Cestoda

Lecturer: Omer Sardar

Medical Parasitology Ⅱ

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Lecture 6

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Introduction

- Cestodes are multisegmented, dorsoventrally flattened tape -like worms whose sizes vary from a few millimeters to several meters. The adult worms a re found in the small intestine of humans.

Classification of cestodes

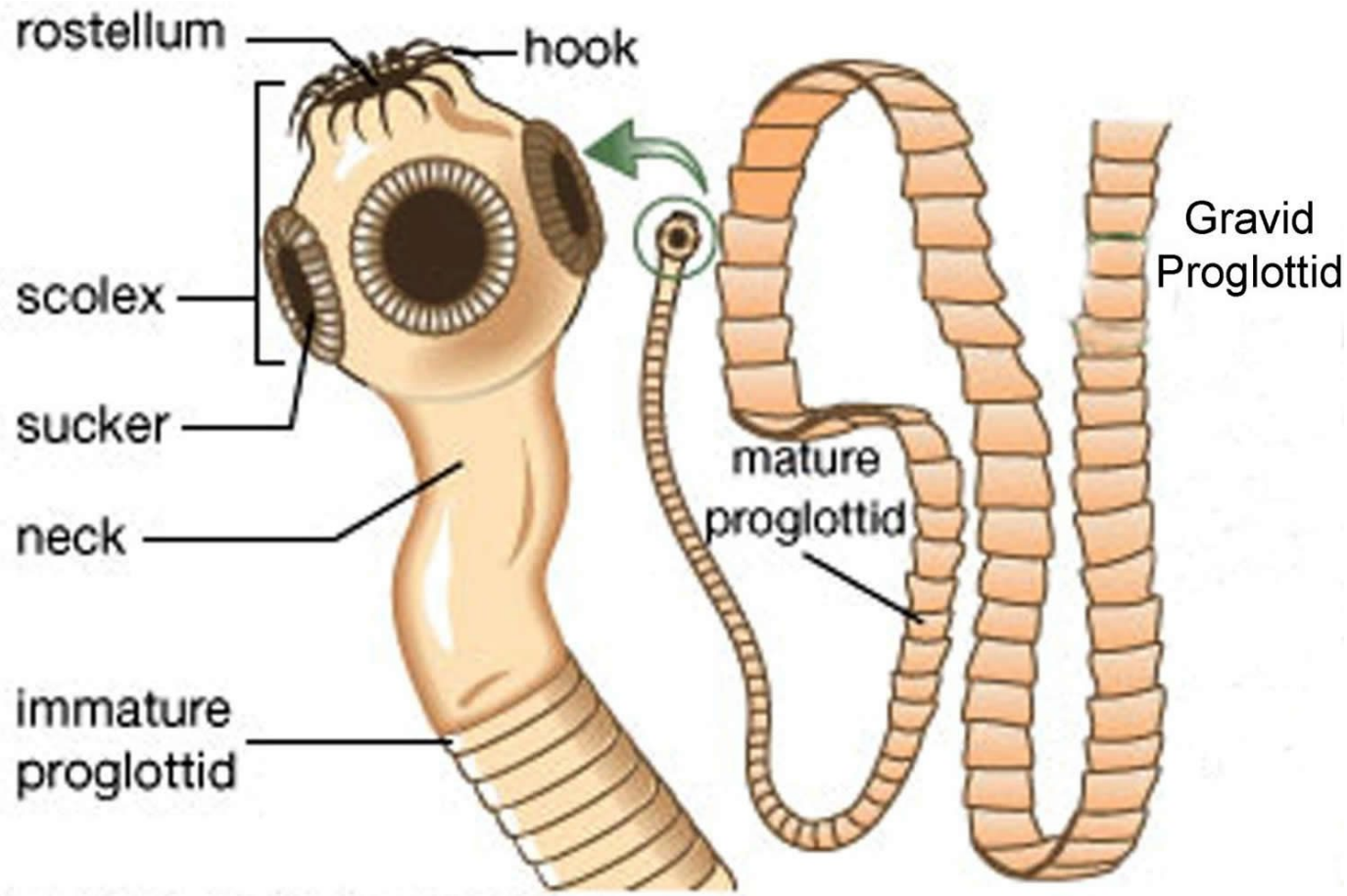
Cestodes belong to the Phylum Platyhelminthes and the class Cestoda. The class cestoda includes two orders:

1. Pseudophyllidea
2. Cyclophyllidea

Tapeworms: General characteristics

Adult worm consist of three parts:

- Scolex
- Neck
- Trunk(proglottids)

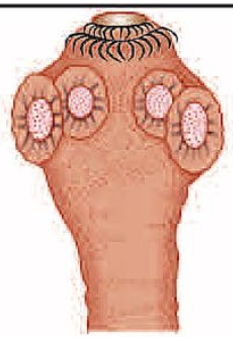
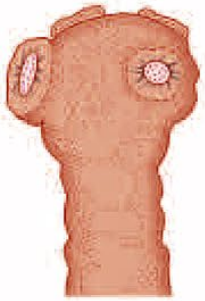
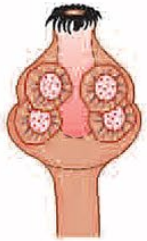
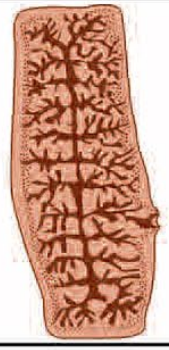


- **Scolex:** It is the organ of attachment to the intestinal mucosa of the definitive host, human or animal

- **Neck:** It is the part, immediately behind the head and is the region of growth from where the segments of the body (proglottids) are being generated continuously.

