Parasitology

Cestodes Lecture: 4

Dr. Usama Ali 25-2-2020

Larval tapeworm infections

Objectives of this lecture:

At the end of this lecture the 3rd year student is able to:

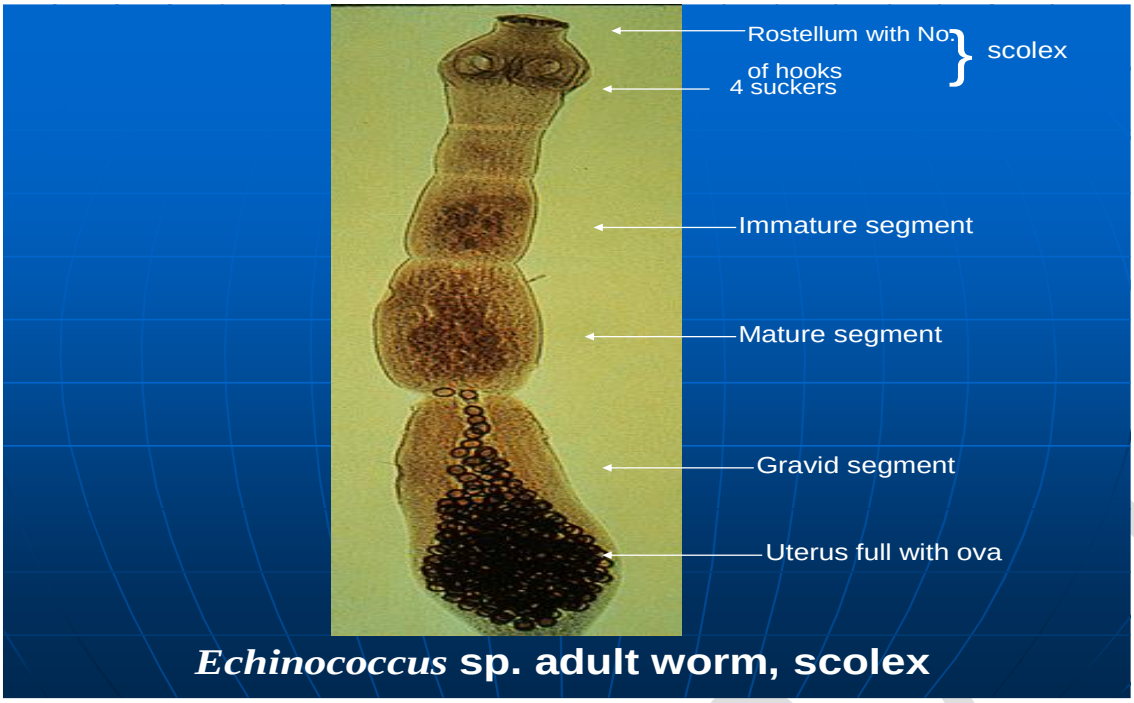
1. Define larval tapeworm infections of Hydatid cyst of *Echinococcus spp*. & their disease: Hydatid disease or Echinococcosis.
2. Describe *Echinococcus granulosus* morphology ,life cycle pathogenesis, clinical symptoms, treatment and control measures.

Hydatid cyst of *Echinococcus spp.*(Pages 1-9)

Disease: Hydatid disease or Echinococcosis

الاكياس المائية او الاكياس العدرية

- The larval stage (hydatid cyst) is found in humans and herbivorous animals (sheep, goat, cattle and horse). The adult worms which however is found in the intestine of dogs and canines (dogs, wolves, foxes and related carnivorous mammals).
- Usually there are several adult worms in an infection and at times there may be hundreds or thousands.
- The adults of all species are small rarely over a centimeter in length. The strobila consists of scolex, neck, one immature, one mature and one or two gravid proglottids.
- In addition to 4 minute suckers, the scolex is provided with a double row of alternating rostellar hooks.
- Gravid proglottids disintegrate in the intestine and eggs are evacuated in the feces.
- These eggs can not be distinguished from those species of *Taenia*.



