diagnose tenia– sis and teniarynosis.

Microscopic methods:

1. **Native smear.** A small part of excrements is brought by a stick on the object glass into a drop of the 50 % of water–glycerin solution and rubbed untill an even smear is obtained, then it is examined under the microscope.

2. **Thick smear with cellophane (Kato's method).** Helminthes eggs are revealed in a thick smear of excrements, lighted by glycerin and stained with malachite green. The method reveals eggs of ascarides, vlasoglavs, diphyllobothria, trematodas, tenias.

3. **Schulman's method.** 2–3 g of excrements are mixed with a 5–fold volume of physiological solution or water with circular motions of a glass stick. Eggs and larvae accumulate in the center. After mixing a drop is carried on the end of the stick to the object glass, it is covered with the cover glass and examined under the microscope. This method reveals larvae of an assassin worm, necator, dwarf treadworm.

4. **Method of a sticky tape** is used for diagnosis of enterobiosis. A piece of translucent polyethylene tape 4–5 cm long is applied with a sticky side acrossthe anus to perineum folds, is taken off at once and is stuck to the object glass. The obtained preparations are studied under the microscope. Investigations are performed in morning hours.

Enrichment methods:

1. **Sedimentation methods:** if the specific weight of eggs is greater than the specific weight of the fluid, then eggs are concentrated in the sediment, which is studied under the microscope. It is used for revealing trematoda eggs.

Goryachev's method is used for diagnosis of opistorchosis.

Krasilnikov's method. Under the action of detergents included in the composition of washing substances helminthes' eggs are concentrated in the

sediment. The method allows revealing eggs of all helminthes excreted with excrements.

2. **Floatation methods:** if the specific weight of eggs is less than the specific weight of the fluid, then eggs float to the surface of the fluid and thenthe film is studied. It is used for revealing eggs of assassin worms, vlasoglavs and dwarf tenias.

Fulleborn's method. Saturated solution of NaCl is used. Eggs of nematodas, dwarf tenia and diphyllobothrium float up well.

Kalantaryan's method. Excrenments are mixed up with a saturated solution of $NaNO_3$ in ratio 1:20. Eggs of the majority of helminthes quickly float up and are revealed in a superficial film. Oncosphere of tenias and eggs of trematodas do not float up.

Diagnosis of tissue helminthes. To diagnose tissue helminthes (thrichonellosis, cysticercosis and etc.) **immunological methods** are used: a complement linkage reaction (CLR), reaction of a indirect hemaglutination and others.

Muscular biopsy method for diagnosis of trichinellosis: a piece of the acromiahumoral muscle or a calf is taken in aceptinc conditions. Under the microscope one can see spiralized larvae of thrichionellas in capsules inside muscular fibers.

Method of digesting muscles: finely cut muscles are flooded with gastric juice and placed into the termostat in 37 °C for 12–16 hours. Then the sediment is put on the object glass with a dropper and studied under the microscope. Trichinella larvae are revealed to be free of capsules.

Method of a blood smear and a thick drop for diagnosis of filariatoses. The blood is taken from a finger mainly at night. Microfilarias are revealed as thin twisted filaments.

Basic terms and concepts:

1. Dracunculesis – a disease caused by medinas.

2. Rabdit larva – a non– infectious stage of assassin worms.

3. Filarious larva – an infectious stage of assassin worms.

4. Microfilarias –larvae of filarias parasitizing in the blood or tissues.

5. Onchocercoma – a subcutaneous node, where are sexually mature forms of onchocercs.

6. Tissue helminthes – diseases caused by parasites localized in tissuesand closed cavities.

7. «Tropical eosinophilia» – a syndrome that develops at an early stageof wuchereriosis.

8. Filariatoses – a group of diseases caused by filarias.

9. Chyluria – the presence of pus in the urine.

10. Elephanthiasis – impairment of the off–flow of lymph and «over–growing» of the organ.

OPEN TESTS

1. Symplastic tissue of Nematode's dermato–muscular sac is called ... .

2. Body wall of roundworm consists of smooth muscle layer(s).

3. Contact helminth among roundworms is … .

4. Life span of mature Ascaris in the human body is about ... .

5. Pig and dog Ascaris larva migrating in the human body cause syndrome.

6. Nematode with anterior end of the body is filament–like, the posterior – is thickened is called ... .

7. Enterobius vermicularis life span in human organism is about ... .

8. Following methods are used for the diagnosis of trichinellosis: .., muscle digestion and immunological.

9. Funnel–like mouth capsule with 4 cuticular teeth on the head part is typical for ... .

10. Noninvasive ancylostomas larvae with bulbus in the esophagus are called ... .

11. Nematode with parasitic and free living stages in development cycle is called ... .

12. Nodules covered with connective tissue capsule and containing deador alive pubertal Onchocerca volvulus are called ... .

13. Following methods can be used to reveal intact helminthes, their scolex and parts of their body in faeces: ... .

14. Method of diagnosing helminthiasis using saturated sodium nitrate solution with specific gravity 1,4 is called … .

15. Method of diagnosing helminthiasis based on helminth's ovum heaving in saturated solution NaCl is called ... .

16. Biopsy and muscle digestion, smear and thick blood drop, and refer to diagnostic methods of tissue helminthiasis.

CLOSE TESTS

1. Sequence of ascarids larvas migration in a human being body is: a) intestine → dextral heart → lungs → blood vessels → liver → bronchi → trachea → pharynx → intestines; b) intestine → liver → bronchi → dextral heart → lungs → blood vessels → trachea → pharynx → intestines; c) liver → bronchi → dextral heart → lungs→ blood vessels → trachea → pharynx → intes– tines; d) intestine → blood vessels → liver → dextral heart → lungs → bronchi → trachea → pharynx → intestines; e) intestine → blood vessels → dextral heart → lungs → liver → bronchi → trachea → pharynx → intestines.

2. Diagnostic migratory ascariasis signs are: a) an intestinal obstruction; b) fever and an asthmatic bronchitis; c) flying eosinophilic lungs infiltrates; d) the common bile duct occlusion; e) appendicitis.

3. Surgical ascariasis complications are: a) mechanical jaundice and intestinal obstruction; b) development of an adult species in an eyeball; c) perforation of the intestinal wall; d) pneumonia and bronchitis; e) pancreatitis and appendicitis.

4. The morpho–physiological features of trichuris are: a)female length – 5 cm, vesicula on the anterior end of a body; b) 3–5 cm female length, presence of a bulb and an oral capsule with teeth; c) 3–5 cm female length, threadlike anterior end of a body, thickened posterior end; d) cuticular lips available, eats the intestinal contents; e) eats blood.

5. The features of trichina development cycle are: a) there are 2 hosts:the basic and mediate; one organism is mediate at first and then is the basic host; one organism is the basic one and then the mediate host; c) larva's development occurs in soil or in water; d) larva's are capable to in pour through the intact skin.

6. The Basic diagnostic signs of trichinosis are: a) brain lesion;

b) gastrointestinal disorders; c) temperature rise and eosinophilla; d) eyelids faceswelling, pains in muscles; e) liver and spleen enlargement.

7. The morpho–physiological features of filarial are: a) the form ofa body is threadlike, lay eggs; b) the form of the body is ribbon–shaped, viviparous; c) the form of the body is threadlike; viviparous; d) the dimensions of the body are 3–10 mm; e) the dimensions of the body are 3–10 cm.

8. The features of filaria development cycles are: a) with the change of the hosts, mediate hosts are mainly representatives of dipterous group; b) larvae are capable to penetrate through the intact skin; c) discharge larvae into soil or water; d) discharge larvae into the tissues of the basic host; e) lay eggs in subcutaneous fatty tissue.

9. Final hosts of filaria are: a) human being man, monkeys; b) cats, dogs; c) herbivorous mammals; d) pigs and wild boars; e) the lowest crustaceans.

10. Intermediate filaria host are: a) man and monkeys; b) mosquito's and gnats; c) cats and dogs; d) crustaceans Cyclopes and daphnia; e) gnats and gadflies.

11. The means of filariasis mans invasion are: a) active penetration of larvae through the skin; b) the ingestion of Cyclopes with microfilaria; c) personal hygiene neglect; d) at contacts with filariasis patients; e) transmissibly.

12. The means of laboratory filariasis diagnostics are based on:

a) detection of microfilaria in blood; b) detection of eggs and larvae in excrements; c) detection of microfilaria in skin sections and subcutaneous nodes;

d) immunologic methods; e) detection of larvae in cross–striated muscles.

13. The Basic diagnostic features of ankylostomiasis are: a) pains along the large intestine; b) a headache and memory weakening; c) physical and intellectual retardation in children; d) anemia; e) pains in joints.

14. The means of laboratory ankylostomiasis diagnostics are based on: a) detection of eggs or larvae in excrements; b) detection of larvae or adult anky–lostomas in blood; c) immunologic methods; d) detection larvae in cross–striated muscles; e) ankylostomae detection in punctated liver and pancreas.

PHYLUM ARTHROPODA, CLASS ARACHNOIDEA

1. General characteristic and systematization of the Arthropoda phulum (Arthropoda).

The number of species is over 1,5 million. **Characteristic features:** 1) development of organ systems from 3 germinal layers; 2) bilateral symmetry of the body; 3) heteronomous segmentation; 4) 2 departments (the head–breast and the abdomen) or 3 (the head, the breast and the abdomen); 5) segmental extremi ties; chitinized cuticle (an external skeleton); 7) appearance of striated muscles and separation of muscular groups; 8) mixocele; 9) development of the circulatory, respiratory, digestive, excretory, nervous and genital systems of organs.

