BIOLOGICAL factors influencing person

Tapeworms

- **Class Cestoidea**
- **Order Cyclophyllidea**
- **Blood line Taeniidae**

Echinococcus granulosus - эхинококк однокамерный –provokes echinococcosis disease

Alveococcus multilocularis - –provokes alveococcosis disease. **(see, also, hydatid disease)**

***Hymenolepis (Vampirolepis) nana* (dwarf tapeworm)** – Цепень карликовый - provokes **hymenolepiasis**

***Taenia* spp. (pork and beef tapeworms of humans)** – цепень свиной **–** provokes **taeniasis и (see, also, cysticercosis) - цистицеркоз**

***Taeniarhynchus saginatus* - цепень бычий –** Provokes beef tapeworm infection

Отряд Pseudophyllidea - Отряд Лентецы

***Diphyllobothrium latum* (broad fish tapeworm)** – цепень широкий - provokes bothriocephaliasis

Cestodiasis:

beef tapeworm infection,

taeniasis and cysticercosis,

hymenolepiasis,

bothriocephaliasis,

echinococcosis,

alveococcosis

Cestodiasis

Pathogens of ***cestodiasis*** - tapeworms (cestodes) are characterized by ribbon-like body consisting of a head (***scolex***) , neck ***and strobila*** divided into segments or ***proglottids*** . Segments come from the bud neck . Head is provided with attachment bodies such as muscular suckers, grooves slots and proboscis in some species provided with cuticular hooks. Segments have different shapes . Nearest to the neck segments are asexual . With the growth in the strobila of proglottids first male and then the female genital organs are laid. Development of tapeworms usually goes with a change of owners.

Stages of development of tapeworms: egg - hexacanth-finn - marita

. ***Hexacanth*** has an oval shape and is provided with six hooks. Egg with hexacanth entering the body of the intermediate host, becomes the second larval stage - ***Finn.*** Larval stage develops in the intermediate host and parasites reach sexual maturity in the final host. There are several forms of measled stages

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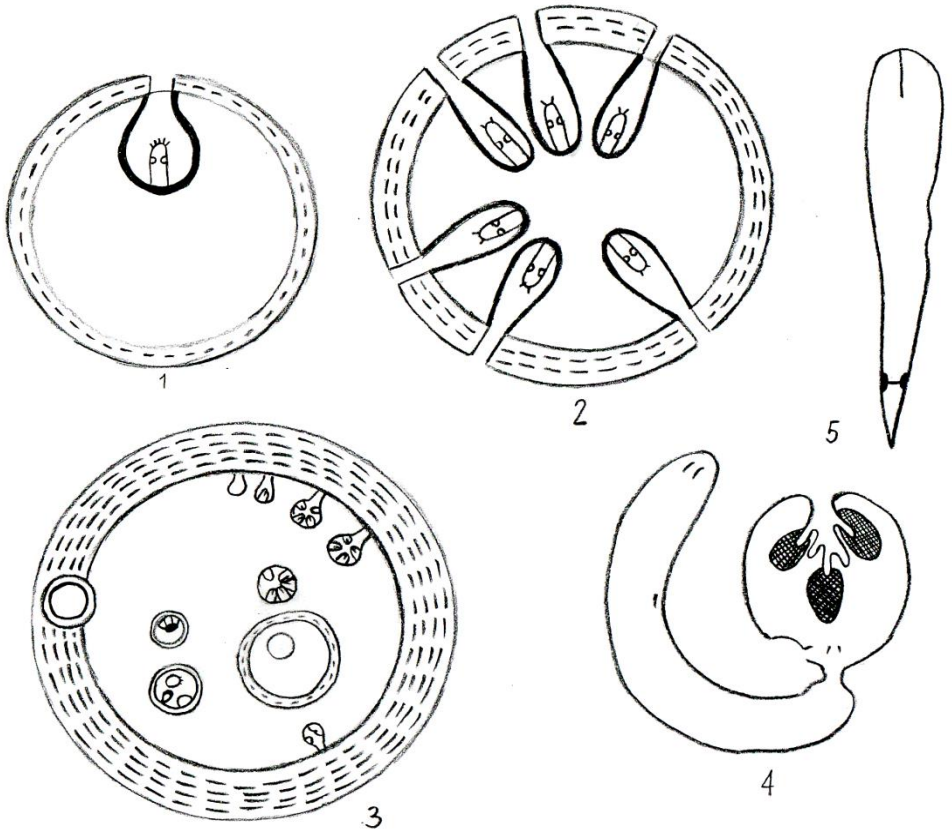
tapeworms:

1 - cysticerci; 2 -coenurus; 3 - Echinococcus with brood capsules such as children and great-bubbles with scolex; 4 - cysticercoids; 5 - plerocercoid.



***Cysticerci - Finn**, which has the shape of a small bubble size of a grain of rice, filled with liquid which has concave head inside (armed and unarmed tapeworm);*

Coenurus- Finn, on the inner side of thin-walled bubble which has many concave heads (mozgovik sheep, multitseps);

***Hydatid bubble** - big Finn (sometimes reaching to the size of children's head), filled with liquid, which have subsidiaries walled bubbles inside; the latter may have more grandchild bubbles. On the inner surface of each of the bubbles (parent, child and grandchild) develop brood capsules with plenty of heads screwed into echinococcus.*

Cysticercoids - Finn, in which the front part is inflated with the head screwed and has a compact tail appendage (dwarf tapeworm);

Plerocercoid – wormlike Finn of whitish opalescent color, ranging in length from 1 to 25 mm, has a head with bothria. The body is not divided into segments, but is covered with deep wrinkles, devoid of cilia (villi) and capsule (broad tapeworm).

By biological peculiarities tapeworms having medical value can be divided into groups.

First group: *lifecycle is associated with water,life cycle is not associated with water.*

The second *group is divided into helminths: using man as the definitive host, found in man as in the Intermediate host, living in the human body their entire life cycle.*

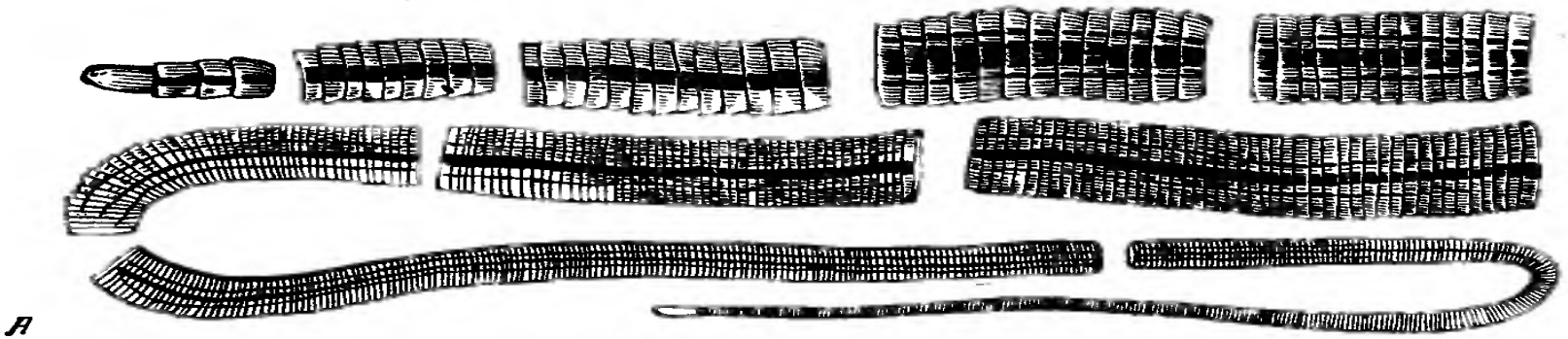
Accordingly, the path of human infection, pathogenic action of parasites, diagnosis, treatment and prevention of the relevant diseases are different.

Bothriocephaliasis

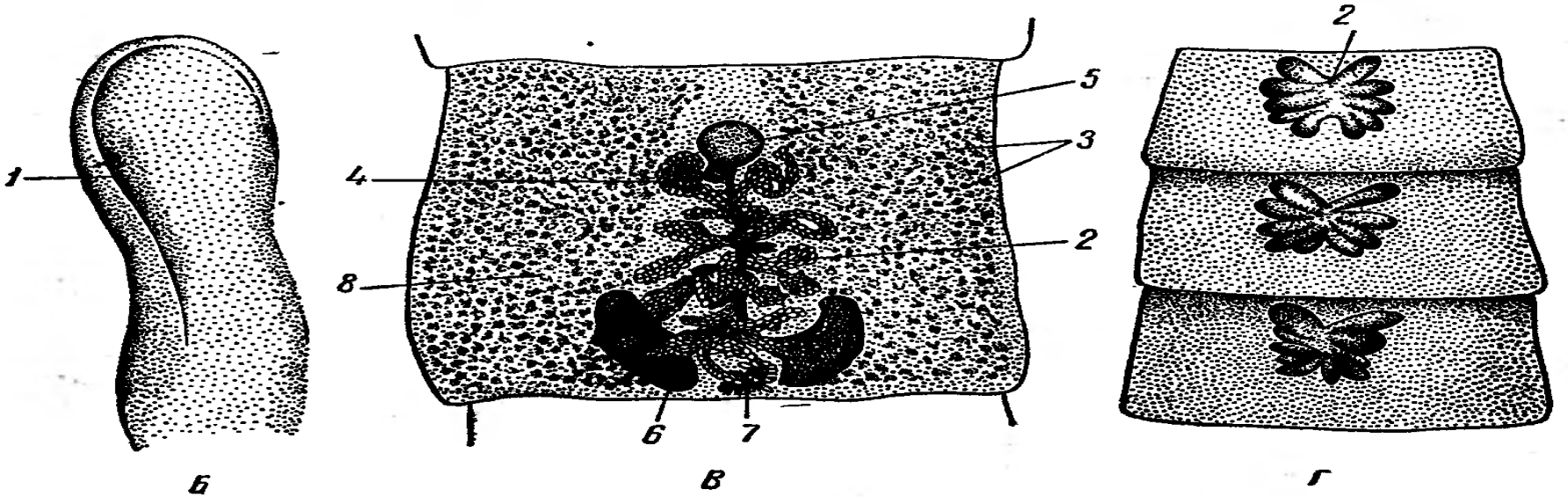
Pathogen - a tapeworm (Diphyllobothrium latum)

Strobila consists of 3000-4000 segments and reaches a length of 2-9 m or more . Head is oblong-oval with length of 1-5 mm, has two grooves - bothria located on the ventral and dorsal sides. The width of mature segments is more than their length, inside them there is overgrown uterus filled with eggs. Mature eggs come out from the uterus to the outside of the intestine and are excreted into the environment with the faeces. One tapeworm produces several million eggs daily .