- In a suitable intermediate host, eggs hatch in the duodenum and the hexacanth embryo work their way through the wall of the intestine, reach a mesenteric venule or lymphatic vessel and become lodged in hepatic, pulmonary, or other tissue.
- The embryo then transform into a hydatid having a mother cyst wall and many protoscolices that are derived from germinal membrane.

The hydatid of three species: *Echiococcus granulosus, E. multilocularis* and *E. vogeli* develop in the human host. That of a fourth species *E. oligarthus* is not known to occur in man.

Larval tapeworm infections

Hydatid cyst of *Echinococcus granulosus*

Common name: Dog tape worm

Disease: Unilocular Hydatid disease or *Echinococc*osis or Hydatidosis

Morphology:

- **<u>Adult:</u> live in the small intestine of the canine host; with its scolex embedded between the villi.**
- **It is the smallest of all tapeworms (3 to 6 mm long) with only 3-4 proglottids.**

- **Scolex: pyriform, provided with 4-suckers and rostellar crown of a double row of alternating hooks.**
- **Gravid proglottid: disintegrates in the intestine and eggs are evacuated in the feces.**
- **Eggs: cannot be distinguished from those of *Taenia* spp.**

Unilocular hydatids (larval stage) characterized by:

- **Bladder like cyst has a fluid- filled cavity lined with external, milky white laminated membrane (hyaline cuticula).**
- **Internal germinal layer that produce multiple protoscolices.**
- **Daughter cysts within the parent cyst.**
- **Primary cyst has a dense layer of host connective tissue over the laminated membrane (adventitious or fibrous layer).**
- **The cyst wall secreted by the embryo consists of three indistinguishable layers:**

1. **Pericyst: is the outer host inflammatory reaction consisting of fibroblastic proliferation, mononuclear cells, eosinophils, and giants cells, eventually developing into dense fibrous capsule which may even calcify.**
2. **Ectocyst: is the intermediate layer composed of characteristic a cellular, chitinous, laminated hyaline material. It has the appearance of the white of a hard-boiled egg.**
3. **Endocyst: is the inner germinal layer which is cellular and consists of number of nuclei embedded in a protoplasmic mass and is extremely thin (22–25 mm).The germinal layer is the vital layer of the cyst and is the site of asexual reproduction giving rise to brood capsules with scolices. It also secretes hydatid fluid, which fills the cyst.**

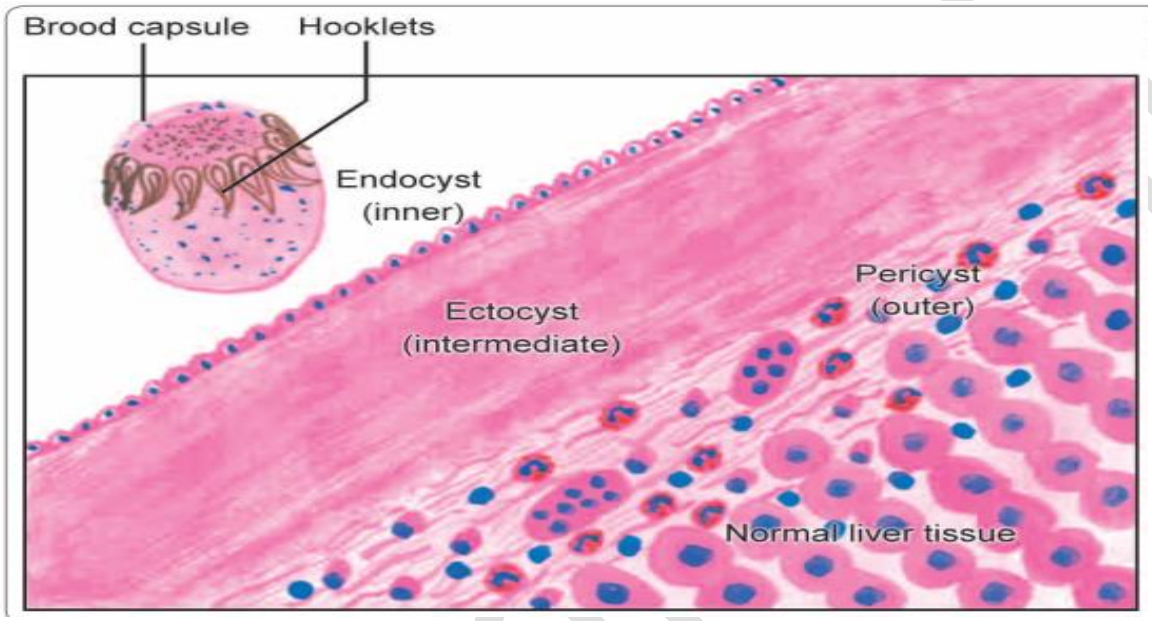
- **Brood capsules:** From the germinal layer, small knoblike excrescences or gemmules protrude into the lumen of the cyst. These enlarge, become vacuolated, and are flled with fluid. These are called as brood capsules.

