Lecture # 5
Metazoa
Helminthes

Dr Sadia IKram

Learning objectives

By the end of lecture students should be able to recall

- Phylum platyhelminthes , Helminthes & their respective subclasses.
- Life cycles, clinical features of diseses,laboritory diagnosis, treatment and prevention
- Able to diagnose their clinical casses.

Platyhelminthes & Helminthes

- **Platyhelminthes: (Flat worms)**
- Cestodes or Tape worms
- Trematodes or Flukes

- **Helminthes: (Round worms)**
- Nematodes or Round worms

Platyhelminthes (platy--flat; helminth--worm) Divided into two classes:

1. Cestodes (tapeworms).

2. Trematodes (flukes).

- **<u>Cestodes:</u>**
- Four medically important cestodes (tapeworms):

1. Taenia solium.

- *Taenia saginata.*

2. Diphyllobothrium latum.

3. Echinococcus granulosus.

4. Hymenolepis nana.

Introduction to cestodes

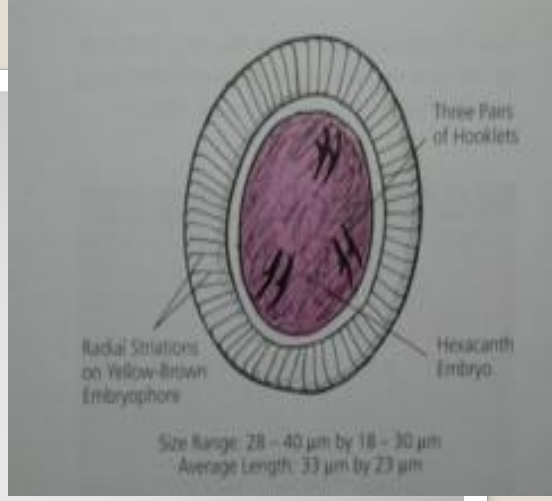
(tapeworm)

Hymenolepis nana

Taenia saginata, Taenia solium, or echinococcus

Diphyllobothrium latum

1.Taenia Transmission



- ***Taenia solium* (Pork tapeworm):** Ingestion of undercooked flesh of pork containing larva.
- Ingestion of food or water contaminated with human feces causing eggs of *Taenia*.
- ***Taenia saginata* (Beef tapeworm):** Ingestion of undercooked flesh of cattle containing larva.

Taenia

Cestode	Mode of transmission	Intermediate host	Sites infected	Diagnosis
T. solium	A. Ingests larva in undercooked pork. B. Ingests eggs in food or water contaminated with human feces **cysticercosis**	Pigs	Intestine Brain & eyes (cysticerci)	Proglottids in stool Biopsy, CT scan.
T. saginata	Ingests larva in undercooked beaf.	Cattle	Inestine	Proglottids in stool

Geographical Distribution

- Worldwide.
- Related to access of pigs to human feces & consumption of raw or undercooked pork.
- Endemic in areas of Asia, South America & eastern Europe.
- Cases in United States mostly imported.

Habitat & Life cycle

- Adult worm lives in the small intestine (upper jejunum) of man.

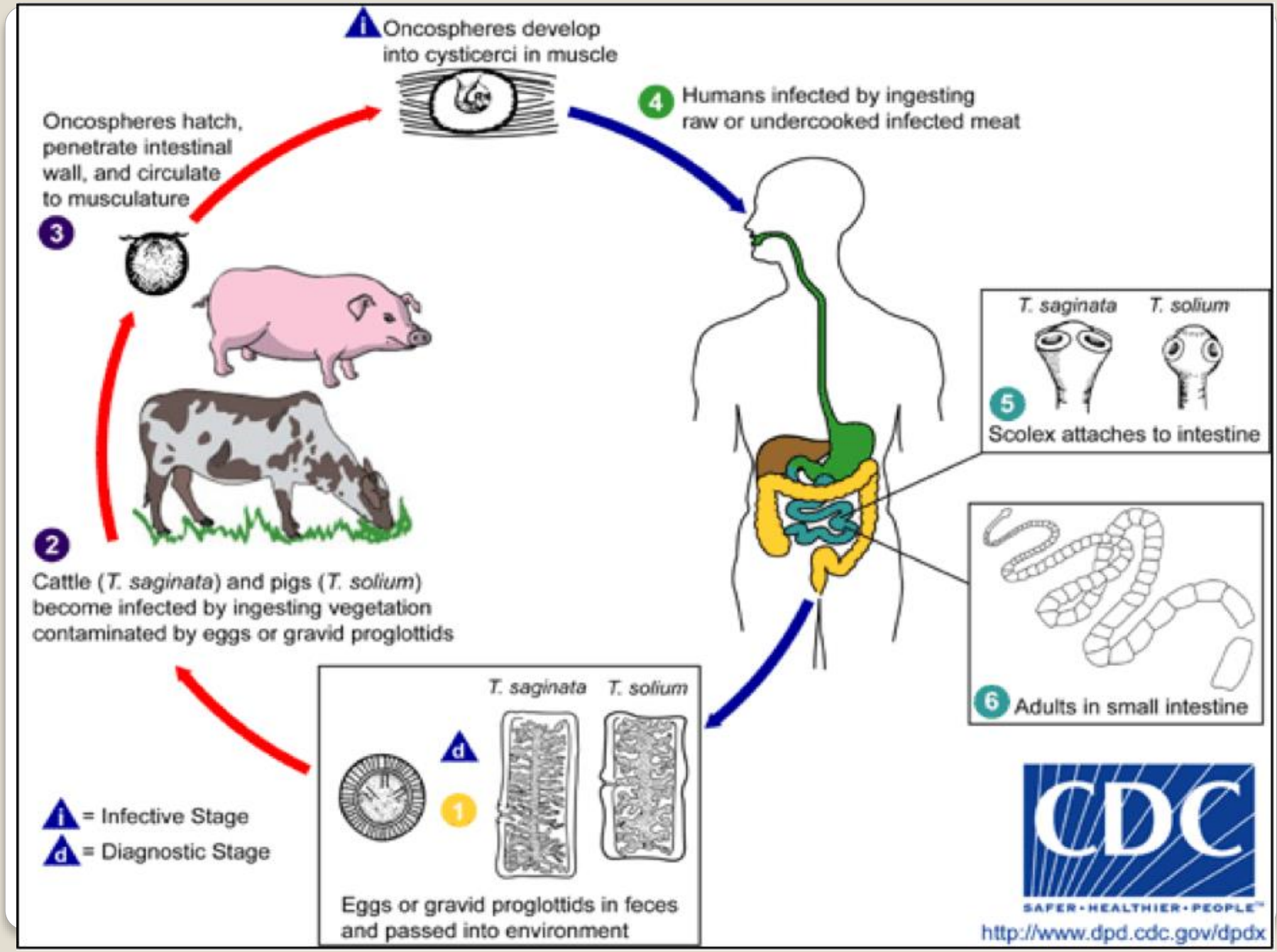
- ***T. solium* (pork tapeworm)**
- **Definitive hosts:** humans.
- **Intermediate hosts:** pigs.