- **The trunk** also called as ***strobila*** is composed of a chain of ***proglottids*** or *segments*. The proglottids near the neck, are the young *immature* segments, behind them are the *mature* segments, and at the hind end, are the *gravid* segments. Tapeworms are ***hermaphrodites*** *(monoecious)* and every mature segment contains both male and female sex organs. In the **immature segments**, the reproductive organs are not well-developed. They are well-developed in the **mature segments**. The **gravid segments** are completely occupied by the uterus filled with eggs. Rudimentary excretory and nervous systems are present. The differences between heads and proglottids of various Cestodes have been illustrated

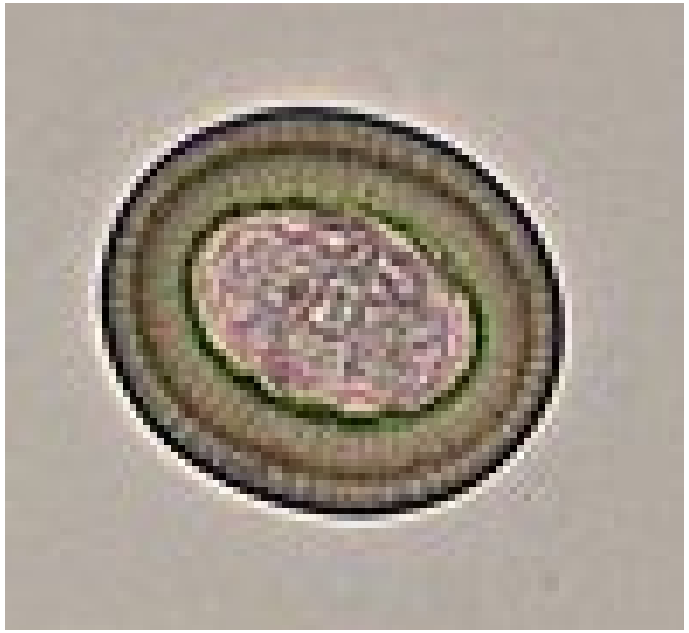
Examples of Tapeworms

	Taenia solium	*Taenia saginata*	*Hymenolepis nana*	*Hymenolepis diminuta*	*Diphyllobothrium latum*	*Echinococcus granulosus*
Heads						
Proglottids	4 suckers 2 rows of hooks	4 suckers No hooks	4 suckers single row of 20–30 hooks	4 suckers No hooks	2 Suctorial grooves or bothria No suckers, No hooks	4 suckers 2 rows of hooks
						
	Longer than broad 7–12 uterine branches on each side	Longer than broad 15–30 uterine branches on each side	Broader than long	Broader than long	Broader than long Uterus coiled	Longer than broad

Eggs

- The eggs of Cyclophyllidea and Pseudophyllidea are different from each other
- The embryo inside the egg is called the *oncosphere* (meaning *hooked ball)* because it is spherical and has hooklets. Oncospheres of human tapeworms typically have three pairs of hooklets and so, are called *hexacanth* (meaning *six-hooked)* embryos.

Cyclophyllidean egg	Pseudophyllidean egg
Covered by two layers: (1) egg shell and (2) embryophore	Covered by one layer: egg shell
Spherical	Ovoid in shape
Embryonated from the beginning	Freshly-passed eggs in feces are unembryonated
Eggs are not operculated and the embryo is not ciliated	Eggs are operculated and the embryo is ciliated



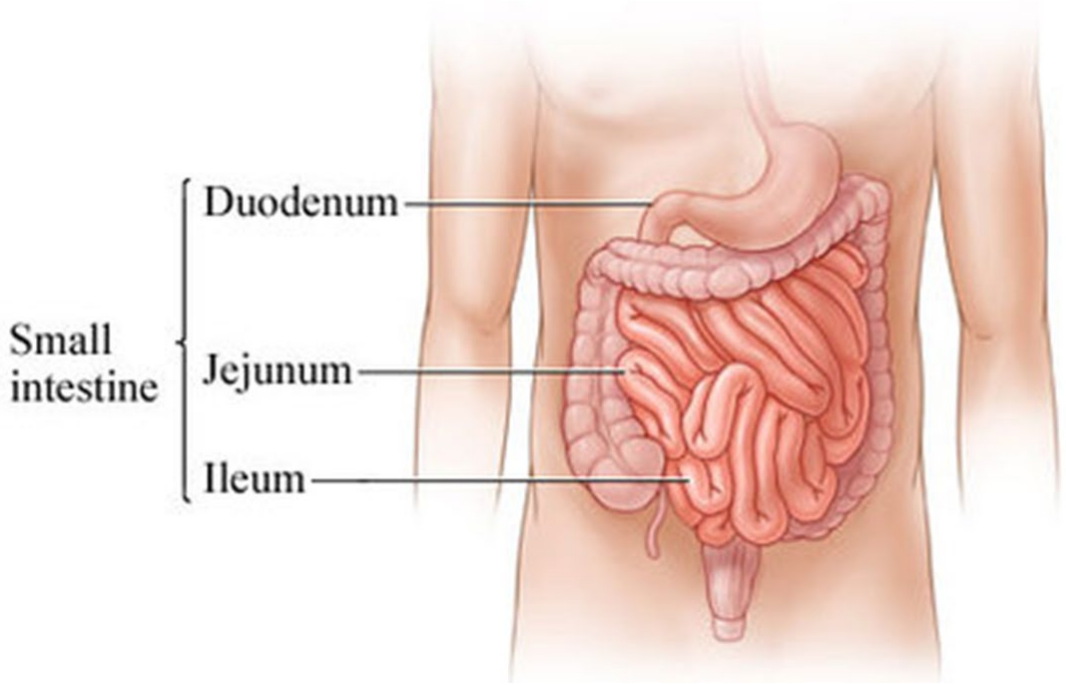
Diphyllobothrium latum

Introduction

- *Diphyllobothrium latum* is the largest human tapeworm, also called the broad fish tapeworm.
- Belongs to the class Cestoda.
- Infection in humans is known as diphyllobothriasis.