The digestive system consists of 3 departments: anterior, middle and posterior. It starts with an oral and ends with an anal opening. A complex oral apparatus is developed. There are digestive glands in the middle department. *Excretory organs* **–** **are** modified metanephridia (green and coxal glands) and Malpighian vessels. *Respiratory organs* –branchia, pulmonary sacs and trachea. The circulatory system is not locked. The heart is located on the dorsal side. *The nervous system*: a large suprapharyngeal ganglium performing the function of the brain, a periopharyngeal nervous ring and an abdominal nervous chain. *Sense organs* are developed (tactile, olfactory, gustatory, vision and hearing). Arthropoda have separate sexes (with a complete and incomplete metamorphosis).

Classes: Crustacea, Arachnoidea and Insecta.

2. General characteristic and systematization of the Arachnoidea class (Arachnoidea).

The number of species is about 40 000. They adapted for living on the ground. They have 2 departments of the body – the head–breast and the abdomen. The body is covered with a chitinized cuticle, the hypoderm is located beneath it. Derivatives of the hypoderm webbed and venomous glands. 6 pairs of extremities are located on the breast. The first 2 pairs (cheliceres and pedipalpa) are to grasp and fragmentize food. The rest 4 pairs – are walking limbs. The *digestive system* is adapted for eating semi–fluid food. *The excretory system*: coxal glands and Malpighian vessels. *Respiratory organ*s: pulmonary sacs and trachea. The circulatory system has a very complex structure in scorpions and spiders, whose respiratory organs are pulmonary sacs. There is a tube– like heart with orifices – *ostia* (3–7 pairs), 2 short aortas (anterior and posterior) and per a pair of lateral arteries branching off from each heart chamber. The hemolymph contains *hemocyanin*. The head ganglium performs functions of «the brain». The nervous chain is characterized by concentration of ganglia. Sense organs (vision, tactile, olfaction and taste) are well developed. Arachnoidea have s*eparate sexes*. Dimorphism is marked. The reproduction is sexual, thedevelopment is direct and indirect.

Orders: scorpions (Scorpiones), spiders (Aranei), ticks (Acarina).

3. Ixodous, argasal and gamasal ticks. Order of Acariticks. Family of Ixodaeixodous ticks.

Representatives: Ixodes ricinus – a dog’s tick, Ixodes persulcatus – a

Russian spring–summer tick, Dermacentor pictus, Dermacentor marginatus.

Morphological peculiarities: the body sizes are from 5 to 25 mm. They inhabit open spaces (forests). The body has no departments. There are 4 pairs of walking limbs. The first 2 pairs of limbs form the oral apparatus of a stabbing–sucking type – «head». The head is located terminally on the anterior end ofthe body and is seen from the dorsal side. There is a chitin corselet that covers the whole dorsal part in the male, in the female –only the frontal part, which provides a greater resilience of the abdomen in blood sucking. In ticks of Ixodes genus the corselet is dark–brown; in ticks of Dermacentor genus it has a marble pattern. There are eyes (fig. 33).

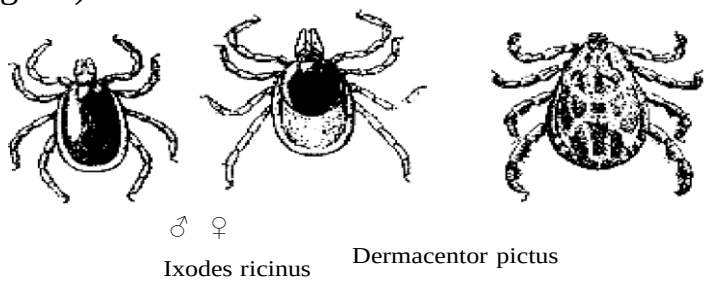

Fig.33. Ticks of Ixodae family

Peculiarities of biology. Blood sucking lasts up to several days. They can fast up to 3 years. Their bites are painless, the saliva contains anesthetics.The female lays about 17 000 eggs in soil fissures, bark of dead trees. **Develop– ment stages**: an egg – a 6–legged larva – several stages of nymphs – an imago. Blood sucking occurs at every stage.

Medical significance: they are specific pathogen transmitters of a Russian spring–summer encephalitis. The virus of encephalitis affects salivary glands and gonads of ticks; transmission of pathogens is possible in blood sucking and transovarially. Reservoirs of an encephalitis virus – birds, wild rodents. Ixodous ticks transmit hemorrhagic fevers, brucellosis, tick enteric fever, they support foci of plague and tularemia. Ticks of Dermacentor genus transmit a pathogen of a Scotch encephalitis.

Family of Argasidae – argasal ticks.

Representatives: Ornithodorus papillipes, Argas percicus.

Morphological peculiarities: the body sizes of a tick are from 2 to 30 mm. A chitin corselet is absent. The «head» is not seen from the dorsal side. There is a marginal welt. Vision organs are absent (fig. 34).

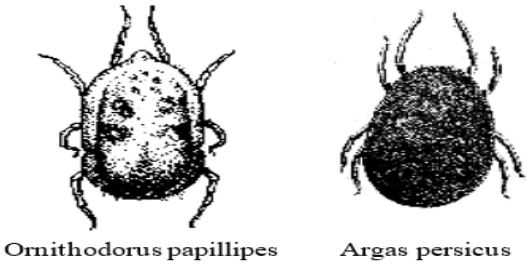

Fig. 34. Ticks of Argasidae family

Peculiarities of biology: argasal ticks –sheltic forms (caves, holes of

rodents, abandoned buildings). Blood sucking lasts to about 50 minutes. They can fast up to 12–15 years. Egg–laying contains 50–200 eggs. There are several stages of nymphs. Transovarial transmission of pathogens is possible.

Medical significance: they are specific transmitters of a tick recurrent fever (tick sperochetosis). Natural reservoirs of the pathogen – cats, dogs and wild rodents. The saliva of ticks has a toxic action, and at bite sites ulcers may develop.

Gamasidae family –gamasal ticks. Representative: Dermanissus gallinae – a hen's tick.

Morphological peculiarities: Body sizes are 0,2–0,3 mm. The body is covered with bristles. Eyes are absent.

Peculiarities of biology: females feed on blood, there is a gonotrophic cycle; they inhabit holes of rodents, birds' nests. From pigeons' nests they can get to human dwellings through ventilation pipes.

Medical significance: they are permanent or temporary ectoparasites. The saliva of ticks is poisonous and causes dermatitis. When they get into respiratory ways, they cause asthmatic symptoms. Transmit pathogens of tick sperochetosis, encephalitis, hemorrhagic fevers. May transmit pathogens of the plague and tularemia.

Fighting measures against ticks: wearing special clothes, using repellents, examination of the clothes and the body to remove ticks after going to the forest; use of acaricides, killing rodents (hosts –feeders).

4. Sarcoptic and tyroglyphic ticks. Tyroglyphidae family – tyroglyphic ticks.

Representative: Tyroglyphus farinaea flour tick.

Morphological peculiarities: they are small (0,4–0,7 mm), have no eyes, the body is of a light–yellow color and egg–shaped.

The place of inhabitance is soil, decaying wood, birds' nests, rodents' holes. Birds and insects transmit ticks. They may inhabit food stores (flour, groats, corn, cheese, etc.), spoil them contaminating with their excretions; affect corn in granaries.

Medical significance: while eating contaminated food one may have catarrhal symptoms of the gastric– intestinal tract. During harvesting and threshing the corn, ticks get into respiratory ways causing asthmatic symptoms, or if it is the skin–dermatitis (grain scabby).

Sarcoptidae family – sarcoptic ticks. Representative: Sarcoptes scabiei – a scabby tick.

Morphological peculiarities: the sizes are 0,3–0,4 mm. Legs are shortened, of a conical shape; the body is broad, oval, of a yellow color, is covered with bristles, eyes are absent. It breathes with the surface of the whole body.

Development cycle: they are permanent hyperdermal parasites of the human and animals. A tick's female gnaws passages in the thickness of the corneous layer of the skin per 2 mm a day. Males do not make any passages. Ticks feed on the host's tissues. After fertilization, the female lays about 50 eggs. The development from an egg to an imago takes about 1–2 weeks. Adult ticks live up

to 2 months. Infection occurs in a direct contact with a sick person or their things, where may be ticks.

Medical significance: they cause scabby, affect the skin of the hand back side of interdigital spaces and flexor surfaces of joints. Ticks cause a severe itching, becoming worse at night. Secondary infection gets in scratches causing suppuration. Ticks of dogs, horses, pigs and other animals may parasitize on the human.

Prophylaxis of scabby: following hygienic rules in dealing with animals and sick people, neatness of the body, linen and dwelling; revealing and treating sick persons, sanitary supervision over hostels, baths, sanitary–popularization activity.

5. The study of E. N. Pavlovsky about the natural origin of foci of transmissible diseases. Characteristic of a natural focus.

The diseases are **transmissible**, if their pathogens are transmitted through blood by a transmitter – an Arthropoda (ticks and insects).

Transmission of a pathogen by a transmitter occurs in blood sucking through a proboscis (*inoculation*), through coverings of the host contaminated by transmitter's excrements containing pathogens (*contamination*), through eggs in sexual reproduction (*transovarially*). Pathogens undergo definite development stages in the organism of specific transmitters (malaria plasmodia in a female of a malaria mosquito). Mechanic transmitters (flies, cockroaches) transmit pathogens on body coverings, on parts of the oral apparatus.

In an obligate–transmissible disease the pathogen is transmitted only by a transmitter (leischmanioses). *Facultative–transmissible diseases* (the plague, tularemia, anthrax) are transmitted through a transmitter and in other ways(through respiratory organs, foods of animal origin).

