

Nematodes & Filarial nematode

Wuchereria bancrofti

Echinococcus

Schistosoma (blood flukes)

Lec-5 & 6-
parasitology

Nematode(round worm)

- Nematodes are roundworms with a cylindrical body and a complete digestive tract, including a mouth and anus.
- The body is covered with a non-cellular, highly resistant coating called a **cuticle**.
- Nematodes have **separate sexes**; the female is usually larger than the male. The male typically has a coiled tail.
- The medically important nematodes can be divided into two categories according to their primary location in the body, namely, **intestinal(example: ascaris)** and **tissue (Loa loa)** nematodes.

Wuchereria bancrofti

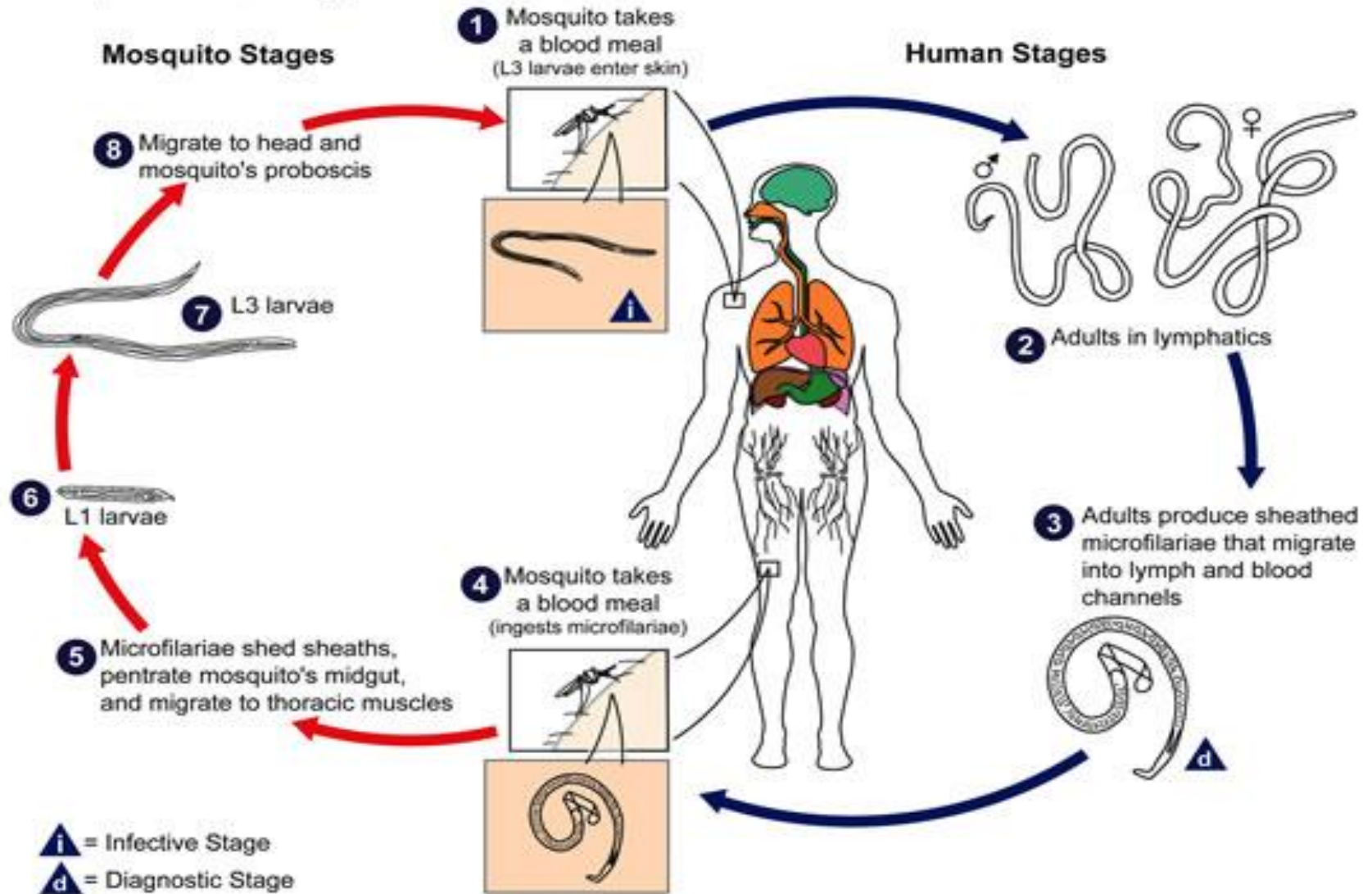
- *Wuchereria bancrofti* causes **lymphatic filariasis (Elephantiasis)**.
- *Wuchereria* is thread-like worm that lies coiled in the lymphatic vessels, male and female together, for the duration of their decade-long lifespan.
- The female *W. bancrofti* measures 100 mm in length, and the male 40 mm.

Wuchereria bancrofti

- **Distribution:** *W. bancrofti* occurs in Africa, India, parts of southeast Asia, Indonesia, the Pacific islands, South America, Southeast China and Northern South America.
- **Transmission and reservoirs:** *W. bancrofti*, transmitted primarily by mosquitoes of the *Anopheles* or *Culex* species. (Mosquito is essential vector and intermediate host)

Filariasis

(*Wuchereria bancrofti*)



➤ Life cycle

- 1- Adult worms can live in the mammalian host lymphatic system for up to **17 years**, where they viviparously produce blood-dwelling microfilariae (pre L1). The microfilariae are ingested by mosquitoes, penetrate the stomach wall, grow, and metamorphose through stage L2 and L3 within the thoracic flight muscle.
- 2- After approximately 10 days, L3s migrate to the mosquito's salivary glands, proboscis, and associated structures, from which they are injected into the next host.
- 3- In humans, the L3 migrates through blood to the deep tissues, molting to an L4 and then an adult in approximately 10 days. The adult penetrates the lymphatics after **4-12 months**.

