

Taenia solium

Structure, life cycle and pathogenicity (ppt 2)

B.Sc. Part I

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Life cycle of *Taenia solium*

Taenia solium completes its life cycle in two different vertebrate hosts , man and pig.

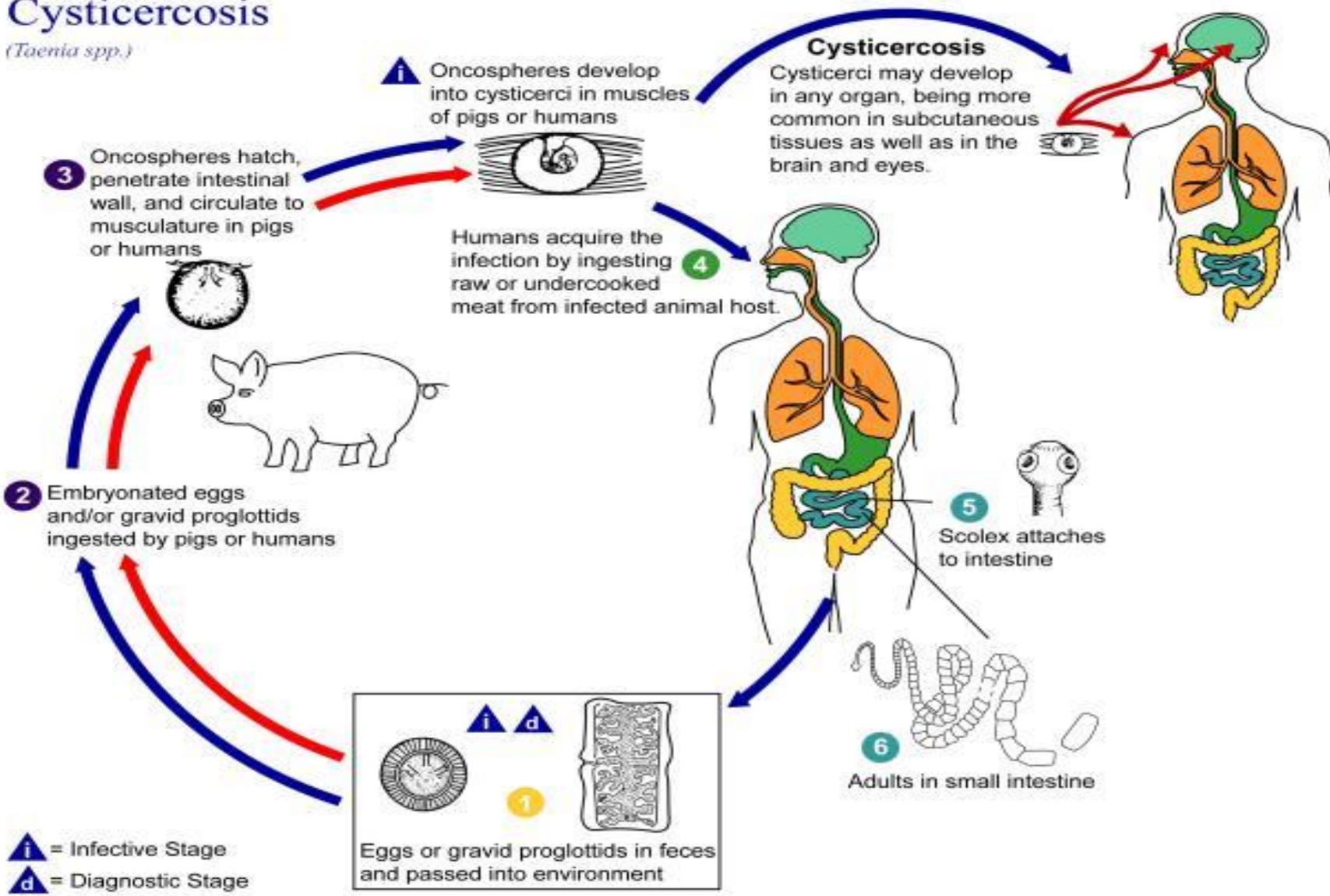
Man is considered to be the definitive host and the pig is considered as the intermediate host.

