

# Advanced Medical Parasitology For M.Sc. Students

Assistant Prof. Dr. Ahmed A. Mohammed

## Lec. 10 Helminths-Cestodes

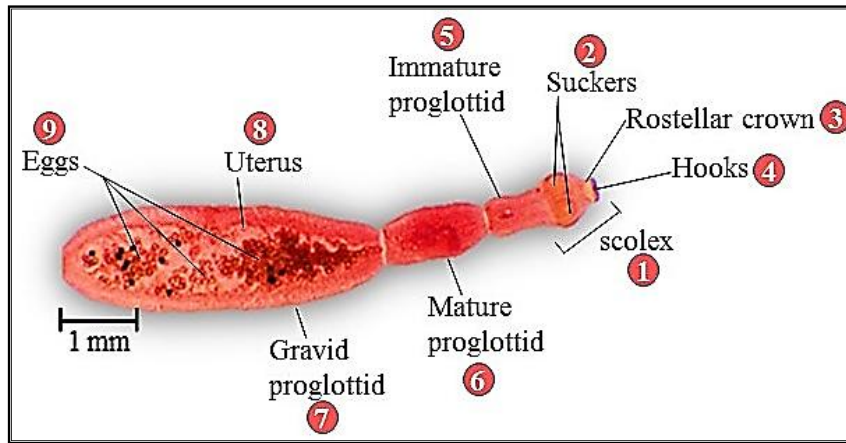
### B- Larval Tapeworm infection

#### 1. *Echinococcus granulosus*

This parasite causes a disease called **unilocular** or **cystic (hydatid disease, or echinococcosis, or hydatidosis)** which is resulted from the infection with its unilocular larval stage (the **metacestode**) which called the **hydatid cyst**. Hydatid disease is widely distributed in the temperate and subtropical regions where domestic livestock (the intermediate host) are extensively raised in association with the definitive host (dog mostly), which harbour the adult worm stage. Although humans are an accidental intermediate host, however, human Echinococcosis causes an important public health problem, causing severe and sometimes even lethal illness in many endemic countries around the world.

The adult worm lives in the small intestine of the canine host (dog, fox, wolf, ...), whereas the larval stage lives in the herbivorous animals (sheep, cattle, goats, cows, horses, camels) as well as man. Whereas the hydatid cyst infects all the body organs except the nails and hair, with particular localization in the liver and the lungs.

The adult worm is small in size, it measures 2-9mm length and characterized by its limited number of proglottids. It has a pyriform scolex provided with 4 suckers and a rostellar crown of 28-50 hooks. After the scolex, there are three proglottids, immature, mature and a gravid proglottid. The mature one has (45-65) testes (pyriform) and pair of ovaries and a single vitelline gland (vitellaria) behind the two ovaries; the genital pore is lateral in position. The gravid proglottid has a uterus filled with eggs and measures more than half of the body length.

