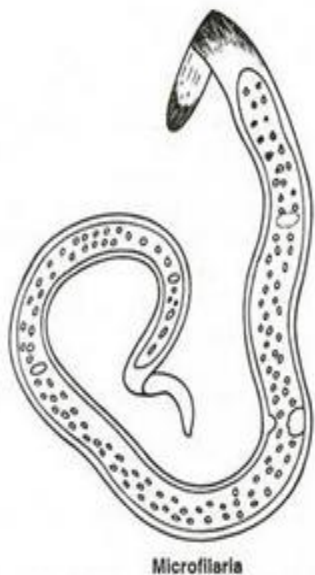


Amoeba can be luminal, or tissue parasites and go to liver, lung..

Nematodes are tissue parasites

Filarian worms



These do not lay eggs, they lay larvae which are called microfilaria. And because they're tissue nematodes, they're transmitted by an intermediate host. The luminal nematodes that we have taken so far do not require an intermediate host.

Microfilaria are really a tube full of nuclei. Size is about 18 micro meters.

It may have a sheath or not. Details are used for diagnosis. Just know that these are microfilaria, a tube full of nuclei, with or without a sheath. Disposition of nuclei and the presence of the sheath can act in diagnosis of which species the worm is.

Wuchereria bancrofti

A worm of about 6-7 cm and usually lives in the lymphatics. They produce microfilaria, which gains access to the blood. The intermediate host which is usually the mosquito. So the mosquito comes and bites the person infected and takes the microfilaria. These develop in the mosquito and become infective. When it bites someone else, the microfilaria are injected to the new person and cause infection, spreading the disease. Simple life cycle, microfilaria are in the blood, mosquito is the intermediate host, and the worm itself lives in the lymphatics.

Because the intermediate host is the mosquito, it tends to bite at night. The presence of microfilaria in the blood has some sort of periodicity. We find that microfilaria are present in the blood during the night. And this gives the clue to diagnose the disease, by taking a blood sample at night because that's when the microfilaria are more likely to be present. While in the morning they are usually present in other places than the blood.

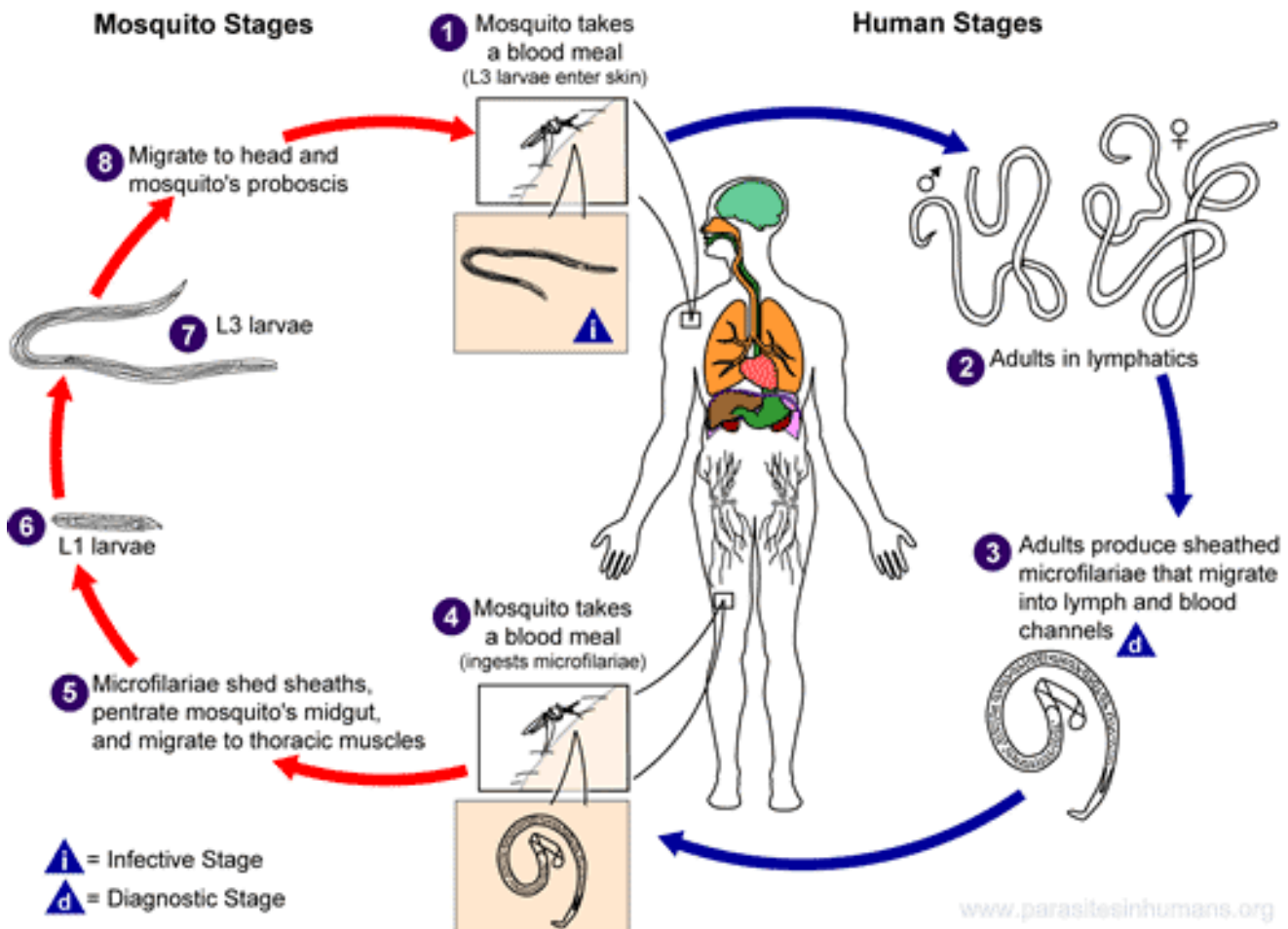
Periodicity: presence of something during the day or the night. Circadian rhythm.

