LESSON № 12

Ph. PLATHELMINTHES

CLASS CESTODAE (TAPEWORMS)

General characteristics (fig.1).

- Flattened dorsoventrally.
- Ribbon - shaped body.
- The length varies from 0.02 inch (0.6 millimeter) to 98 feet (30 meters).
- Bilaterally symmetrical.
- Body cavity is absent.
- Outer coating is *tegument* through which worm absorbs nutrients from the host's intestine. This covering also protects the worms from the host's immune reactions and digestive acids.
- Organs of fixation: *suckers(acetabulum), hooks, bothriums.*
- Body is segmented. It has three regions: *scolex, neck, strobili.*
- The *scolex* is the head. It has hooks, suckers.
- The *neck* is the region of grouth. It is usually short.
- The *strobila i*s behind the neck. It consists of a row of segments called proglottids. strobila contains the following types of proglottids, from front to back: *immature proglottids*, with the beginnings of reproductive organs; *mature proglottids*, which contain functioning male and female reproductive organs; *gravid proglottids*, which contain uterus with eggs. The gravid proglottids at the end of the worm break off and pass into the environment with the host's feces.
- ***Digestive system****:* absent.
- ***Excretory system***: some *protonephridia (flame cells)*.
- ***Nervous system*****:** the main nerve centre of a cestode is a cerebral ganglion in its scolex. Smaller nerves emanate from the ganglion to supply the general body muscular and sensory ending. Sensory function includes both tactoreception (touch) and chemoreception (smell or taste). Some nerves are only temporary.
- ***Reproductive system***: true tapeworms are *hermaphrodites*; they have both male and female reproductive systems in their bodies. The reproductive system includes one or more *testes*, *cirri*, *vas deferens*, and *seminal vesicles* as male organs, and a single *lobed* or *unlobed* *ovary* with the connecting *oviduct* *and* *uterus* as female organs. The common external opening for both male and female reproductive systems is known as the genital pore.

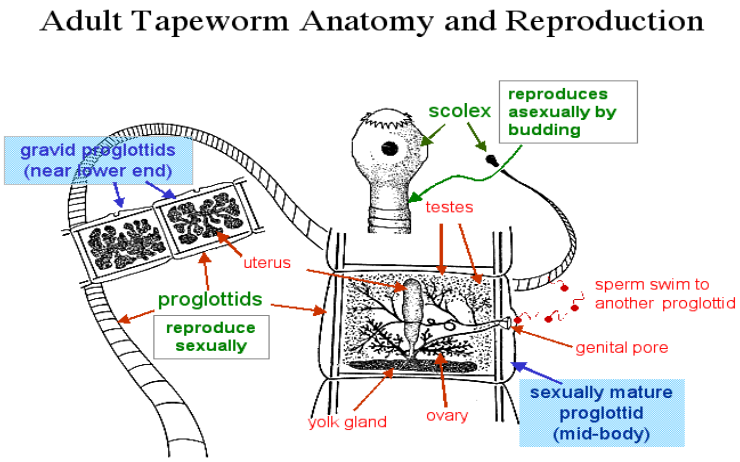


Fig. 1. Structure of tapeworms. (Modified from Jeffery HC, Leach RM: Atlas of Medical Helminthology and Protozoology).

- ***Life cycle***: The life cycle may consist of 3-4 stages. In the first stage, the adult worms live in the intestines of the definitive host produce eggs. In the second stage, the eggs fall into the environment: in soil or in water. On land in the egg is formed the larva or embryo. If eggs develop in water, they becomes a free-floating larva with cilia, and it is the second larval phase. The third stage is the development of larvae in the intermediate host, where it develops into one from the following forms of larva: plerocercoid, cystecercoid, cystecerk, coenoir, echinococcus (fig.2).