A transmissible disease is characterized by the presence of: 1) parasite – a pathogen; 2) a vertebrate – a host; 3) an arthropoda – a transmitter.

The natural focus and its structure. In 1940 E. N. Pavlovsky formulated a **study about natural foci of diseases**. A natural focus is a definite geographic landscape, where circulation of the pathogen from a donor to a recipient occurs through a transmitter. *Donors of a pathogen* – are sick animals, *recipients of a pathogen* – are healthy animals, which after getting infected become donors.

Basic terms and concepts:

1. Pedipalps and cheliceres – are the 1^{st} and 2^{nd} pair of modified extremities of the oral apparatus of Arachnida that serve for grasping and fragmentizingfood.

2. Mechanic transmitter – is a transmitter, who carries pathogens on body coverings.

3. Specific transmitter – is a transmitter, inside which the pathogen undergoes its development.

4. Natural focus – is a definite geographic landscape, where the circulation of a pathogen occurs from a donor to a recipient through a transmitter without human assistance.

5. Transovarial transmission of a pathogen – is the transmission of a pathogen through eggs.

OPEN TESTS

1. Representatives of the family … of acarians have eyes.

2. Ixodae family includes genuses Ixodes, Hyalomma and ... .

3. Method of pathogen transmission from imago to larval stages through ovum is called ... .

4. Ticks I. ricinus are pathogen carriers of ... and ... .

5. Ticks I. persulcatus are pathogen carriers of ... .

6. Ticks D. pictus are pathogen carriers of tularemia and ... .

7. Ticks D. marginatus are pathogen carriers of tularemia, brucellosisand ... .

8. Ticks D. nutalli are pathogen carriers of ... .

9. Hyalomma acarians genuses are pathogen carriers of ... .

10. Absence of dorsal shield and eyes, and presence of marginal welt are typical for acari family ... .

11. Grain scabby is caused by … acarian.

CLOSE TESTS

PHYLUM ARTHROPODA, CLASS INSECTA, ORDER DIPTERA

CLASSES I

1. General characteristic and systematization of Insecta class.

The number of species if over 1 million. There are 3 body departments: ahead, a breast and an abdomen. There are 2 pair of feelers (sense organs),an oral apparatus and a pair of eyes on the head. The thoracic department consists of three segments bearing per one pair of walking legs. In many of them on the 2nd and 3rd segments from the dorsal side are 1 or 2 pairs of wings. The abdomen consists of 6–12 segments. The body is covered with chitin, beneath is the hypoderm containing odorous, waxen and sloughing glands. *The muscular system* is differentiated and specialized. *The digestive system* consists of an anterior, middle and posterior departments. A complex oral apparatus contains upper jaws, lower jaws, a lower lip, an upper lip and a tongue (hypopharynx). Types ofthe oral apparatus: gnawing (bugs), stabbing–sucking (mosquitoes, fleas), licking (flies), sucking (butterflies). *The excretory system*: Malpighian vessels and a fat body (accumulation bud). *Respiratory organs* –trachea. *The circulatory system*is poorly developed. A multichamber tube–like heart and a branching off aorta are located on the dorsal side. The hemolymph transports nutrients and dissimilation products. The nervous system consists of «the brain» (a head ganglium) represented by 3 departments – anterior, middle and posterior. An abdominal nervous chain has a tendency to confluence of ganglia. *Tactile organs* – sensitive hairs scattered around the body. *Olfactory organs* are located on feelers and antennae on lower

jaws. Taste receptors are on oral extremities and on paw segments. Eyes are simple or complex (facetic). The insects have separate sexes, a sexual dimorphism is marked. The reproduction is sexual. The development is direct or indirect (with a complete or incomplete metamorphosis). The followingcriteria were used for the division into classes: a type of the oral apparatus,the presence and the number of wings and the type of development (tab. 4).

Medical significance: they are pathogens transmitters of transmissible diseases, pathogens of diseases (larvae of flies, fleas), ectoparasites and venomous animals.

Table 4 – Orders of insects

Order	Metamorphosis	Wings structure	Oral apparatus
Bugs	Incomplete	2 pairs: front wings are semi–hard, ontops –membranous, the 2nd pair — membranous	Stabbing–sucking
Cockroaches	Incomplete	2 pairs: cutaneous overwings and thin membranous back w	Gnawing
Lice	Incomplete	Are absent	Stabbing–sucking
Fleas	Complete	Are absent	Stabbing–sucking
2 winged	Complete	The front paire of wings –membra–neous, are narrowed at the base, the back pair is reduced and transformed into halteres	Stabbing–sucking,licking–sucking

2. Order of Lice (Anoplura).

Representatives: genus of Pediculus and genus of Phthirus. The Pediculus genus is represented by one species of Pediculus humanus including 2 subspecies – a head louse and a body louse who freely cross and give fertile fillies, though they have some morphological and biological differences.

Head louse (Pediculus humanus capitis).

Morphological peculiarities: the length of a male is 2–3 mm, of a female – 3–4 mm. The posterior end of the male's body is rounded, of the female's – is forked. The oral apparatus is of a stabbing–sucking type (fig. 35).

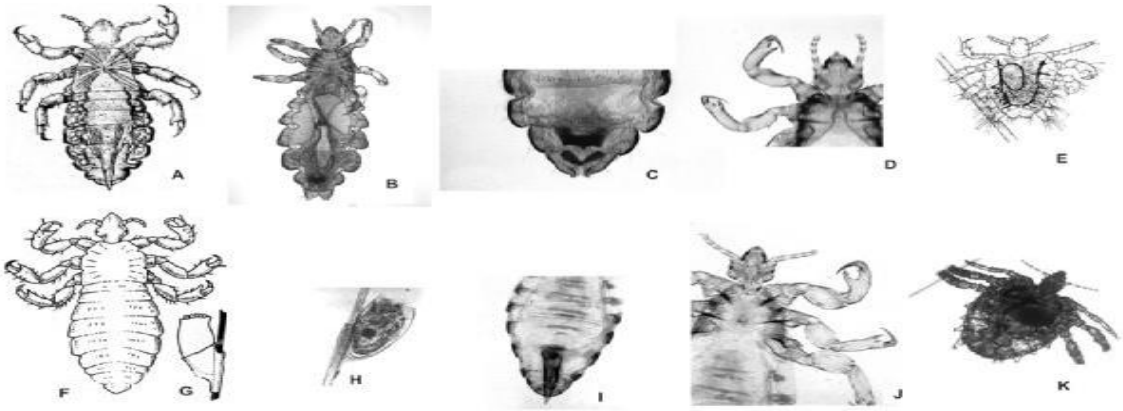

Fig. 35 Representatives of the Lice order: A – Pediculus humanus capitis (a sketch); B, C, D – Pediculus humanus capitis (7×8);F – Pediculus humanus humanus (a sketch); G, H – nits; I, J – Pediculus humanus humanus (7×8); E – Phthirus pubis (a sketch); K – Phthirus pubis (7×8)

Development cycle: lives in the hairy area of the head. Feeds on human blood 2–3 times a day, may fast for some days. Eggs (nits) stick to hairs witha sticky secrete. During the whole life (about 38 days) a female lays about 300 eggs. A larva comes from an egg that in several days transforms into an imago (a sexually mature form).

Body louse (Pediculus humanus humanus).

Morphological peculiarities: has larger body sizes than a head louse (to 4,7 mm), carvings along the body edge are not so deep and pigmentation is slightly marked. **Development cycle:** lives on underwear and linen, but feeds onthe skin. Nits stick themselves to hairs of the clothes. The life span is up to48 days, the development cycle is no less than 16 days. By the end of its life the female can have about 4000 fillies.

Medical significance: lice of g. Pediculus cause pediculosis (a disease of tramps). Feeding on blood lice introduce saliva into the wound that causes itching in the human. Pediculosis is characterized by pigmentation and hardening of the skin. Lice are specific pathogens transmitters of a louse–born relapsing and a louse–born enteric fever. Getting infected with a louse–borne relapsing fever (pathogens – Obermeier's Spirochaeta) occurs by a specific contamination (while squashing it and rubbing its hemolymph into the skin during scratching). Getting infected with louse–borne enteric fever (pathogens – Provachek's rickettcia) occurs by *contamination* (in rubbing lice's feces into the skin or bya *specific contamination* (in squashing a louse the content of its intestine gets into bites wounds or into scratches on the skin).

Pubic louse (Phthirus pubis).

Morphological peculiarities: sizes up to 1,5 mm. The body is short, broad, trapeziform. **Life cycle**: parasitizes on the body parts covered with thin hard hair: on the pubis, in armpits, on brows and eye–lashes, in the beard. The female lays about 50 eggs during its life. The life cycle duration (from an egg to a sexually mature form that starts laying eggs) – 22–27 days. **Medical significance**: Causes phthiriosis (severe itching and hardening of the skin). Getting infected occurs in sexual contacts, rarely –through underwear and linen.

Fighting against lice: killing them in the environment, on the human body and on clothes.

3. Order of Fleas (Aphaniptera).

Morphologicval peculiarities: the body is flattened from the sides, a hard chitin covering, wings are absent. There are multiple hairs, bristles, small teeth on the body surface. There are short feelers and a pair of simple eyes on the head. The last pair of legs is longer than all the rest and serves for leaping. The oral apparatus is of a stabbing–sucking type. The life cycle lasts about 19 days. Fleas lay eggs in slits of the floor, in dry garbage. Development is accompanied with a complete metamorphosis. Larvae have a worm–like shape without limbs. In some time a larva pupates. An imago feeds on warm blood, a larva –on organic leftovers. The life span of fleas may be over 1 year. **Representatives**: human fleas (Pulex irritans) and rats' fleas (Ceratophyllus fasciatus and Xenopsylla cheopis) (fig. 36).