Broad tapeworm (Diphyllobothrium latum A strobe; Б -scolex,); В - androgynous segment; Г- mature segments;



А



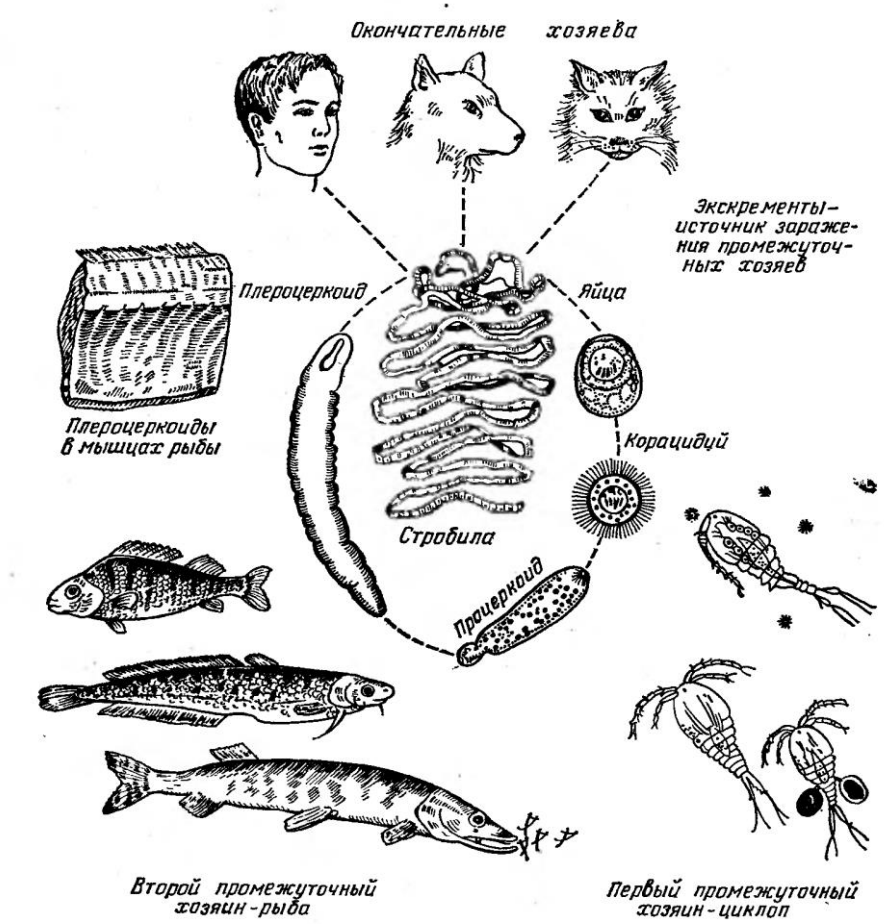
Б В Г

Development cycle of Diphyllobothrium latum

- ***For egg development they should fall into the pond where mature larva is formed that is called coracidium (round shape, covered with cilia) that goes into the water.***
- ***Coracidia are swallowed by freshwater crayfish – Cyclops, where procercoids develop . Copepods are ingested by fish. The body of the fish develop larvae -plerocercoids that accumulate in the muscles, internal organs and fish roe. Most often pike, rockfish, hake, perch get infected . People become infected by eating contaminated fish with plerocercoids.***

- ***The longevity of the parasite life is 10 years.***
- ***Diphyllobothriasis - natural focal disease. The disease is more common among fishermen, tourists and people who consume light-salted fish and caviar of home production.***
- ***The disease usually*** occurs with mild symptoms: weakness, dizziness, nausea, indigestion, abdominal pain. The parasite has a large body size and may cause intestinal obstruction. The broad tapeworm develops dysbiosis. This disrupts the absorption of vitamin B12, which is essential for the maturation of erythrocytes.
- *Humans develop severe anemia with impaired hematopoiesis in the bone marrow.*

Development cycle of Diphyllobothrium latum



Plerocercoids D. latum in the stomach wall of Baikal cisco

Diagnostics

- Disease diphyllobothriasis is diagnosed after detecting broad tapeworm eggs in the faeces of patients.
- Broad tapeworm eggs are relatively large - up to 75 mm, gray or yellowish color, with a thin smooth skin and broad-oval form. At one pole there is a lid, on the other a small hillock. Inside the egg is filled with a variety of coarse cells. Often, especially in the stale feces, eggs are found without lids or holes on their side. Sometimes the diagnosis is based on finding strobilae fragments in the faeces.

Armed tapeworm (Taenia solium) pathogen - teniasis

Strobila tapeworm

- Strobila of armed tapeworm reaches 2-3, rarely 8 m in length and consists of 800-900 segments.
- Mature segments are hermaphrodite. The length mature segments at the end of strobilae is twice more than the width and reaches 12-20 mm, the entire segment is the uterus. It is visible to the naked eye, and has a longitudinal shaft from which 8-12 side arms extend on each side. Uterus has no venting and is filled with infective eggs.

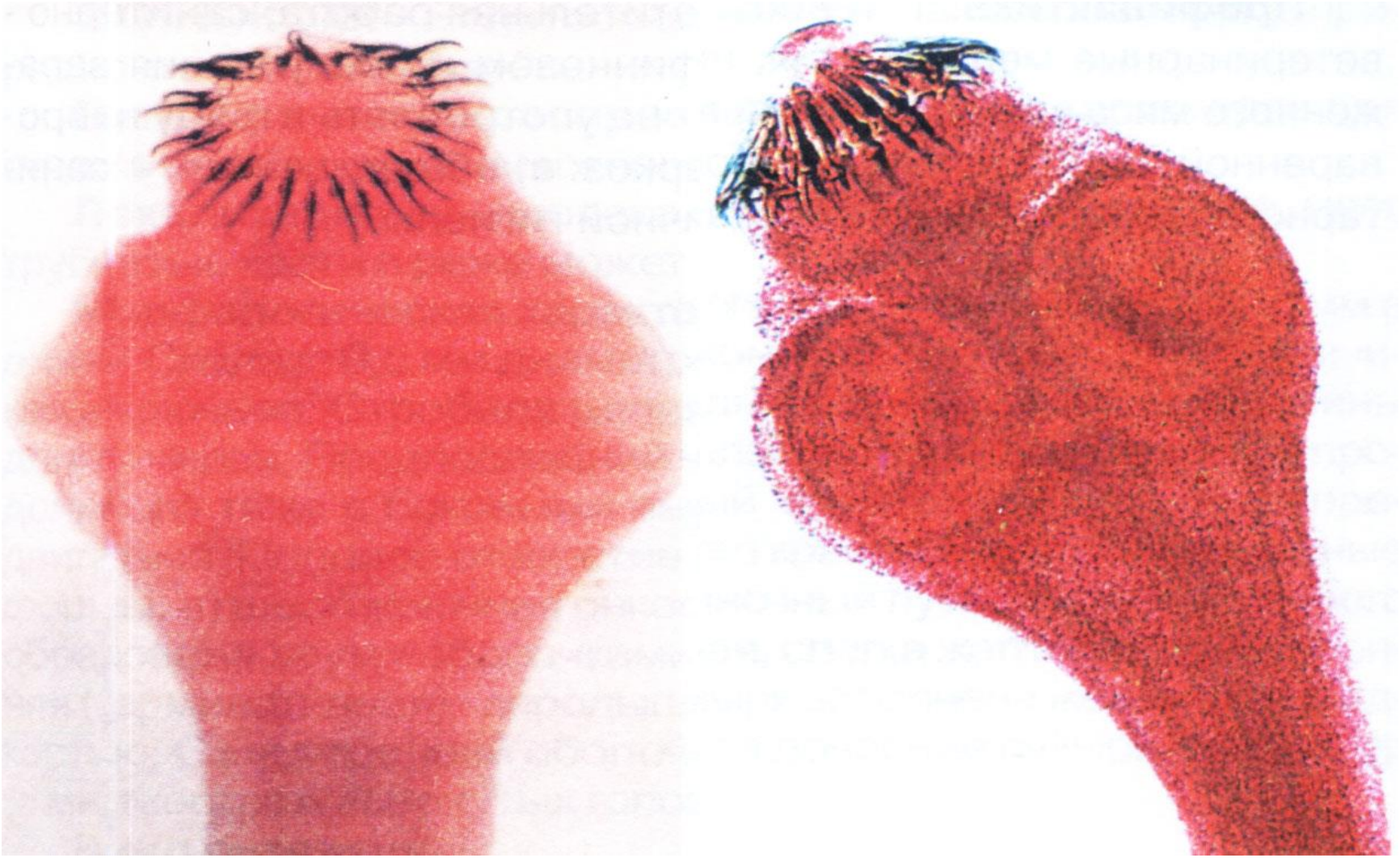
cycle of the parasite

- Eggs come into feces only through separation of segments or when they are damaged. The outer shell of the eggs is quickly destroyed, and that's why feces have oncospheres) which are almost spherical, yellow-brown, with a thick radial shell (with the size 31-40x20-30 microns.
- Infection occurs while eating lard or meat infected with Finns (cysticerci) without proper cooking. Head of cysticerci is released in the duodenum due to bile. The parasite sucks to the intestinal mucosa and is attached by hooks. Growth and formation of mature strobilae occurs within 3 months. Period of adult parasite life is about15 years.