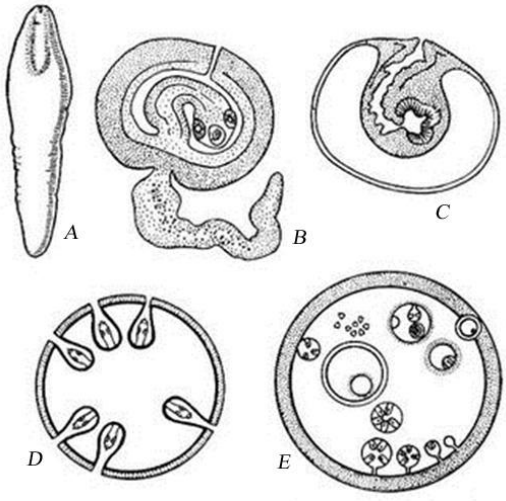


Fig. 2. Larval forms of Tapeworms:

A- plerocercoid, B – cystecercoid, C – cystecercus, D – coinoir, E – echinococcus.

TAENIA SOLIUM (PORK TAPEWORM)

The pork tapeworm, ***Taenia solium***, is the most harmful tapeworm in humans.

Disease: taeniasis, cysticercosis.

Geographic distribution: Africa, Asia, South America and Southern Europe. Taeniasis is rare in Muslim countries since people there do not consume pork.

Localization in human body: small intestine; in case of cystecercosis – brain, spinal cord, eyes, muscle tissues, myocardium, lungs, peritoneal cavity, intestinal submucosa, thyroid glands, and subcutaneous tissues.

Morphology: length of adult 2-7m, 1000 proglottids (1 cm long and 2 cm wide) each contains up to 50000 eggs; scolex has 4 suckers with crown of hooks; mature proglottide includes trilobed ovary, vaginal opening is absent; gravid proglottide – 7-12 branches of uterus. Larva of T.solium called ***cysticercus.*** A cysticercus consist of a pea-sized fluid-filled bladder with an invaginated scolex.

Mode of transmission: by eating raw or undercooked pork.

Life Cycle:

Definitive host – human.

Intermediate host – pig.

First larval form – oncosphere.

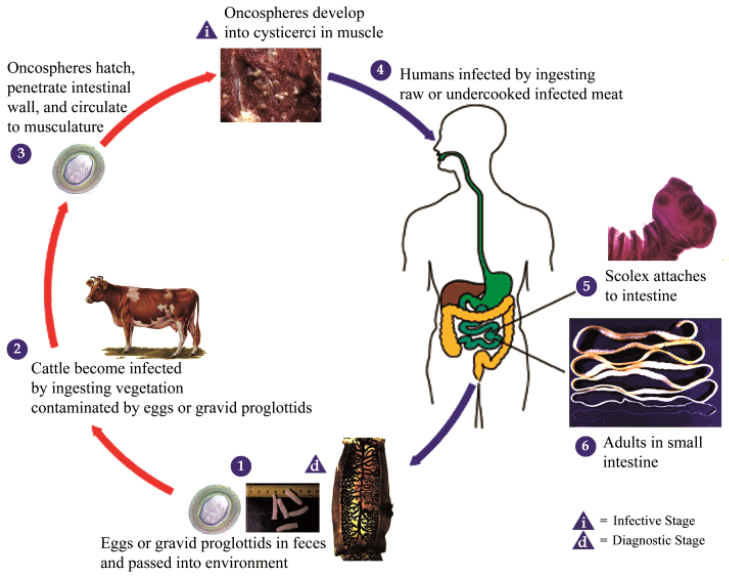
Second larval form – cystecercus.

Eggs or gravid proglottids are passed with feces 1; the eggs can survive for days to months in the environment. Pigs become infected by ingesting vegetation contaminated with eggs or gravid proglottids 2. In the animal's intestine, the 6-hooked ***oncospheres*** hatch 3, invade the intestinal wall, and migrate to the striated muscles, where they develop into ***cysticerci.*** A cysticercus can survive for several years in the animal. Humans become infected by ingesting raw or undercooked infected pork 4. In the human intestine, the cysticercus develops over 2 months into an adult tapeworm, which can survive for years. The adult tapeworms attach to the small intestine by their scolex 5and reside in the small intestine 6. The adults produce proglottids which mature, become gravid, detach from the tapeworm, and migrate to the anus or are passed in the stool (approximately 6 per day) (fig. 3).