The life cycle of taenia solium includes

1. Fertilization,
2. The human phase,
3. The pig phase.

Cysticercosis

(*Toenia spp.*)



Fertilization

1. Fertilization occurs in the ootype.
2. In taenia solium both self – fertilization and cross – fertilization occurs in tapeworm.
3. In self fertilization , sperms produced in proglottid in a proglottid fertilize the ova produced in the same proglottid.
4. In cross fertilization , sperms produced in a proglottid fertilize ova produced in another mature proglottid of the same worm.
5. As a result of fertilization, zygotes are formed.
6. A yolk cell or vitelline cell is attached to each zygote.
7. Later, the vitelline gland secretes a shell around these two cells.
8. Such a shell bearing zygote is called capsule.
9. These capsules now roll up into the uterus. This is facilitated by a lubricating substance secreted by Mehli's glands.
10. The uterus develops lateral branches and occupies almost the entire space in the proglottid as thousands of capsules enter into it. Such proglottids are called gravid proglottids .
11. These gravid proglottids are discharged through faeces of the host by the process apolysis.

The human phase

1. The embryonic development of *Taenia solium* begins in the uterus itself.
2. The zygote cell in the capsule undergoes an unequal cleavage and forms a megamere and an embryonic cell.
3. Through unequal divisions, the embryonic cell forms mesomeres and micromeres.
4. The micromeres undergo further cleavages and develop into a ball of cells called morula, which later becomes the embryo.
5. The mesomeres surrounding the embryo form an inner embryonic membrane or embryophore.
6. The megamere also divides and these cells form the outer embryonic membrane outside the embryophore.
7. The vitelline cell provides nourishment to the embryo during embryonic development.
8. The oncoblasts of the embryo secrete six chitinous hooks. In the embryo, these hooks are arranged in three pairs. The embryo with six hooks is called hexacanth embryo. A pair of penetration glands is present in the hexacanth.
9. The hexacanth, which is surrounded by two embryonic membranes, is called oncosphere.
10. In each gravid proglottid, the uterus shows 7-10 lateral branches on each side. 30,000 to 40,000 oncospheres are stored in these branches in each proglottid. Such gravid proglottids are discharged out by apolysis..

Pig phase

1. infection of the intermediate host , the pig , takes place by the oncosphere stage.
2. The gravid proglottids containing oncospheres are present in the human faeces.
3. When a pig takes such faecal matter as food the gravid proglottids enter the stomach and oncospheres are released into the stomach.
4. In the stomach of the pig , the shell and embryonic membranes of the oncosphere are digested and the hexacanth larva is set free.
5. These free hexacanth larvae pass into the intestine and attach to the mucous layer of the intestine with the help of its hooks.
6. they penetrate the intestinal wall with the help of the substances secreted by the penetration glands.
7. Later, hexacanth larvae enters the hepatic portal vein through which it goes to the liver. From the liver it goes to the heart through post caval vein. From the heart , it goes to the voluntary muscles of pig.
8. Generally, the hexacanth settles in the voluntary muscles of the tongue , elbows, neck and limbs.
9. Some times , the hexacanth may also enter organs like lungs, eyes, kidneys , brain etc.,
10. The hexacanth loses its hooks in the voluntary muscles of the pig. It develops into cysticercus larva.
11. This early cysticercus larva absorbs nutritive substances from the tissues and grows in size.
12. A cavity appears in the center of the cell mass due to disintegration of mesenchyme and is get filled with a liquid material. This liquid contains large amount of plasma of the host blood(pig).

13. At this stage , the embryo is surrounded by two layers, the outer cuticle and the inner mesenchymal layers or germinal layer.

14. The wall of the embryo on one side gets thickened and invaginates into its cavity, in the form of a knob.

15. The knob internally develops four suckers ,a small rostellum and hooks at its base. This inverted scolex is called pro scolex. Now the embryo is the mature cysticercus, or bladder worm.

16. The cysticercus is an ellipsoid milky whitish bladder surrounded by fibrous capsule. Now these cysts are called Cysticercus cellulosae, as they appear to cover by cellulose cyst wall.

17. It requires about 10 weeks time for the transformation of hexacanth into mature cysticercus larva.

18. the pork with cysticercus larvae shows light brown patches , such pork is termed measly pork.

19. Cysticercus larva does not undergo further development in the muscles of pig. In this stage it can survive in pig for 5 or 6 years and dies if it is not transferred to man within this period.