  -They are initially attached to the germinal layer by a stalk, but later escape free into the fluid filled cyst cavity.

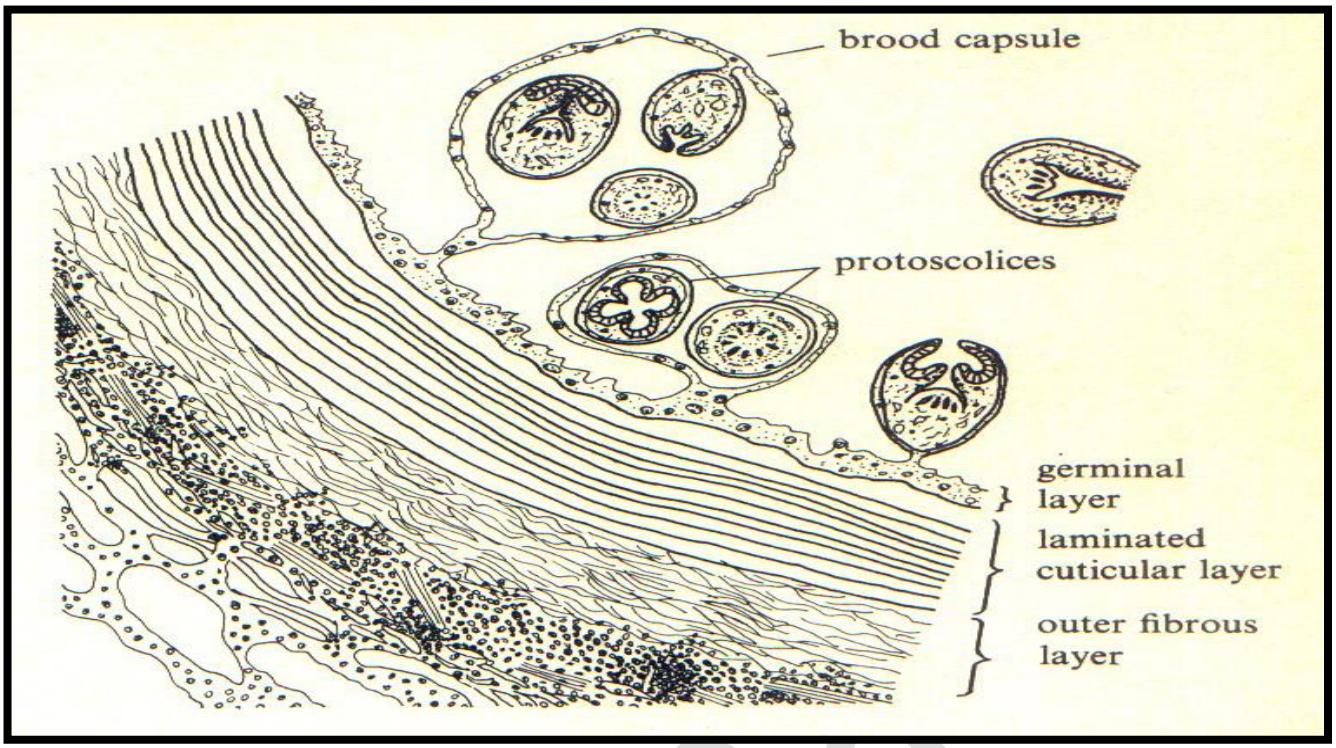
  -From the inner wall of the brood capsules, protoscolices (new larvae) develop, which

represent the head of the potential worm, complete with invaginated scolex, bearing suckers and hooklets. Several thousands of protoscolices develop into a mature hydatid cyst, so that this represents an asexual reproduction of great magnitude.