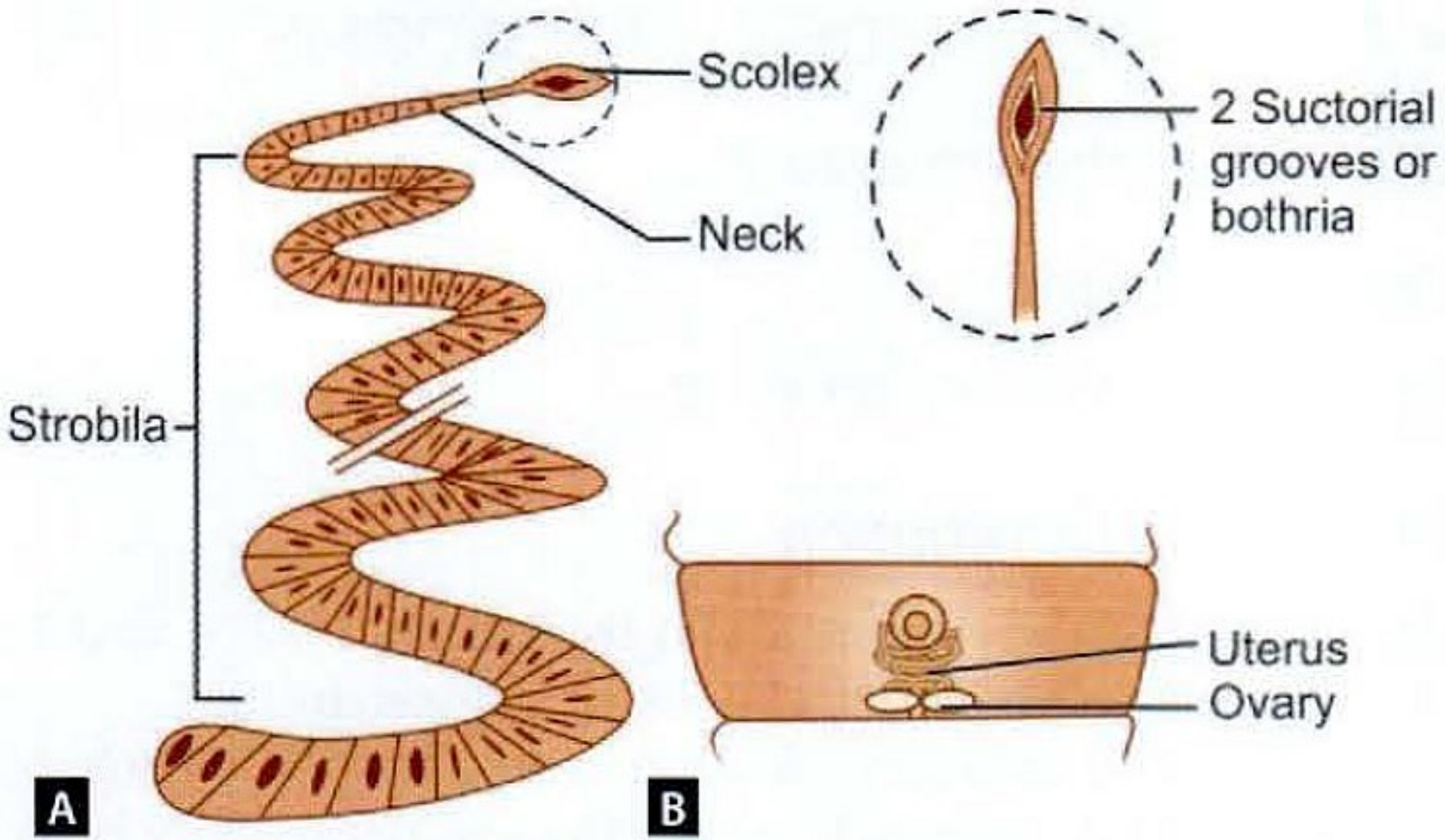
Habitat

The adult worm is found in the small intestine, usually in the ileum, where it lies folded in several loops with the scolex embedded in the mucosa.



Morphology

- Adult worm can reach up to 10 meters long.
- Scolex: elongated with two longitudinal sucking grooves (bothria) instead of suckers or hooks.
- Proglottids are broader than long, giving the name “broad tapeworm.”
- Eggs: operculated, unembryonated when passed in feces.



Figs 3A and B: *Diphyllobothrium latum*. (A) Adult worm showing spatulate scolex, neck and strobila; and (B) Mature proglottid