- ***T. saginata* (beef tapeworm)**
- **Definitive hosts:** humans.
- **Intermediate hosts:** cattle.

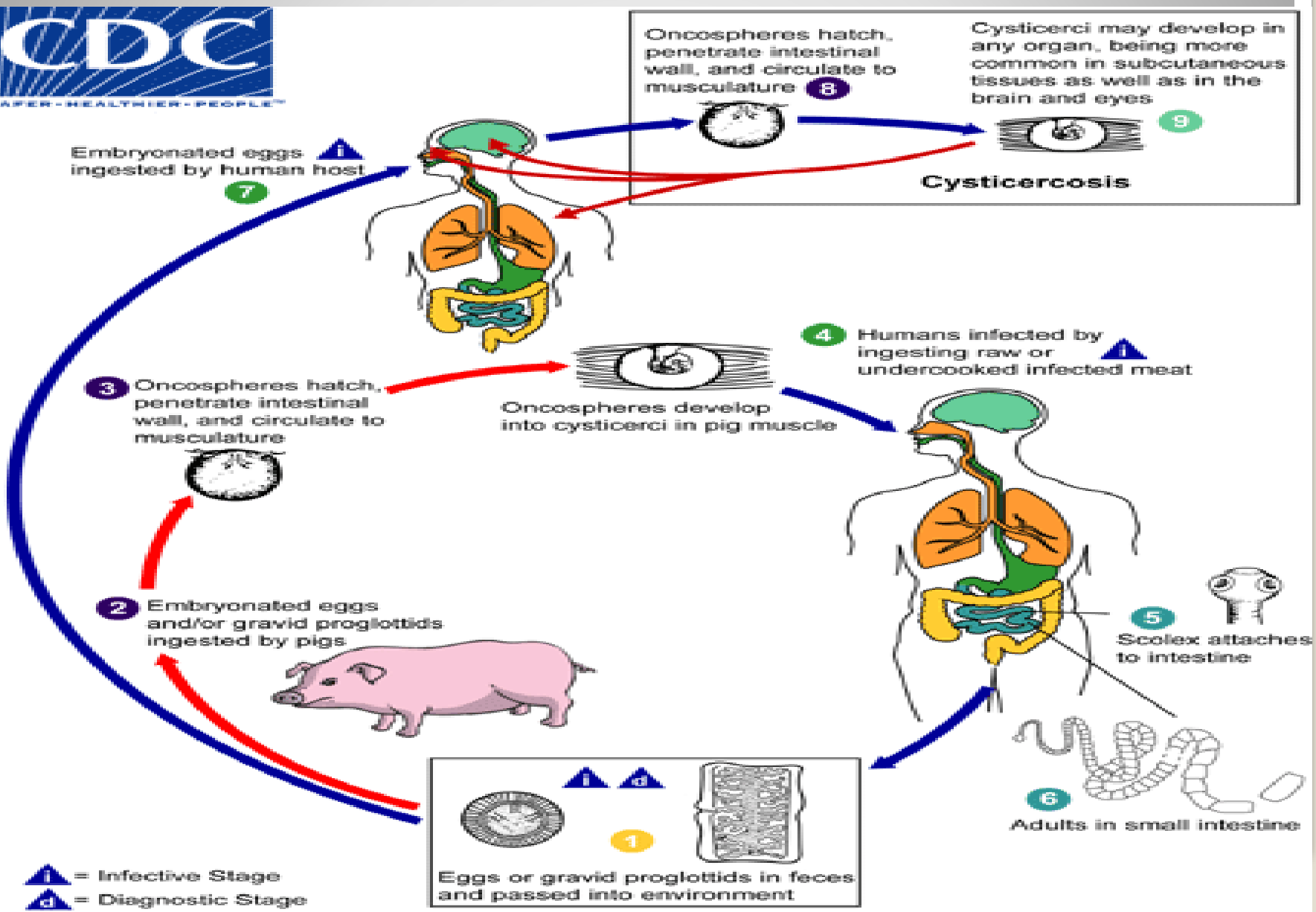
Taenia solium

Important Properties

- *T. solium* can be identified by its scolex, which has **four suckers and circle of hooks.**
- Gravid proglottids, which have **5–10 primary** uterine branches.


i Oncospheres develop into cysticerci in muscle
4 Humans infected by ingesting raw or undercooked infected meat
Oncospheres hatch, penetrate intestinal wall, and circulate to musculature
3
T. saginata
T. solium
5 Scolex attaches to intestine
2
Cattle (T. saginata) and pigs (T. solium) become infected by ingesting vegetation contaminated by eggs or gravid proglottids
6 Adults in small intestine
T. saginata
T. solium
d
1
i = Infective Stage
d = Diagnostic Stage
Eggs or gravid proglottids in feces and passed into environment
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx

Life cycle of *Taenia solium*



Pathogenesis

- **Taeniasis:**
- Adult tapeworm attached to intestinal wall causes little damage.

- Occasional abdominal discomfort, indigestion, diarrhoea alternating with constipation.