Tapeworm head

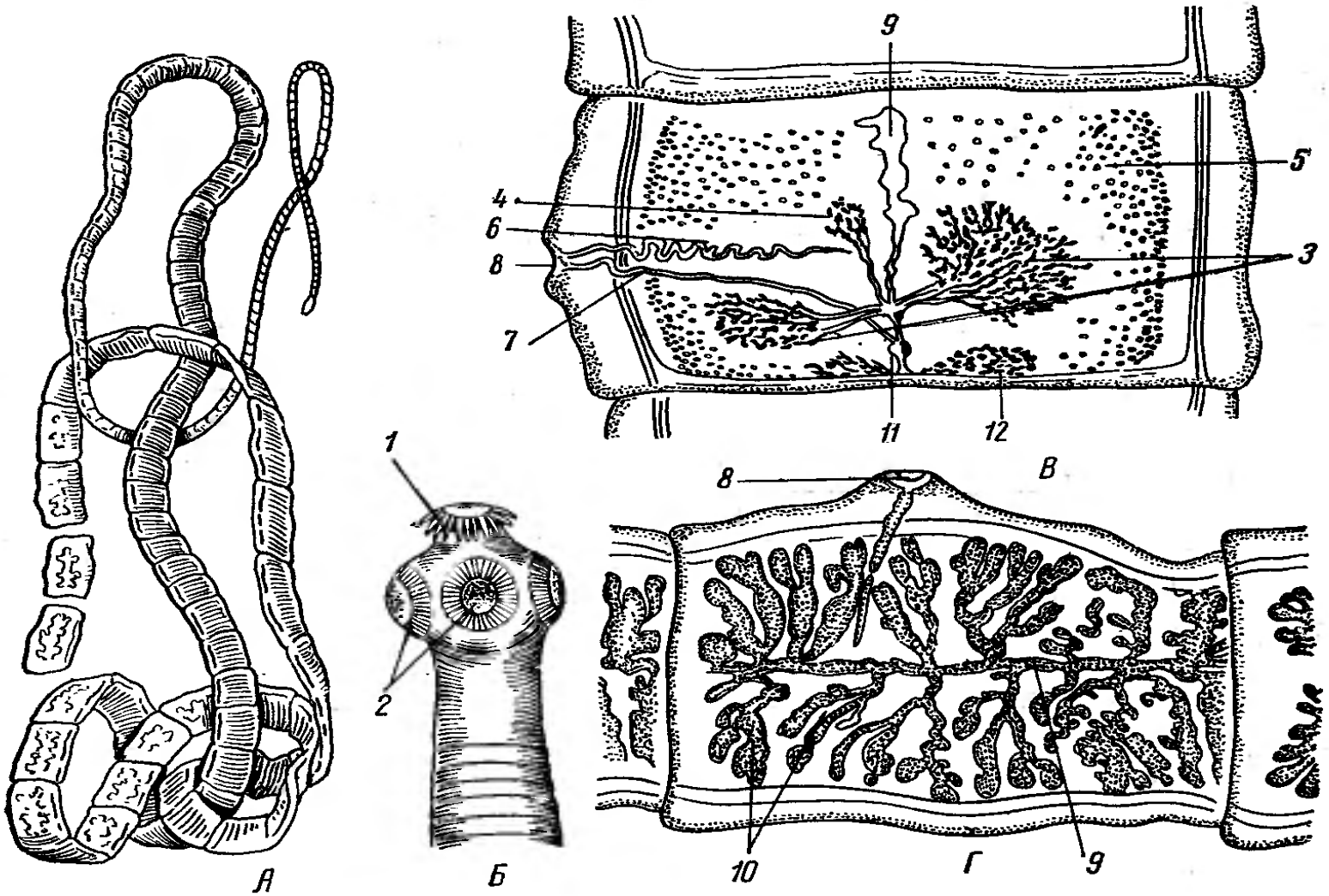
- The head of the armed tapeworm is spherical, about 1 mm in diameter, 2-3 mm long. The head has a proboscis with two rows of hooks; behind the proboscis there are 4 suckers on the sides of the head

Scolex Taenia solium



Armed tapeworm Taenia solium.

A - Gates; B - scolex; In - proglatida hermaphrodite; T - mature proglatida; 1 - hooks on scolex; 2 - sucker; 3 - ovary; 4 - the third extra slice of ovary; 5 - testes; 6 - spermaduct; 7 - vagina; 8 - cirrus pouch; 9 - the main stem of the uterus; 10 - lateral branches of the uterus; 11 - Mehlis' gland;. 12 - vitellarium



Development cycle of pork tapeworm

- Mature segments containing the uterus, stuffed with eggs, are thrown out with the human faeces.
- At the time of the segmentgoing out , the egg already has a fetus - hexacanth. This embryo with 6 hooks of round shape (diameter 31-38 nm), has a thick radial shell of a brown color; outside the embryo is covered by thin egg shell.

For further development it is necessary for hexacanth to enter an intermediate host body - pigs (camel , boar , cat, dog , rabbit) . Eggs with hexacanth come into pig stomach by eating a variety of waste contaminated with pig tapeworm eggs. In the stomach, eggs' shell dissolve and freed hexacanth actively penetrates through the intestinal wall into the lymphatic system or the bloodstream; and spreads through the body. Larva usually stays in the muscles and is undergoing further development : resets hooks and turns into a bubble

(measled) stage called cysticerci. Cysticerci is a follicle filled with a liquid, with the head screwed inside. Finns development occurs within 2.5-4 months after infection of pigs .

Clinical manifestations of teniasis

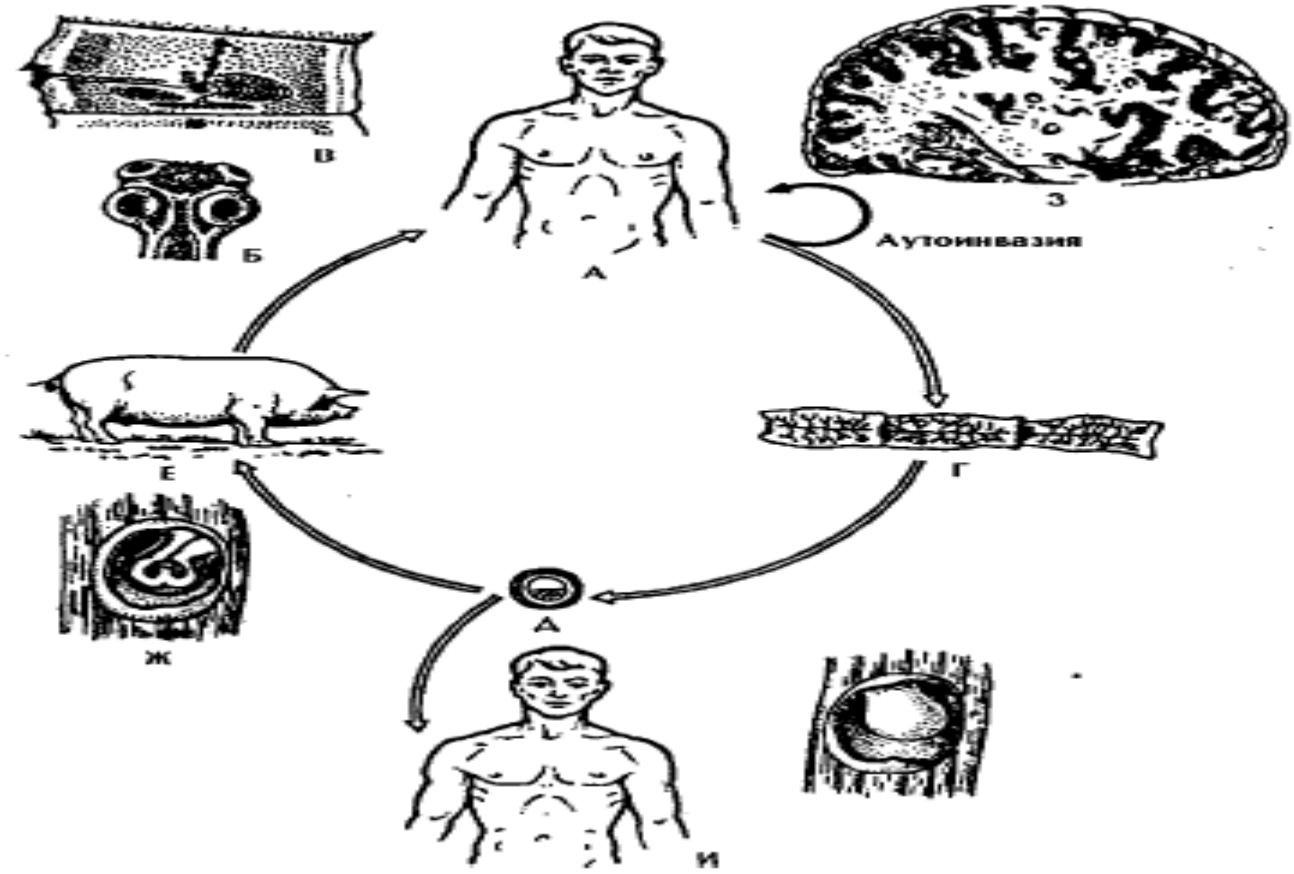
When pork tapeworm is parasitizing the intestinal wall in the area of attachment of the scolex is irritated. Parasite interferes with the digestion and nutrition of the host, the patient may experience diarrhea, abdominal pain and intoxication with parasite waste products. In case of long-term toxicity may occur anemia, eosinophilia, nervous system disorders, weakness, headache, dizziness, irritability.

diagnosis of teniasis

Diagnosis is often made on a survey of the patient's about discharge of segments. Monitoring the effectiveness of the treatment is effected by viewing feces. If the head is found, then the parasite has been removed entirely. Otherwise, after about three months segments may reappear in the feces, that indicates the need for re-treatment.