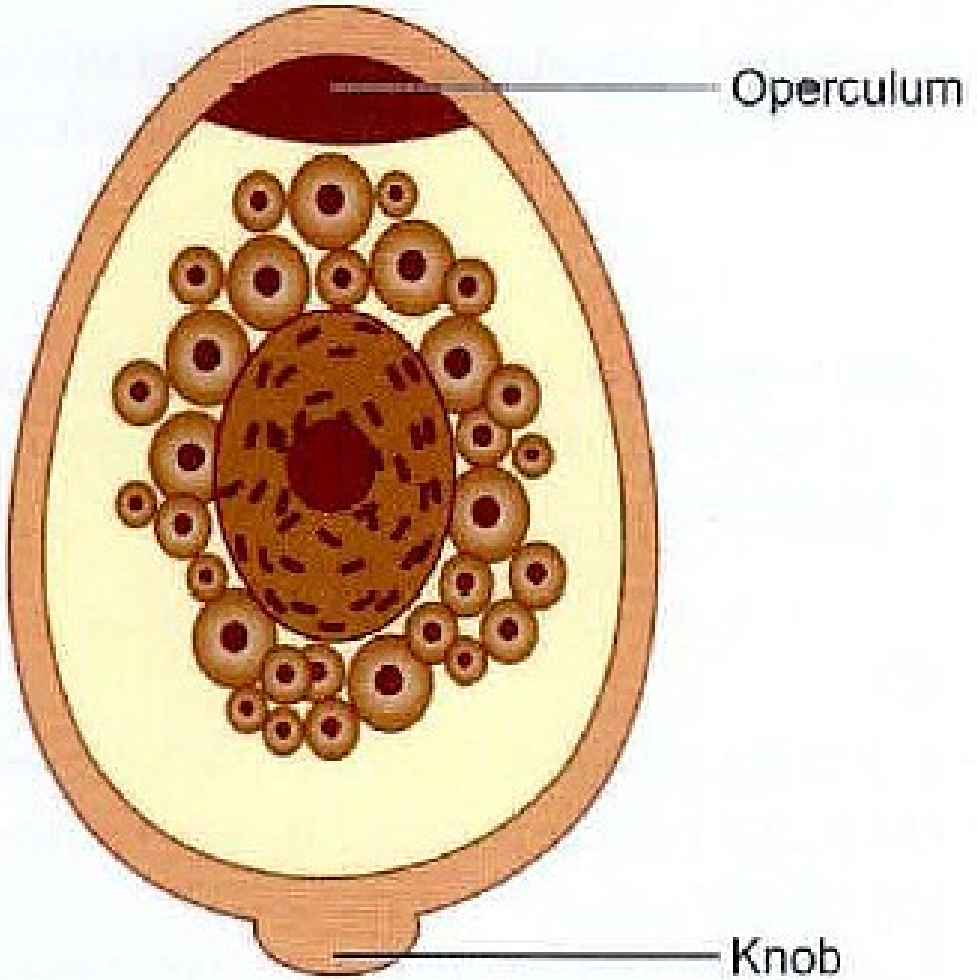


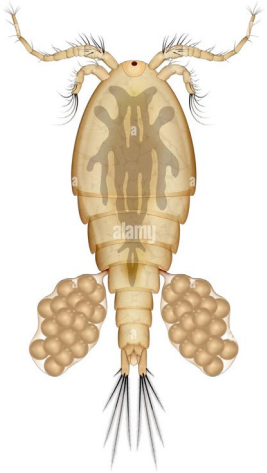
Fig. 4: Operculated egg of *Diphyllobothrium latum*

Life Cycle

Definitive host: Humans are the principal definitive host

Intermediate hosts:

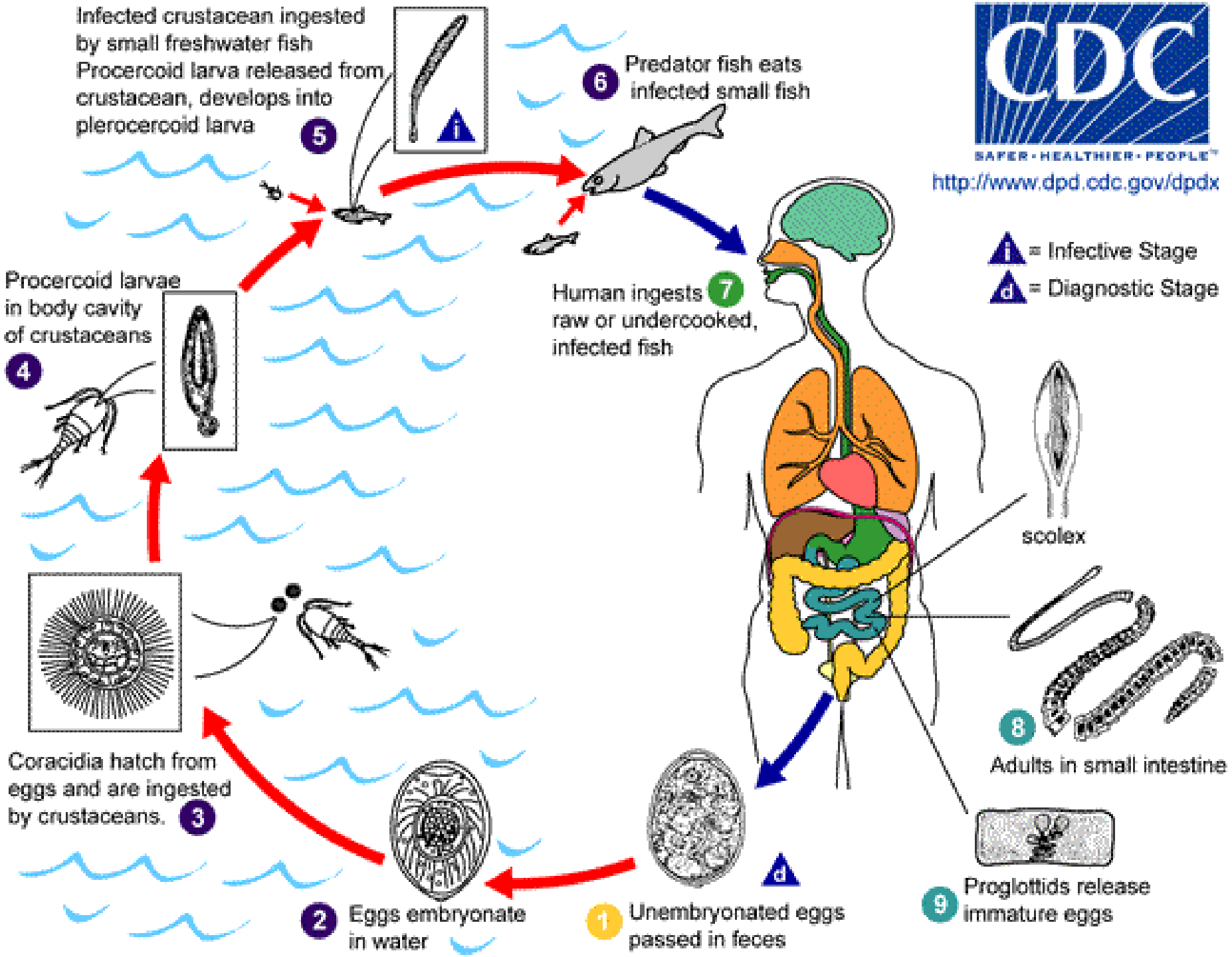
- *First intermediate host:* Copepod *(Cyclops)*



- *Second intermediate host: FreshwaterFish*

Life cycle

1. Eggs passed in feces → reach freshwater.
2. Hatch into coracidia (ciliated larvae).
3. Ingested by first intermediate host: freshwater copepods (Cyclops) → develop into procercoid larvae.
4. Copepod eaten by second intermediate host: freshwater fish → larvae develop into plerocercoid in fish muscles.
5. Humans (definitive host) acquire infection by eating raw or undercooked freshwater fish.
6. In the small intestine, larvae mature into adult worms.
7. Adult produces egg and passes through faeces



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Pathogenesis and clinical manifestation

- Often asymptomatic, but may cause abdominal discomfort, diarrhea, and weight loss.
- Proglottids in stool may be noticed.
- Worm competes for Vitamin B12 → megaloblastic anemia.
- Severe deficiency can cause neurologic complications.