Wuchereria bancrofti

➤ Clinical disease & manifestation:

- *Wuchereria bancrofti* causes Lymphatic filariasis.
 1. Many cases remain clinically symptomless for years.
 2. Headache, fever, lymphangitis, nausea, urticaria develop during the early, acute stages of the disease. Adult worms in the lymph nodes cause inflammation that eventually obstruct the lymphatic vessels, causing edema. Massive edema of the legs is called **elephantiasis**.

Wuchereria bancrofti

3. Tropical pulmonary eosinophilia is characterized by coughing and wheezing, especially at night. These symptoms are caused by microfilariae of ***Wuchereria bancrofti*** in the lung that elicit an immediate hypersensitivity reaction characterized by a high immunoglobulin E (IgE) concentration and eosinophilia.

Wuchereria bancrofti

Laboratory diagnosis:

➤ **Microscopic examination**

Definitive diagnosis is made by demonstrating microfilariae in a blood smear. Physicians must take into account that microfilariae typically exhibit nocturnal periodicity(e.g., they remain sequestered in the capillary beds of the deep organs during the day and appear in the peripheral circulation at night, coinciding with the biting habits of the vector mosquitoes).

Wuchereria bancrofti

Elephantiasis



Microfilaria in blood

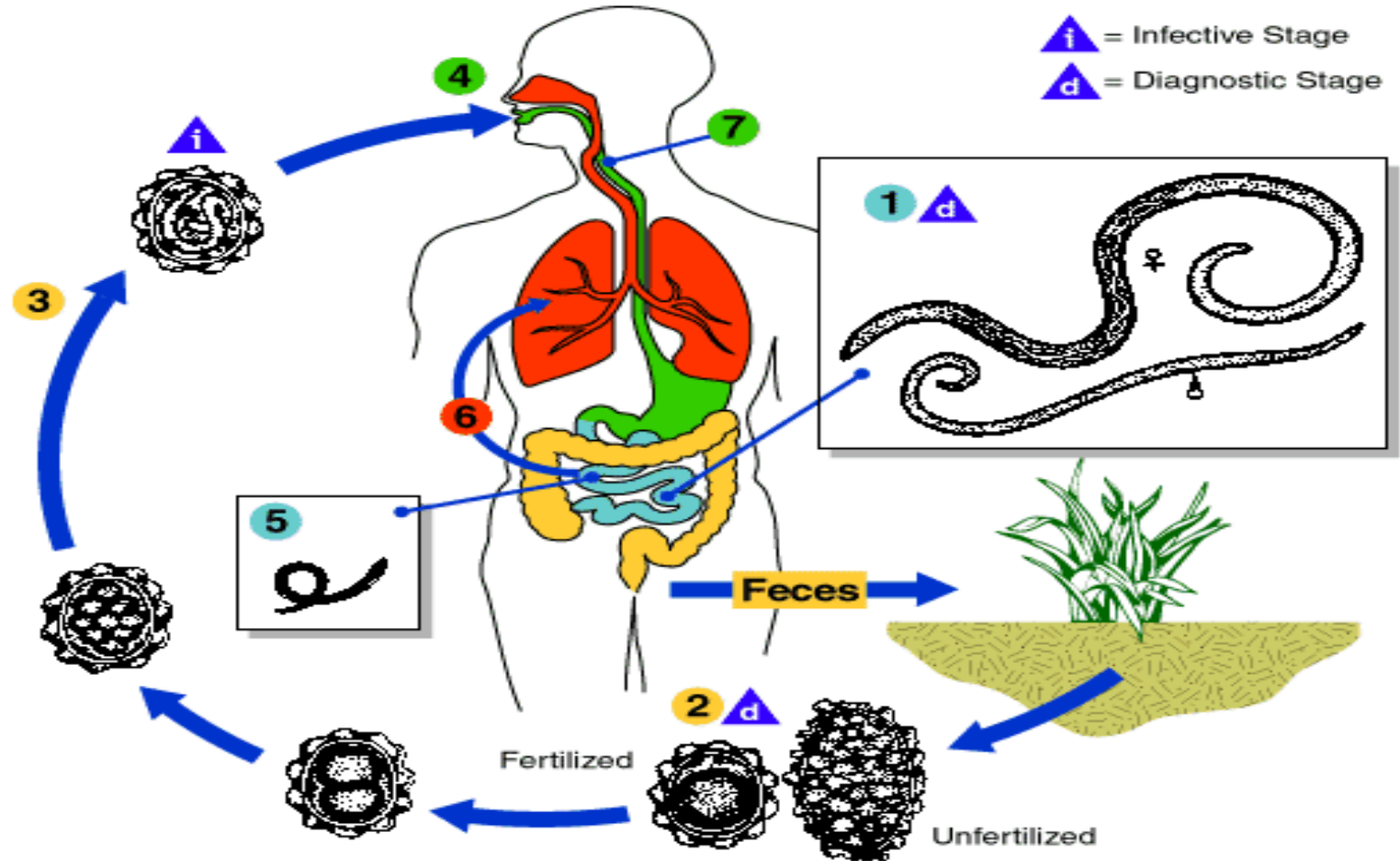
Wuchereria bancrofti

- **Treatment:**
- Diethylcarbamazine citrate (DEC) is the drug of choice because it kills microfilariae as well as adult worms (slowly).
- The tissue changes of elephantiasis are often irreversible, but the enlargement of the extremities may be ameliorated with pressure bandages.

Ascaris Lumbricoides

- a short-lived worm (6 to 18 months), is the **largest and most common of the intestinal helminths**, that usually inhabits in the ileum and jejunum.
- known as the **large intestinal roundworm** of humans, females may attain a length of 40 cm while male worms may reach 30 cm
- **Epidemiology:**
 - (1) **Distribution:** *Ascaris* has a cosmopolitan distribution and causes approximately 1 billion infections per year worldwide.
 - (2) **Transmission.** Infective eggs may survive years in shaded, moist, Worm soil. Eggs can be ingested with vegetables or drinking water.