20. When man consumes improperly cooked measly pork, the cysticercus reaches the stomach.

21. In the stomach the fibrous capsule of the bladder is dissolved by the action of digestive enzymes.

22. This stage now reaches the intestine. The pro scolex evaginates and forms the scolex. With the help of suckers and rostellar hooks, it attaches to the wall of the intestine.

23. New proglottids begin to proliferate from the neck region and the bladder gets disintegrated. It develops into an adult tapeworm within two or three months.

EGGS

- Each egg is round, brown in color, measures 40-50 μm in diameter
- Each egg consists of two shells.
- The outer shell is thin, transparent and represents the remnant of yolk mass.
- The inner shell, also known as embryophore is brown, thick walled and radially striated. It encloses the embryo.
- The embryo measures 14-20 μm in diameter with hook lets.
- Eggs are infective to pigs as well as to humans.



CYSTICERCOSIS CELLULOSAE LARVAE

- Larvae is cysticercosis cellulosae and is the Infective form of parasite.
- It is also known as Taenia cyst.
- The larval form develops in the muscle of pigs as well as various organs of the human.
- A mature cyst is an opalescent ellipsoidal body and measures 8-10 mm width by 15mm in length. It has a fluid filled milky white bladder like structure.
- The long axis of cyst lies parallel with the muscle fiber. The cyst is separated from the host tissue by a thin collagenous capsule. There is a dense milk white spot at the side, where the scolex with its hooks and suckers remain invaginated.
- The cavity of cyst is fill with a clear fluid rich in albumin and salts.
- The larvae can live for about 8 months in muscles of pig and can only develop into adults when ingested by man.