Pathogenesis: Cysticercosis

- **Due to ingestion of worm eggs** in food or water contaminated with human feces.
- Eggs hatch in small intestine, oncospheres burrow through wall into a blood vessel.
- Disseminate to organs (eyes & brain & encyst to form cysticerci).
- Each cysticercus contains larva.
- **Cysticerci (en**large in **brain,** causing **space-occupying lesion).**
- No inflammation by living cysticerci.
- Dead cysticerci release substances provoking inflammatory response.
- Later cysticerci calcify.

Clinical Findings

- **Taeniasis:** Most patients with adult tapeworms asymptomatic, anorexia & diarrhea can occur.
- **Cysticercosis in brain:** headache, vomiting, & seizures.
- **Cysticercosis in eyes:** uveitis or retinitis, larvae visualized floating in vitreous.
- Subcutaneous nodules containing cysticerci.
- **Complications:**
- Uveitis, Retinitis & Subcutaneous nodules.

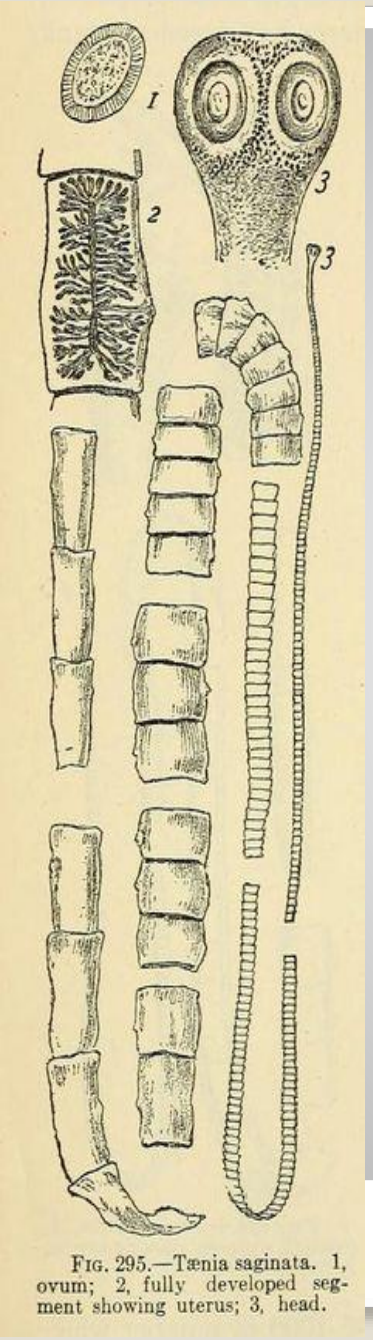
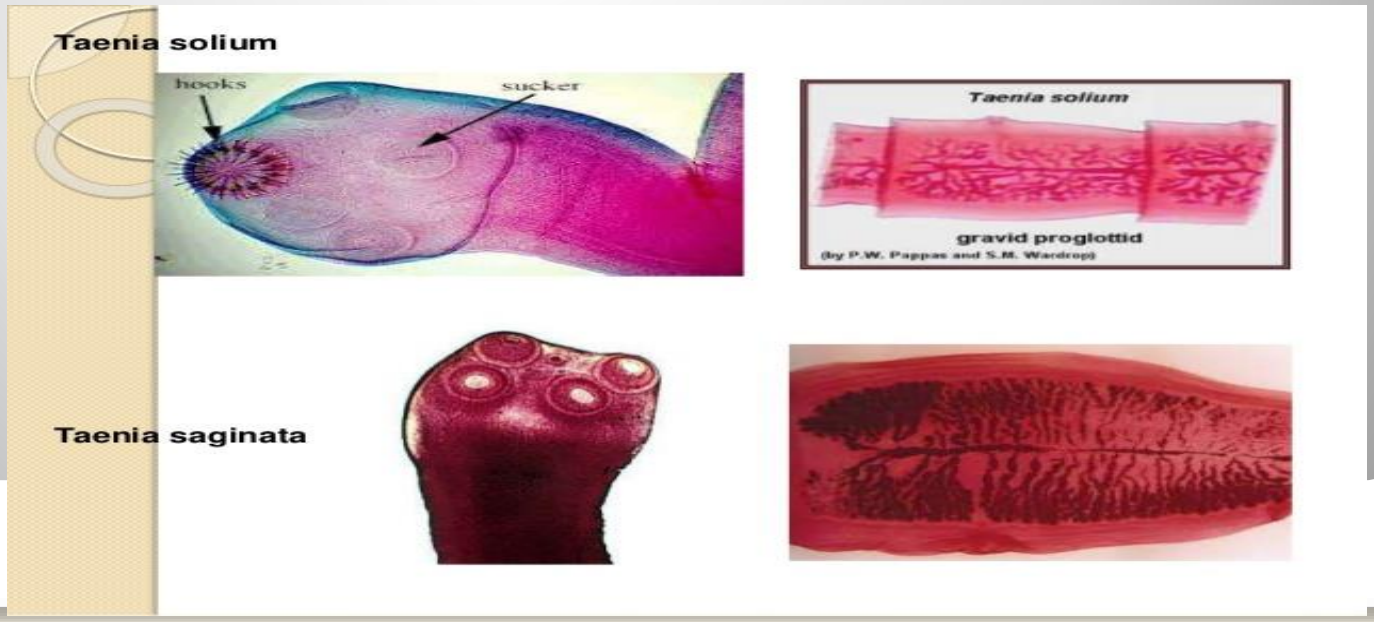


FIG. 295.—Tænia saginata. 1, ovum; 2, fully developed segment showing uterus; 3, head.

Laboratory Diagnosis
1. Taeniasis:

Stool examination:

- ***T. solium:*** Proglottids with 5 to 10 primary uterine branches in stools.
- ***T. saginata:*** Proglottids with 15 to 20 primary uterine branches.



- **Eggs:** less often found in stool.