Laboratory Diagnosis

- ***Stool microscopy:*** Eggs are passed in very large number in feces, and therefore, their demonstration in feces offers an easy method of diagnosis. The proglottids passed in feces can also be identified by their morphology.

- ***Serodiagnosis:*** A coproantigen detection test is available to diagnose diphyllobothriasis.

Treatment

Praziquantel in a single dose of 10 mg/kg is effective

Taenia Saginata and Taenia Solium

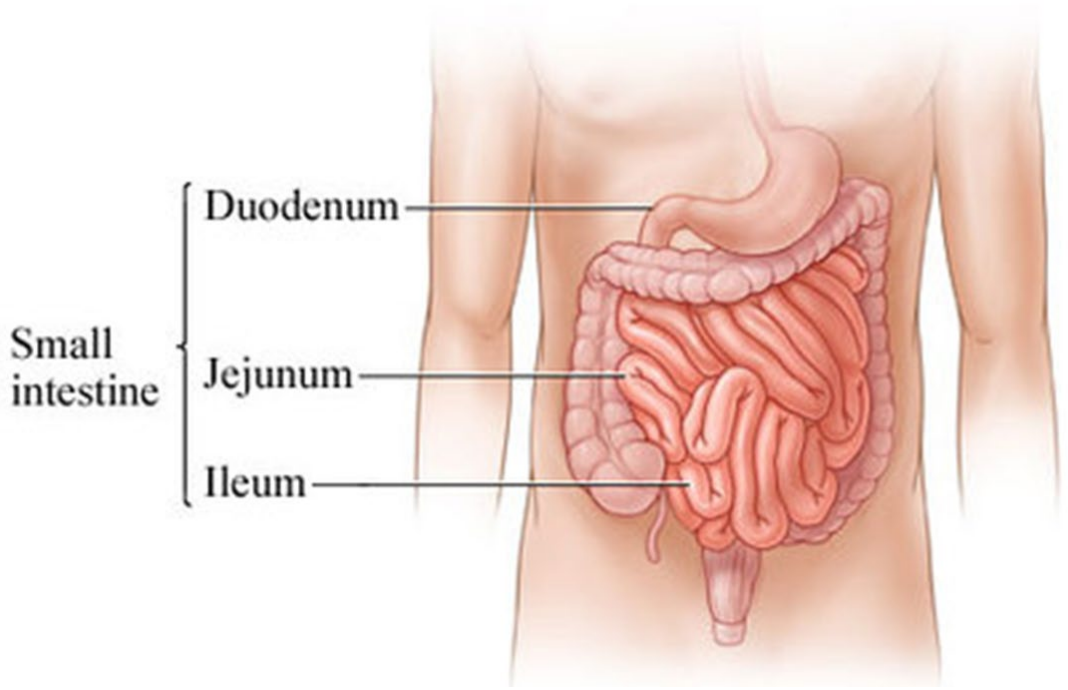
Common Name

- *Taenia saginata:* Beef tapeworm
- *Taenia solium:* Pork tapeworm.

- The name *Taenia* is derived from the Greek word meaning *tape or band*. It was originally used to refer to most tapeworms but is now restricted to the members of the Genus *Taenia*.
- *Taenia saginata* is worldwide in distribution, but the infection is not found in vegetarians and those who do not eat beef.
- *Taenia solium* is also worldwide in distribution except in the countries and communities, which proscribe pork as taboo.

Habitat

Both *Taenia saginata* and *Taenia solium* Adult worms live in the small intestine.



Morphology

	Taenia Saginata	***Taenia solium***
Length	5-10 meter	2- 3 meter
Scolex	Large quadrate	Small and globular
	Rostellum and hooks are absent	Rostellum and hooks are present
	Suckers may be pigmented	Suckers not pigmented
Neck	Long	Short
Proglottids	1,000-2,000	Below 1,000
Measurement (gravid segment)	20mmx 5mm	12mmx6mm

	Taenia Saginata	***Taenia solium***
Expulsion	Expelled singly	Expelled passively in chains of 5 or 6
Larvae	Cysticercus bovis; present in cow not in man	Cysticercus cellulosae; present in pig and also man
Egg	Not infective to man	Infective to man
Definitive Host	Man	Man
Intermediate Host	Cow	Pig, occasionally man
Disease	Causes intestinal taeniasis	Causes intestinal taeniasis and cysticercosis