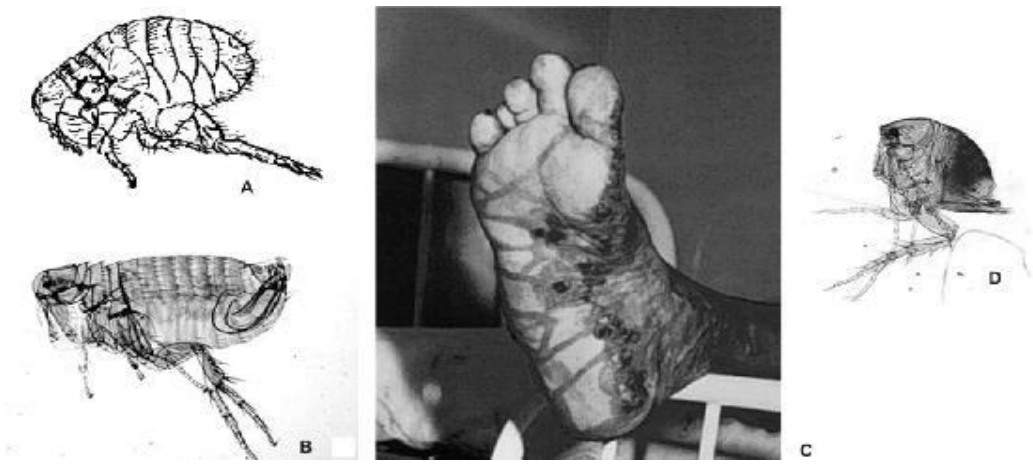

Fig. 36. Morphology of fleas:
A – Pulex irritans (a sketch); B – Pulex irritans (7×8); C – affected extremity in sarcopsyllesis; D –Sarcopsylla penetrans (7×8)

Medical significance: they are temporary ectoparasites (bites cause itching, dermatitis). Specific transmitters of the plague and tularemia pathogens. Natural reservoirs of the plague – rodents (rats, gophers and marmots). The human gets infected with the plague during contacts with a sick animal (taking off skins) or with a sick person (an air–drop way) and transmissively. Infection occurs on blood–sucking (*inoculation*). Infection is also possible in contamination: when the plague bacilli with fleas' feces get on the skin injured during scratching. Fleas of g. Oropsylla and Xenopsylla also transmit tularemia and rat's enteric fever, they are intermediate hosts of rats' and dogs' tenias.

Chigger flea (Sarcopsylla penetrans).

It is common in countries of South America and Africa, lives in sand, in dry grass and in shacks. **Morphological peculiarities:** it is 1 mm long, hasa yellowish–grey color. **Life cycle:** Fertilized females are on the surface of the soil. They attack the human, get into the skin between toes or under nails. They feed on blood and lymph, which results in the development of some thousands eggs and enlargement of a flea to the sizes of a pea. There is marked a tumor–like tissue growth around such a flea. Mature eggs are excreted into the environment, the female dies and tears away together with injured tissues. **Medical significance:** It is a parasite of the human and mammals (dogs, pigs and rodents), causes sarcopsyllosis. The formed wounds get inflamed and are very painful; often a secondary infection follows. Complications of sarcopsyllosis –gangrene and tetanus.

Fighting against fleas – keeping the rooms neat, wet cleaning, elimination of slits in the floor and walls, fighting against rodents (deratization), using insecticides and repellents. In countries of Africa and South America one should not walk on the ground bare–footed.

4. Order of cockroaches (Blattoidea).

Morphological peculiarities: large insects, the body length reaches 3 cm. The body is flattened in a dorsal–ventral direction. They have 2 pairs of wings: upper are cutaneous, lower are thin, membranous. In females the wings are reduced. The oral apparatus is of a gnawing type (fig. 37).

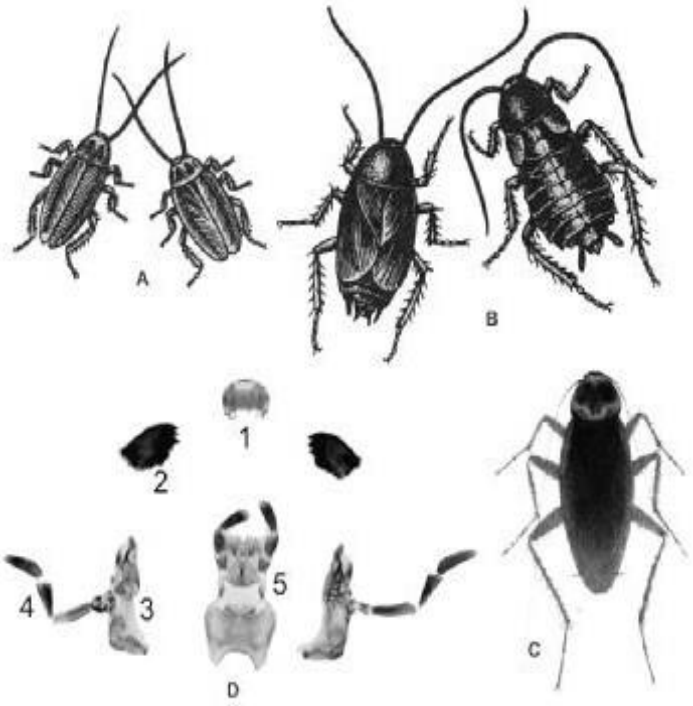

Fig. 37. Morphology of cockroaches:
A – Blattella germanica; B – Blatta orientalis; C – Periplaneta americana; D –oral organsof a black cockroach: 1 – an upper lip; 2 – an upper jaw; 3 – a lower jaw; 4 – mandibular probes; 5 – a lower lip

Life cycle: the development with an incomplete transformation lasts for several months. Females lay eggs in cocoons, which they carry about them 14–15 days. They are active at night, at day they hide in slots. They are met in human dwellings, at food production and public catering enterprises, in shops and canteens. Obligatory conditions for their existence in human dwellings: the presence of fluid, a definite temperature, sufficient amount of food. They feed on foods, human excretions and various wastes.

Representatives: a black cockroach or a kitchen cockroach (Blatta orienta lis), a red or Prussian cockroach (Blattella germanica) and an American cockroach (Periplaneta americana).

Medical significance: mechanic pathogens transmitters of infectious and invasive diseases.

To fight cockroaches – insecticides, borax baits, ecological methods are used (one should not water flowers before night, to leave leftovers on the table,it is necessary to clean the room, to close up slots in the floor).

5. Order of Bugs (Heteroptera).

Bed bug (Cimex lectularius). **Morphological peculiarities:** their sizes are up to 8 mm (males are less than females), wings are reduced (fig. 38).

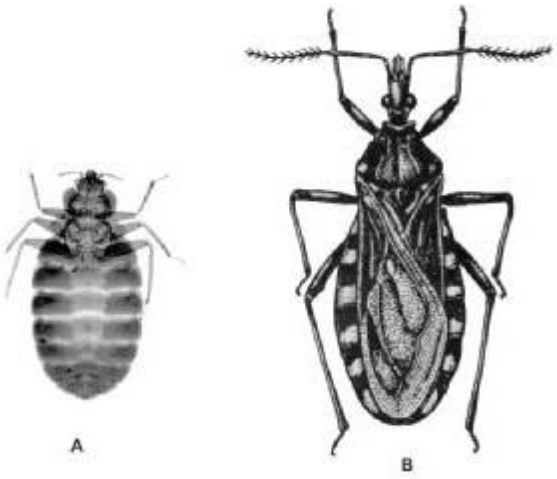

Fig. 38. Morphology of bugs:
A – cimex lectularius; *B* –Triatoma infestans

A chition cover is of a dark–brown–red color. It has a specific smell excreted by odorous glands. The body is flattened in a dorsal–ventral direction. The abdomen shape changes from elongated–oval to round, depending on blood saturation.

Life cycle: at day and under artificial illumination bugs hide in slots of the floor, behind plinths, under wall–paper, in furniture grooves, behind the curtains. At night they appear from their shelter, attack the human and feed on blood. Females lay eggs in slots of the floor, books, on linen. In 2–3 weeks (depending on the temperature) larvae come out of eggs, which also feed on blood. Larvae slough several times and transform into imagos. Mature bugs and larvae may fast long (for several months).

Medical significance: the saliva of a bug is poisonous and its bites are painful.

Kissing bug (Triatoma infestans).

Morphological peculiarioties: large sizes (1,5–3,5 cm), an oval flattened in a dorsal–ventral direction body and well developed wings. **Peculiarities of biology**: inhabit rodents' holes, mud–houses and shacks of humans. At nightthey attack sleeping people and introduce their proboscis into the skin of the neck, face (more often around lips). Having satiated with blood, the bugturns around and defecates into the bite wound or a site of scratches.

Medical significance: a temporal ectoparasite and specific pathogens transmitter of American tripanosomosis (Chaggas disease) – a natural–focal disease common in South America. In some people bugs' saliva causes a severe allergic reaction.

To fight against bugs insecticides are used, rodents are combated, as they are feeders of bugs, hygienic rules are observed.