One need to be cautious in the study of feces. As in case of accidental ingestion of eggs in the human body, patients can develop cysticercosis, because a person may be an intermediate host in the development cycle of armed tapeworm – that is even more dangerous.

Cysticercosis. Person - as an optional, intermediate host.



Cysticerci - larval tapeworms, trapped in a human body

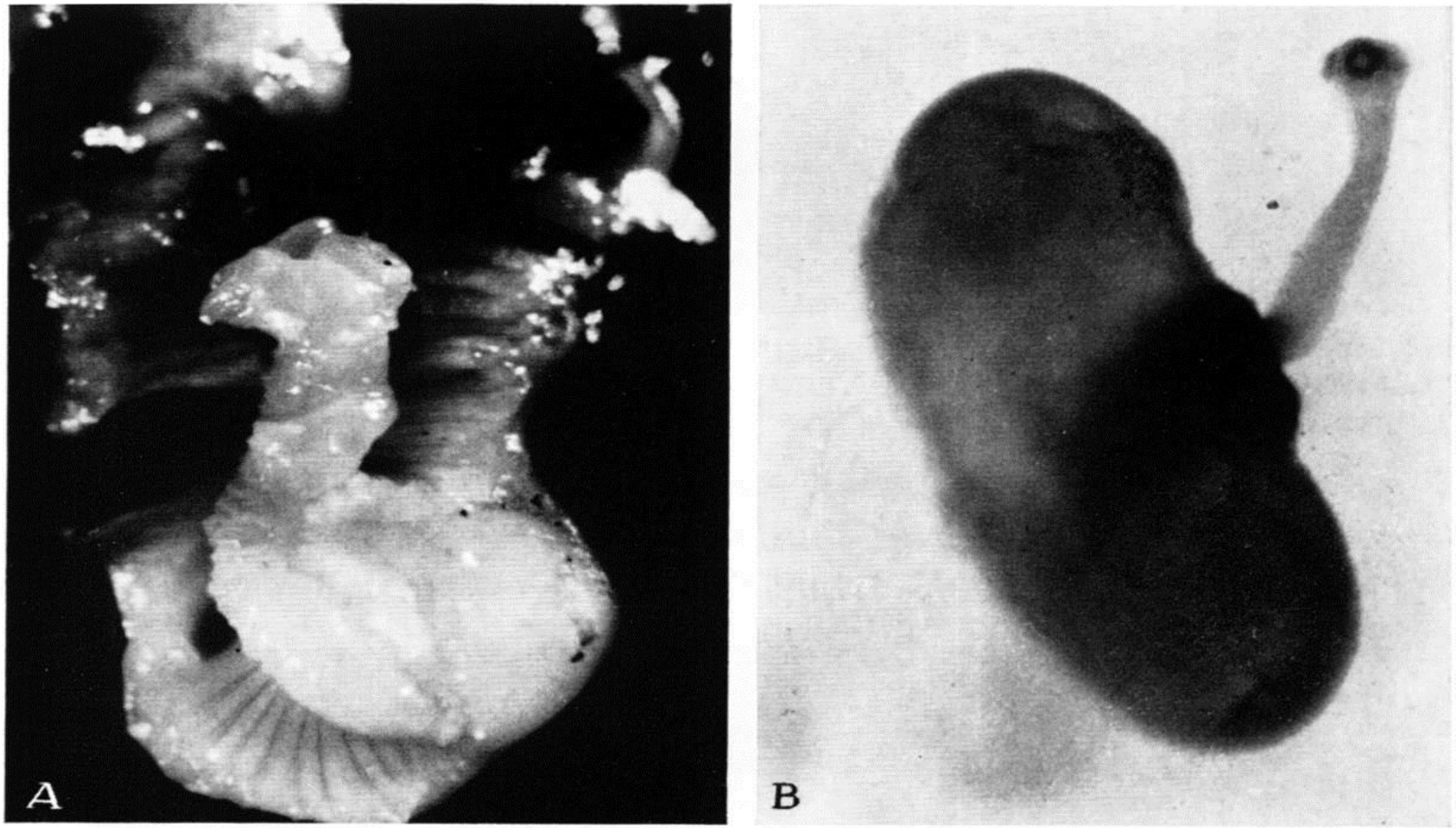
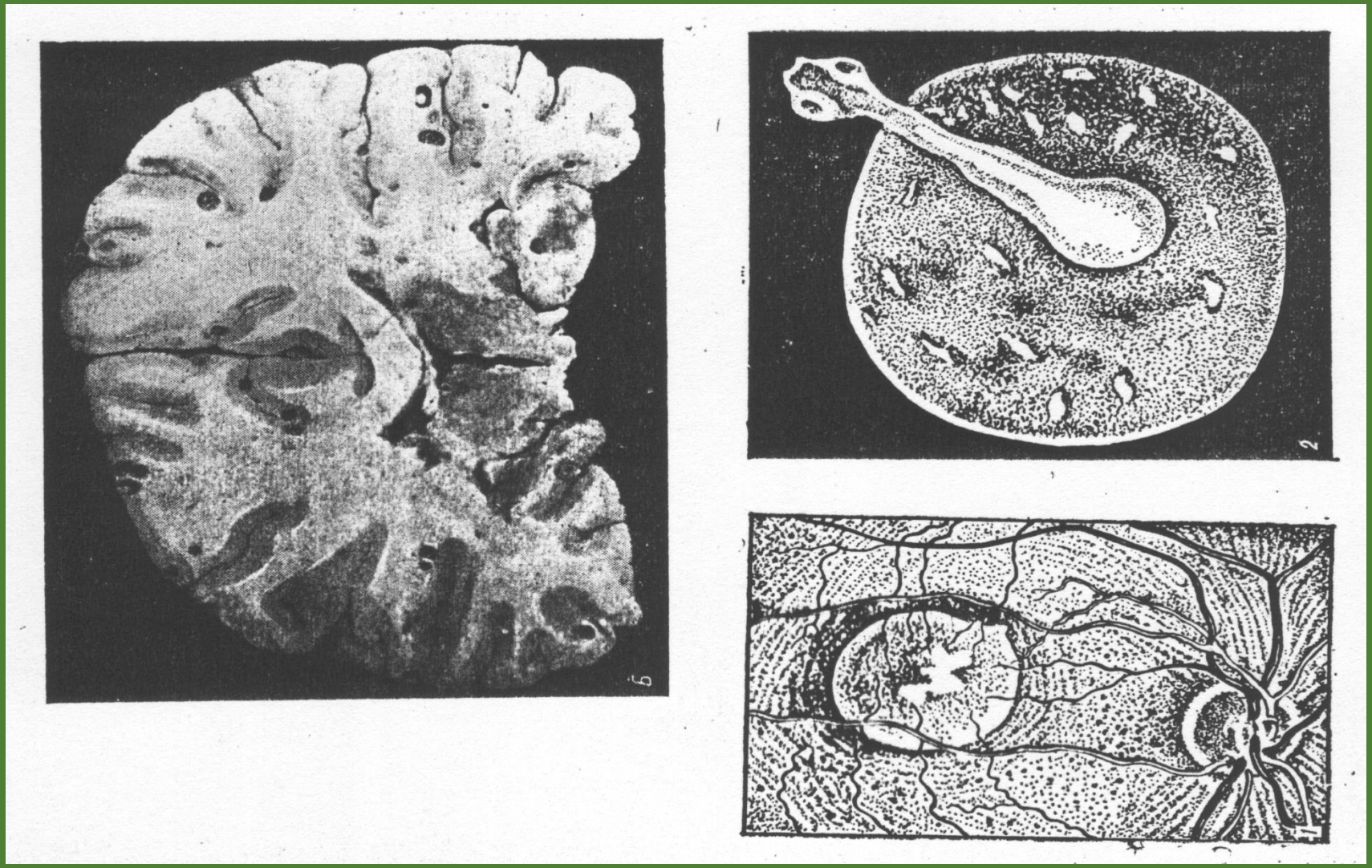


Abb. 6. A Der Skolex auf dem kurzen Hals, das in dem eingestülpten Kanal bei C. bovis herausgewachsen war. Gesamtpräparat (13 ×). B C. bovis mit dem Skolex, der auf einem dünnen Hals weit aus dem eingestülpten Kanal an die Oberfläche des Bläschens führt. Abbildung in durchgehendem Licht (5 ×)

Cysticercosis in the brain (on the left). Screwed out cysticerci (on the right)



cysticercosis

- Is provoked by armed tapeworm larvae – cysticerci, that come out of the ingested eggs. It is also possible in the case of autoinvasion when mature segments come into the stomach while vomiting.
- Cysticerci are located in the subcutaneous tissue, muscle, brain, eyes, which is reflected in the clinical picture of the disease.

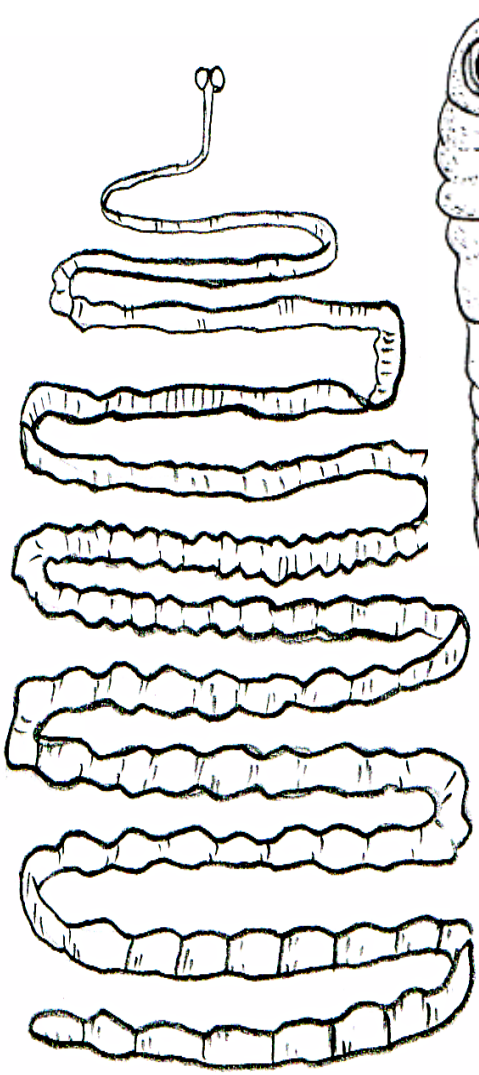
On the subcutaneous tissue and tongue muscle Finns can be explored by biopsy and histology. Cysticerci have a size ranging from a pea to a bean. Inside there is visible tapeworm head in a screwed position.