Round to oval
30-40um in diameter
3 pairs of hooklets
Thick, brown, striated embryophore

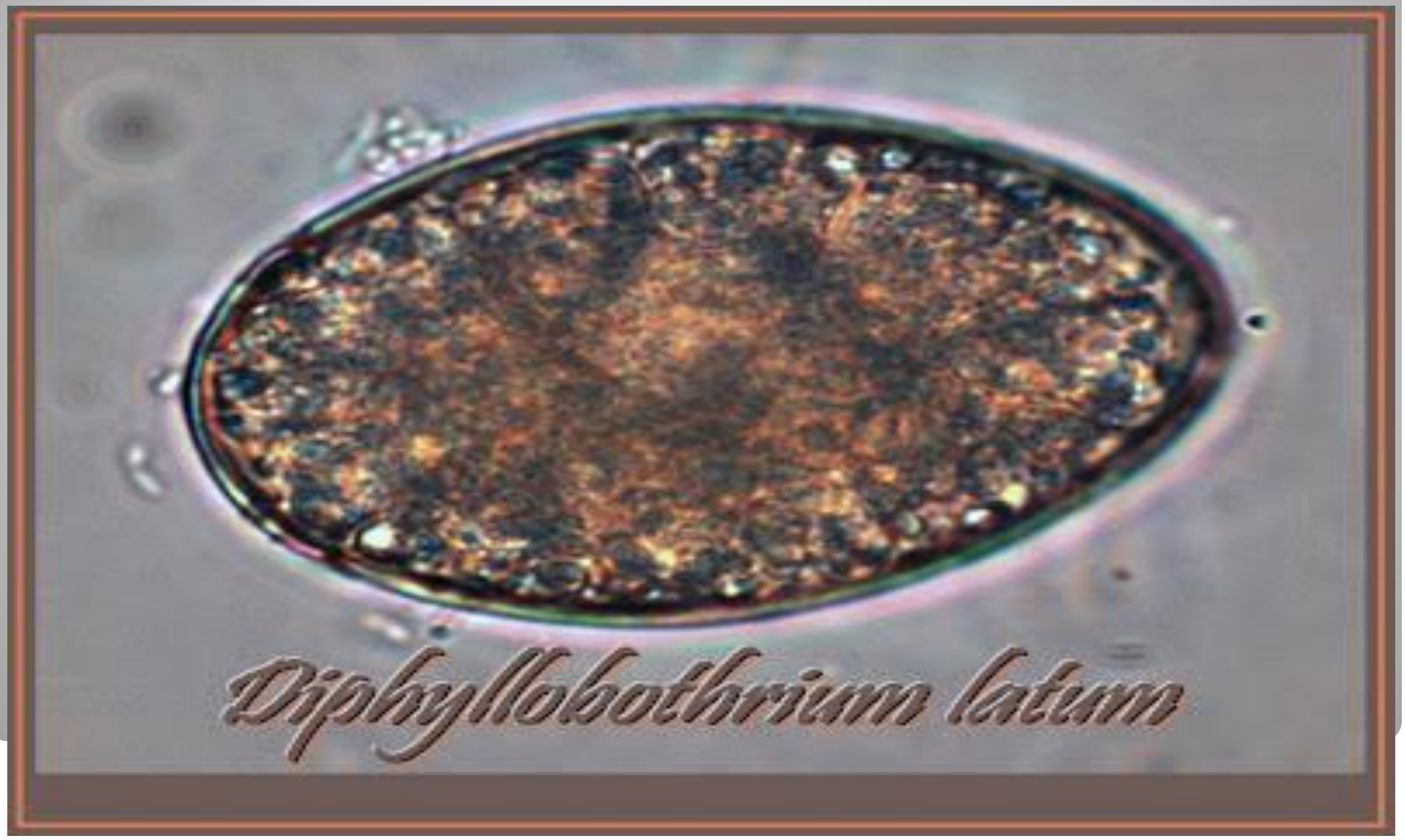
Laboratory Diagnosis
2.Cysticercosis:

1. **PCR:** To differentiate eggs of *Taenia solium and Taenia saginata.*
2. ELISA: Detect antibodies to *T. solium* antigens. May be negative in neuro-cysticercosis.
3. Demonstration of cyst in tissue biopsy or by surgical removal.
4. CT scan brain.
5. MRI brain.

Treatment & Prevention

- **Treatment for intestinal worms:** praziquantel.
- **For cysticercosis**: Praziquantel or albendazole, & surgical excision.
- Cooking pork adequately.
- Disposing waste properly so that pigs cannot ingest human feces.
- **Prevention of cysticercosis:** Prevention of autoinfection by observing proper hygiene, handwashing.