Ascaris Lumbricoides



Ascaris Lumbricoides

- **Life cycle:**
- Humans are infected by ingesting worm eggs in food or water contaminated with human feces.
- The eggs hatch in the small intestine, and the larvae migrate through the gut wall into the bloodstream and then to the lungs.
- They enter the alveoli, pass up the bronchi and trachea, and are swallowed.
- Within the small intestine, they become adults.
- They live in the lumen of small intestine, do not attach to the wall, and derive their residence from ingested food. **The adults are the largest intestinal nematodes.**
- Thousands of eggs are laid daily, are passed in the feces, and form embryos in warm, moist soil .(The adults multiply and laid undeveloped eggs , these fertilized eggs become infectious after 2 weeks in soil; they can persist in soil for 10 years or more, are passed in the feces.)
- Ingestion of the embryonated eggs completes the cycle.

Ascaris Lumbricoides

- **Pathogenesis:**
- Eggs hatch in the duodenum, releasing Larva that penetrate the mucosa, enter the circulatory or lymph system, and migrate via to the lungs.
- Clinical manifestations of ascariasis may result from either the migration of the larvae through the lung or the presence of the adults in the intestinal lumen.

Ascaris Lumbricoides

Clinical disease:

- *Ascaris lumbricoides* causes ascariasis.
- a) Most infections are asymptomatic.
- b) A transient pneumonitis occurs during the larval migration phase of ascariasis. this pulmonary infiltration with eosinophilia, also known as **loeffler's syndrome**, that is characterized by fever, a dry cough, and radiograph mottling. Hypersensitive patients may experience urticaria and asthma.
- c) Adult worm may cause nausea and vomiting. Intestinal obstruction occurs in 0.2% of patients (usually small children with very heavy worm burdens).
- d) Heavy infections can exacerbate malnutrition and contribute to vitamin A and C deficiency.
- e) Death occurs in 0.02% of cases and usually associated with obstruction or with hypersensitivity reactions

Ascaris Lumbricoides

- **Laboratory diagnosis:**
- Diagnosis is usually made microscopically by detecting eggs in the stools. The egg is oval with an irregular surface. Occasionally, the patient sees adult worms in the stools.
- The pulmonary symptoms may be attributed to *Ascaris* following detection of larvae in sputum.

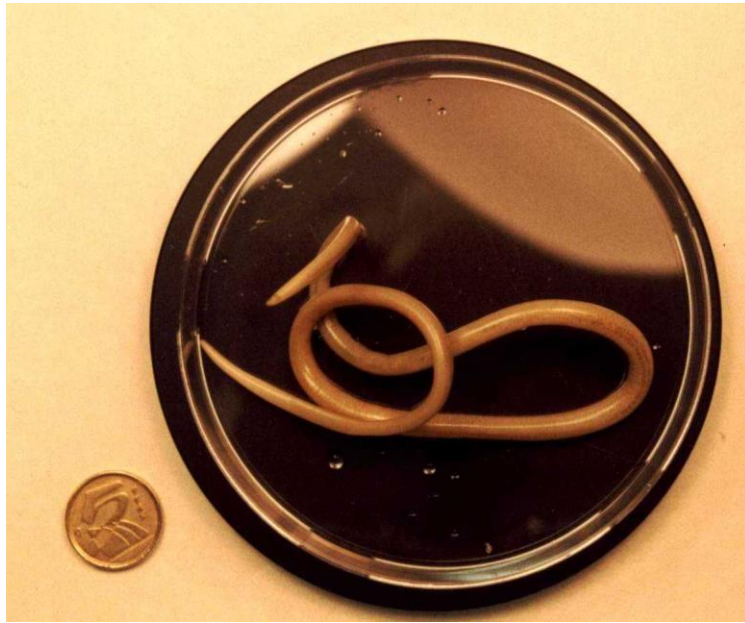
Ascaris Lumbricoides

➤ Treatment:

- Albendazole, mebendazole, and pyrantel pamoate are highly effective

➤ Control and prevent

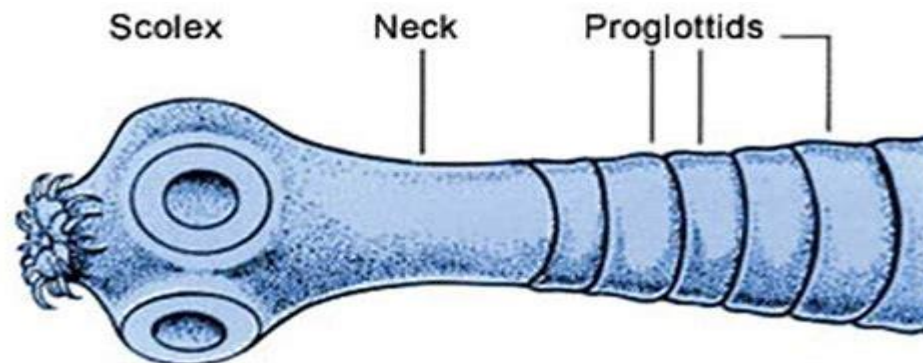
- Ascariasis is associated with poor sanitation and hygiene. Proper treatment and disposal of sewage, don't use human feces as fertilizer and filtering of drinking water reduces incidence.
- Vegetables and hands should be washed well before meals.



Source: Infect Med © 2003 Cliggett Publishing, Division of SCP Communications

Cestodes (Tape worm)

- **Anatomy:** Cestodes lack a digestive tract. Adult cestodes consist of three regions:
 - (1) A **scolex** (with suckers and possibly hooks) for attachment.
 - (2) An undifferentiated **neck** region, from which proglottids develop.
 - (3) Mature or gravid **proglottids**, which contain the hermaphroditic reproductive system (male organs develop before female organs).



Echinococcus granulosus* and *Echinococcus multilocularis
(Hydatid worm or Hyper Tape-worm)

- **Echinococcosis** is a tissue infection of humans caused by larvae of *Echinococcus granulosus* and *E. multilocularis*
 - The larva of ***Echinococcus granulosus*** (dog tapeworm) causes unilocular hydatid cyst disease.
 - Multilocular hydatid disease is caused by ***Echinococcus multilocularis***, which is a minor pathogen.