Basic terms and concepts:

1. Inocculation – infecting the host through the transmitter's oral apparatus during blood sucking.

2. Insecticides –substances used against insects.

3. Contamination – infecting the host while rubbing transmitter's excrements in during scratching of bite sites.

4. Pediculosis – a disease caused by lice of g. Pediculus.

5. Phthiriosis – a disease caused by a pubic louse.

CLASSES II

1. Peculiarities of morphology and biology of Diptera order represent atives.

They have one (anterior) pair of membranous translucent wings. The posterior pair transformed into halteres performing the function of an equilibrium organ. A large head is connected with a thoracic department with a thin stem that supports its mobility. Big facetious eyes are located on the head. The oral apparatus is licking, sucking or stabbing–sucking. They feed on blood and plants juices. The development goes with a complete metamorphosis.

2. Components of winged blood–sucking insects (midges, greases, mosquitoes, horse–flies).

Midges (Simuliidaer family) resemble small flies (sizes of 2–3 mm). They live in damp wooded areas. Their development occurs in water, where females lay eggs on underwater stones and plants. Larvae develop in running water. Females feed on blood, attack animals and humans at day time in the open air. The saliva is toxic, bites are painful. Midges are mechanic pathogens transmitters of tularemia, anthrax, leper, are intermediate hosts and specific transmitters of onchocercosis.

Greases (Ceratopogonidae family) have sizes of 1–2,5 mm. They differ from midges as they have a more slender body, a comparatively long proboscis and longer legs (fig. 39). Are common everywhere. Only females feed on blood, they attack animals and humans in twilight (in the morning and in the evening). Larvae and crysalices develop in damp soil, forest litter, in small stagnant water reservoirs. Greases – are mechanic pathogens transmitters of tularemia, are intermediate hosts and specific transmitters of filariatosis.

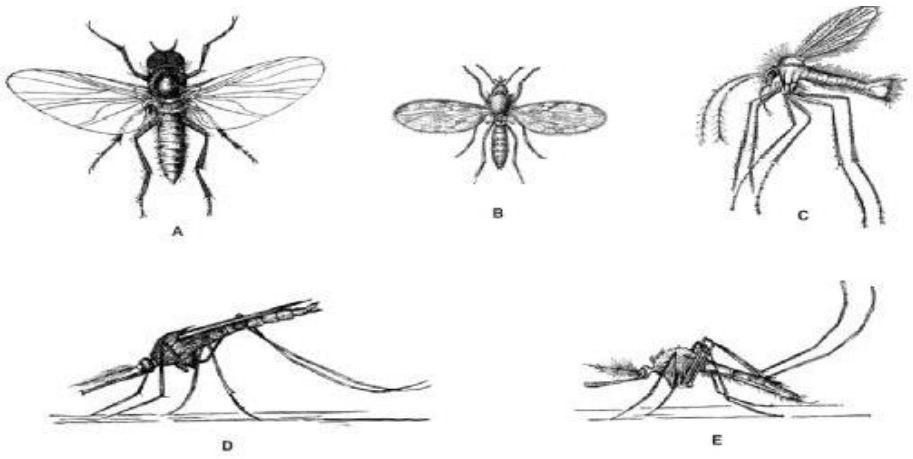

Fig. 39. Morphology of representatives of winged blood–sucking insects:
A – a midge (Similiidae); B – a greas (Ceratopogonidae); C – a mosquito (Phlebotomiodae); D – a gnat of g. Anopheles; E – a gnat of g. Culex

Mosquitoes (Phlebotomidae subfamily) inhabit countries with a warm climate, keep close to human dwellings. Besides they live in caves, rodents' holes, etc. Their sizes are 1,5–3,5 mm, coloration is brown–grey or light–yellow. The head is small. The oral apparatus is stabbing–sucking. Legs are long and thin. The body and wings are edged with fur. They lay eggs in protected from the sun places: rodents' holes, caves, tree hollows, in birds' nests, in garbage. Males feed on juices of plants, females –on blood (in twilight and at night). Bites are painful, blisters and itching appear at bite sites. Mosquitoes are specific transmitters of leischmaniosis and pappatachi fever. Transovarial transmission is characteristic of them.

Horse–flies (Tabanidae family) resemble big flies (their body length is up to 3 cm). They live in a forest and steppe zone. Males feed on plants' juices. Females have a stabbing–sucking oral apparatus and feed on blood of animals and humans. They attack more often in hot weather on pastures or near water reservoirs. They lay eggs (from 200 to 1000) on leaves of plants at river–sides. Larvae develop in silt on the bottom of water reservoirs or in damp soil. The saliva is toxic, bites are painful and cause itching. They are mechanic pathogens transmitters of tularemia, anthrax and poliomyelitis, are intermediate hosts and specific transmitters of loaiasis.

Fighting measures with winged blood–sucking insects: treatment of living houses with insecticides, putting nets on windows and using repellents.

3. Gnats of Culex, Anopheles and Aedes genera.

Gnats (Culicidae family). There are often met gnats of three genera – **Anopheles, Culex and Aedes**.

Morphological peculiarities: mature gnats have a slender stretched body of small sizes. There are large facetious eyes, feelers and an oral apparatus on the head. Females have a stabbing–sacking oral apparatus and feed on blood. In males the oral apparatus is sucking. They feed on flowers nectar. Segmented feelers are on the sides of the oral apparatus. A pair of translucent wings is attached to the breast. The abdomen has 10 segments, the last two of them are modified into sexual appendices (fig. 40).

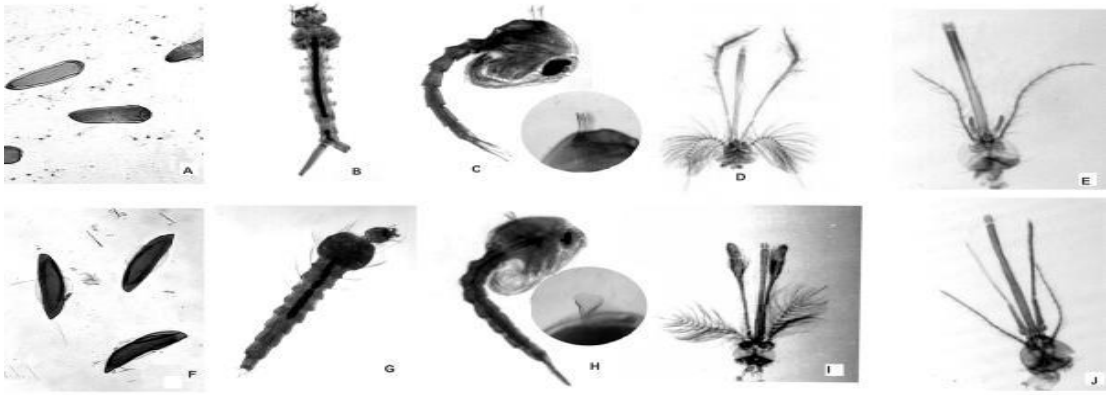

Fig. 40. Morphology of gnats:

A –gnat's eggs of Culex genus; B – a larva of Culex; C – a chrysalis of Culex; D – the head of a male of Culex; E – the head of a Culex female; F –gnat's eggs of g. Ano– pheles; G – a larva of Anopheles; H – a chrysalis of Anopheles; I – the head of an Ano– pheles male; J – the head of an Anopheles female

Biology of gnats. A new generation of gnats undergoes a period of physiological maturation lasting about 4 days. During this time they are near water re– servoirs and feed on nectar. Then in twilight males form a swarm, females fly into it, crossing occurs, after which females must obligatorily drink some blood for eggs to develop. During digesting blood maturation of eggs occurs (**a gonotrophic cycle**). After the eggs have matured, the female flies to a water reservoir and lays eggs (350–450) on its surface. Larvae come out of eggs. A minimum term of development is 15 days in an optimal temperature (25 °C). In the majori– ty of species of gnats (g. Anopheles and Culex) fertilized females and in species of g. Aedes –eggs are wintering. When autumn colds come males fertilize females and die.

Eggs. Gnats of Anopheles lay eggs in stagnant or slowly running waters with clean water. Eggs have a belt with air chambers and swim separately. Gnatsof Aedes lay eggs by one into temporary reservoirs: in puddles, tins, tree hollows. Eggs without air chambers have an oval stretched shape. Eggs of Culex without air chambers have a wedge shape and are laid on the surface of water stuck in a form of a boat.

Larvae. Larvae of Culex and Aedes gnats have a respiratory siphon on the last but one segment. Larvae form an angle with the water surface. Larvae of Anopheles gnats have no siphon and are located parallel to the water surface.

Chrysalises. Chrysalises have a comma shape. On the dorsal side of the head–breast is a pair of respiratory siphons. With their aid chrysalises «get hung» to a superficial film of the water. In gnats of Culex and Aedes siphons have a cylinder shape, in Anopheles they are funnel–like (conic).

Mature forms (imago) are distinguished by their seat, pattern of wings and structure of head appendices. In gnats of Culex and Aedes the abdomen is located parallel to the surface where they sit, in gnats of Anopheles – a posterior end of the abdomen is elevated. There are dark spots on the wings of malaria gnats, in non–malaria gnats they are absent. Feelers on males' heads are edged with thick fur, in females their fur is thin. In females of Anopheles mandible probes are equal in length to the proboscis, and in females of Culex and Aedes they comprise $^1/_3$–$^1/_4$ of the proboscis length. In males of Anopheles mandible probes are equal in length to the proboscis and have mace–like thickenings, in non–malaria gnats they are usually longer that the proboscis and have no thickenings.

Medical significance: Gnats are temporary ectoparasites. Gnats of Ano pheles are specific transmitters and final hosts of malaria pathogens, specific transmitters and intermediate hosts of wuchereria and brugia. Gnats of Aedes are specific pathogens transmitters of Japanese encephalitis, yellow fever, Denge fever, lymphocytic choriomeningitis, anthrax, wuchereriosis, bruggiosis, tularemia. Gnats of Culex – are specific pathogens transmitters of Japanese encepha litis, tularemia and wucheriosis.