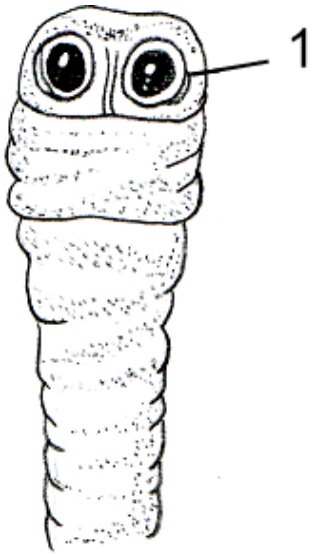
Unarmed tapeworm-Taeniarhynchus saginatus- pathogen of Teniarinhozis

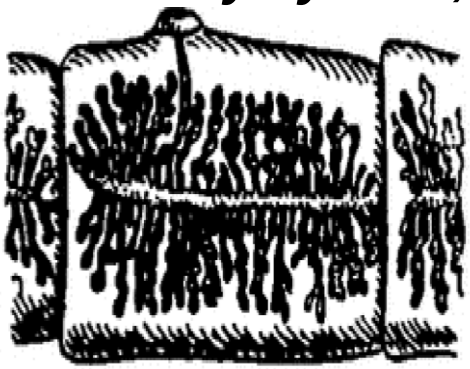
- ***Strobila of*** unarmed tapeworm reaches 4-10 m in length and contains more than 1000 segments.
- ***The head*** has a diameter of 1.5-2 mm and has four powerful suction cups placed on its lateral sides. It has no proboscis and hooks.
- ***Mature segment*** length exceeds its width. Uterus as a thin tube passes through the middle portion of the segment. The number of lateral branches ranges from 18 to 35 on each side. Eggs are the same as in the armed tapeworm.

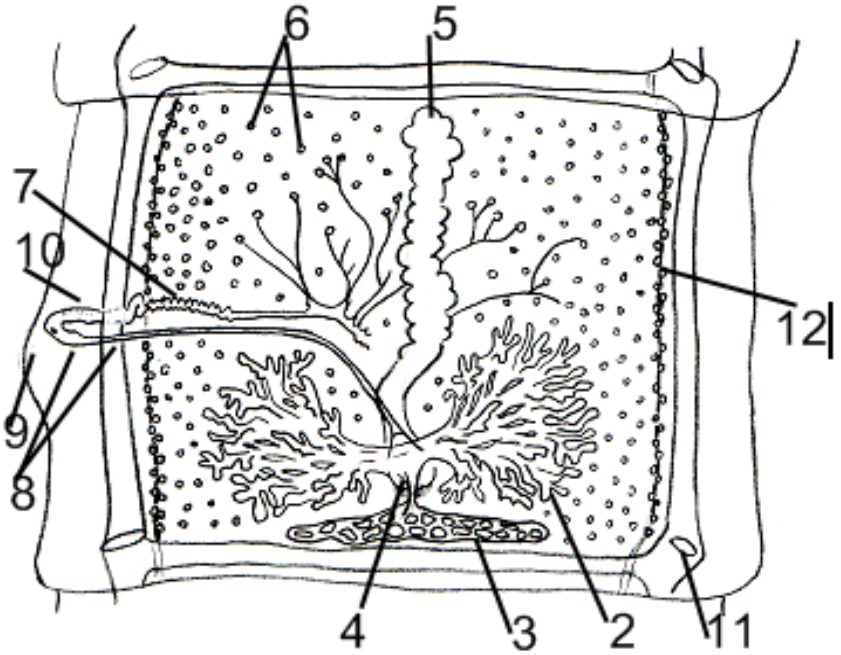
Unarmed tapeworm Taeniarhynchus saginatus.

А - Gates; В - scolex; Б- mature proglatida; Г – proglatida hermaphrodite;
1 - suckers on scolex; 2 - 3 ovary - vitellarium; 4 - Mehlis' gland; 5 - the uterus; 6 - testes; 7-spermaduct; 8 - vagina; 9 - sexual cesspool; 10 - Cirrus bag 11 - channels of the excretory system; 12 - nerve trunk.









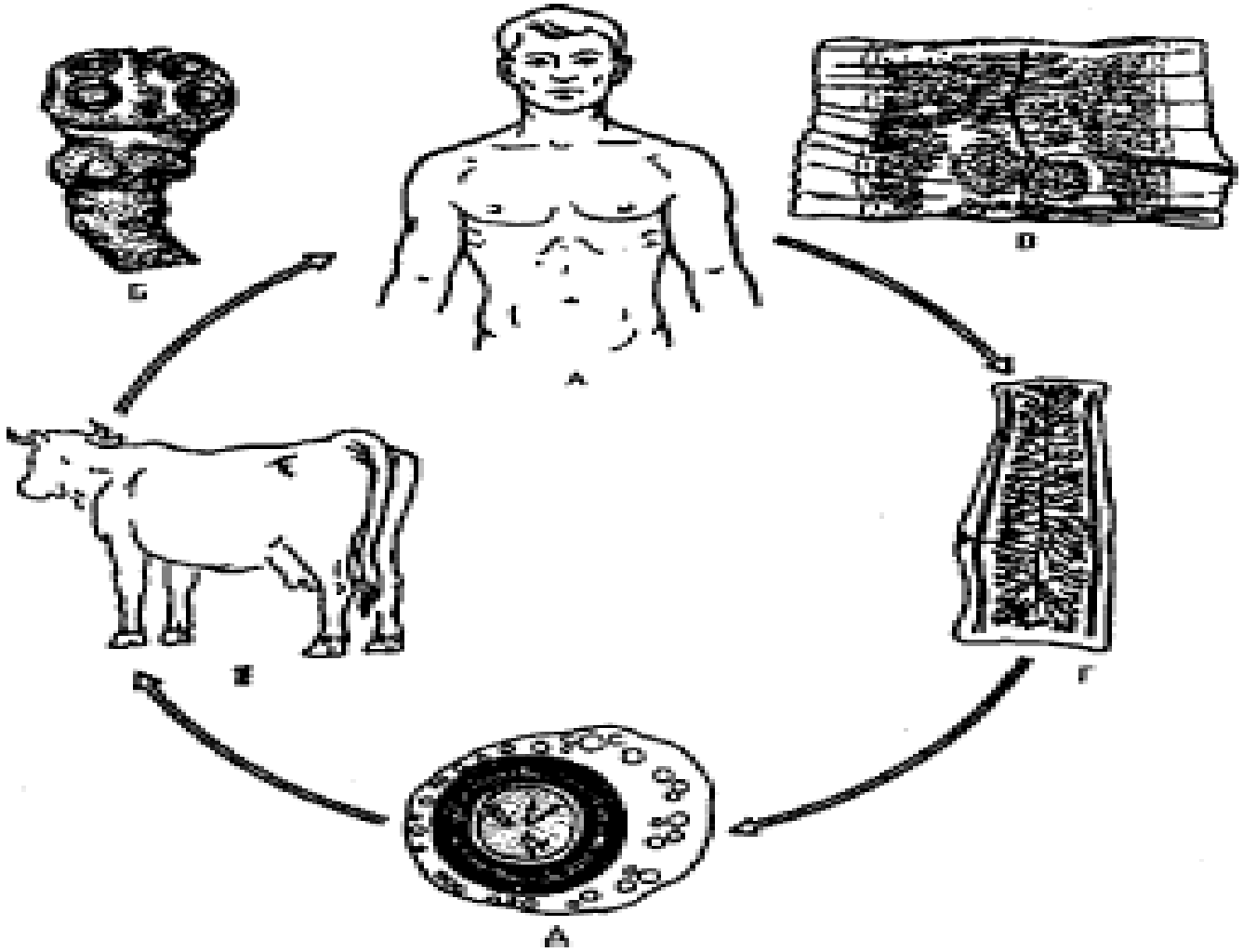
Development cycle of bovine tapeworm

- Definitive host of bovine tapeworm is only a man; intermediate hosts may be cattle, buffalo, zebu, yak, saiga, antelope species and some reindeer. While swallowing eggs with hexacanth intermediate hosts form cysticerci in the intermuscular connective tissue of skeletal muscle, cardiac muscle, tongue, chewing muscles, etc. Development of Finn ends in 7 months after infection. Finn period of life in case of single infection is within 11-12 months.

- Finn swallowed by man (with meat of an intermediate host) has its scolex everted in 12 duodenum. After 3 months tapeworm in the intestines becomes sexually mature and separation of proglottids from strobila starts. Cysticercosis in humans usually does not occur.
- Bovine tapeworm segment, actively moving through the intestines, can leave some amount of hexacanth because of uterus muscle contraction and its damage.

Lifecycle of Taeniarhynchus saginatus.

А – definitive host- people. Б - scolex. В - androgynous segment. Г - mature segment. D - egg. E-intermediate host, infested by Finn (cattle).



Clinical manifestations of teniarinhozis

- When this helminth is parasitizing patients have bowel obstruction, followed by surgery, mucous and catarrhal phenomena, which are stronger with higher degree of hyperinvasion.
- There are cases of the intestinal wall perforation, blockage of the bile ducts of the liver and gall bladder, introduction of some tapeworm segments in the appendix, which can provoke appendicitis.