Echinococcus

➤ General properties:

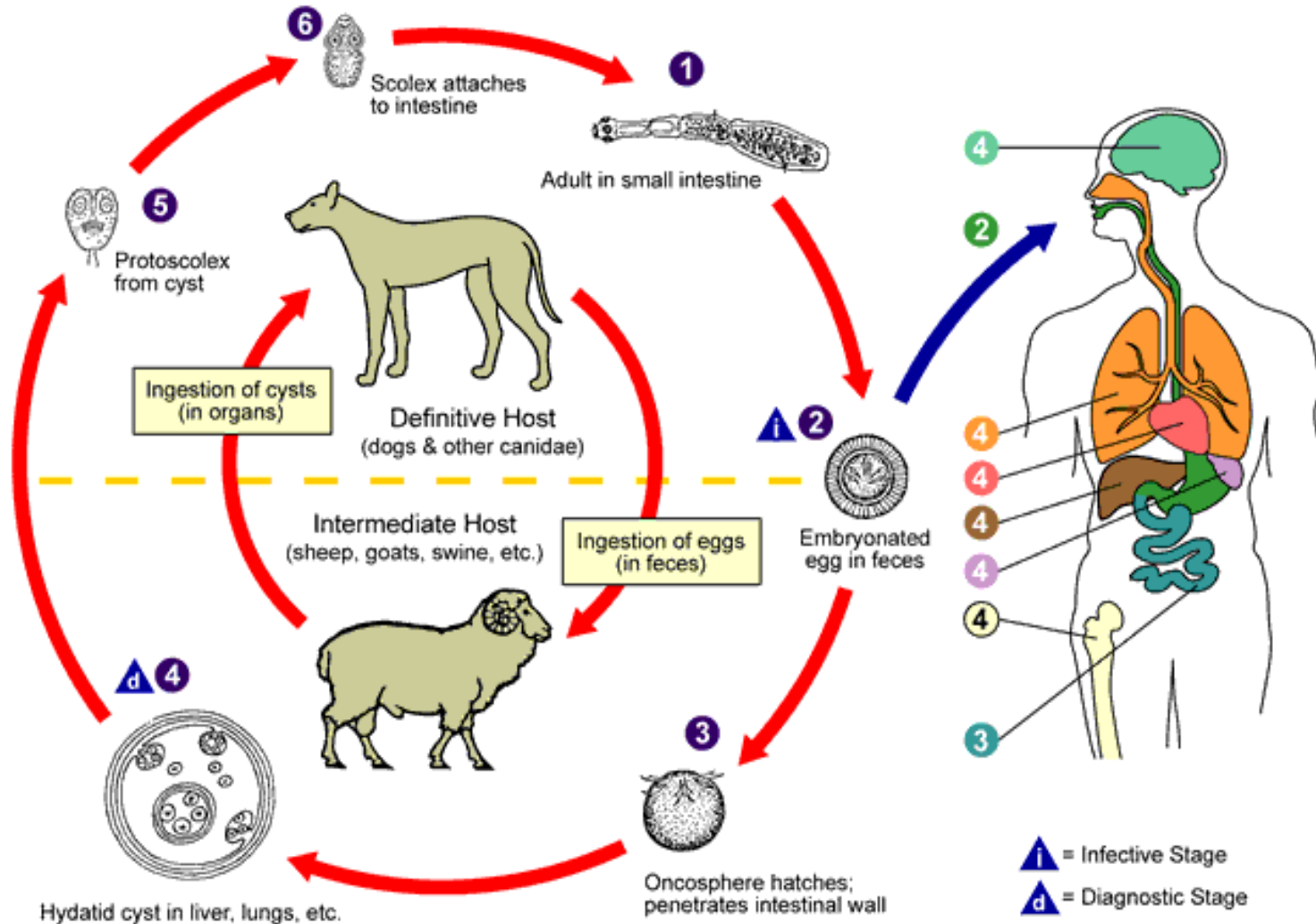
- *E. granulosus* is composed of a scolex and only three proglottids, making it **one of the smallest tapeworms** .
- The scolex possesses four sucking discs and a double row of hooklets and composed of three proglottids; one immature, one mature, and one gravid.

Echinococcus

- **Hosts:**
- Dogs are **definitive hosts** for the adult worms of the *Echinococcus* species.
- Herbivores and human serve as **intermediate hosts**.