4. Flies family (Muscidae).

Filth fly (Musca domestica) is common everywhere. Females' sizes are up to 7,5 mm. The body and paws are of a dark color, are covered with hairs (fig. 41).

There are claws and sticky cushions on the paws, due to them flies move on

any planes. The oral apparatus is licking–sucking. The saliva contains enzymes diluting hard organic substances which it licks off later. They feed on foods and decaying organic leftovers.

Life cycle: in 4–8 days after crossing, in the temperature not lower than 17–18 °C the female lays up to 150 eggs in decaying organic leftovers, refuse, manure, human feces. In the tempereature of 35–45 °C larvae come out of eggs in a day, they pupate in soil in 1–2 weeks in the temperature not higher than 25 °C. A new generation of flies appears in a month. Their life span is about 1 month. **Medical significance:** they are mechanic transmitters of enteric infections (cholera, paratyphus, dysentery, enteric fever), tuberculosis, diphtheria, helminthes eggs and protists cysts. There are up to 6 million bacteria on the fly's body, and up to 28 million in the intestine.

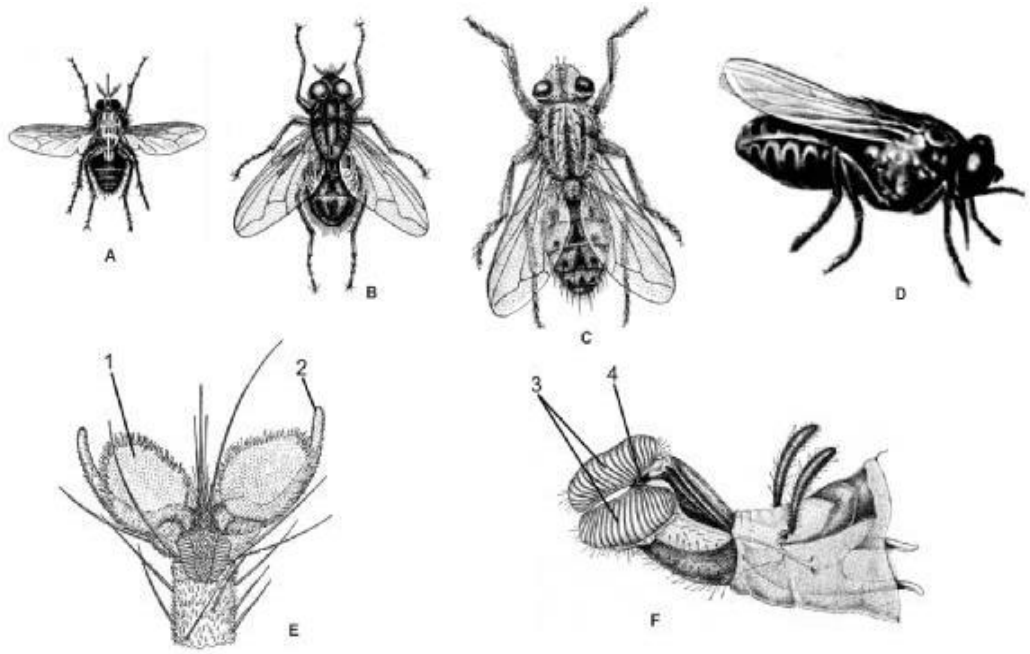

Fig. 41. Morphology of Mucsidae family representatives:
A –Stomoxys calcitrans; B –Musca domestica; C –Wohlfahrtia magnifica; D –Glossina palpalis; E – a paw of the filth fly, F –oral organs of the filth fly: 1 – a cushion; 2 – a claw; 3 – a lower lip; 4 – an oral opening

Fighting against flies. To fight against winged flies, insecticides, sticking tapes, baits with poisons are used, they are also eliminated mechanically. In fighting against pre–imago stages, building of public facilities is of great importance: the presence of sewerage systems, closed garbage collectors, manure storehouses, toilets, refuse removal, using insecticides.

Biting fly (Stomoxys calcitrans). It is 5–6 mm in size, coloration is grey with dark stripes on the breast and with spots on the abdomen. Using its proboscis the fly scrubs off the skin epidermis and feeds on blood (both males and females); the saliva contains poisonous substances causing a severe irritation. Bites are painful. The population of flies reaches its maximum in August–September. The female lives about 20 days. It is a mechanic pathogens transmitter of anthrax and sepsis. **Fighting measures**: the same as against the filth fly.

Tsetse fly (Glossina palpalis) is met in western areas of the African continent. It lives near human dwellings along banks of rivers and lakes with a high humidity of the soil. They have large sizes (up to 13 mm), the proboscis is strongly chitinized, protrudes forward. The coloration is dark–brown. Females are viviparous, lay only one larva on the soil surface. The larva permeates into the soil, pupates and in 3–4 weeks an imago form comes out. During the whole life (3–6 months) females lay 6–12 larvae. It feeds on blood of animals and humans, is a reservoir and a specific pathogens transmitter of African trypanosomosis. **Fighting measures:** cutting down bushes and trees along river and lake banks near settlements and along roads. Insecticides are used to fight against mature flies.

Wohlfahrt's fly (Wohlfahrtia magnifica) is common in countries witha moderate and hot climate. The body is of a light–grey color, its size is 9–13 mm and there are 3 dark longitudinal stripes on the breast. Mature flies feed on nectar of plants. Females lay 120–150 larvae in open cavities (the nose, eyes, ears) on the wounds and ulcers on animal bodies, sometimes – on humans (during sleep in the open air. Larvae live in ears, nose, frontal sinuses and eyes. Having implanted into tissues they destroy them to the bones. Parasitizing of larvae causes myiasis. The disease is accompanied by a severe pain, tissue necrosis. In 5–7 days larvae fall out into the soil and pupate. Prophylactic measures are directed towards prevention people from attacks of flies.

5. Medical significance of horse–flies.

Horse–flies (families: gastric horse–flies – Gastrophilidae, subcutaneous horse–flies –Hypodermatidae and cavital – Oestridae) are common everywhere. Mature horse–flies live several days and do not eat. They lay eggsor produce living larvae that cause myiasis.

Large gastric horse–fly (Gastrophilus intestinalis) lays eggs on the hair of horses (fig. 42). Larvae implant into the skin causing itching. Scratching itch ing sites with teeth horses swallow larvae. Larvae together with horse excre– ments get into the soil and pupate. Sometimes a female of the horse–fly lays eggs on the human hair. Larvae permeate into the skin (face, breast), where they make passages of 3–5 cm long and parasitize 1–2 months.

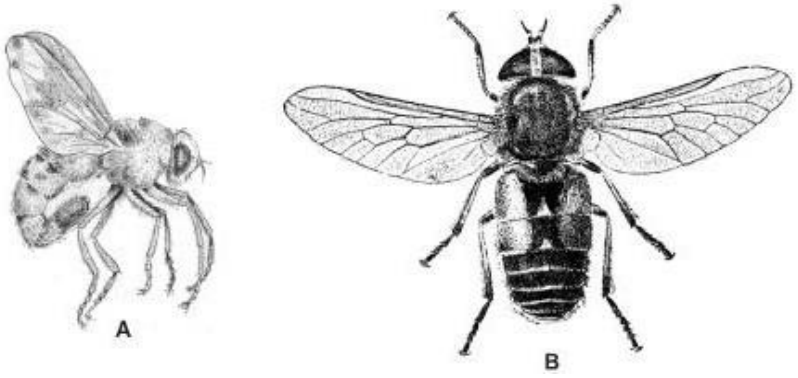

Fig. 42. Gadflies and horse–flies:
A – a horse–fly (Gastrophilus intestinalus); B – a gadfly (Tabanus autumnalis)

Ox gadfly (Hypoderma bovis) lays eggs on the hair of animals, sometimes

on hairy parts of the human body, from where larvae migrate into tissues completing their development in the hypodermal adipose cellular tissue onthe back, arms, face. Pupation occurs in soil.

Sheep gadfly (Oestrus ovis) and Russian gadfly (Rhinoestrus purpureus). Females are viviparous; they throw out a stream of fluid containing larvaein the air, into nostrils or eyes of animals or humans. The development of larvae occurs in nasal cavities, sinuses, in eye–balls, in the cranial cavity. They leavethe host before pupation entering the environment through nostrils. Larvae of gadflies in the human are removed surgically.

6. Fighting measures with 2–winged insects.

Direct protection from attacks of insects (wearing of closed clothes, putting nets on windows), using insecticides and repellents; zooprophylaxis – making biological barriers (cattle breeding farms) between hatching places of insects and dwelling houses; drainage of marshes, dissipation of chemical substances in wintering places of insects.

Basic terms and concepts:

1. Winged blood–sucking insects – a group of small 2–winged blood–sucking insects (midges, greases, gnats and mosquitoes).

2. Gonotrophic cycle –maturation of eggs in females of 2–winged insects in digestion of blood.

3. Zooprophylaxis –making biological barriers between hatching places of gnats (houses for the cattle) and dwelling houses.

4. Myiasis – a disease caused by larvae of flies and horse–flies.

5. Repellents – chemical substances, which scare away insects.

OPEN TESTS

1. Types of the insects oral cavity are: a) gnawing and stinging; b) sucking, licking and piercing–gnawing; c) gnawing, licking, piercing–sucking; d) sucking–gnawing and sucking; e) drinking up, sucking, stinging.