-Inside mature hydatid cysts, further generation of cyst, daughter cysts and grand-daughter cysts may develop. The cyst grows slowly often taking 20 years or more to become big enough to cause clinical illness and is therefore, particularly seen in man.



- **Daughter cysts attach to the germinal layer, although some cysts, known as brood cysts, may have only larvae (hydatid sand). These found in older cysts.**
- **Some cysts may never produce brood capsules, or the brood capsules may fail to produce protoscolices (sterile cyst). In other cases, hydatids may become sterile because of secondary bacterial infection or they may die and become calcified.**
- **The cyst is round and measures 1 to 7 cm in diameter, although it may grow to be 30 cm.**
- **A majority of human hydatids develop in the liver followed by lungs and may develop in any organ or tissue including bone.**
- **Fate of hydatid cysts: The cyst may get calcifed or spontaneously evacuated following inflammatory reaction. Hydatid cyst of liver may rupture into lung or other body cavity producing disseminated hydatid lesions.**



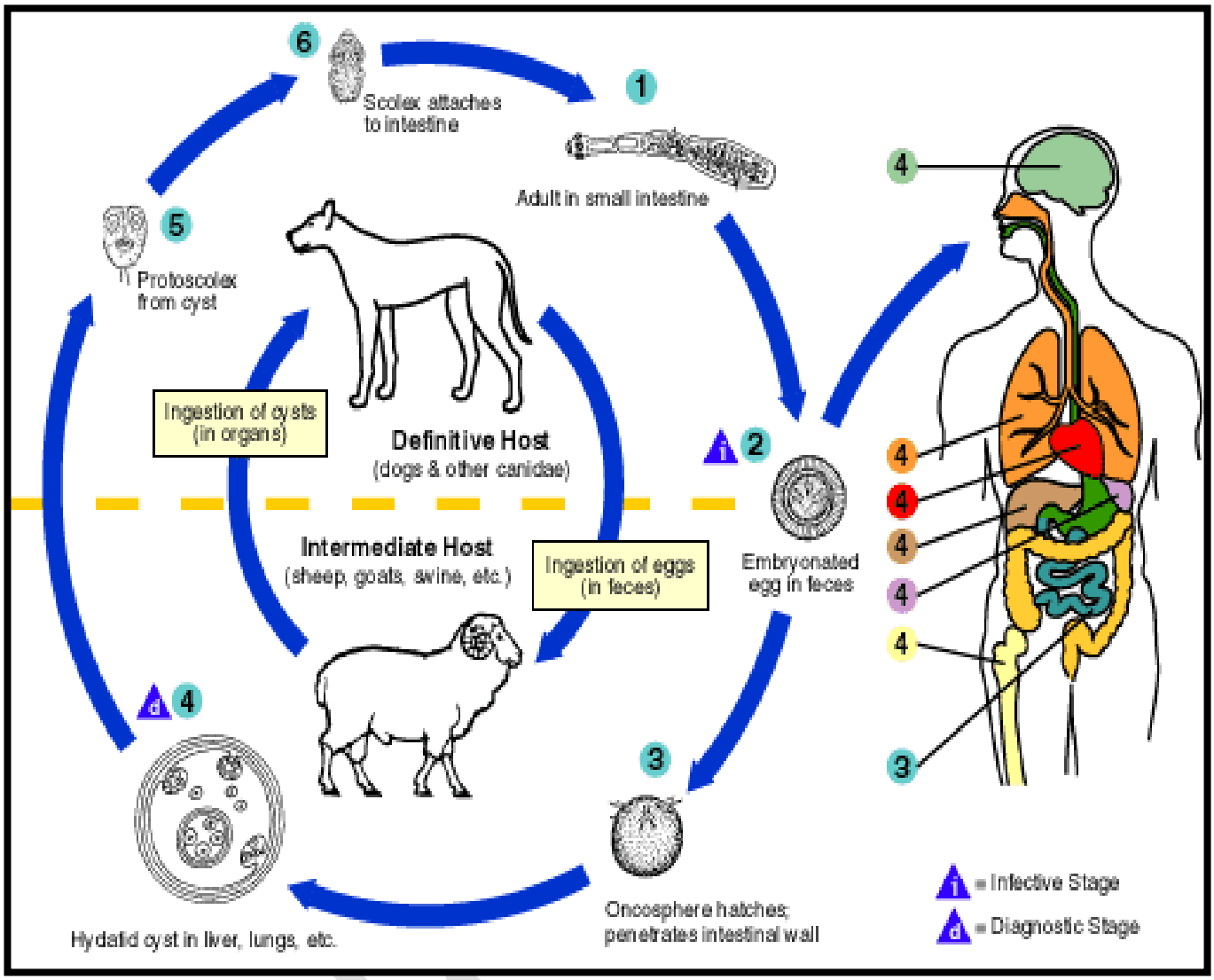
- **Outer laminated layer → inner germinal layer→ Brood capsules → detached into cavity→ protoscolices.**
- **Cyst secretes hydatid fluid-clear, colourless, PH 6.7, contain salt and protein.**
- **Cyst grows slowly, often 20yrs to become big enough to cause clinical illness.**
- **Inside mature cyst, daughter and grand-daughter cyst.**