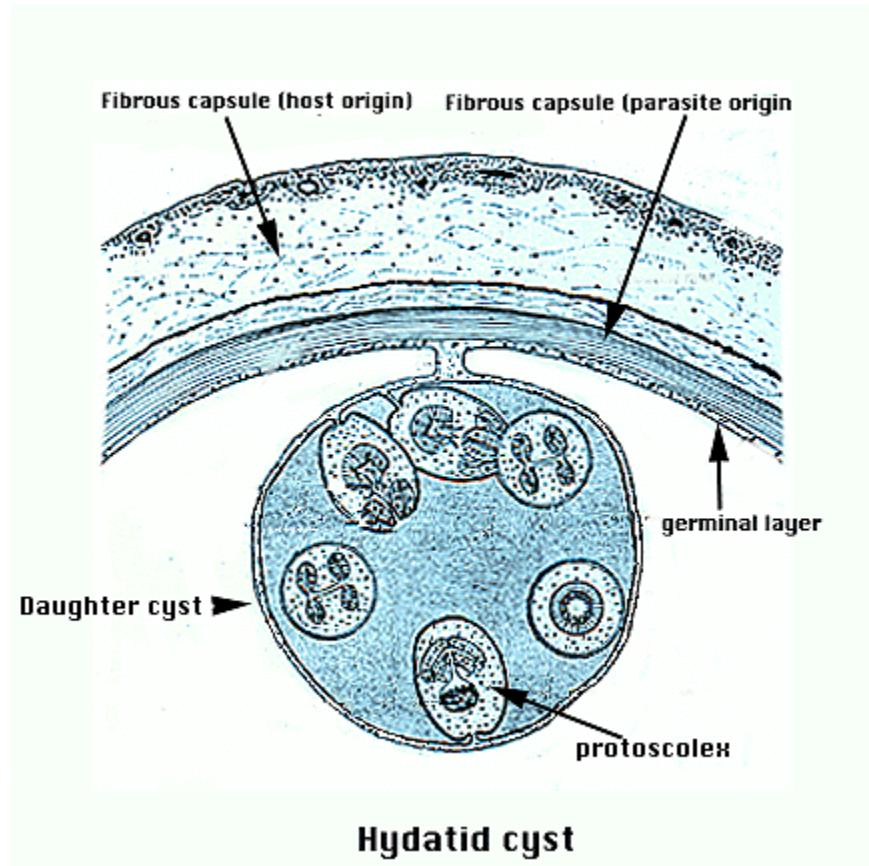
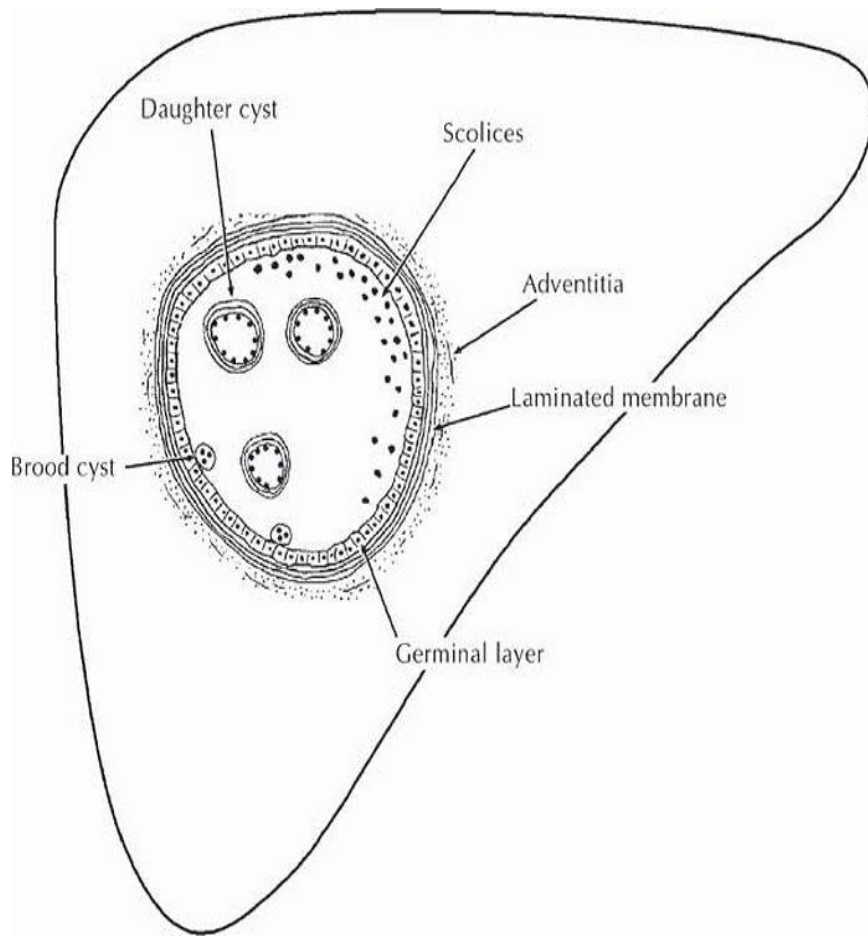
- **Transmission:**
- While dogs, the definitive host, are infected by eating contaminated meat, humans like the usual intermediate hosts, become infected following ingestion of eggs passed in dogs feces.

Echinococcus



Echinococcus

- Life cycle:
- In the typical life cycle, worms in the dog's intestine liberate thousands of eggs, which are ingested by sheep (or humans).
- The oncosphere embryos emerge in the small intestine and migrate primarily to the liver but also to the lungs, bones, and brain.
- The embryos develop into large fluid-filled **hydatid cysts**, the inner germinal layer of which generates many protoscoleces within "blood capsules.
- The life cycle is completed when the cysts in organs (e.g., liver containing hydatid cysts) of infected sheep are eaten by dogs, thousands of scolices are released in the intestine to develop into adult worms.



➤ Pathogenesis :

- *E. granulosus* usually forms one large fluid-filled cyst (unilocular) that contains thousands of individual scoleces as well as many daughter cysts within the large cyst.
- Individual scoleces lying at the bottom of the large cyst are called "hydatid sand."
- The cyst acts as a space-occupying lesion, putting pressure on adjacent tissue. The outer layer of the cyst is thick, fibrous tissue produced by the host. The cyst fluid contains parasite antigens, which can sensitize the host. Later, if the cyst ruptures spontaneously or during trauma or surgical removal, life-threatening **anaphylaxis** can occur. Rupture of a cyst can also spread protoscoleces widely.

Echinococcus

- **Clinical disease:** is known as echinococcosis (hydatid disease).

(1) In humans, *E. granulosus* **hydatid cysts** take several years to develop sufficiently to cause symptoms.

Many individuals with hydatid cysts are asymptomatic. Symptoms depend on the size of the cyst and on its location. Cyst induce inflammation (with eosinophilia in approximately 25% of cases), leading to fibrosis and pressure on the affected organ.

➤ A. Most cyst occur in the liver or lungs.

B. Cysts in bone, the CNS, heart, and kidney carry a serious prognosis. Up to 10% of all diagnosed cases are fatal.

Echinococcus

- (2) *E. multilocularis* hydatids are also predominantly located in the liver, where they form a mass of cyst vesicles in a dense fibrous stroma surrounded by tissue necrosis.
- Multilocularis hydatids do not grow well in humans, may not contain protoscolices, and may become calcified early. Because the cyst walls are thin, there is little pressure on the infected organ. However, secondary cysts may spread to the lungs, brain, and lymph glands.