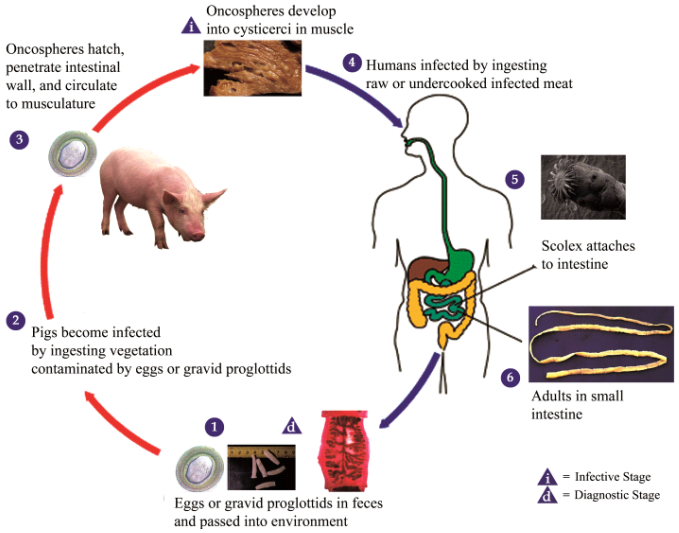
Pathogenesis:

Taeniasis: abdominal pain, nausea, diarrhea, weight loss, infection may by asymptomatic.

Cystecercosis: the symptoms of cysticercosis are caused by the development of cysticerci in various sites. Of greatest concern is cerebral cysticercosis (or neurocysticercosis), which can cause diverse manifestations including seizures, mental disturbances, focal neurologic deficits, and signs of space-occupying intracerebral lesions. Death can occur suddenly. Extracerebral cysticercosis can cause ocular, cardiac, or spinal lesions with associated symptoms.



A.



B.

Fig. 3. A. Life cycle of Taenia saginata. B. Life cycle of Taenia solium. (from http://www.cdc.gov).

Diagnosis:

Taeniasis.

- microscopic identification of eggs and proglottids (7-12 branches) in feces.
- concentration techniques.

Cystecercosis.

- x-ray.
- computed tomography scan.

Prevention and control:

- cooking pork adequately.
- preventing pigs from ingesting human feces by disposing of waste properly. Prevention of cysticercosis.
- treatment of patients to prevent autoinfection.
- observation of proper hygiene, including hand washing, to prevent contamination of food with the eggs.

TAENIA SAGINATA (BEEF TAPEWORM)

Taenia saginata is a large tapeworm. It is commonly known as the beef tapeworm or cattle tapeworm because it uses cows as intermediate hosts.

*Disease**:*** taeniasis.

Geographic distribution: worldwide and is relatively common in Africa, Eastern Europe, Latin America and the Philippines.

Localization in human body: small intestine.

Morphology: length of adult 4-6(10)m, 1000 proglottids about six of them detach every day; scolex has only 4 suckers mature proglottide includes two lobules of ovary, vaginal opening present; gravid proglottide – 17-35 branches of uterus; produce up to 100,000 eggs per proglottid. Larva of T.solium called ***cysticercus.*** A cysticercus consist of a pea-sized fluid-filled bladder with an invaginated scolex.

Mode of transmission: by eating raw or undercooked beef.

Life Cycle:

Definitive host – human.

Intermediate host – cow.

First larval form – oncosphere.

Second larval form – cystecercus.

Eggs or gravid proglottids are passed with feces ❶; the eggs can survive for days to months in the environment. Cattle become infected by ingesting vegetation contaminated with eggs or gravid proglottids ❷. In the animal's intestine, the 6-hooked oncospheres hatch ❸, invade the intestinal wall, and migrate to the striated muscles, where they develop into cysticerci. A cysticercus can survive for several years in the animal. Humans become infected by ingesting raw or undercooked infected meat ❹. In the human intestine, the cysticercus develops over 2 months into an adult tapeworm, which can survive for years. The adult tapeworms attach to the small intestine

by their scolex ❺and reside in the small intestine ❻. The adults produce proglottids which mature, become gravid, detach from the tapeworm, and migrate to the anus or are passed in the stool (approximately 6 per day) (fig. 3).

Pathogenesis: the disease is often asymptomatic. Heavy infection can cause allergic reactions, diarrhea, nausea, obstruction of the bowel, stomach ache, weight loss.

Diagnosis:

- microscopic identification of eggs and proglottids (17-35 branches) in feces.
- concentration techniques.