Life cycle:

- The adult *Echinococcus granulosus* (3 to 6 mm long) resides in the small bowel of the definitive hosts, dogs or other canines.
- Gravid proglottids release eggs that are passed in the feces.
- The infection follows ingestion of the eggs passed by infected dogs. This may occur by eating raw vegetables or other food items contaminated with dog feces.
- The pet dogs may carry eggs to the mouth. Kissing pet dogs may cause the eggs to be transferred directly to the mouth. Infection is often acquired during childhood, but the clinical disease develops only several years later.
- After ingestion by a suitable intermediate host (under natural conditions: sheep, goat, swine, cattle, horses and camel), the egg hatches in the small bowel and releases an oncosphere that penetrates the intestinal wall and migrates through the circulatory system into various organs, especially the liver and lungs.
- In these organs, the oncosphere develops into a cyst that enlarges gradually, producing protoscolices and daughter cysts that fill the cyst interior.
- The definitive host becomes infected by ingesting the cyst-containing organs of the infected intermediate host.

⌘ After ingestion, the protoscolices evaginate, attach to the intestinal mucosa, and develop into adult stages in 32 to 80 days.

⌘ Man is accidental intermediate host and a dead end host.



The adult *Echinococcus granulosus* (3 to 6 mm long) (1) resides in the small bowel of the definitive hosts, dogs or other canids. Gravid proglottids release eggs (2) that are passed in the feces. After ingestion by a suitable intermediate host (under natural conditions: sheep, goat, swine, cattle, horses, camel), the egg hatches in the small bowel and releases an oncosphere (3) that penetrates the intestinal wall and migrates through the circulatory system into various organs, especially the liver and lungs. Inthese organs, the oncosphere develops into a cyst (4) that enlarges gradually, producing protoscolices and daughter cysts that fill the cyst interior. The definitive host becomes infected by ingesting the cyst-containing organs of the infected intermediate host. After ingestion, the protoscolices (5) evaginate, attach to the intestinal mucosa (6), and develop into adult stages (1) in 32 to 80 days. The same life cycle occurs with *E. multilocularis* (1.2 to 3.7 mm), with the following differences: the definitive hosts are foxes, and to a lesser extent dogs, cats, coyotes and wolves; the intermediate host are small rodents; and larval growth (in the liver) remains indefinitely in the proliferative stage, resulting in invasion of the surrounding tissues. With *E. vogeli* (up to 5.6 mm long), the definitive hosts are

bush dogs and dogs; the intermediate hosts are rodents; and the larval stage (in the liver, lungs and other organs) develops both externally and internally, resulting in multiple vesicles. *E. oligarthrus* (up to 2.9 mm long) has a life cycle that involves wild felids as definitive hosts and rodents as intermediate hosts. Humans become infected by ingesting eggs (2), with resulting release of oncospheres (3) in the intestine and the development of cysts (4) in various organs.