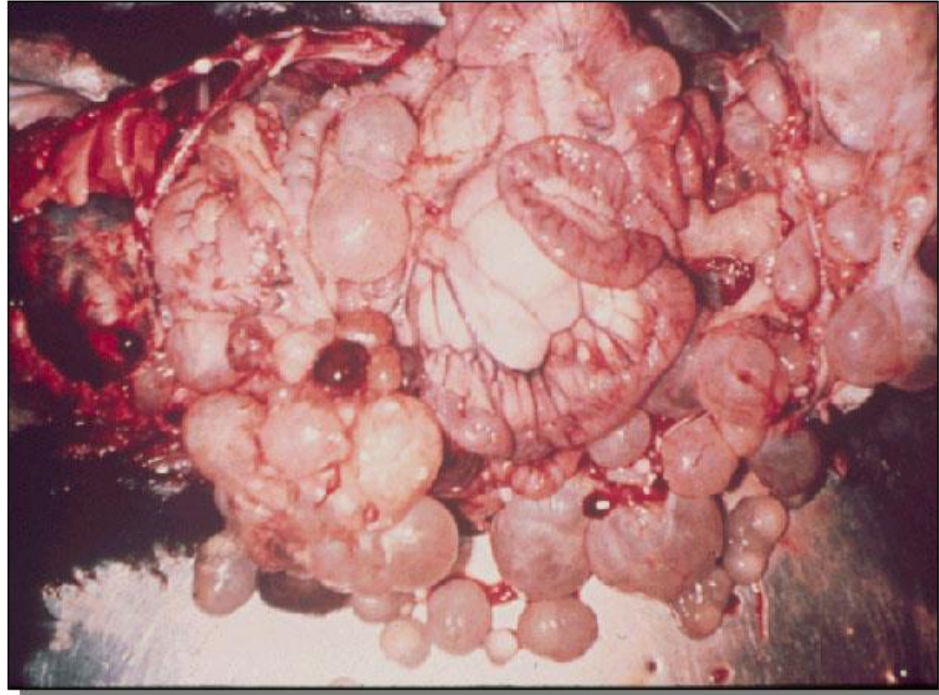
Echinococcus

➤ Diagnosis:

1. Radiographs, ultrasound, and computed tomography (CT) scan are helpful visualizing cysts.
2. Routine histology: *Echinococcus* species can be detected in aspirates or biopsies of liver or lungs.
3. Serological tests.

➤ Treatment:

- Albendazole is the drug of choice.
- Surgical removal of cysts may follow successful treatment.



Trematodes (Flatworms, Flukes)

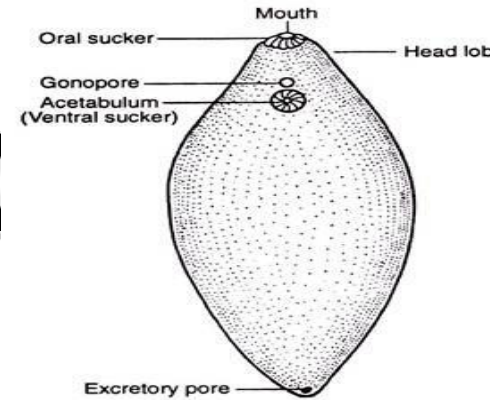


Fig. 14.10: A digenetic trematode, *Fasciola hepatica*.

➤ General properties

- **Morphology:** The trematodes are typically leaf shaped.
- **Anatomy:**
 - (1) Trematodes have an oral and a ventral sucker used for attachment and movement.
 - (2) The digestive tract begins at the oral sucker and continues as a muscular pharynx and esophagus. They have a blind-ending gut and a flame cell excretory system ending in a posterior excretory duct.
 - (3) They are hermaphroditic, except for the blood flukes (The schistosomes have separate sexes)

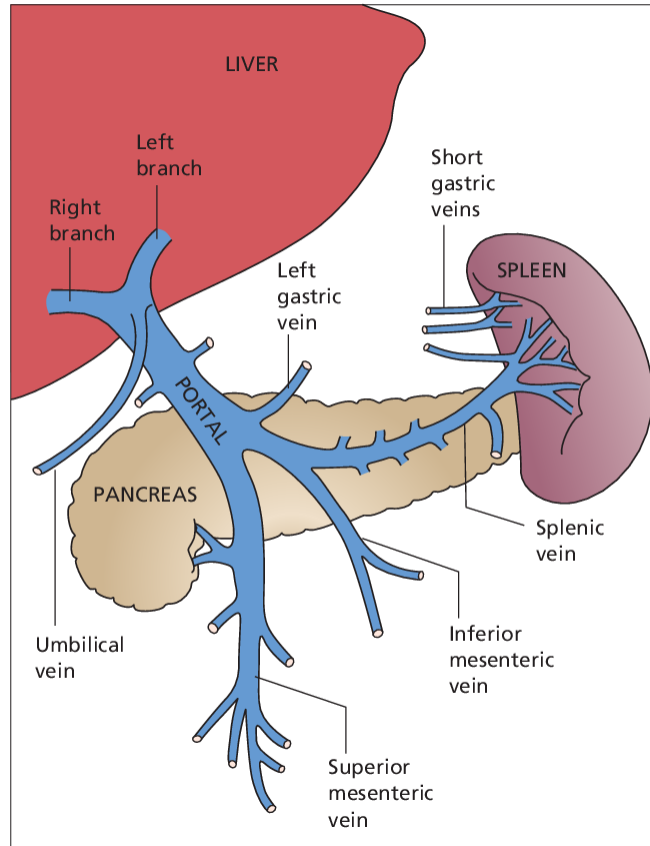
Trematodes

(Flatworms, Flukes)

- Classification:
- Four major groups of trematodes affect humans:
 1. Blood flukes (*Schistosoma* species)
 2. liver flukes (*Clonorchis sinensis*)
 3. lung flukes (*Paragonimus westermani*) and
 4. intestinal flukes (*Fasciola*).