2. Morphological features of cockroaches: a) the dimensions of a bodyare up to 3 cm, compressed to the dorsoventral direction; b) the dimensions of a body are up to 3 cm, laterally clinched; c) the dimension of the body are up to 8 cm, the oral cavity is of a gnawing type; d) the dimensions of a body are up to 3 cm, the oral cavity is of a gnawing type; e) the body is flattened in dorsoven– tral direction, the oral cavity is of a piercing–sucking type.

3. Medical aspect of cockroaches: a) mechanical transmitting agents of eggs of helminths, cyst protists and originators of intestinal infections; b) specific transmitting agents of tularemia and a tuberculosis originators; specific transmitting agents of malaria and filariasis originators; c) gnaw in– fant's epidermis in nasolabial triangle and cause infection; d) originators of the cartarral symptoms in the gastrointestinal tract.

4. Morphological features of a bed bug: a) the body is laterally flat– tened, its dimensions are up to 8 cm; b) the body is flattened in dorsoventral di– rection, its dimensions are up to 8 mm; c) the body is flattened to a dorsoventral direction, its dimensions are up to 8 cm; d) dark brownish–red colour, there are scent glands; e) dark brownish–red colour, the scent glands are absent.

5. Morphological features of kiss bug: a) the dimensions of a body are up to 3,5 cm; b) the dimensions of a body are up to 3,5 mm; c) the body is flat– tened to a dorsoventral direction, there are wings; d) the body is laterally flat– tened, there are wings; e) dark brownish–red colour, the wings are absent.

6. Morphological features of Pediculus type lice are: a) the dimensions of a body are of 1–4 cm, the absence of wings; b) the dimensions of a bodyare of 1–4 mm, the presence of one pair of wings; c) the oral cavity is of a gnawing type; d) the dimensions of a body are of 1–4 mm, the absence of wings; e) the oral cavity is of a pricking–sucking.

7. Medical aspect of a bed bug: a) a mechanical transmitting agent of helminths eggs and cysts protists; b) a specific transmitting agent of the plague and tuberculosis originators; c) punctures are painful and causes dermatitis; d) a mechanical transmitting agent of the tularemia originator; e) larva causes myiasis.

8. Morphological features of fleas are: a) the body is flattened to a dorsoventral direction; b) the body is laterally flattened; c) the oral cavity is of a pricking–sucking type and absence of wings; d) presence of one pair of wings and «salutatory» extremities; e) the oral cavity is of a gnawing type.

9. The medical aspect of fleas is: a) mechanical transmitting agents of tuberculosis and dysentery originators; b) specific transmitting agents of cyst protists and eggs of helminths; c) specific transmitting agents of the plague ori– ginator; d) punctures are painful and causes dermatitis; e) mechanical transmit– ting agents of tularemia originators.

10. Features of Pediculus family louse life cycle are: a) lay eggs in dry dust and on food products; b) eggs stick to hair; c) the development is direct; d) the development is with semimetamorphosis; e) the duration of life cycle is 2–3 months.

11. The medical aspect of Pediculus family louse is: a) mechanical transmitting agents of helminths eggs and cyst protists; b) specific transmitting agents of the louse–born recurrent typhus originator; c) specific transmitting agents of the louse–born typhus originator; d) pediculosis originators, punctures produce itching; e) originators of phthiriosis, punctures produce itching.

12. Morphological features of Phthirus type lice are: a) a body is short and wide, the dimension is up to 10 mm; b) a body is short and wide, the dimen–sion is up to 1,5 mm; c) a body is extended, the dimension is up to 5 mm; d) the oral cavity is of pricking–sucking type; e) the oral cavity is of gnawing type.

13. Medical aspect of P. pubis louse is: a) mechanical transmitting agents of the recurrent and classical typhus originators; b) specific transmitting agents of cyst protists and of helminths eggs; c)originators of phthiriosis; d) specific transmitting agents of malaria originators; e) damages the skin with rare rigid hair, punctures produce itching.

14. Morphological features of a room fly: a) the dimensions of a body are about 7 cm, the oral cavity is licking–sucking; b) the dimensions of a body are about 7 mm, the oral cavity is licking–sucking; c) the body is covered with hair, one pair of wings; d) the oral cavity is licking–sucking, there's a pair of great facet eyes; e) the oral cavity is gnawing, two pairs of wings

15. The medical aspect of a room fly is: a) a specific transmitting agent of bacteria, cyst protists and helminths eggs; b) a mechanical transmitting agent of bacteria, cyst protists and helminths eggs; c) a specific transmitting agent of the plague and Japanese enphalitis originators; d) larvae produce myiasis; e) a specific transmitting agent of African trypanosomiasis originators.

16. The medical aspect of a stable fly is: a) a mechanical transmitting agent of cyst protists and helminths eggs; b) mechanical transmitting agent of sepsis and the anthrax originators; c) a specific transmitting agent of sepsis and the anthrax originators; d) larvae produce myiasis; e) punctures are painful.

17. The medical aspect of midges is: a) mechanical transmitting agents of cyst protists and helminths eggs; b) mechanical transmitting agents of the tuberculosis originator; c) mechanical transmitting agents of the tularemia originator, punctures unhealthy; d) mechanical transmitting agents of sepsis and anth– rax originators; e) specific transmitting agents of the onochocercosis originator.

18. The medical aspect of black gnats is: a) mechanical transmitting agents of cyst protists and helminths eggs; b) mechanical transmitting agents of the tuberculosis originator; c) mechanical transmitting agents of tularemia origi–nators, punctures are painful; d) mechanical transmitting agents of sepsis and anthrax originators; e) specific transmitting agents of filariasis originators.

19. The Family of horse fly is called: a) Muscidae; b) Tabanidae; c) Simuliidae; d) Culicidae; e) Phlebotomidae.

20. Morphological features of preimago stages of Anopheles mosquitos are: a) eggs have no air chambers, larvae have a siphon; b) eggs have air chambers, larvae have a siphon; c) larvae have no siphon, and pupas havea conical siphon; d) eggs have air chambers, pupas have a cylindrical siphon; e) eggs have air chambers, pupas have a conical siphon.

21. Morphological features of adult stages of Anopheles mosquitos are: a) short moustaches and mandibular feelers of female are very downy, feelers are equal to proboscis by length; b) short moustaches and mandibular feelers of a femail are poorly downy, feelers are equal to proboscis by length; c) mandibu–lar feelers of males are very downy and by length are shorter than proboscis; d) mandibular feelers of males are very downy and at the end have clavate thickenings; e) mandibular feelers of males are very downy and at the end have no clavate thickenings.

22. The medical aspect of Anopheles sort mosquitos is: a) mechanical transmitting agents of helminths eggs and cyst protists; b) specific transmitting agents of tularemia and the plague originators; c) specific transmitting agents of malaria originators; d) specific transmitting agents of the onchocercosis originator; e) punctures are painful.

23. The medical aspect of Aedes sort mosquitos is: a) mechanical transmitting agents of tularemia and Japanese encephalitis originators; b) specific transmitting agents of cyst protists and helminths eggs; c) specific transmitting agents of the plague and tuberculosis originators; d) specific transmitting agents of malaria originators; e) specific transmitting agents of bancroftian filariasis originators.

24. The medical aspect of Culex sort mosquitos is: a) mechanical transmitting agents of tularemia and Japanese encephalitis originators; b) specific transmitting agents of cyst protists and helminths eggs; c) specific transmitting agents of malaria originators; d) specific transmitting agents of bancroftian filariasis originators; e) punctures are painless.

25. The mosquitoes Family refers to: a) Muscidae; b) Tabanidae; c) Simuliidae; d) Culicidae; e) Phlebotomidae.

CLOSE TESTS

1. Types of the insects oral cavity are: a) gnawing and stinging; c) sucking, licking and piercing–gnawing; c) gnawing, licking, piercing–sucking; d) sucking–gnawing and sucking; e) drinking up, sucking, stinging.

2. Morphological features of cockroaches: a) the dimensions of a bodyare up to 3 cm, compressed to the dorsoventral direction; b) the dimensions of a body are up to 3 cm, laterally clinched; c) the dimension of the body are up to 8 cm, the oral cavity is of a gnawing type; d) the dimensions of a body are up to 3 cm, the oral cavity is of a gnawing type; e) the body is flattened in dorsoven– tral direction, the oral cavity is of a piercing–sucking type.

3. Medical aspect of cockroaches: a) mechanical transmitting agents of eggs of helminths, cyst protists and originators of intestinal infections; b) specific transmitting agents of tularemia and a tuberculosis originators; specific transmitting agents of malaria and filariasis originators; c) gnaw in– fant's epidermis in nasolabial triangle and cause infection; d) originators of the cartarral symptoms in the gastrointestinal tract.

4. Morphological features of a bed bug: a) the body is laterally flat– tened, its dimensions are up to 8 cm; b) the body is flattened in dorsoventral di– rection, its dimensions are up to 8 mm; c) the body is flattened to a dorsoventral direction, its dimensions are up to 8 cm; d) dark brownish–red colour, there are scent glands; e) dark brownish–red colour, the scent glands are absent.

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6. Morphological features of Pediculus type lice are: a) the dimensions of a body are of 1–4 cm, the absence of wings; b) the dimensions of a bodyare of 1–4 mm, the presence of one pair of wings; c) the oral cavity is of a gnawing type; d) the dimensions of a body are of 1–4 mm, the absence of wings; e) the oral cavity is of a pricking–sucking.