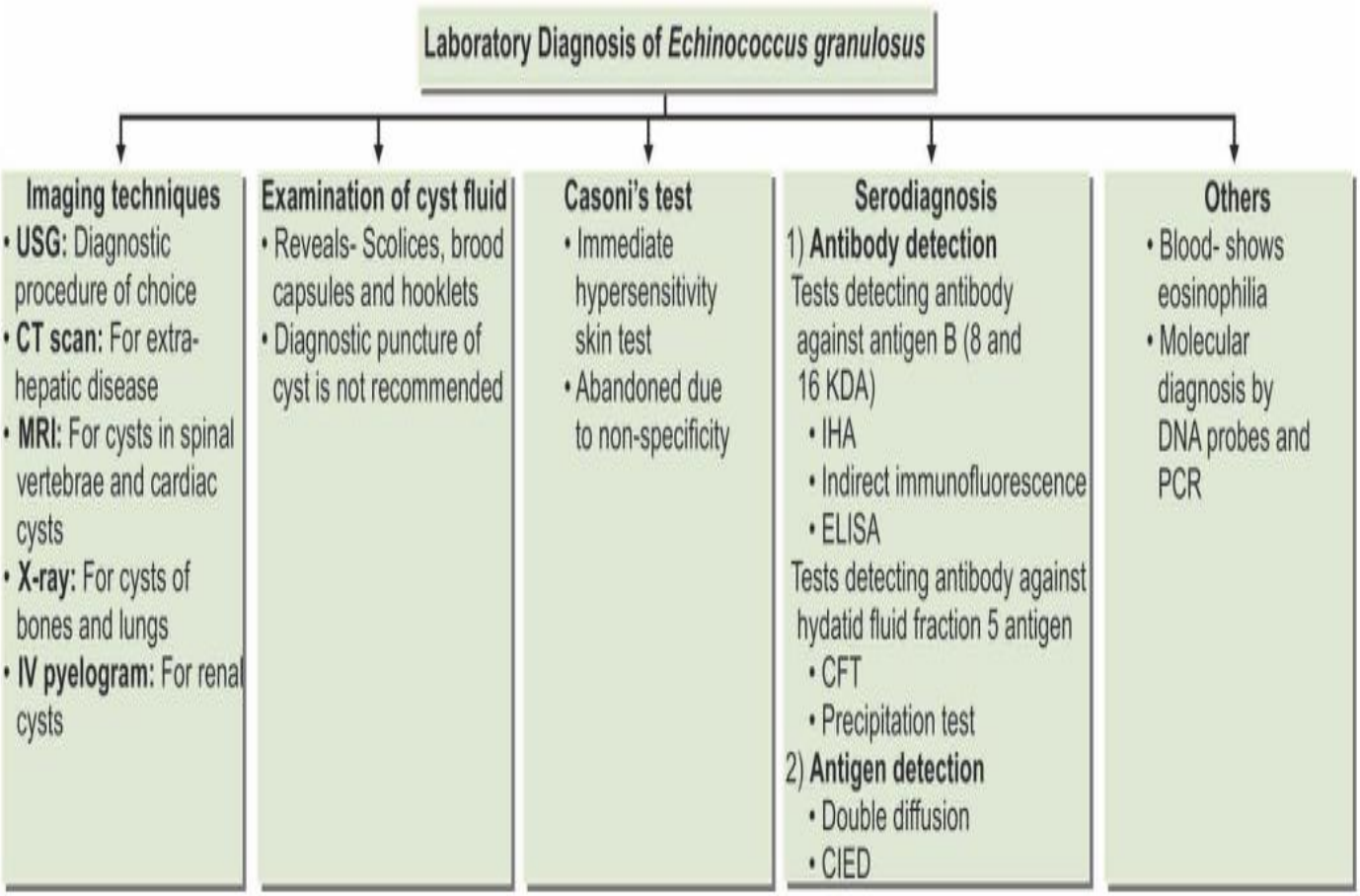
Note:

- Human infection with hydatid cyst of *E. granulosus* is apt to occur where dogs harbor the adult worms and sheep or hogs serve common reservoirs of the larval stage.
- The hydatid in cattle is sterile.
- Exposure commonly occurs in childhood particularly among boys who play with infected dogs.
- The hydatid may grow for 5-20 years before it causes serious concern. Hence, exposure usually occurs several to many years before diagnosis is made.