Beef tapeworm absorbs large amounts of nutrients - protein, vitamins, etc., which is the cause of protein deficiency and vitamin deficiency in spite of the normal diet of the host. Consequences of the toxic effect of the parasite can be observed in a variety of morbid symptoms : weakness, cramps , headaches , vomiting , diarrhea , respiratory disorders, allergic reactions .

- In case of teniarinhozis patients usually have dramatically reduced gastric acidity. Trypsin is stored only on the lower limit of the norm. Blood picture also changes . One can observe a decreased number of red blood cells.

diagnostics

- In case of teniarinhozis segments usually come out, making active movements, so they are often noticed by patients. Since actively moving segments leave eggs on the perianal skin folds, the diagnosis of perianal scraping is applied in the same manner as in case of enterobiozeis.

diagnostics is based on segments viewing against the light, which flattened between two slides. As noted above, the central segment of the armed tapeworm barrel uterine has 8-12 side branches while an unarmed tapeworm has 18-35 and they are thinner. If the uterus is hard to see, before watching the segments must endure 50% glycerol solution.

Differences in the structure of segments and heads of bovine and porcine Taenia

evidence	beef tapeworm	pork tapeworm
Character selection of segments of the patient	Active, spontaneous, usually out of defecation	Passive during the act defecation
mobility of joints	mobile	fixed
mature segments		
a) length, mm	16-20	10–12
b) width, mm	4–7	5-6
c) the ratio of length to width	1:3–1:4	1:2
g) form	more elongated	less elongated
The structure of the uterus	By lateral branches 18-36 on each side of the uterus middle trunk	8-lateral branches 12 on each side of the uterus middle trunk
Hooks on the head	absent	Available as a corolla amount of 22-32

The larval stage of Echinococcus granulosus echinococcosis pathogen

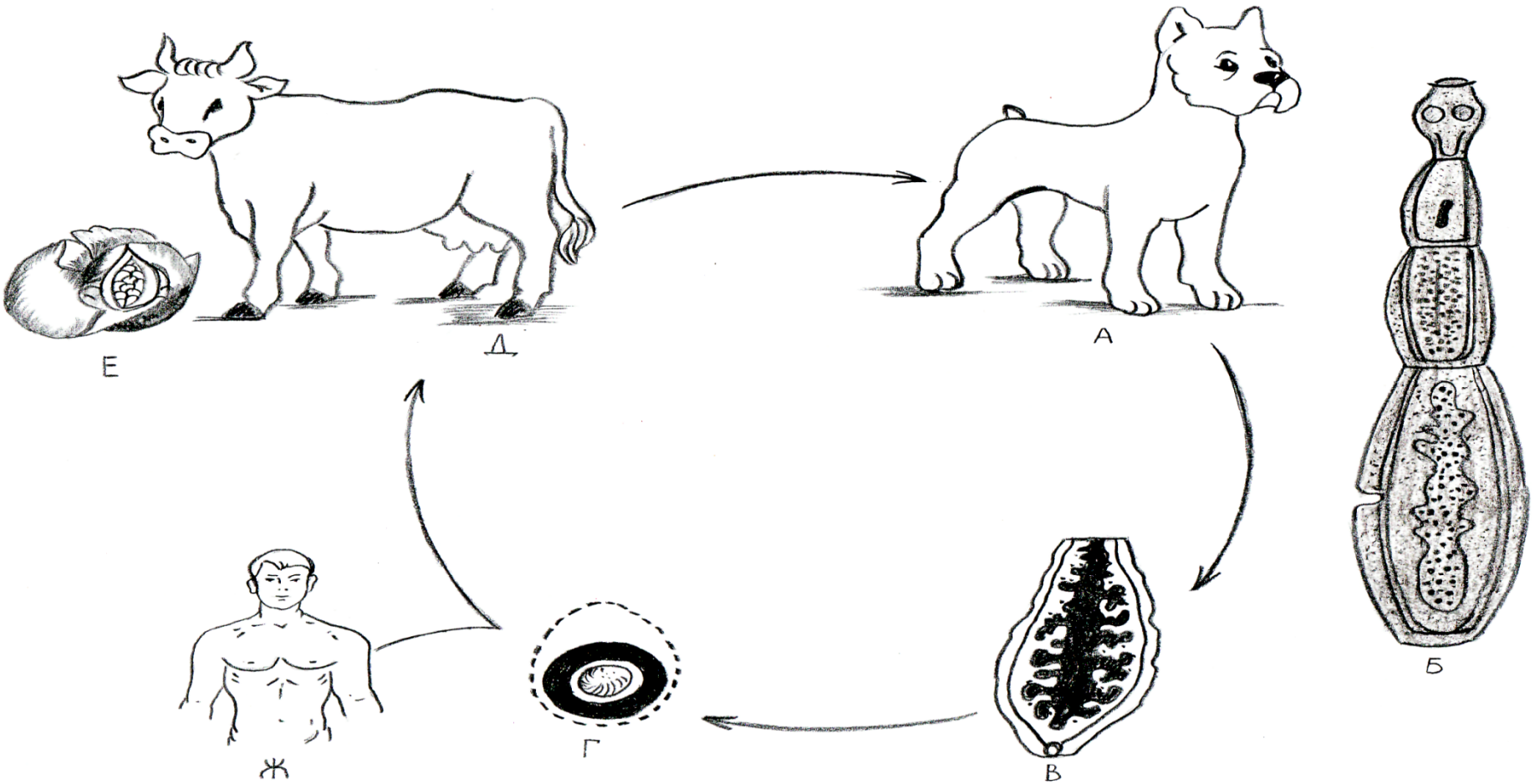
Disease refers to a natural focal. ***Definitive host in whose body pubescent echinococcus lives may be dog, wolf, jackal, fox Korsakov, raccoon dog, spotted hyena, lion, leopard, dingo etc. Most people get infected with echinococcosis when communicating with dogs.***

Infective stage for human is an egg. ***The rest intermediate hosts - wild and domestic herbivores, may be infected mainly through the grass, water, as well as predatory animals licking feces, containing salt.***

An adult tapeworm form has a length ***of 2 – 4 mm and consists of 3- 4 segments.Penultimate segment is androgynous, while the last has mature uterus which contains up to 5000 eggs with developed hexacanth. Scolex has 4 suckers and a proboscis with two beaters of hooks .***

Development cycle of *Echinococcus granulosus*

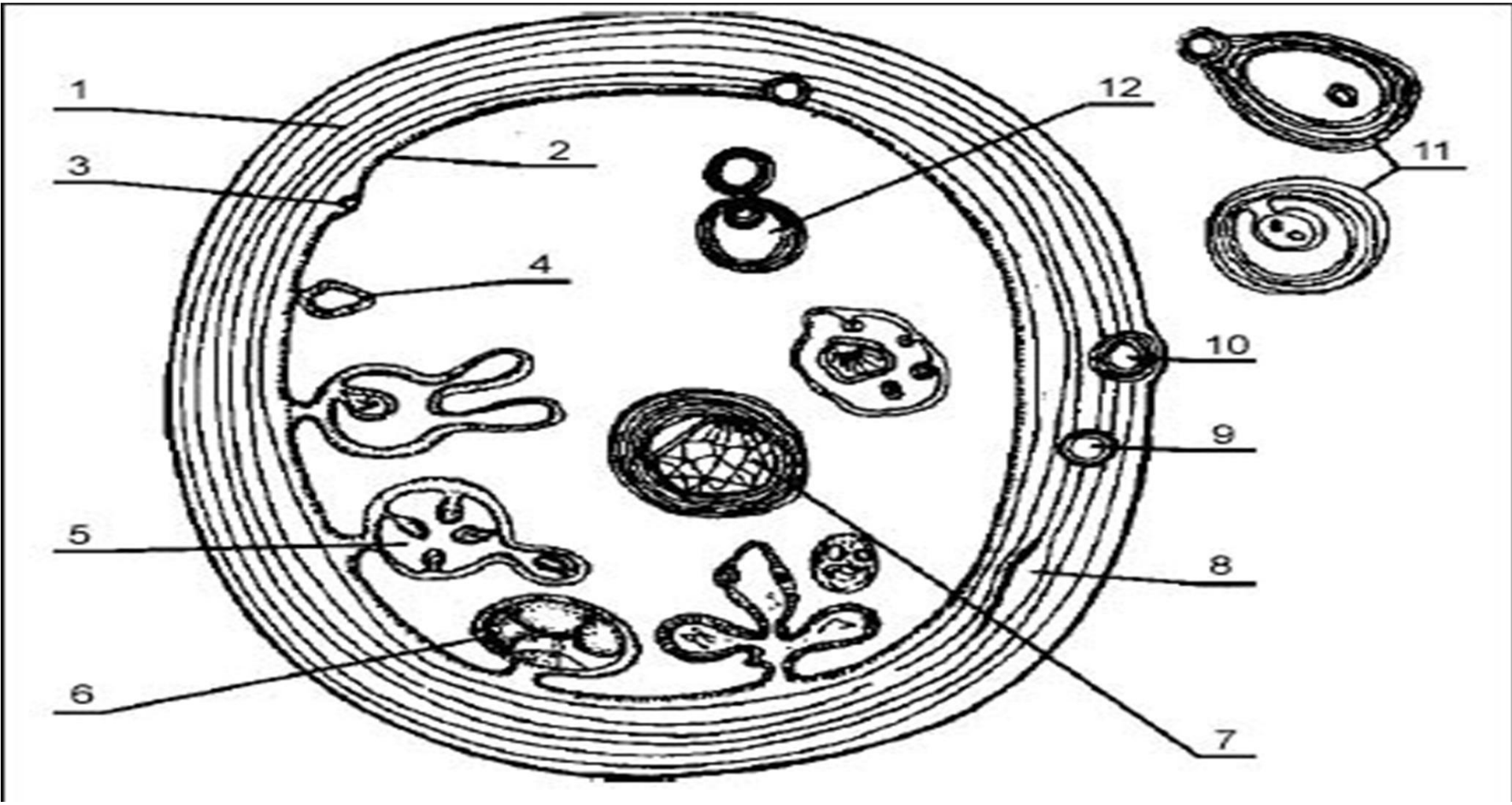
A - the definitive host Б- carnivores; - Marita; В - mature segment released into the environment; Г - egg; Д - intermediate host - livestock, etc.; Е - echinococcus bubble in the liver; Ж - optional intermediate host - man.