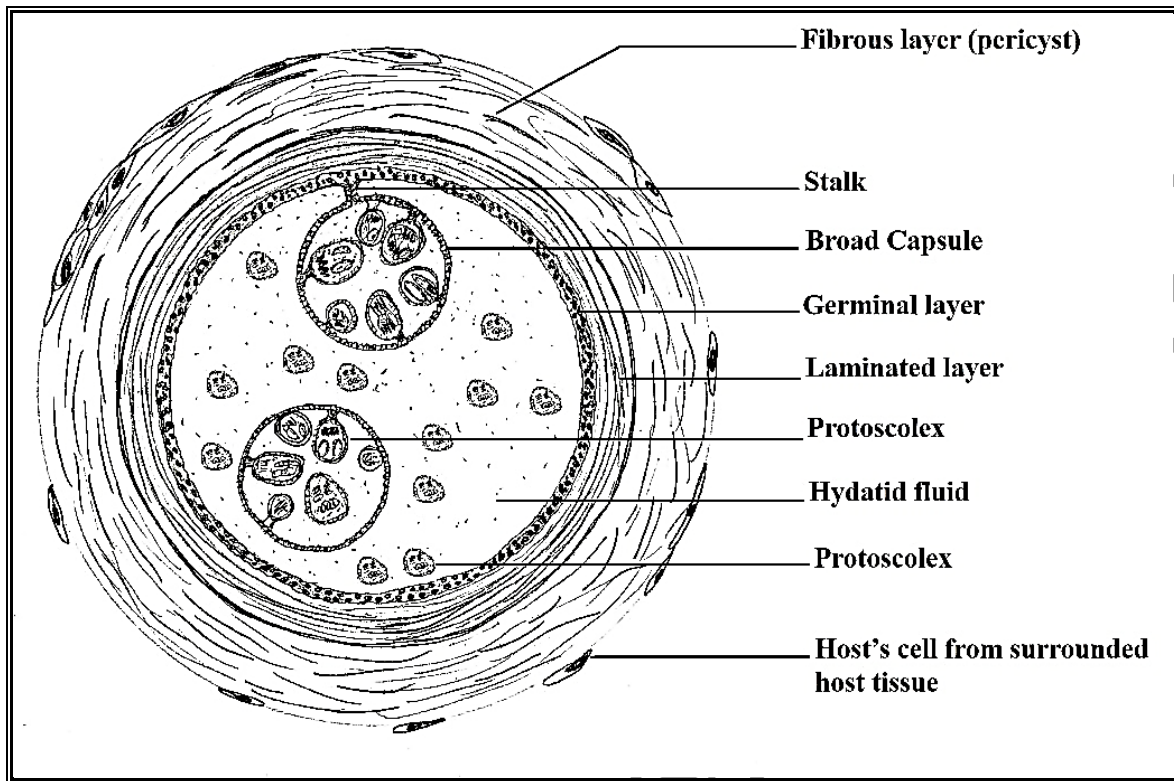


*Echinococcus granulosus*: adult worm.

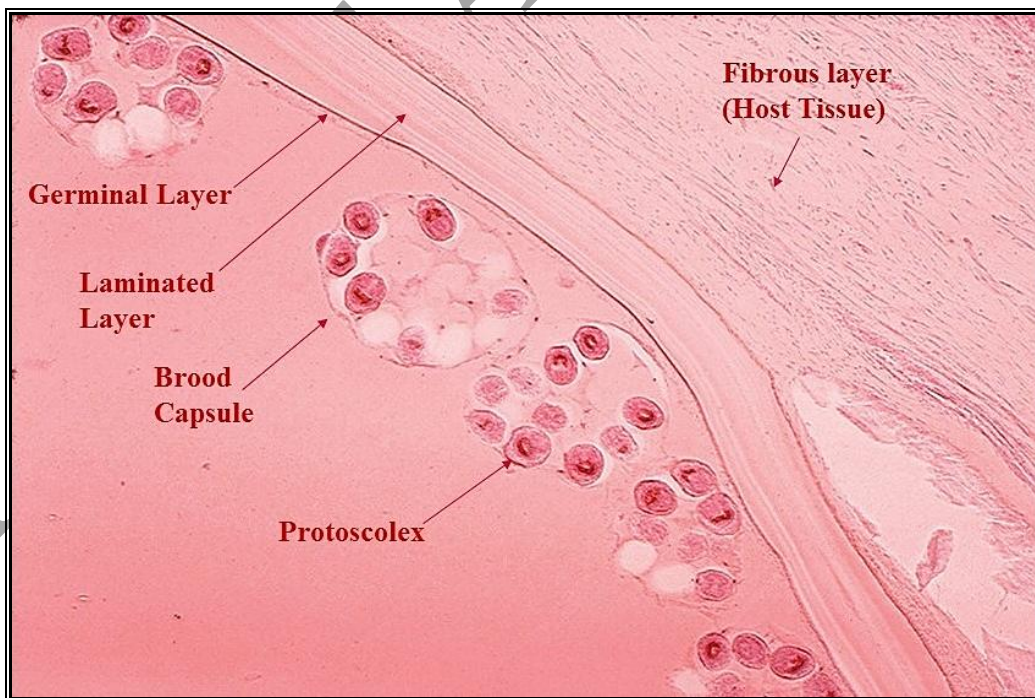
## Life cycle

### 1. The intermediate host:

It is infected by the ingestion of the worm eggs which are hatching in the duodenum into hexacanth embryos and penetrate the intestinal wall then enter the mesenteric venules or the lymph vessels and reach to different tissues in the body where 70% of these eggs will stay in the liver, the others will reach mostly to the lungs, and may be to other body organs. The eggs develop rather slowly into unilocular hydatid cysts, which grow and reach to large size depending on the infected tissue organ. The cyst surrounded by a **fibrous capsule** consists of a host connective tissue constructed by the infected organ as a mechanical immune response. The cyst also surrounded with 2 different layers, the outer one lay directly under the fibrous capsule; it is milky white, striated and consists of many layers, called the **laminated layer**. The inner layer consists of a thin layer of germinative epithelium and called the **germinative layer**; it appears as a granular membrane with much nuclei. The latest layer producing numerous **protoscolices** and **daughter cysts** within the parent cyst. The germ layer also produces vesicles or capsules contain 30-40 protoscolices called **brood capsules**, which become free in the cyst fluid. If the cyst has no protoscolices it is called sterile cyst as the cysts of the camels. The cyst filled with a transparent or white-yellowish liquid called **hydatid cyst fluid**, it is toxic and responsible for the symptoms which appear if the cyst ruptured.