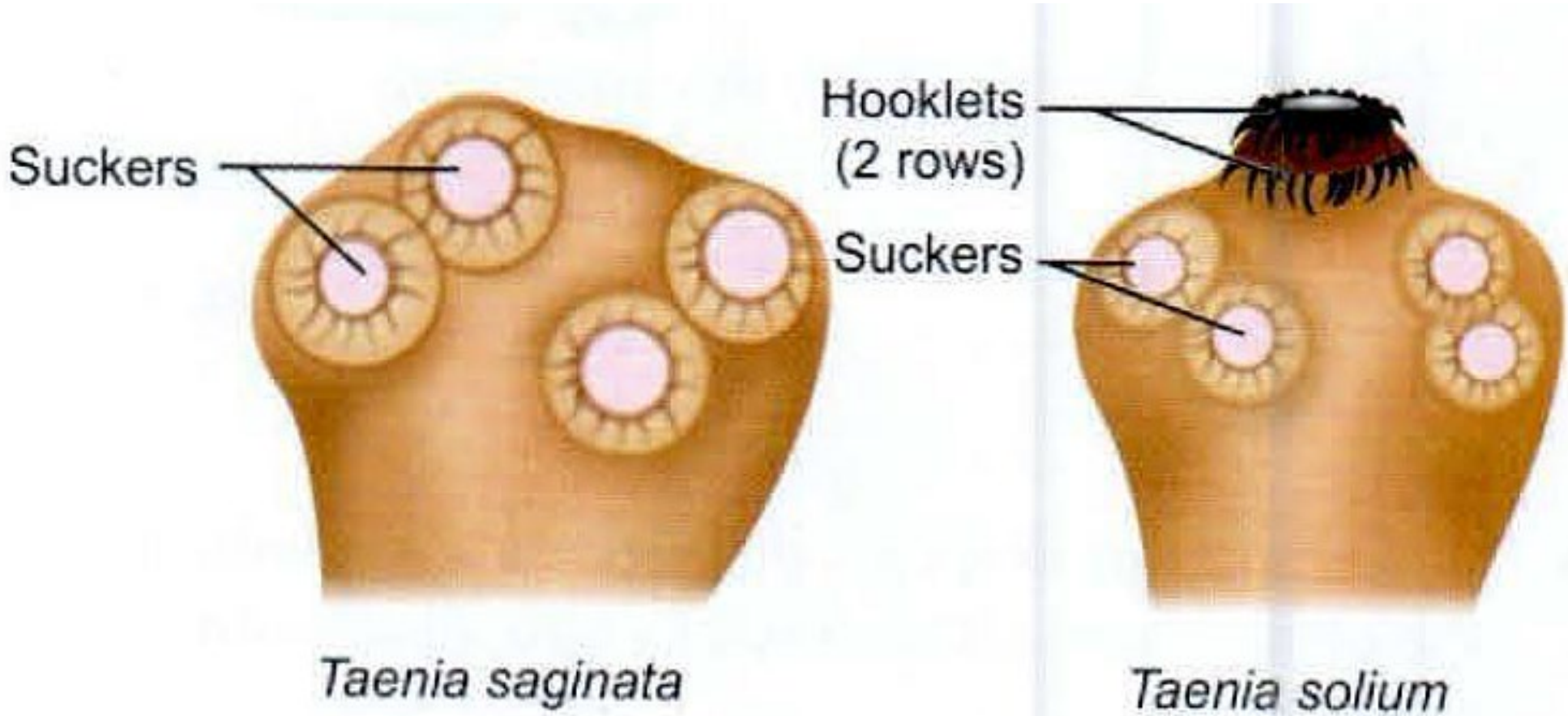


Fig. 8: Scolex of *Taenia saginata* and *Taenia solium*

Cysticercus bovis:

- It is the larval form of *T. saginala*.
- The larva (cysticercus bovis) is the *infective stage* for humans.
- The cysticercus is an ovoid, milky-white measuring about 5 mm x 10 mm in diameter and contains a single invaginated scolex *(bladder worm)*. The cysticerci are found in the muscles of mastication, cardiac muscles, diaphragm, and tongue of infected cattle.
- They can be seen on visual inspection as shiny white dots in the *infected beef*.
- Cysricercus bovis is unknown in humans.

Cysticercus cellulosae:

- lt is the larval form of *T. solium* and also the *infective form* of the parasite.
- It can develop in various organs of pig as well as in man.
- the cysticercus cellulosae or **"bladder worm"** is ovoid opalescent milky-white, measuring 8-10 mm in breadth and 5 mm in length.
- The scolex of the larva, with its suckers, lies invaginated within the bladder. It remains viable for several months

Cysticercus Bovis

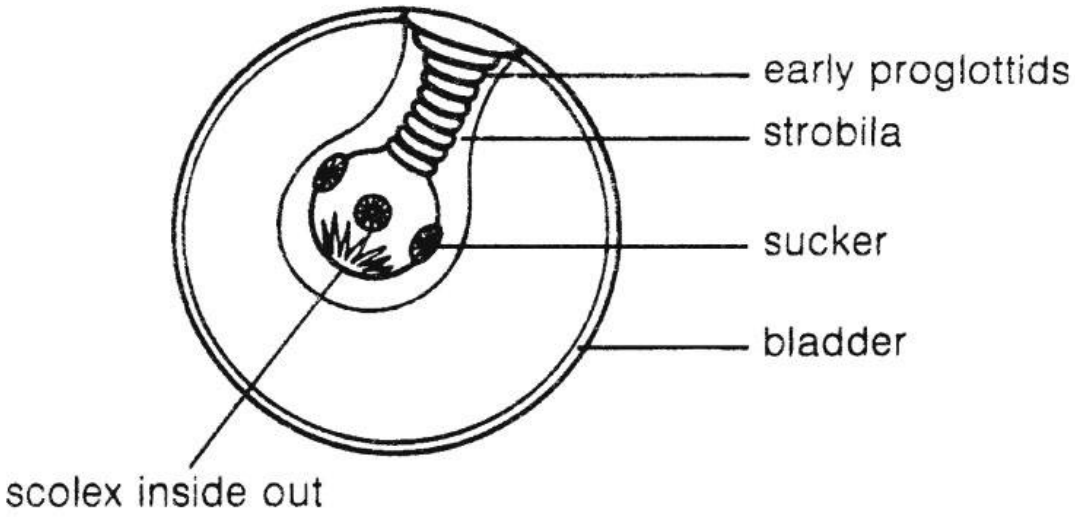


Fig. 126 **Cysticercus**. Generalized structure.

Cysticercus cellulosae

Life cycle

Taenia saginata passes its life cycle in two hosts**:**

1. ***Definitive host:*** Humans are the definitive hosts and harbor the adult worm.

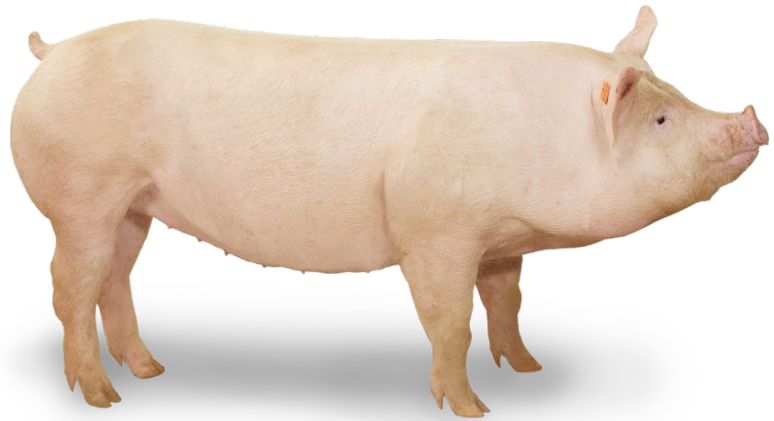
2. ***Intermediate host:*** Cattle (cow or buffalo) are the intermediate host and harbor the larval stage of the worm. *Infective stage:* Cysticercus bovis (larval stage)

Life cycle

Taenia solium passes its life cycle in two hosts:

1. ***Definitive host:*** Humans are the definitive hosts and harbor the adult worm.