- ***Finn of echinococcus*** is a bubble that grows continuously throughout the life of the host. A few years later Finn reaches the size of the child head, it is filled with liquid.
- ***Finns wall consists of two layers***: superficial - cuticular and internal - embryonic or germinal.
- Embryonic ***layer*** forms brood capsules in the form of small bubbles, connected with it by a thin stem. To the inner wall of the brood capsules larval oval scolexes of size 143 159x98-123 microns are attached.
- ***The head is*** oval or egg-shaped, with hooks, grouped around its longitudinal axis forming a corolla.
- *With the destruction of the brood capsules scolexes fall into a liquid bubble, where they can develop into the child bubbles of the same structure.*

Finn of one-chamber echinococcus.

1 - cuticular shell 2 - germinal blastoderm, 3,4,5,12-endogenous formation of bubbles; 6- scolex, 7 - the transformation of the scolex in a bubble, 8-11 - the formation of exogenous subsidiary bubbles.



The clinical picture

Echinococcus affects various organs and tissues, but most often the liver and lungs, brain, heart , etc.

The clinical picture of Echinococcus depends on its localization. However, in almost all cases, except the central nervous system and the eye infection they experience prolonged asymptomatic disease.

Thus, in liver echinococcosis patients go to the doctor when the disease duration ranges from 3 to 5 years.

When echinococcosis affects lungs sometimes the bubble breaks through into the bronchus . In these cases scolexes with hooks can be found in the sputum.

Diagnosis of echinococcosis

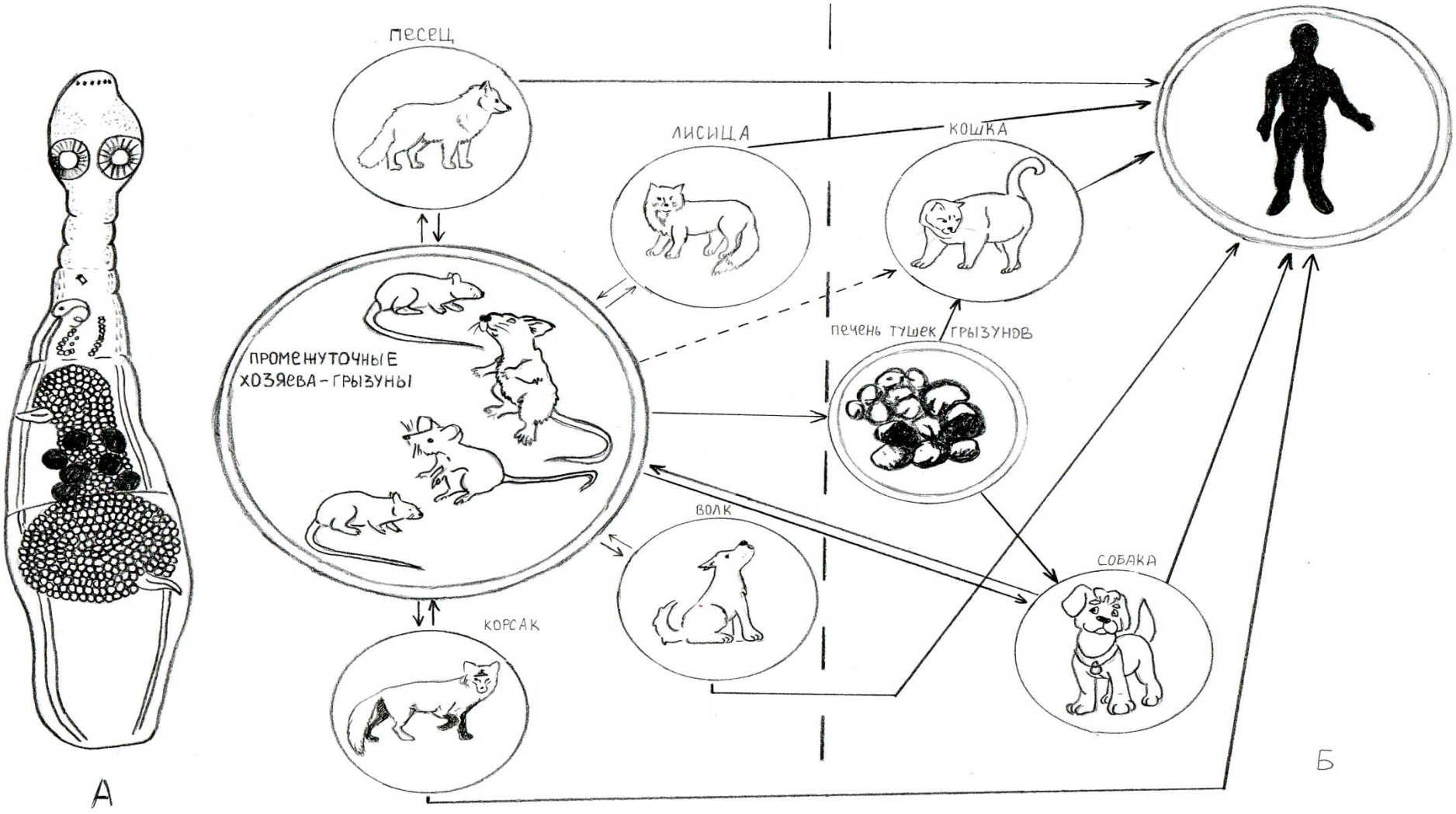
- Is carried out by immunological methods – IFA, indirect immunofluorescence reaction (RNIF), indirect hemagglutination (IHA) and others.
- To establish the localization of parasites they use radiographic, radioisotope scanning survey methods, as well as ultrasound, computed tomography and methods of using nuclear magnetic resonance.

alveococcosis

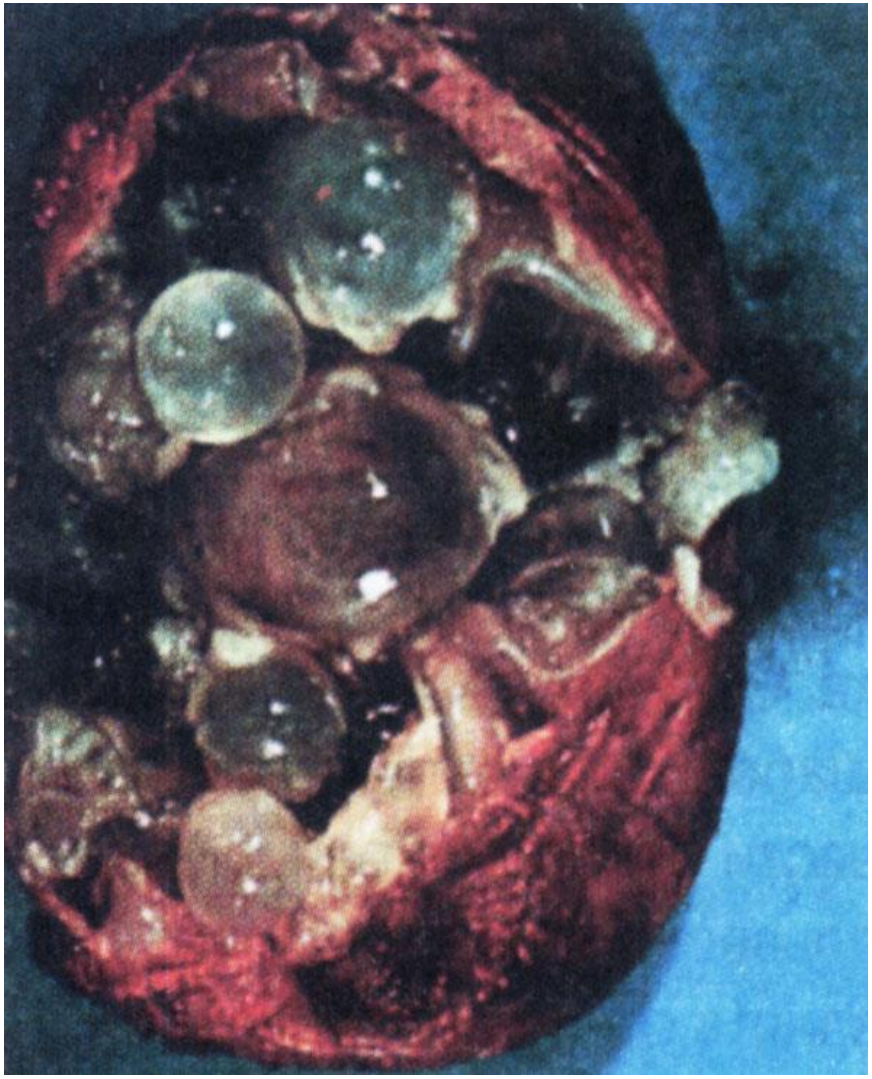
- Allveococcosis - natural focal disease provoked by alveococcus larval stage localized mainly in the liver.
- Man as an intermediate host is accidentally included in the chain of alveococcus development. Definitive hosts are foxes, foxes, sometimes dogs and wolves.
- Duration of asymptomatic alveococcosis may range from 1.5 to 5 years.
- Diagnosis is based on the results of immunological reactions (IFA, RNIF, IHA, ELISA), which allow to differentiate it from echinococcosis.