A scheme for a cross section in the hydatid cyst of *Echinococcus granulosus*.

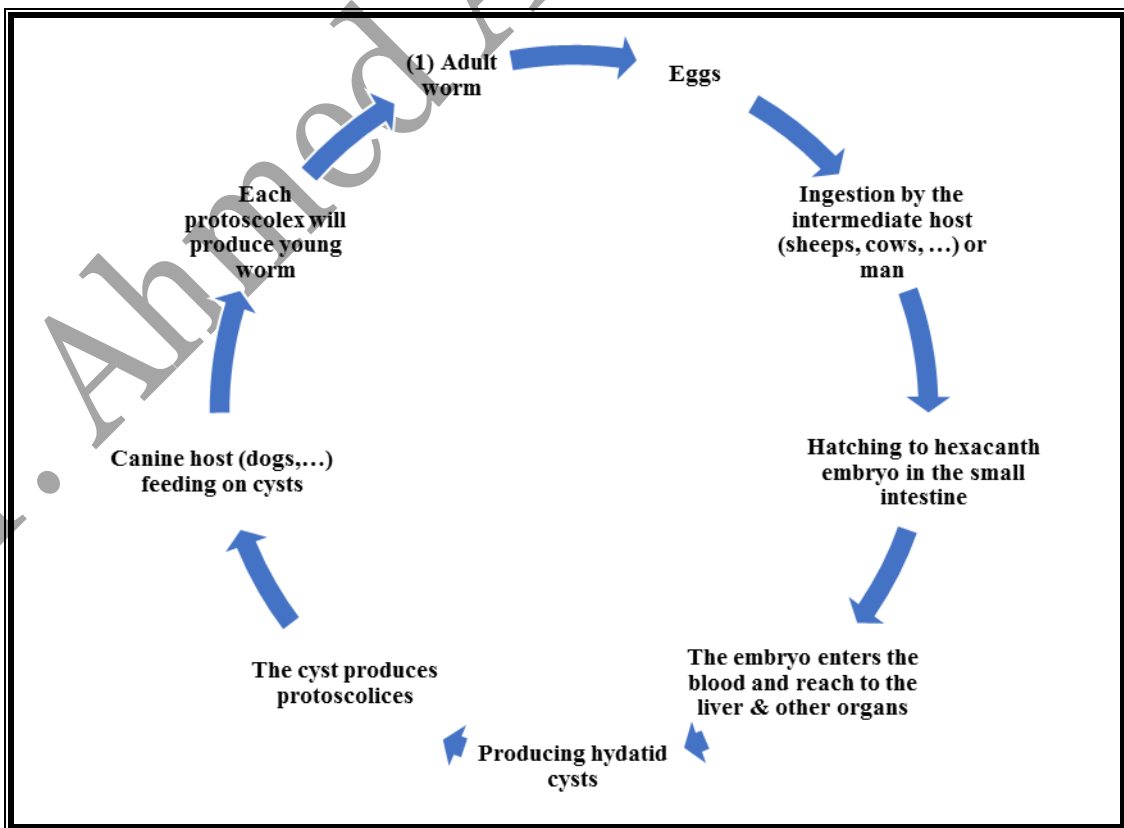


Section in the hydatid cyst of *Echinococcus granulosus*.

