

Echinococcus Granulosus

Small Tapeworm (1 cm), Cestode.

This is the smallest tapeworm that can affect human being but it's not really proper human tapeworm (the human is not the primary host).

The primary host is the dog or members of the canine family (foxes, wolves) and the human can be an intermediate host.

Morphology

Scolex which has 4 suckers and has a rostellum and only 3 proglottids:

First one immature second is mature and the third is gravid.

They live in the small intestine of the dogs.

They don't live long (4 or 5 months) and then they die.

Then they produce eggs and the eggs pass into feces either in the proglottids or if the proglottid has ruptured, they'll come out in feces.

These eggs are typical taenia eggs (striated outer covering and in the middle we have hexacan – the same as taenia saginatum and taenia solium).

Life story

We have the dog (primary host) which harbors the tapeworm (which will produce eggs and then go out with the feces).

The normal story is that these canine animals pass the eggs into the feces, they contaminate the grass and the eggs are eaten by the intermediate host proper (sheep, cattle, pigs, goats).

They will release the hexacan and it will penetrate the small intestine of the intermediate host and then it will go and become distributed all over the tissues - same as taenia saginatum and taenia solium BUT the morphology of this tape worm in the intermediate host is different; in T.saginatum & T.solium it is cysticercus, but in case of E.granulosus it is a hydatid cyst.

Human can be an accidental intermediate host (the dogs can pass the eggs through their tongue by licking themselves & the human may contaminate his hands with the eggs if the dog licks his hands or face, or if the child plays with the dog and touches an area contaminated with the eggs).

The human is a dead end host; no one eats on human so it will not transfer & the life cycle of the worm will end there.

The lesion in the intermediate host is the cyst and it's known as hydatid cyst and disease is called hydatid cyst disease.

The cysticercus of the taenia saginatum and taenia solium is a balloon full of clear fluid and invaginated in it the rudimentary (primary) scolex.

The hexacan after it penetrates the wall of the small intestine of the intermediate host, it goes and becomes distributed all over the place, but the first place to go is the liver so the 1st place & most likely to find the cyst in is the liver then u can have them anywhere in the body.

This cyst starts as a very small structure (about 1 cm in diameter) and it consists of a membrane and inside the membrane there is fluid which is yellowish in color and then it goes bigger and bigger.

The membrane consists of 2 layers:

An outer layer which is laminated and acellular and there are no nuclei and the inner is cellular and it's known as the germinal layer (because it proliferates).

From this germinal layer you will get budding / formation of new cysts.

The first cyst is called the mother cyst and from it we can have daughter cysts and we can have granddaughter cysts from the daughter – that's why it becomes bigger and bigger, it's something neoplastic about this disease (may become up to 10 or 12 cm in diameter like a tumor).

Mother cyst – daughter cyst – granddaughter cyst after that we get structures which are different to the cyst in the fact that they only have a germinal layer and no laminated layer and it's known as brood capsule (can develop in any of the cysts – mother/daughter/granddaughter), they're named brood because they'll hatch later to give rise eventually to worms.

Inside the germinal epithelium, we will get the development of structures which are very small (can be seen with the microscope) – there is suckers and a rostellum marking the beginning of scolex and then they start to fill the inside of the cyst and they are known as protoscolices (protoscolices will become scolex).

The entire cyst is called Hydatid cyst.

These protoscolices look like sand grains حبوب الرمل that's why it's called hydatid sand (we mean the protoscolices in this name).

Hydatid cyst disease

When infected (as intermediate hosts), these cysts will be space occupying lesions living as tumors in the liver (first place) but we can have spread to other places like the lung, brain, skin, bone, subcutaneous tissue, kidneys or any other place.

It's common in shepherds because they are next to the cycle (sheep and dogs; as they feed their dogs with the offal from the sheep they've slaughtered). Also children maybe at higher risk because of the hygiene issue.

Somebody will present with a lump in the right hypochondriac region and we can use X-ray or CT-scan to be certain so you don't confuse it with a tumor, it can get bigger and can be metastatic.

If the cyst ruptures, the hydatid sands will go and settle and give rise to more cysts; so it is metastatic.