7. Medical aspect of a bed bug: a) a mechanical transmitting agent of helminths eggs and cysts protists; b) a specific transmitting agent of the plague and tuberculosis originators; c) punctures are painful and causes dermatitis; d) a mechanical transmitting agent of the tularemia originator; e) larva causes myiasis.

8. Morphological features of fleas are: a) the body is flattened to a dorsoventral direction; b) the body is laterally flattened; c) the oral cavity is of a pricking–sucking type and absence of wings; d) presence of one pair of wings and «salutatory» extremities; e) the oral cavity is of a gnawing type.

9. The medical aspect of fleas is: a) mechanical transmitting agents of tuberculosis and dysentery originators; b) specific transmitting agents of cyst protists and eggs of helminths; c) specific transmitting agents of the plague ori–

ginator; d) punctures are painful and causes dermatitis; e) mechanical transmit–ting agents of tularemia originators.

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13. Medical aspect of P. pubis louse is: a) mechanical transmitting agents of the recurrent and classical typhus originators; b) specific transmitting agents of cyst protists and of helminths eggs; c)originators of phthiriosis; d) specific transmitting agents of malaria originators; e) damages the skin with rare rigid hair, punctures produce itching.

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15. The medical aspect of a room fly is: a) a specific transmitting agent of bacteria, cyst protists and helminths eggs; b) a mechanical transmitting agent of bacteria, cyst protists and helminths eggs; c) a specific transmitting agent of the plague and Japanese enphalitis originators; d) larvae produce myiasis; e) a specific transmitting agent of African trypanosomiasis originators.

16. The medical aspect of a stable fly is: a) a mechanical transmitting agent of cyst protists and helminths eggs; b) mechanical transmitting agent of sepsis and the anthrax originators; c) a specific transmitting agent of sepsis and the anthrax originators; d) larvae produce myiasis; e) punctures are painful.

17. The medical aspect of midges is: a) mechanical transmitting agents of cyst protists and helminths eggs; b) mechanical transmitting agents of the

tuberculosis originator; c) mechanical transmitting agents of the tularemia originator, punctures unhealthy; d) mechanical transmitting agents of sepsis and anth– rax originators; e) specific transmitting agents of the onochocercosis originator.

18. The medical aspect of black gnats is: a) mechanical transmitting agents of cyst protists and helminths eggs; b) mechanical transmitting agents of the tuberculosis originator; c) mechanical transmitting agents of tularemia origi– nators, punctures are painful; d) mechanical transmitting agents of sepsis and anthrax originators; e) specific transmitting agents of filariasis originators.

19. The Family of horse fly is called: a) Muscidae; b) Tabanidae; c) Simuliidae; d) Culicidae; e) Phlebotomidae.

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22. The medical aspect of Anopheles sort mosquitos is: a) mechanical transmitting agents of helminths eggs and cyst protists; b) specific transmitting agents of tularemia and the plague originators; c) specific transmitting agents of malaria originators; d) specific transmitting agents of the onchocercosis originator; e) punctures are painful.

23. The medical aspect of Aedes sort mosquitos is: a) mechanical transmitting agents of tularemia and Japanese encephalitis originators; b) specific transmitting agents of cyst protists and helminths eggs; c) specific transmitting agents of the plague and tuberculosis originators; d) specific transmitting agents of malaria originators; e) specific transmitting agents of bancroftian filariasis originators.

24. The medical aspect of Culex sort mosquitos is: a) mechanical transmitting agents of tularemia and Japanese encephalitis originators; b) specific

transmitting agents of cyst protists and helminths eggs; c) specific transmitting agents of malaria originators; d) specific transmitting agents of bancroftian filariasis originators; e) punctures are painless.

25. The mosquitoes Family refers to: a) Muscidae; b) Tabanidae; c) Simuliidae; d) Culicidae; e) Phlebotomidae.

ANSWERS TO THE OPEN TESTS

INTRODUCTION TO PARASITOLOGY

1. False parasites. **2.** Obligatory. **13.** Potential.
4. Permissive. **5.** Alimentary. **6.** Air–drop (respiratory).
7. Contact–household. **8.** Transfusive.

PHYLUM SARCOMASTIGOPHORA, CLASSES SARCODINA, ZOOMASTIGOTA

1. Trophozoit. **2.** Dysentery amoeba, balantidium.
3. Meningoencephalytis. **4.** Axostyle. **5.** Tsetse fly.
6. Cruzi. **7.** Chagoma. **8.** Promastigota. **9.** 5.

PHYLUM INFUSORIA, CLASS CILIATA PHYLUM APICOMPLEXA, CLASS SPOROZOA

1. falciparum. **2.** malaria. **3.** Sporozoit.
4. Micro– and macrogametocyte. **5.** malaria.
6. falciparum. **7.** Conoid. **8.** Cats.
19. Sporozoit, trophozoit. **10.** Sporozoit, trophozoit.

PHYLUM PLATHELMINTHES, CLASS TREMATODA

1. Invasive stages. **2.** Cat liver fluke. **3.** Cercaria.
4. Pulmonary. **5.** Metacercaria. **6.** Gynecofornous canal.
7. Sporocyst II. **8.** Cercaria.

PHYLUM PLATHELMINTHES, CLASS CESTOIDEA

1. Dwarf tenia. **2.** 2. **3.** 17–35.
4. Cysticerc. **5.** 3. **6.** 7–12.
7. Cysticercoid. **8.** 200. **8.** Intermediate.
10. Coracidium

PHYLUM NEMATHELMINTHES, CLASS NEMATODA

1. Hypoderm. **2.** One. **3.** Enterobius vermicularis.
4. One year. **5.** Larva migrans. **6.** Whipworm.
7. One month. **8.** Biopsy. **9.** Duodenal assassin worm.
10. Rabtid. **11.** Dwarf treadworm. **12.** Onchocerca.
13. Macroscopic methods. **14.** Kalantaryan.
15. Fulleborn. **16.** Immunological.

PHYLUM ARTHROPODA, CLASS ARACHNOIDEA

1. Ixodidae.**2.** Dermacentor. **3.** Transovarial.
4.Tularemia and Scotch encephalitic.
5.Russian spring–summer encephalitis. **6.** Scotch encephalitic.
7. Spring–summer encephalitis.**8..** Tick enteric fever.
9. Hemorrhagic fevers. **10.** Argasidae. **11.** Flour.

PHYLUM ARTHROPODA, CLASS INSECTA

1. Plague. **2.** Rodents. **3.** «Plague block».
4. Sarcopsillesis. **5.** Pediculosis. **6.** Phthiriosis.
7. Nit. **8.** Louse–born relapsing and a louse–born enteric fever.
9. Obermeier's Spirochaeta. **10.** Mechanical.
11. Anthrax, sepsis. **12.** African trypanosomosis.
213. Myiasis. **14.** Underwater stones and plants.
15. Onchocercosis. **16.** Leischmaniosis and pappatachi fever.
17. Mosquitos. **18.** Gonotrofic cycle. **19.** Anopheles.

CLOSE TESTS
INTRODUCTION TO PARASITOLOGY

1. d. **2.** a, c.**3.** c, d. **4.** a, d, e.
5. d. **6.** b, d.**7.** a, d, e.

PHYLUM SARCOMASTIGOPHORA, CLASSES SARCODINA, ZOOMASTIGOTA

1. d. **2.** b, c, d. **3.** a, c, d. **4.** a, e.
5. b, e. **6.** a, d, e. **7.** b, d. **8.** a, c, e.

PHYLUM INFUSORIA, CLASS CILIATA PHYLUM APICOMPLEXA, CLASS SPOROZOA

1. c. **2.** d. **3.** b. **4.** e. **5.** c.

PHYLUM PLATHELMINTHES, CLASS TREMATODA

1. c. **2.** d. **3.** a, e. **4.** b, c.
5. b. **6.** b, e. **7.** b, c. **8.** a, d.

PHYLUM PLATHELMINTHES, CLASS CESTOIDEA

1. b. **2.** d. **3.** a, e. **4.** b, d, e.
5. c. **6.** a. **7.** b.

PHYLUM NEMATHELMINTHES, CLASS NEMATODA

1. d.	**2.** b, c.	**3.** a, c, e.	**4.** c, e.	**5.** c.
6. b, c, d.	**7.** c, e.	**8.** a, d.	**9.** a, b.	**10.** b, e.
11. e.	**12.** a, d.	**13.** b, c, d.	**14.** a.	

PHYLUM ARTHROPODA, CLASS ARACHNOIDEA

1. d.	**2.** a, c, e.	**3.** a, c.	**4.** d, e.	**5.** a.
6. a, c.	**7.** c.	**8.** e.	**9.** d, e.	**10.** d.
11. e.	**12.** b, d.	**13.** a, c.		

PHYLUM ARTHROPODA, CLASS INSECTA, ORDER DIPTERA

1. c.	**2.** a, d.	**3.** a, d.**4.** b, d.	**5.** a, c.
6. d, e.	**7.** c.	**8.** b, c.**9.** c, d, e.	**10.** b, d.
11. b, c, d.	**12.** b, d.	**13.** c, e.**14.** b, c.	**15.** b.
16. b, e.	**17.** c, e.	**18.** c, e.**19.** b.	**20.** c, e.
21. b, d.	**22.** c, e.	**23.** a, e.**24.** a, d.	**25.** e.

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АЙБАЗОВА Фатима Унуховна
БАТЧАЕВА Альбина Хиссаевна
КУБАНОВА Лейла Тимуровна

МЕДИЦИНСКАЯ ПАРАЗИТОЛОГИЯ

(Medical parasitology)

Учебно-методическое пособие
для студентов I курса обучающихся по специальности
31.05.01. «Лечебное дело»
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