Alveococcus multilocularis

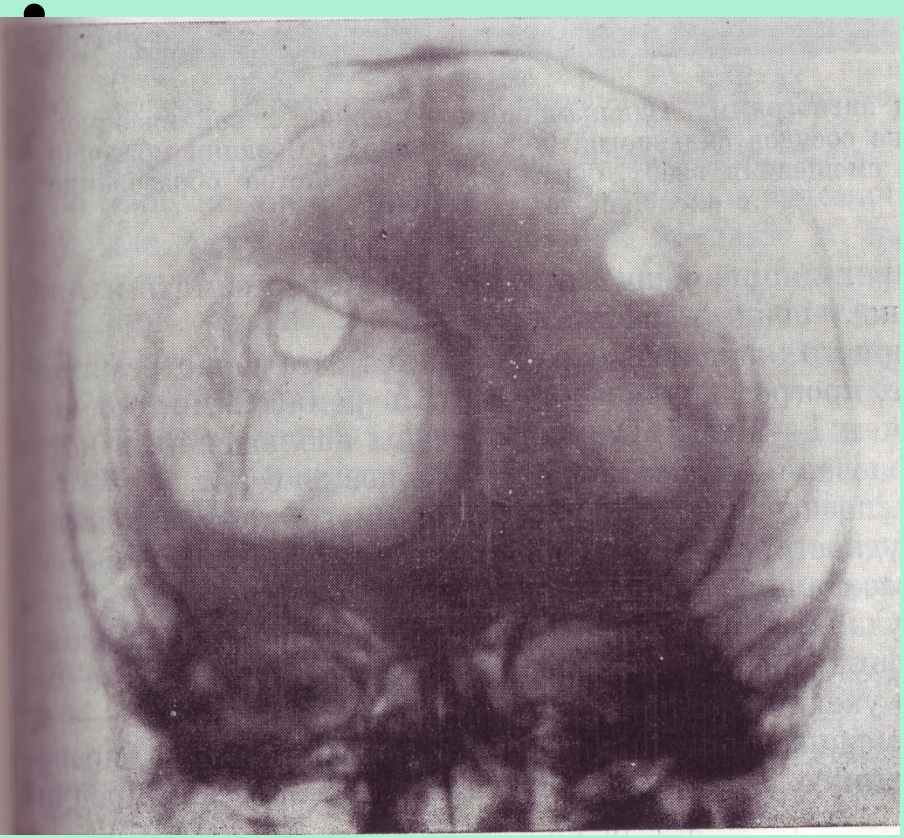
А - Gates; Б - circulation path A. multilocularis in nature



Alveococcosis bubble (on the left) Echinococcus bubble (on the right).



Echinococcus disease of the brain



megrims

Visible changes in the brain occur in case of pathogen infection (Taenia coenurus, Multiceps multiceps).

A mature dithyridium is formed in the brain, the size of which may vary from cherry to chicken eggs.

Humans are usually diagnosed with a brain tumor. Bubbles are located in the base of the brain or in the brain alba.

hymenolepiasis

ss provoked by Hymenolepis nana, parasitic in the small intestine of a man, more often found in children

- Length of parasite strobilae ranges from 1 to 4.5 cm and has 100 to 200 segments. Dwarf tapeworm head has four suckers and retractile proboscis with crown of 24-30 small hooks arranged in a single row. The neck is thin, long. Mature segments at the back of their body have a sac-like uterus filled with eggs. Eggs are transparent, colorless, oval (48 - 60h36 -48 microns). Larval and adult stages of tapeworm are consistently developing in the human intestine.

- Inside the egg has an almost spherical hexacanth (embryo) with six hooks. Long thin threads (filaments) extend from its shell.

Pygmy tapeworm

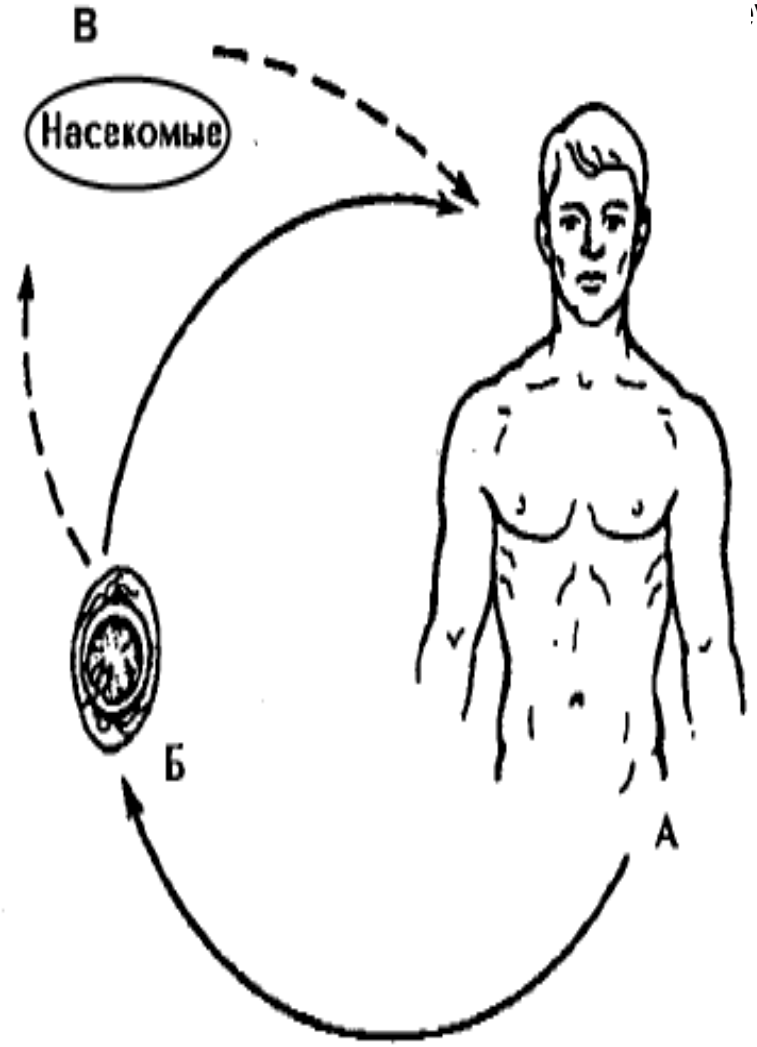
The cycle of development

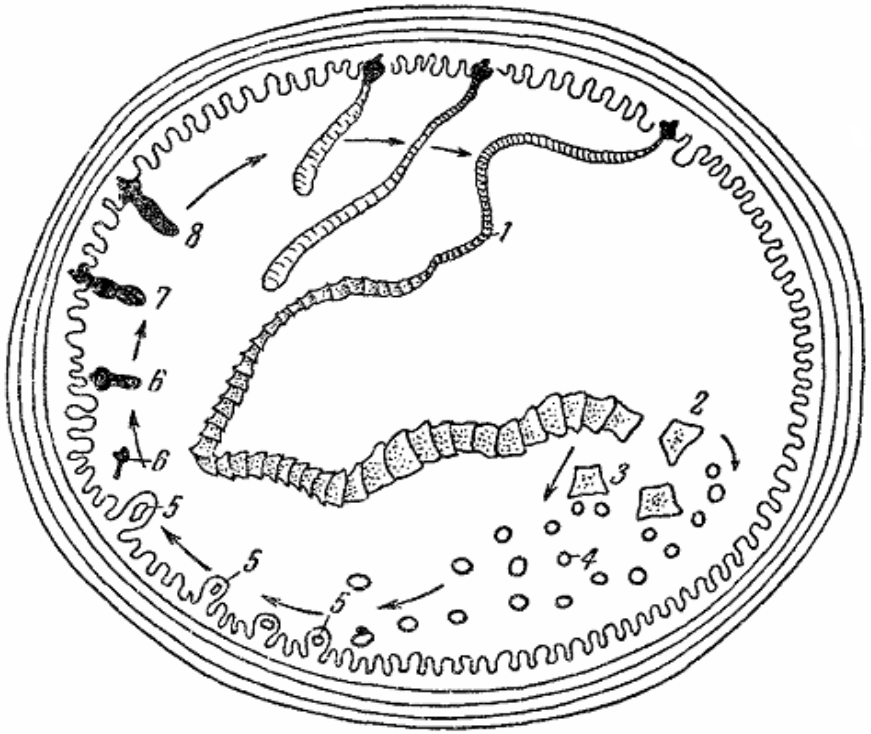
- ***The faeces of hymenolepiasis patients usually have parasite eggs due to the fact that uterus gets easily destroyed.***
- ***Excreted egg is invasive, contagious. Getting into the small intestine of man, hexacanth loses its membranes and penetrates into the intestinal villi, where in 2-3 days turns into a Finn - cysticercoid, and in 5-7 days cysticercoids falls into the intestinal lumen, as a result of villus being destroyed.***
- ***Young parasite attaches to the intestinal wall by suckers and segments come from the neck and the parasite transforms into the adult form.***
- ***Pygmy tapeworm development from egg to adult form lasts about 3 weeks.***
- ***Often there is a re-infection (re-infestation*), since the patient already produces hymenolepiasis invasive eggs and due to poor personal hygiene can get infected again.**

Life cycle of Hymenolepis nana

А - the definitive host - man. Б - egg with hexacanth. В- the - in the haemocoel cysticercoids optional intermediate host.

1 - mature individuals; 2 and 3 - coming off segments; 4 - eggs; 5 - cysticercoids vllus; 6-8 velopment of a tapeworm.





diagnostics

- The feces of the patient is examined for the presence of segments and pygmy tapeworm eggs. They examine feces of no more than one day old as eggs in the external environment are rapidly destroyed.
- They must combine a native smear method with flotation methods. Inspection is recommended to be done three times at intervals of 5-7 days. Since a single examination reveals only 40-50% of patients
- People are considered healthy if at repeated (at least 4-6) assays done 6 months after treatment pygmy tapeworm eggs are not detected in the their feces. They recommend clinical supervision extending to one year, with 8-10 control analyzes.

pathogenic effect of the parasite

- The life period of the parasite in the human intestine can reach fifteen years.

Thank you for your attention