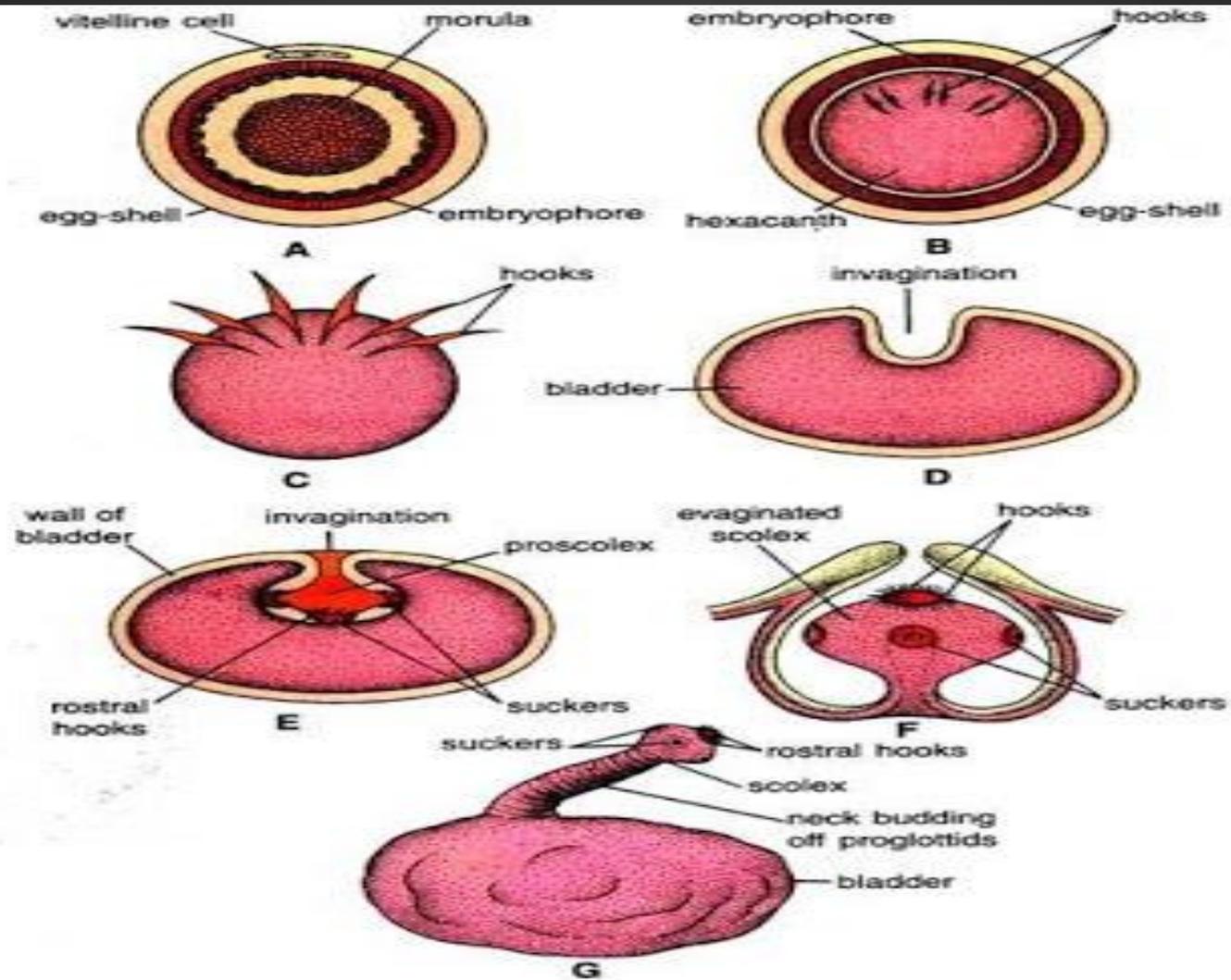


Fig. 42.14. *T. solium*. Stages in the life cycle. A—Young onchosphere; B—Mature onchosphere; C—Free hexacanth; D—Bladderworm with invagination; E—Bladderworm with proscolex; F—Bladderworm with evaginated scolex and G—Cysticercus with neck budding off proglottids.

MODE OF TRANSMISSION

- Ingestion of uncooked pork infected with tape worm
- Ingestion of food and water contaminated by the eggs present in the infective feces of a *Taenia* carrier.
- Endogenous auto infection: Anus-hand-mouth transfer of eggs by contaminated hands of person with poor personal hygiene.
- Autoinfection: Reverse peristalsis in which eggs produced by *T. solium* are thrown back to the duodenum, where they hatch and cause tissue infection

PATHOGENESIS OF TAENIA SOLIUM

- Both adult worm and cyst are pathogenic. The adult worms are less pathogenic. They occasionally cause mild irritation or inflammation of the intestinal mucosa by their armed scolex.
- The cyst, (**Cysticercos cellulosae**) are more pathogenic. They cause a serious disease cysticercosis in human, mostly cyst are produced in the skin, skeletal muscles, eye and CNS.
- The cyst can remain viable for few years.
- In the brain the cyst survives by overcoming the host defenses. It secretes the prostaglandins and other substances that inhibit activation of the complement and production of cytokines. This result in minimal host inflammation around the live cysticercoses. The live cyst is surrounded by a local minimal cellular reaction that consists of few eosinophils and macrophages.
- The dead cyst is surrounded by a dense infiltration that consists entire spectrum of inflammatory cells, including leucocytes and multinucleated giant macrophages, inflammatory cells and less frequently foreign body giant cells. Outside this area a zone of fibrosis and chronic inflammatory infiltration are present.

CLINICAL DISEASES CAUSED BY *TAENIA SOLIUM* INFECTION

1. Intestinal Taeniasis:

- Infection in the intestine by the adult *T. solium*
- Mostly the infection is asymptomatic.
- In symptomatic cases, the clinical symptoms are nonspecific and mild and includes- nausea, abdominal discomfort, hunger pain, loss of weight, constipation etc.
- Less frequently nausea, vomiting, headache and diarrhea are present in few cases.
- If left untreated it is common that the infection lasts for 2-3 years.

2. Cysticercosis:

- Cysticercosis is the infection with the larval stage of the parasite.
- Human beings acquire infection through fecal oral contamination with *T. solium* eggs from tapeworm carriers or by auto infection.
- Infection with the egg causes serious medical conditions.
- Clinical manifestation depend on the affected organ; neurocysticercosis and ophthalmic sticercosis are associated with substantial morbidity.
- In symptomatic cases headaches ,dizziness and seizure can be seen.
- Brain infection by the cysticerci is called neuro cysticercosis and main cause of seizure
- In more severe cases ,dementia or hypertension occur..

PREVENTION AND CONTROL

- **Prevention and control of taeniasis:**
- Avoidance of eating raw or insufficiently cooked pork
- Inspection of pork for cysticerci.
- Proper sanitation facilities.
- Proper hand hygiene.
- Treatment of infected persons.
- Avoidance of food contaminated with eggs of *T. solium*