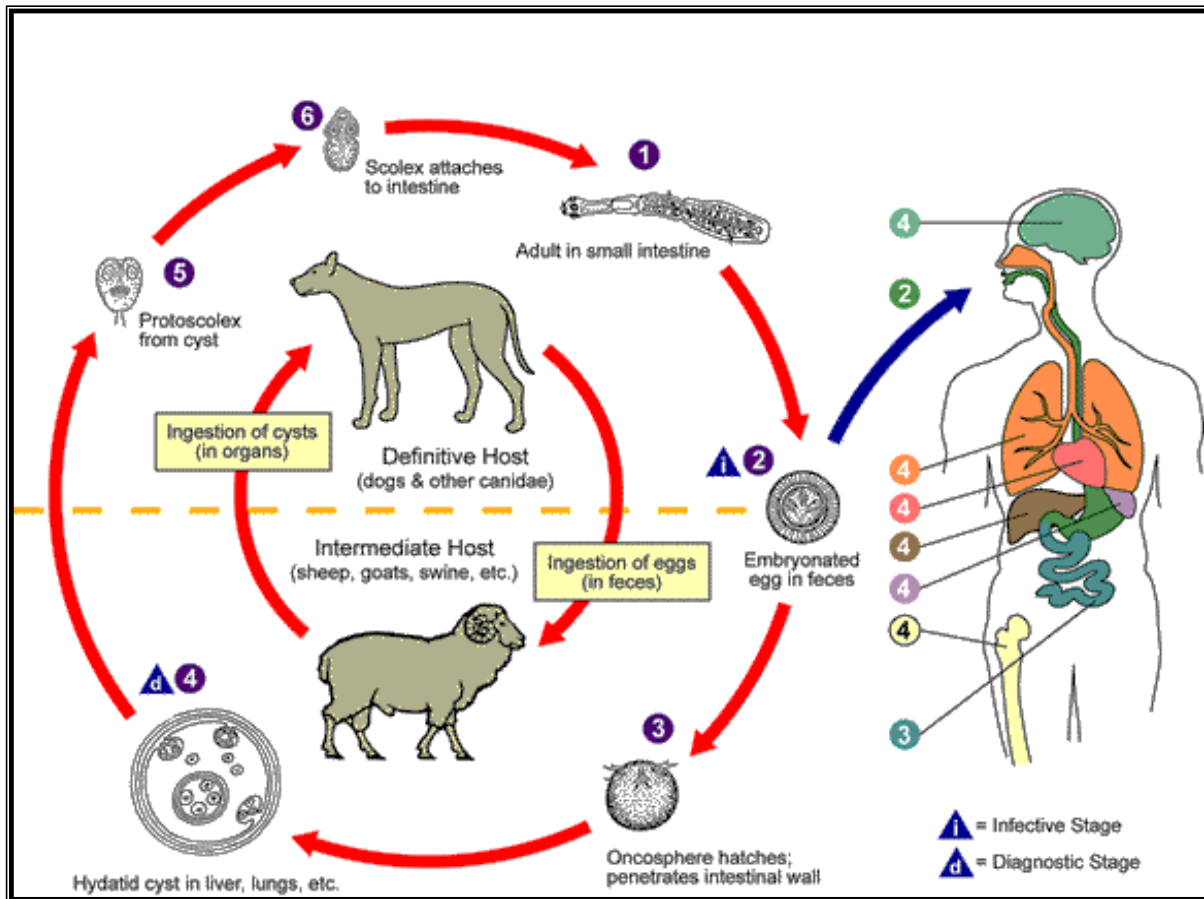


## 2. The definitive (or final) host:

When the carnivores feed on the infected organs of the intermediate host, the protoscolices become free in the intestine. They grow into adult worms in about one month. The adult worms live 5-20 months in dogs.



“Scheme for the life cycle of *Echinococcus granulosus*”.



“Diagram for the life cycle of *Echinococcus granulosus*”.

## Pathology and Symptomatology

The presence of the unilocular cysts elicits a host inflammatory reaction that results in encapsulation of the cyst. The primary pathology of the unilocular cyst is impairment of organs from mechanical pressure. Increased pressure resulting from cyst growth may cause surrounding tissues to atrophy. The symptoms, therefore, are not unlike those caused by a slow-growing tumor, varying according to the affected tissues. It may take many years for symptoms to appear. The infections remain silent for years before the enlarging cysts cause symptoms in the affected organs. The signs depend primarily on the size of the cyst which depends on the cyst age. For instance, while the liver is the most commonly affected organ, symptoms such as jaundice may take as long as 20 years to emerge. The infection can result in abdominal pain, a mass in the hepatic area, and biliary duct obstruction. Pulmonary involvement can produce chest pain, cough and hemoptysis; allergic reactions are also common. The brain, kidneys, spleen, and vertebral column may also be invaded and, over a protracted period, symptoms ranging from seizures to kidney dysfunction appear.