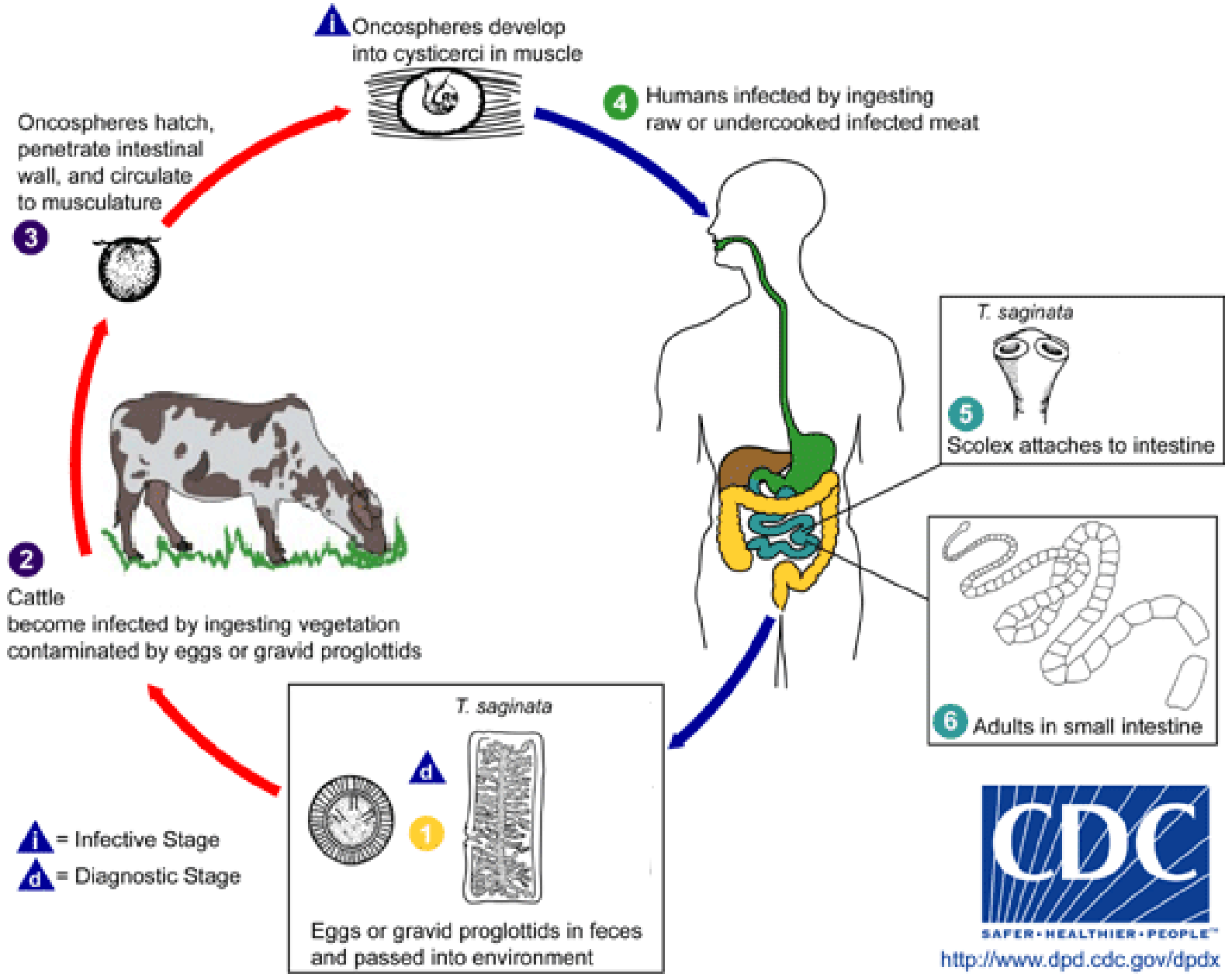
2. ***Intermediate host:*** Pigs are the intermediate host and harbor the larval stage of the worm.



Life cycle

Taenia saginata

1. Adult worm lives in the human small intestine (definitive host).
2. Gravid proglottids or eggs are passed in feces and contaminate soil, water, or pasture.
3. Eggs are ingested by cattle (intermediate host).
4. Oncospheres hatch and penetrate the intestinal wall, then reach muscles via the bloodstream.
5. They develop into cysticerci (larval stage) in bovine muscle.
6. Humans acquire infection by eating raw or undercooked beef containing cysticerci.
7. In the human intestine, cysticerci mature into adult worms.