Prevention and control:

- Cook beef at or above 60 C until it is no longer pink inside. Alternatively freeze the meat at or below -5 C for a few days.
- Prevent cattle from eating in areas, where vegetation might be contaminated with humans feces.

DIPHYLLOBOTHRIUM LATUM (FISH TAPEWORM)

Diphyllobothrium latum, the fish tapeworm, is the biggest tapeworm in humans.

Disease: diphyllobothriasis.

Geographic distribution: northern Asia, Europe and America in areas of rivers and lakes the most common and mostly found in Scandinavia, the Baltics and western Russia.

Localization in human body: small intestine.

Morphology: length of adult 10-13m, 3000 proglottids, which are about 10 mm wide and 3 mm long; scolex has two elongated *sucking grooves (bothria)*; gravid proglottide has rosette-shaped uterus; one adult tapeworm can shed up to a million eggs per day. Larva is called plerocercoid.

Mode of transmission: by eating raw or undercooked fish.

Life Cycle:

Definitive host - carnivorous mammals, humans.

First intermediate host – freshwater crustacean.

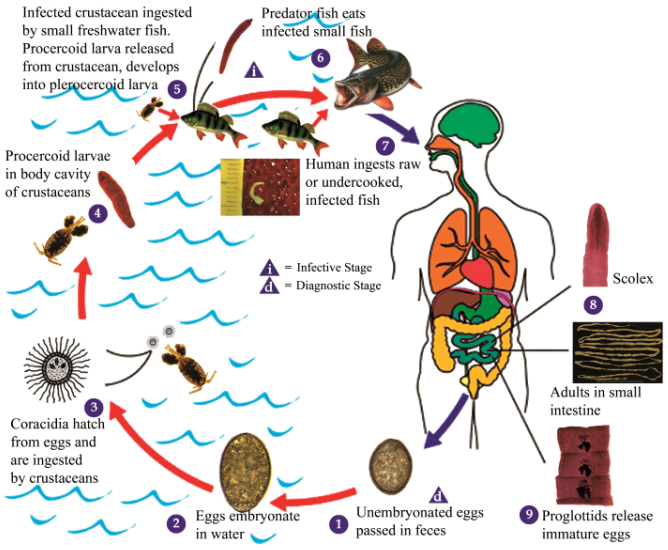
Second intermediate host – fish.

First larval form – oncosphere (coracidia).

Second larval form – (procercoid) plerocercoid.

Immature eggs are passed in feces❶. Under appropriate conditions, the eggs mature (approximately 18 to 20 days)❷ and ***oncospheres*** develop into a ***coracidia***❸. After ingestion by a suitable freshwater crustacean. The coracidia develop into ***procercoid*** larvae❹. Following ingestion

of the copepod by a suitable second intermediate host, typically minnows and other small freshwater fish, the procercoid larvae are released from the crustacean and migrate into the fish where they develop into a ***plerocercoid*** larvae❺. The plerocercoid larvae are the infective stage for humans. Second intermediate hosts can be eaten by larger predator species, ❻. In this case, the it migrates to the musculature of the larger predator fish and humans can acquire the disease by eating these later intermediate infected host ❼. After ingestion of the infected fish, the plerocercoid develop into adult and reside in the small intestine. The adults of *D. latum* attach to the intestinal mucosa by means of the two bilateral groves (bothria) of their scolex ❽. Immature eggs are discharged from the proglottids (up to 1,000,000 eggs per day per worm)❾(fig. 4).



Infected crustacean ingested by small

Fig. 4. Life cycle of Diphyllobothrium latum (from http://www.cdc.gov).

Pathogenesis: Diphyllobothriasis is usually asymptomatic. In some cases it causes severe vitamin B12 deficiency because *D. latum* can absorb most of the B12 intake. In some cases it can lead to neurological symptoms. Diphyllobothriasis symptoms include: diarrhea, fatigue, obstruction of the bowel, pernicious anemia (caused by vitamin B12 deficiency) which can lead to subacute combined degeneration of spinal cord.

Diagnosis: microscopic identification of eggs and proglottids in the stool.

Prevention and control:

- Cook fish properly. If you eat sushi, freeze it first at -10 °C (or below) for two days to kill the tapeworm larvae.

- Do not defecate in water (rivers, lakes etc.). If the fish tapeworm larvae cannot get in touch with the intermediate hosts, they cannot infect humans.