2. Diphyllobothrium latum (fish tapeworm)



Diphyllobothrium latum (fish tapeworm) causes diphyllobothriasis

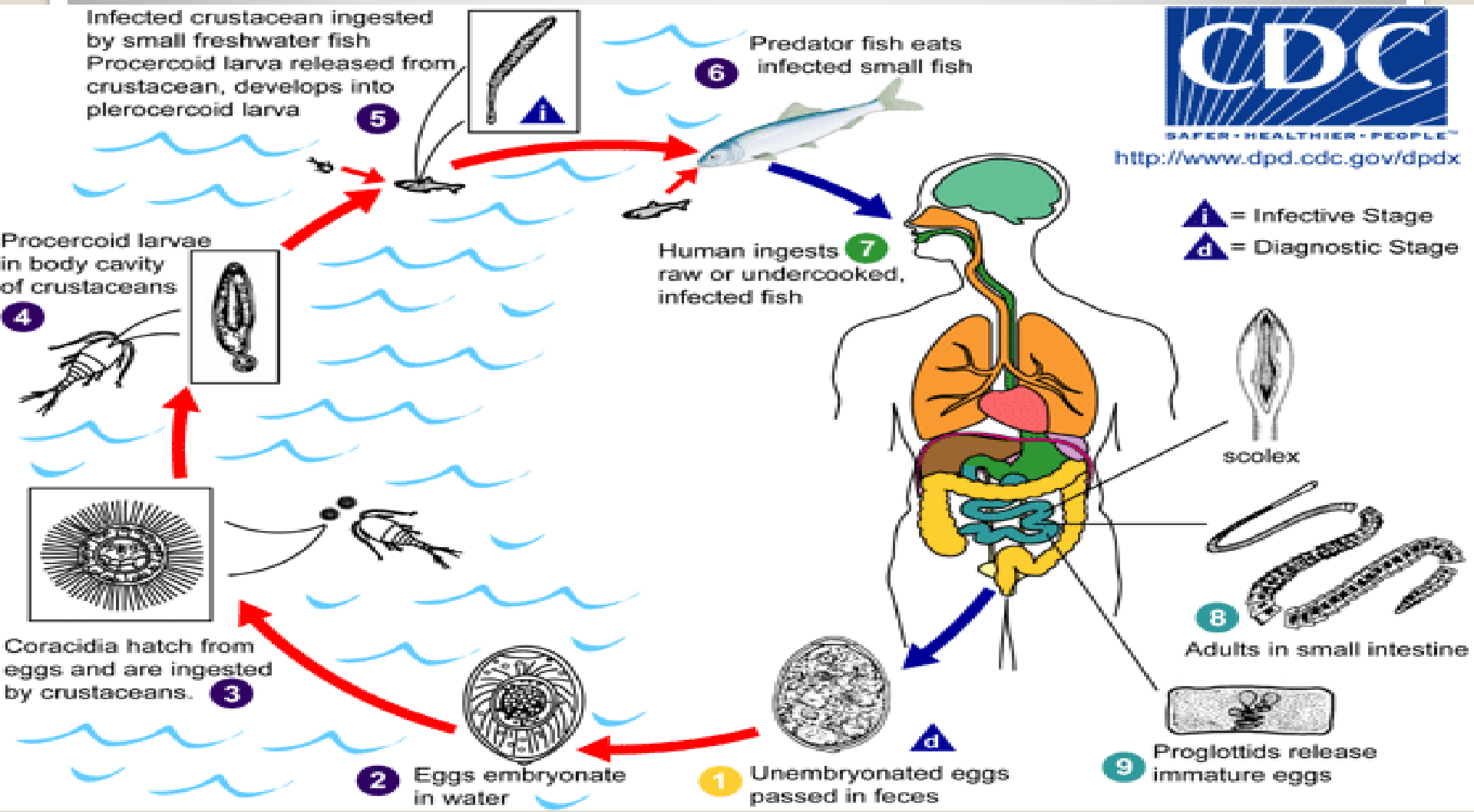
- **Morphology of worm:**
- *D. latum* longest tapeworms, measuring up to 13 m.
- Scolex of *D. latum*: Two elongated **sucking grooves** for attachment to intestinal wall.
- Scolex has no hooks.
- Proglottids wider & gravid uterus in form of rosette.

- *D. latum* eggs: Oval with a lid like opening (**operculum**) at one end.

Geographical Distribution

- Disease found worldwide.
- Endemic in areas where eating raw fish custom (Scandinavia, northern Russia, Japan, Canada & north-central states of United States).
- Ingestion of raw or inadequately cooked fish & contamination of bodies of fresh water with human feces.

Life Cycle
Definitive host: Humans.
First intermediate host: Crustacean.
Second intermediate host: Fish.



Transmission & Life Cycle

- Humans infected by **ingesting** raw or undercooked **fish** containing larvae (plerocercoid larvae).

- In small intestine, larvae attach to gut wall & develop into adult worms.
- Gravid proglottids release eggs passed in stools.

- Immature eggs deposited in fresh water.
- Embryos emerge from eggs and eaten by tiny **copepod crustacea (first intermediate hosts) &** form procercoid larvae.

- Copepod eaten by freshwater fish, e.g. (pike, trout), larvae differentiate into plerocercoids in muscle of **fish (second intermediate host).**
- Cycle completed when raw or undercooked fish eaten by humans.

Pathogenesis & Clinical Findings

- Infection causes little damage in small intestine.
- Megaloblastic anemia due to vitamin B_{12} deficiency due to uptake of vitamin by worm.
- Most patients asymptomatic.
- Abdominal discomfort and diarrhea can occur.

Laboratory Diagnosis

- **Stool Examination:** Typical eggs oval, yellow-brown with an operculum at one end.
- No serologic test.

- Yellow, brown oval.
- Measuring 70x40um.
- Has operculum.
- Contains mass of granulated ovum.

Treatment & Prevention

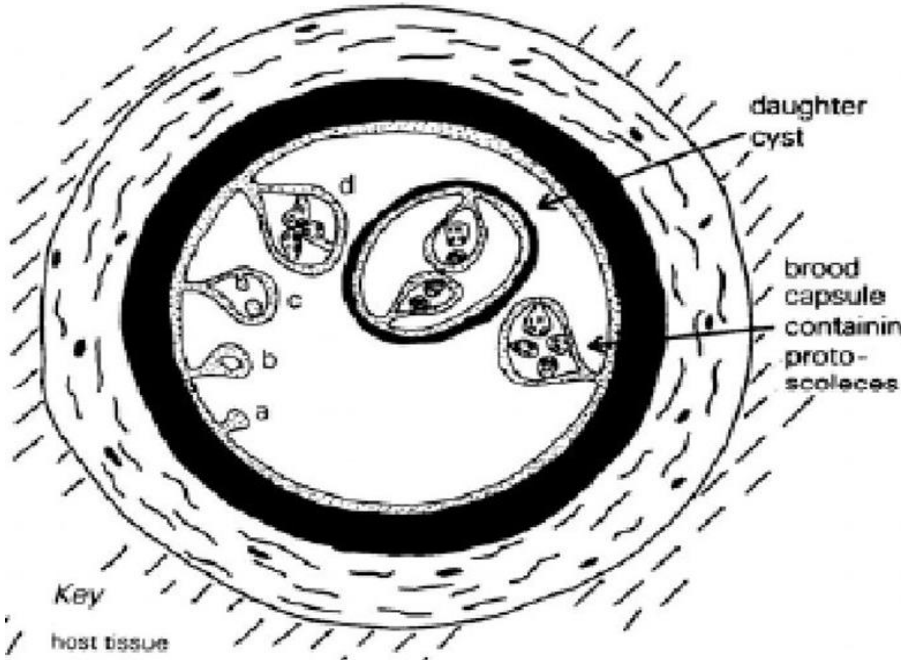
- Praziquantel.
- Niclosamide.