Oncospheres develop into cysticerci in muscle
Humans infected by ingesting raw or undercooked infected meat
Oncospheres hatch, penetrate intestinal wall, and circulate to musculature
3
T. saginata
5
Scolex attaches to intestine
2
Cattle become infected by ingesting vegetation contaminated by eggs or gravid proglottids
6
Adults in small intestine
T. saginata
d
1
Eggs or gravid proglottids in feces and passed into environment
= Infective Stage
= Diagnostic Stage
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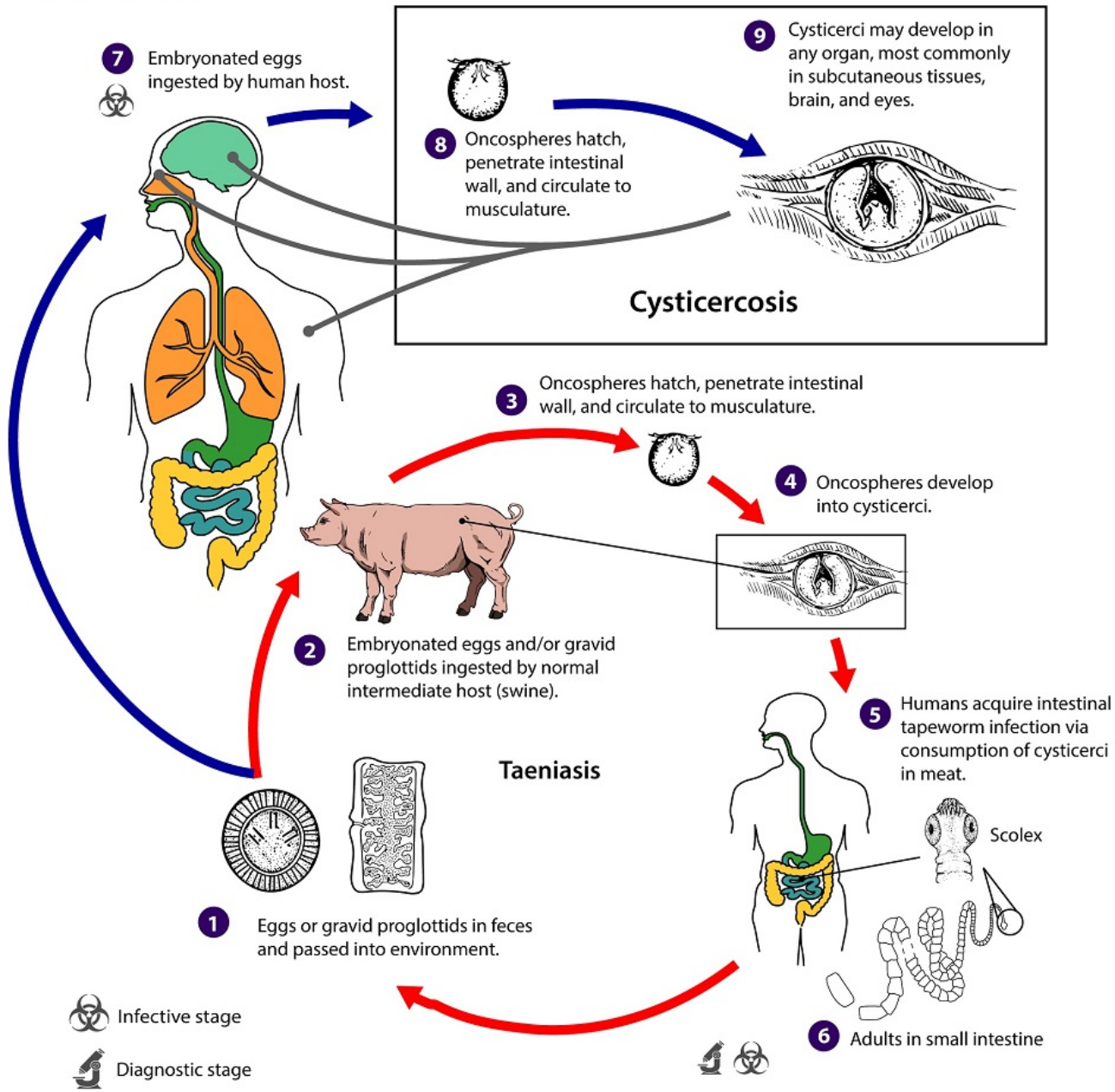
Life cycle

Taenia solium

1. Adult worm lives in the human small intestine.
2. Eggs or proglottids are passed in feces and contaminate the environment.
3. Eggs are ingested by pigs (intermediate host).
4. Oncospheres penetrate the intestine and spread to muscles and organs via the blood.
5. They develop into cysticerci in pig muscle.
6. Humans acquire infection by eating raw or undercooked pork containing cysticerci, which develop into adult worms.
7. Autoinfection or accidental ingestion of eggs by humans can lead to cysticerci in human tissues, causing cysticercosis.

Taenia solium



Clinical manifestation

Intestinal Taeniasis (both species)

- Usually mild or asymptomatic despite worm's large size. Possible symptoms: abdominal discomfort, nausea, diarrhea, weight loss.
- Rarely: intestinal obstruction, appendicitis, or pancreatitis.

Clinical manifestation

Cysticercosis (T. solium only)

- Can occur in **muscle, subcutaneous tissue, eye, brain, and other organs**.
- Host reaction: inflammation → fibrosis → calcification of cysts.
- **Clinical features depend on site**:
  - **Subcutaneous nodules** – usually harmless.
  - **Muscle** – may cause myositis.
  - **Neurocysticercosis** – most serious; causes seizures, hydrocephalus, psychiatric/behavioral changes; leading cause of adult-onset epilepsy.
  - **Ocular cysticercosis** – blurred or lost vision, iritis, uveitis, conjunctivitis.

Transmission

Taenia saginata:

Ingesting undercooked (raw) Beef meat infected with cycticercus bovis that cause **(Taeniasis)**

Taenia solium:

- ingesting undercooked pork meat infected with cysticercus cellulosae **(Taeniasis)**
- Ingesting the egg of taenia solium that cause **(cysticercosis)**

Laboratory Diagnosis

1- Taeniasis:

- **Microscopy:** Diagnosis of *Taenia* tapeworm infections is made by examination of stool samples; individuals should also be asked if they have passed tapeworm segments. Tapeworm eggs can be detected in the stool 2 to 3 months after the tapeworm infection is established.

- **Serodiagnosis:** Specific antibodies to adult stage antigen in serum can be demonstrated by ELISA,

2- Cysticercosis:

Muscle Biopsy

Neurocysticercosis usually requires imaging (MRI or CT brain scans)

Treatment

Intestinal Taeniasis

- Praziquantel (10–20 mg/kg, single dose) – drug of choice.

Cysticercosis (T. solium)

- Surgical excision where possible.
- Symptomatic neurocysticercosis cases – praziquantel (50 mg/kg/day for 20–30 days) or albendazole (400 mg BID for 30 days).
- Corticosteroids to reduce inflammation.
- Surgery if hydrocephalus develops.

Prevention

- **Meat inspection** at slaughterhouses.
- **Avoid raw/undercooked beef or pork** (kill cysticerci at 56 °C for 5 min).
- Maintain **personal hygiene and sanitation**.
- Prevent **fecal contamination** of soil, ensure safe sewage disposal, and avoid raw vegetables from polluted soil.
- **Identify and treat carriers** of adult worms to prevent spread and autoinfection.

References

- Paniker, C. K. J. & Ghosh, S. 2021. *Paniker's textbook of medical parasitology,* New Delhi, Jaypee Brothers Medical Publishers.