The treatment is surgical and you to remove the cyst because it is a tumor and you have to be careful not to rupture it (if ruptured, it will disseminate everywhere & if reaches the blood, there will be anaphylactic shock and maybe death).

Also patients become allergic to the antigens of the echinococcus, so they will have eosinophilia and IgE against its antigens (IgE against any antigen -> this is a type 1 hypersensitivity reaction) which can lead to anaphylaxis which can lead to death.

Diagnosis

By clinical examination by doing CT-scan, X-ray or Ultrasound.

You can use blood test (looking for eosinophilia or specific IgE against the antigens).

Another test is called casoni test (an allergy test), you bring antigens of echinococcus and inject them under the skin and see if there is an inflammatory reaction. If there is a reaction after 15-30 mins, then it's a positive test (it means that the body has IgE against the antigens of the worm) or no reaction then it's negative.

It's a good test but sometimes it can give false positives (20%) it means if we bring 100 patients who showed inflammatory rxn to the antigens, 80 have the hydatid disease and 20 don't have it but for some reason or another – maybe due to cross reactivity between an IgE he has for a certain antigen & the antigens of this worm - and they produced an inflammatory rxn, but if it's negative then surely there is no disease.

Note: although hexacans go to liver, they won't produce symptoms of liver disease like jaundice, because it'll be a localized infection & liver will maintain its functions normally through its intact tissues... so what actually drives the patient to screen himself is the lump we talked about.

Trematodes

We need an intermediate host which is fresh water snail.

Miracidia which enter fresh water snail then cercariae go out of snail which look the same as trematode but have a tail to swim in water; and have ventral sucker and oral sucker, gastrointestinal tract which is blind ending & bifurcates.

They go to the primary host which is the human EITHER by keep swimming until they find the human host & then penetrate the skin to the body and lose their tail after penetration & develop into schistosoma causing bilharzia (discussed next year inshallah).

OR swim until they find a fish or a plant and go to one of them and settle on their surface and they lose their tail (because it's not needed anymore/ no more swimming) and they cover themselves with a protective layer i.e. they become a cyst and these encysted cercariae are known as metacercariae.

They will enter the lumen body when they are eaten and that's why they become cysts.

Summary of the life cycle: Upon defecation, eggs are released & are operculated and they'll release miracidium which is ciliated and swims & it enters the snails and then released from the snails as cercariae, which will penetrate the fish or the plants & become metacercariae, so if you eat these plants or fish without cooking them, metacercariae will be ingested & they will bud inside your GIT & develop into trematodes.

Fasciolopsis buski

Luminal trematode of the small intestine.

It's quite big; it measures about 7 or 8 cm in length.

Life cycle: lives in the small intestine, produces the eggs, the eggs come out with the feces, they release the miracidia which develop in snails, and released as cercariae and settle on fish or plant until being eaten.

May produce some symptoms, for example: they can produce abdominal pain (because of attachment to the wall of the small intestine) or sometimes can cause intestinal obstruction or even perforation of the intestinal wall.

Fasciola hepatica

It lives in the liver and produces the eggs which go in the biliary passages to the small intestine then to feces->miracidia -> snail -> cercariae -> metacercariae -> on grass or fish then eaten by the host.

If you eat the metacercariae, they will bud in the small intestine and then penetrate its wall and then they'll go to the liver (penetrates the liver through its capsule and circulates in the biliary passages) through the peritoneal cavity.

It may cause destruction of the liver and may cause jaundice (because it may block the main biliary passage) or cholangitis.

It is a disease of the cattle & sheep but may affect the human.

Paragonimus westermani (related to respiratory tract not GIT)

A trematode that infects the lungs.

In the lung it produces a cavity which has the trematode in it causing hemoptysis (coughing blood) or blood stained sputum.

Eggs come out in sputum & they reach water by spitting the sputum or swallow the sputum which in that case the eggs are released by feces.

The intermediate host is the crab, so if you eat the crab having the metacercariae, they will bud in the intestine, and then penetrate the wall of the intestine to the peritoneal cavity piercing the diaphragm up to the lungs settling there as an adult worm.

Diagnosis by examination of sputum for the eggs & by radiography or CT- scan of the lungs, it's important because a patient who coughs blood it might be thought that he has cancer, so deferential diagnosis is very imp.