Pathogenesis and symptoms:

- **There are two morphologic types of hydatids in human tissues; unilocular and osseous hydatid.**
- **A majority of human hydatids are unilocular, but if the hexacanth embryo reaches bone tissues, outer membranes are not produced and the organism proceeds to grow in the long bones and pelvic arch, forming an osseous hydatid.**
- **The size of the unilocular hydatid depends on the site of implantation and on its age.**
- **After 12-20 years reach to 15 cm or more in diameter containing a liter or more of clear, sterile hydatid fluid with numerous protoscolices and daughter hydatids.**
- **If a large abdominal cyst bursts, either spontaneously or following a blow on the abdomen, anaphylaxis may be precipitated by the sudden liberation of hydatid fluid into the peritoneal.**
- **Moreover protoscolices spilled of the cyst will become implantation.**
- **The symptoms, comparable to those of a slowly growing tumor, depend upon the location of the cyst.**
- **Large abdominal cysts produce increasing discomfort.**
- **Liver cysts cause obstructive jaundice.**
- **Peribronchial cysts may produce pulmonary abscesses.**
- **Brain cysts produce intracranial pressure and Jacksonian epilepsy.**
- **Kidney cysts cause renal dysfunction.**

Diagnosis:



- ✓ **Specifc echinococcal antigen in sera and in CSF canbe detected by double diffusion and counter immunoelectrophoresis technique (CIEP).**

Treatment:

- ☸ **Surgical removal of cyst, not 100% effective.**
- ☸ **Inactivation of hydatid sand by injecting the cyst with solicidal agents:**
  - ■ **10% formalin and its removal within five minutes.**
  - ■ **Hibitane.**
  - ■ **95% ethanol.**
  - ■ **Hypertonic 30% normal saline solution.**

Scolicidal agents and their complications:

- ■ **Cetrimide—can cause acidosis**
- ■ **Alcohol 95%—can cause cholangitis**
- ■ **Hypertonic saline—hypernatraemia**
- ■ **Sodium hypochlorite—hypernataraemia**
- ■ **Hydrogen peroxide**

<u>Note:</u> In cases with biliary communication only hypertonic saline (15–20%) is used.

- ☸ **Puncture, Aspiration, Injection, and Reaspiration(PAIR).**

Indications of PAIR

- **Cysts with internal echoes on ultrasound (snowflake sign) multiple cysts, cysts with detached laminar membrane.**
- **Contraindications of PAIR for superficially located cysts, cysts with multiple thick internal septal divisions (honey combing pattern), cysts communicating with biliary tree.**

The basic steps of PAIR:

- **€ Ultrasound or CT guided puncture of the cyst.**
- **Aspiration of cyst fluid.**
- **€ Infusion of scolicidal agent (usually 95% ethanol; alternatively, hypertonic saline).**
- **Reaspiration of the fluid after 5 minutes.**
- **Great care is taken to avoid spillage and cavities are sterilized with 0.5% silver nitrate or 2.7% sodium chloride for prophylaxis of secondary peritoneal echinococcosis due to inadvertent spillage of fluid during PAIR.**
- **Albendazole (15 mg/kg in 2 divided doses) is initiated 4 days before the procedure and continued for 4 weeks afterwards.**

Control:

- **Ensuring pet dogs do not eat animal carcass or offal.**
- **Periodical deworming of pet dogs.**
- **Destruction of stray and infected dogs.**
- **Maintaining personal hygiene such as washing of hands after touching dogs and avoidance of kissing pet dogs.**

End of Cestodes Lecture: 4