- Prevention: Adequate cooking of fish & proper disposal of human feces.

3. *Echinococcus granulosus* (dog tapeworm)

causes Echinococcosis

- ***E. granulosus* larva:** causes uni-locular hydatid cyst disease.
- ***E. multilocularis*:** causes multilocular hydatid disease.



Habitat

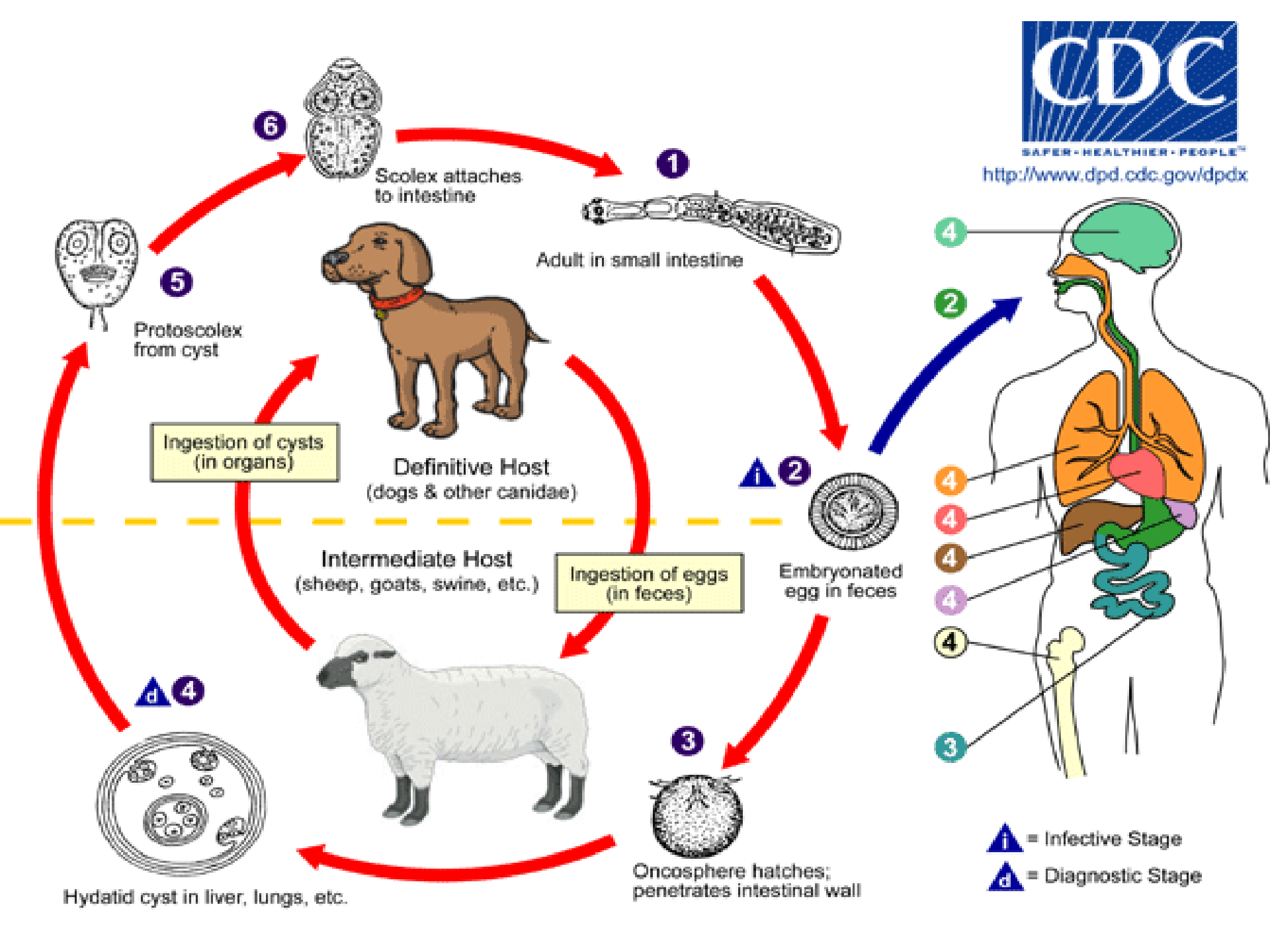
- **Definitive hosts:** Dog, fox.
- **Intermediate hosts:** sheep, cattle, goat
- **Humans dead-end intermediate hosts.**

- Man harbors the larval form of parasite.

- Adult form found in small intestine of dog & other canines.

Geographical Distribution

- Disease found primarily in shepherds in Mediterranean region, Middle East & Australia.
- In United States, western states report largest number of cases.


CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx
6
Scolex attaches to intestine
1
Adult in small intestine
5
Protoscolex from cyst
Definitive Host
(dogs & other canidae)
Ingestion of cysts (in organs)
Intermediate Host
(sheep, goats, swine, etc.)
Ingestion of eggs (in feces)
i 2
Embryonated egg in feces
d 4
Hydatid cyst in liver, lungs, etc.
3
Oncosphere hatches; penetrates intestinal wall
4
2
4
4
4
4
4
3
i = Infective Stage
d = Diagnostic Stage

Life Cycle

- Worms in dog's intestine liberate thousands of eggs, ingested by sheep (or humans).

↓

- Oncosphere embryos emerge in small intestine & migrate primarily to liver, lungs, bones & brain.

↓

- Embryos develop into large fluid-filled **hydatid cysts**, the inner germinal layer of which generates many protoscoleces within brood capsules.

↓

- Life cycle completed when entrails (liver containing hydatid cysts) of slaughtered sheep eaten by dogs.