Schistosoma(blood flukes)

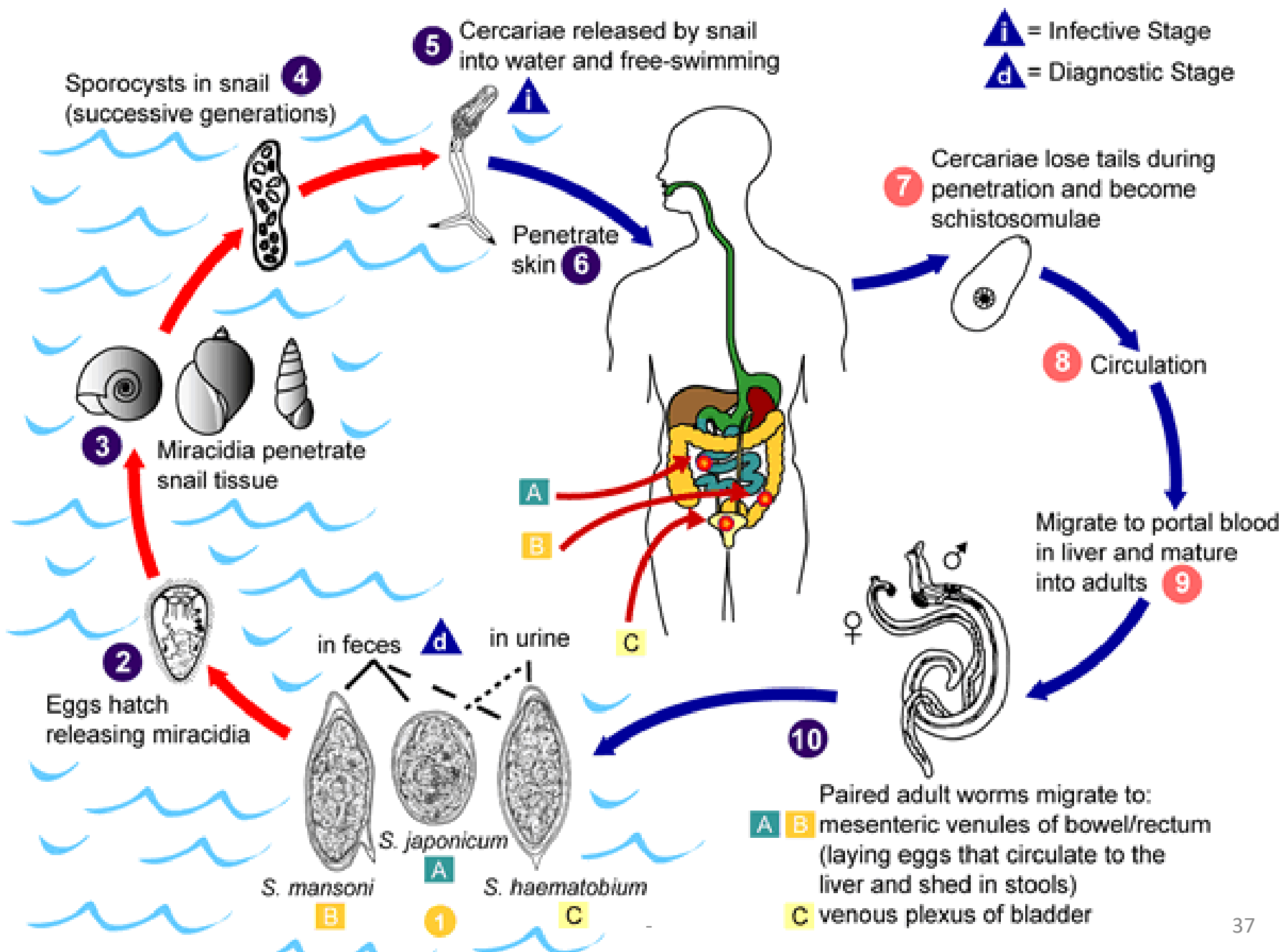
- Schistosomes are therefore known as **blood flukes**.
- The schistosomes are a group of closely related flukes that inhabit the **portal vascular system** of a number of animals.
- *Schistosoma* causes schistosomiasis.
- There are three main species of schistosomes pathogenic to humans:
 - *S. Mansoni*,
 - *S. haematobium*, and
 - *S. japonicum*.
- *Schistosoma mansoni* and *Schistosoma japonicum* affect the gastrointestinal tract (live in the **mesenteric veins**), whereas *Schistosoma haematobium* affects the urinary tract (lives in the veins draining the urinary bladder).
- In contrast to the other trematodes, which are hermaphrodites, adult schistosomes exist as **separate sexes** but live attached to each other.



Schistosoma species (blood flukes)

Epidemiology:

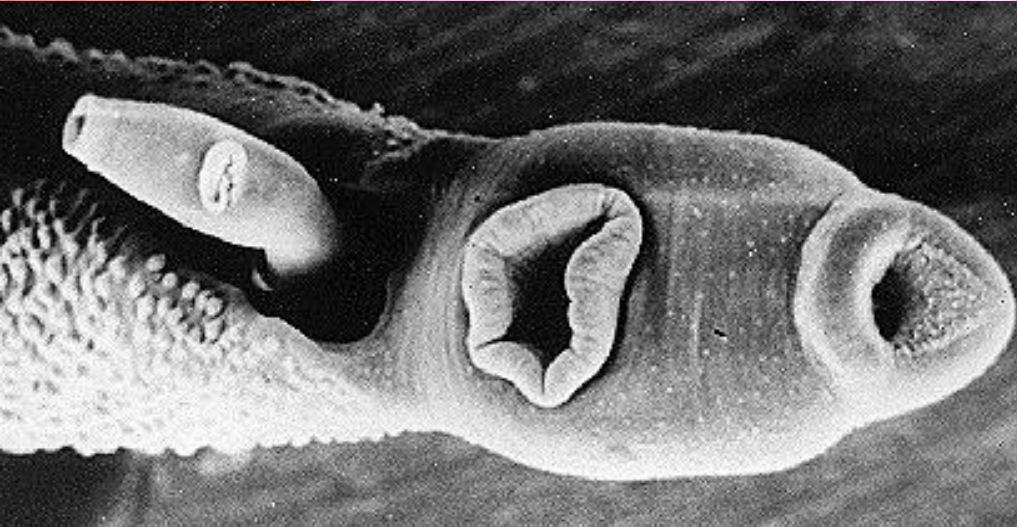
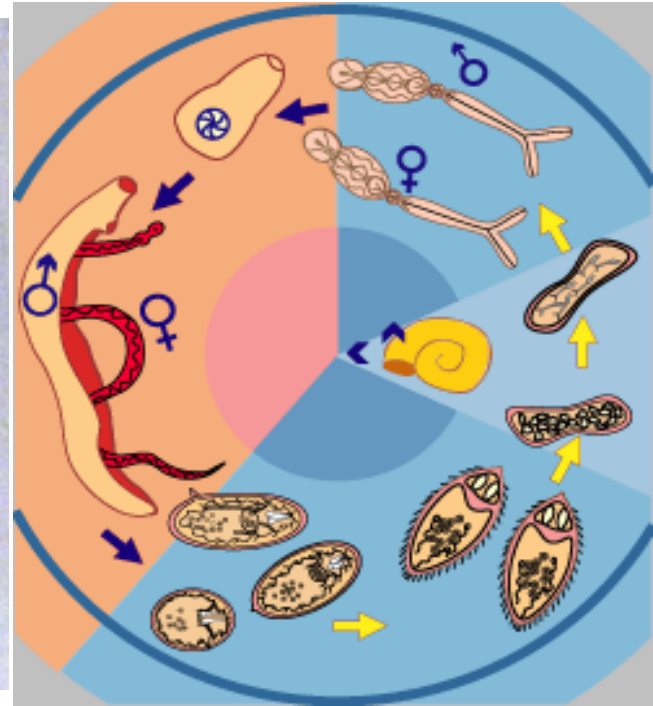
- **Incidence:** Schistosomes, as a group, infect 200-300 million people and cause 750,000 deaths per year.
- **Distribution:** They found in Africa, the Middle East, Southeast Asia, the Caribbean, and South America
- **Hosts and reservoirs:**
 - Each species of schistosome uses a different species of aquatic snail as an intermediate host.
 - Human are essentially the reservoirs of disease.
- **Transmission:** is via penetration of the dermis. Schistosomiasis is associated with activities that involve contact with fresh water (e.g., fishing, washing, irrigating, recreation). Humans are infected when the free-swimming, fork-tailed **cercariae** penetrate the skin



Life cycle

1. The eggs are excreted in the stools (*S. mansoni* and *S. japonicum*) or urine (*S. haematobium*).
2. Eggs enter fresh water to hatch to release miracidia.
3. ciliated larvae (miracidia) penetrate **snails** and undergo further development and multiplication.
4. produce sporocyst in snail.
5. cercariae are released and swim freely in water.
6. Humans are infected when the free-swimming, fork-tailed **cercariae** penetrate the skin.
7. Cercariae lose tails and differentiate to schistosomula larva.
8. schistosomula larva enter the blood.
9. Migrate to portal circulation and reach the liver, where they mature into adult flukes.
10. *S. mansoni* and *S. japonicum* adults migrate to mesenteric venules of rectum. *S. haematobium* adults reach the bladder veins through the venous plexus between the rectum and the bladder. In their definitive venous site, the female lays fertilized eggs.

Blood fluke stages



Schistosoma species (blood flukes)

- Pathogenesis & clinical disease:
- There are three major clinic pathologic stages in schistosomiasis.:
 - The **first stage or early stage** is initiated by the penetration and migration of the schistosomula.
 - The **second or intermediate stage** begins with oviposition and is associated with a complex of clinical manifestations.
 - The **third or chronic stage** is characterized by granuloma formation and scarring around retained eggs.

Schistosoma species

(blood flukes)

➤ **Early stage:**

- The acute stage, which begins shortly after cercarial penetration, consists of itching and dermatitis results in an intensely pruritic papular skin rash.
- As the viable schistosomula begin their migration to the liver, the rash disappears and the patient experiences fever, headache, and abdominal pain for 1 to 2 weeks.

Schistosoma species (blood flukes)

➤ **Intermediate stage:**

- One to two months after primary exposure, patients with Schistosoma infections may experience an acute febrile illness .
- In addition to fever and chills, patients experience cough, urticaria, arthralgia, lymphadenopathy, splenomegaly, abdominal pain, and diarrhea.

Schistosoma species (blood flukes)

➤ Chronic stage:

- The chronic stage can cause significant morbidity and mortality
- Approximately one half of all deposited eggs reach the lumen of the bowel or bladder. Eggs that are retained induce inflammation and scarring, initiating the final and most morbid phase of schistosomiasis.
- In *S. haematobium* infection, the bladder mucosa becomes thickened, papillated, and ulcerated. Hematuria and dysuria result; repeated hemorrhages produce anemia. *S. haematobium* produces bladder lesions with hemorrhage and obstruction .
- In patients with *S. mansoni* or *S. japonicum* infection, gastrointestinal hemorrhage, hepatomegaly, and massive splenomegaly can develop.

Schistosoma species (blood flukes)

➤ Laboratory diagnosis:

a. Microscopic examination. Definitive diagnosis is made by identifying the eggs in the stool or urine.

(1) *S. mansoni* and *S. japonicum*. Eggs of *S. mansoni* are oval with a large lateral spine and those of *S. japonicum* are almost round with a short lateral spine.

(2) *S. haematobium* is usually detected in urine. A first-voided urine is concentrated and examined via a direct wet mount for eggs, which are oval with a prominent terminal spine. A 24-hour urine collection may be used if low levels of infection are suspected.

b. Serologic tests (EIA) may be helpful when no eggs are found.

Schistosoma species (blood flukes)

➤ Treatment:

- Praziquantel is the treatment of choice for all three species.
- **Prevention** involves proper disposal of human waste and eradication of the snail host when possible. Swimming in areas of endemic infection should be avoided.
- Vaccines under development