If a large abdominal cyst ruptured either spontaneously or following a blow on the abdomen, it can produce a fever, urticaria, eosinophilia and anaphylactic shock, as well as cyst dissemination; anaphylaxis may be precipitated by the sudden liberation of hydatid fluid into the peritoneal cavity. Moreover, protoscolices spilled out of the cyst cavity will become implanted in the peritoneum and produce multiple secondary cysts. Sometimes, it enter the circulatory system and are transported to tissues throughout the body where they produce secondary echinococcosis. This condition, which may not appear for 2 to 8 years, is far more serious than the primary infection. The rupture of the cysts also releases hydatid fluid, which sometimes causes severe allergic reactions. If a significant amount of the fluid enters the bloodstream, it can precipitate anaphylactic shock.

Rupture of a pulmonary cyst into a bronchus results in patient's coughing up the contents, with possible spontaneous clearance of the infection. In addition, other organs such as brain, bone and heart can also be involved. Hydatid cysts of the brain produces increasing symptomatic evidence of an intracranial tumor. Osteous hydatid cysts is insidious, gradually eroding the bone to a stage at which fracture or crumbling suddenly occurs.

The other random signs can be observed during the infection is dizziness, vomiting, nausea, enlargements of the infected organs depends on the size and the age of the cyst and also necrosis in the infected tissue of the organ.

## Diagnosis

1. The immunological tests: the intradermal test (or **Casoni test**), indirect fluorescent antibody (**IIFA**) tests. ELISA and enzyme immunoassays (EIA) are sensitive tests for detecting the antibodies in the patient's serum.

False-positive reactions may occur in persons with other helminthic infections, cancer, and chronic immune disorders. Negative test results do not rule out echinococcosis because some cyst carriers do not have detectable antibodies. Whether the patient has detectable antibodies depends on the physical location, integrity and vitality of the larval cyst.

Cysts in the liver are more likely to elicit antibody response than cysts in the lungs, and, regardless of localization, antibody detection tests are least sensitive in patients with intact hyaline cysts. Cysts in the lungs, brain and spleen are associated with lowered serodiagnostic reactivity, whereas those in bone appear to more regularly stimulate detectable antibody. Rupture of a cyst is followed by a high stimulation of antibodies. A patient with aging, calcified or dead cysts is generally found to be seronegative.

2. by X-ray: it is useful in the cysts of the lung, bones, liver capsule.

3. Hydatid thrill.

## Treatment

Surgery remains the preferred treatment for unilocular hydatidosis, although removal of the parasite mass is not usually 100% effective. After surgery, medication may be necessary to keep the cyst from recurring. Most recently, the benzimidazoles (especially albendazole) have been used successfully to reduce the size of the cyst. whereas biotherapy has also used in some trials. **PAIR** technique is used in the diagnosis and the treatment of Hydatid disease. It involves treatment with albendazole for 12 hours, aspiration of some cyst fluid, injection of cyst with 95% ethanol, and subsequent aspiration of the alcoholic solution.

## 2 *Echinococcus multilocularis*

This parasite causes a disease called **alveolar** or **multilocular hydatid disease** or **echinococcosis** which is resulted from the infection with its multilocular larval metacestode. The adult worm is smaller than *E. granulosus*, it is 1.2-3.7mm long; the number of testes is less than in *E. granulosus*, they are 15-30, the definitive host is mainly foxes.

The hydatid cyst is different from the above sample. The alveolar cyst is usually proliferative. While growth occurs at its periphery, its center may become calcified. Such cysts commonly occur in the liver and are often mistaken for hepatic carcinoma. The wall of the cyst is thin, it is grow and produce minute irregular cavities or processes in the host tissues as similar as cancer. The processes may be having many small pockets filled with a liquid and few protoscolices, so that, this type of hydatid cyst called multilocular or alveolar cyst. In the man and other unnatural hosts, the pockets are without protoscolices. These cysts found always in the liver where 90% of the infection are in the liver, and rarely they infect the lungs. The infection with this type of hydatid cysts is dangerous because they are spread as in malignant tumors.

## **Pathology**

*Echinococcus multilocularis* affects the liver as a slow growing, destructive tumor, with abdominal pain, biliary obstruction and occasionally metastatic lesions in the lungs and the brain.

## **Diagnosis**

Specific diagnosis is likely to be missed in the living patient because of the general unfamiliarity of pathologists with this type of hydatid infection. Diagnosis of hydatidosis is based upon a number of criteria, such as symptoms (hepatic hypertrophy, etc.), history of residence in an endemic area, and close contact with dogs.

**Treatment:** Albendazole or Mebendazole, the surgical removal is not amenable.