Pathogenesis

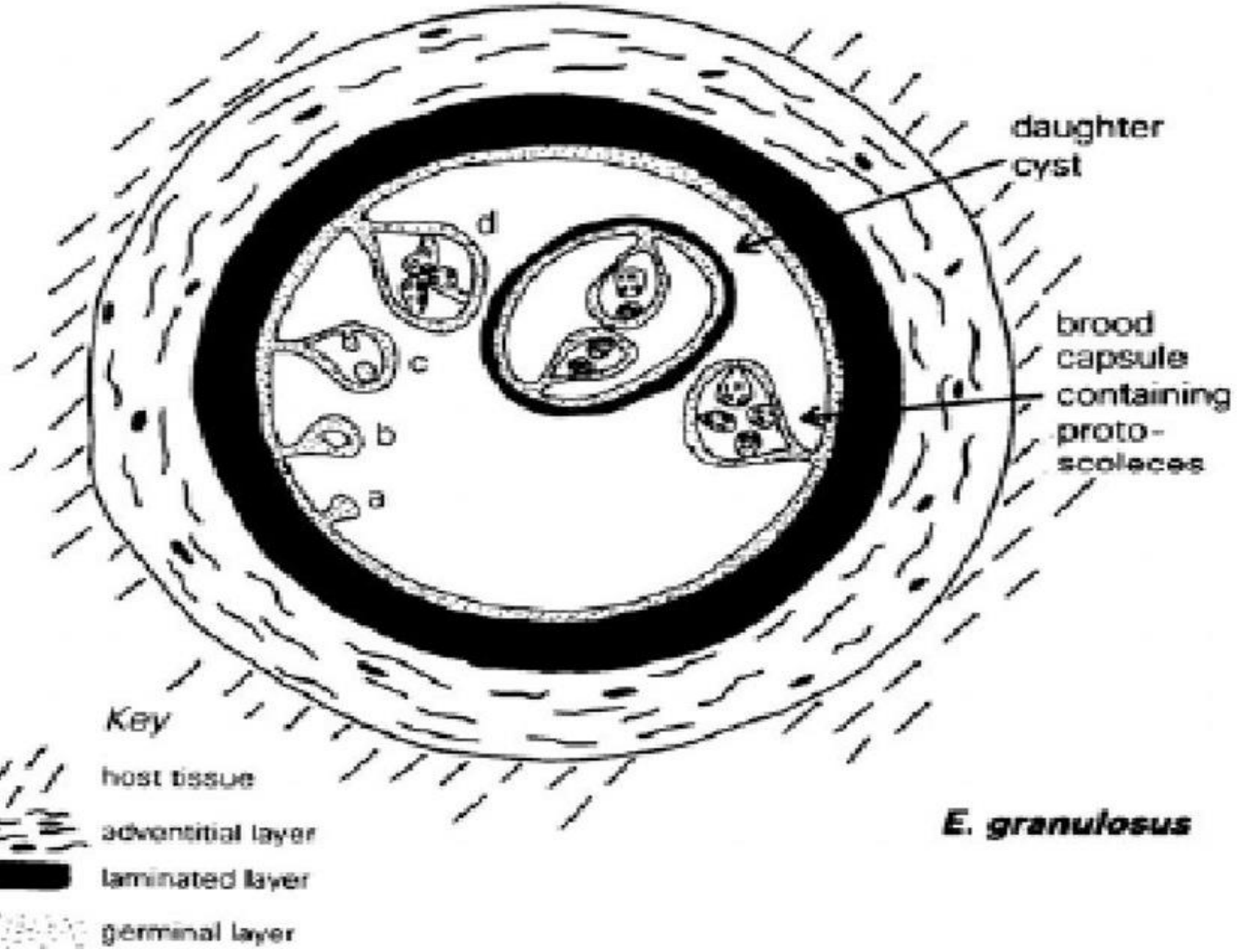
Forms large fluid-filled cyst (unilocular) with thousands of scoleces & daughter cyst.

Hydatid sand: Individual scoleces lying at bottom of large cyst.

Cyst acts as a space-occupying lesion, putting pressure on adjacent tissue.

Outer layer of cyst thick, fibrous tissue produced by host.

Cyst fluid contains parasite antigens, which sensitize host. (If cyst ruptures spontaneously or during trauma or surgical removal, life-threatening **anaphylaxis** occur).


daughter cyst
brood capsule containing proto-scoleces
d
c
b
a
Key
host tissue
adventitial layer
laminated layer
germinal layer
E. granulosus

Clinical Findings

- Mostly asymptomatic.
- Symptoms depend on site of cyst.
- **Liver cysts** cause hepatic dysfunction.
- **Cysts in lungs** erode into bronchus, causing bloody sputum.
- **Cerebral cysts** cause headache & focal neurologic signs.
- Rupture of cyst cause fatal anaphylactic shock.

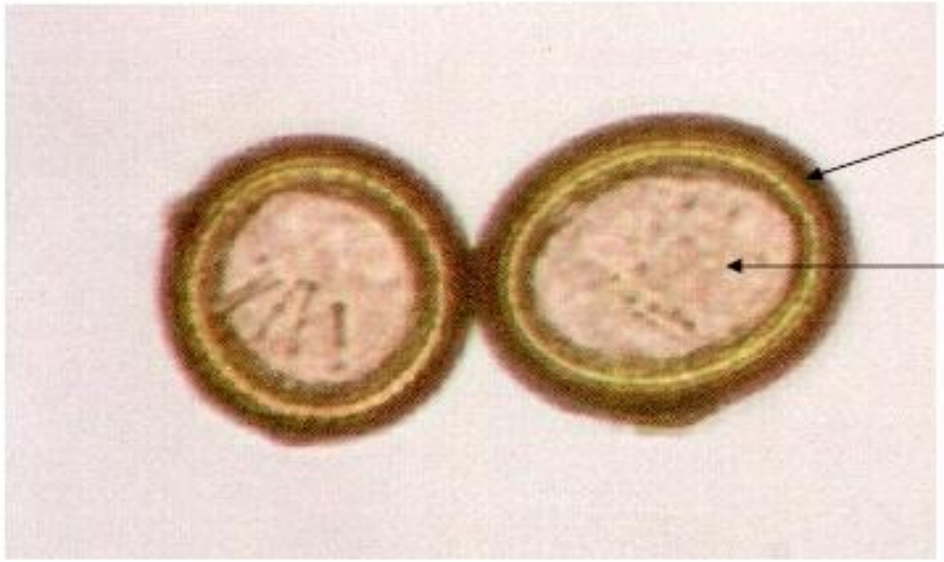
Diagnosis of *Echinococcus granulosus*

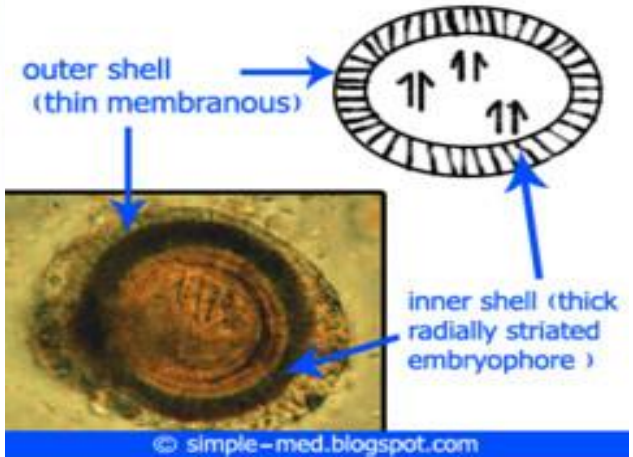
DIAGNOSIS:

IN DOGS: identify eggs in feces. Eggs are characterized by dense striated _____ surrounding _____.

- Eggs, however, cannot be distinquished from any other taeniid.

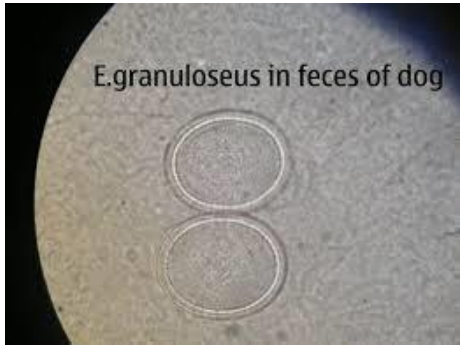
.

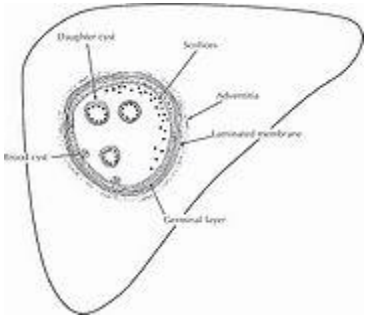




Laboratory Diagnosis

1. **Microscopic examination:** Demonstrating presence of brood capsules containing multiple protoscoleces.





2. **Casoni's test:** Immediate hypersensitivity skin test.

3. Serologic tests:

a. Indirect hemagglutination test
b. DNA probe tests and PCR.
c. ELISA test: IgG detection.

4. Radiological tests: Ultrasound guided biopsy of lung or liver hydatid cyst.

Treatment & Prevention

- Albendazole or mebendazole.
- Surgical removal of cyst. (prevent release of protoscoleces during surgery).
- Protoscolicidal agent, e.g. hypertonic saline, injected into cyst to kill organisms & prevent accidental dissemination.
- **Prevention:** Not to feed entrails of slaughtered sheep to dogs.
- Personal hygeine.

MCQ # 1

- Human infection with the beef tapeworm, Taenia saginata, usually is less serious than infection with the pork tapeworm, T. solium, because
- a. Acute intestinal stoppage is less common in beef tapeworm infection
- b. Larval invasion does not occur in beef tapeworm infection
- c. Toxic by-products are not given off by the adult beef tapeworm
- d. The adult beef tapeworms are smaller
- e. Beef tapeworm eggs cause less irritation of the mucosa of the digestive tract

MCQ #2

- Analysis of a patient's stool reveals small structures resembling rice grains; microscopic examination shows these to be proglottids. The most likely organism in this patient's stool is
- a. Enterobius vermicularis
- b. Ascaris lumbricoides
- c. Necator americanus
- d. T. saginata
- e. Trichuris trichiura

MCQ # 3

- A medical technologist visited Scandinavia and consumed raw fish daily for 2 weeks. Six months after her return home, she had a routine physical and was found to be anemic. Her vitamin B12 levels were below normal. The most likely cause of her vitamin B12 deficiency anemia is
- a. Excessive consumption of ice-cold vodka
- b. Infection with parvovirus B 19
- c. Infection with the fish tapeworm D. latum
- d. Infection with Yersinia
- e. Cysticercosis

MCQ # 4

- **Which of the parasite has dog as the definitive host?**
- *A. Taenia saginata*
- *B. Echinococcus granulosus*
- *C. Echinococcus multilocularis*
- *D. Trichuris trichuara*
- *E. Entrobius vermicularis*

MCQ # 5

- **Which of the following parasite is a cestode?**
- *A. Schistosoma*
- *B. Taenia solium*
- *C. Ankylostoma duodenale*
- *D. Ascaris lumbricoides*
- *E. Enterobius vermicularis*

SEQ # 1

- A 40 years old shepherd of sheep presents with upper right quadrant pain and appeared slightly jaundiced. A stool exam was negative for ova and parasite but a CT scan reveals a large 14 cm cyst that appears to contain fluid, in the right lobe of the liver.
- What is the most likely diagnosis?
- Name the parasite responsible for this lesion.
- Draw and label its life cycle.

SEQ # 2

- What is cystecercosis? Expalin.
- Draw the life cycle of Ecchinococcus granulosus.
- Discuss its laboratory diagnosis.

SEQ # 3

- Explain the pathogenesis of hydatid disease of liver.

- Name the parasites causing hemolytic anemia, megaloblastic anemia and iron deficiency anemia.