The disease.

We don't have it, of course. It's usually asymptomatic, people become tolerant and become immune. But in some cases, the person develops an allergic reaction to the presence of these worms and this reaction leads to an inflammatory process, it may become chronic. This could lead to fibrosis and obliteration of the lymphatics. The patient will have swelling of the tissues drained by the obliterated lymphatics, and hence the term elephantitis.

Clock indicates some sort of periodicity.

Elephantitis develops in the extremities, especially the legs, or sometime the scrotum maybe involved, inguinal lymph nodes are enlargement.



Loa Loa

Another filarian worm, this one lives in the subcutaneous tissues. Produces microfilaria. Microfilaria gain access to the blood and are usually present during the day because the intermediate host is known as the mango fly which bites during the day, especially in the afternoon.

When taking a blood sample for diagnosis of Loa Loa, you should take during the day.

The disease:

It's not usually very serious. Patients complain of creeping or crawling sensation below the skin. Other symptoms, may include allergic reactions when they migrate, especially around the wrists. These known as **calabar swellings**. The swelling is quite big, about the size of a chicken egg.

Sometimes, as they're spreading from one area to another they can reach the conjunctiva. The patient is present with a foreign body symptoms; itching, redness, tears. When you examine the eye, you will see the worm is in the conjunctiva. It does not lead to blindness since it's not really inside the eye, it's in the conjunctiva. But it is irritant to the eye.

Onchocerca Volvulus

This is that causes blindness and is a 2nd cause of blindness, the first being a bacteria, *Chlamydia*.

It lives in subcutaneous tissues and places microfilaria. These they do not go to the blood, they stay within the skin and the subcutaneous tissues.

The intermediate host is the black fly which also feeds on the blood and spreads it to someone else.

At the site of the bite, we find the worm there and cause some sort of induration. The worm stays where it is, it doesn't move. It has some inflammation and swelling around it, from there the microfilaria can swim away under the skin, not the worm.

The loa loa worm itself can migrate, but here only the microfilaria can migrate. Unfortunately it can go inside the eyes and affect the retina.

This is known as river blindness since it is associated with fast flowing rivers which are the breeding and living environment of the intermediate host, the black fly. If someone lives right next to the river, they are affected but if they're 2 to 3 Km away, the disease is not present anymore since the intermediate host is lost at these distances.

Diagnosis:

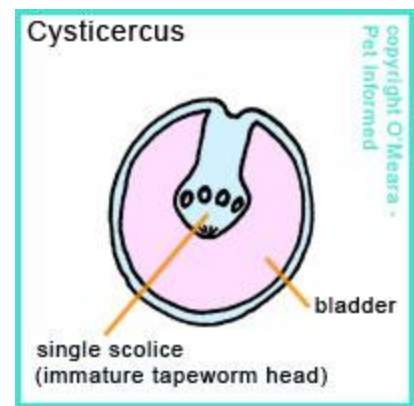
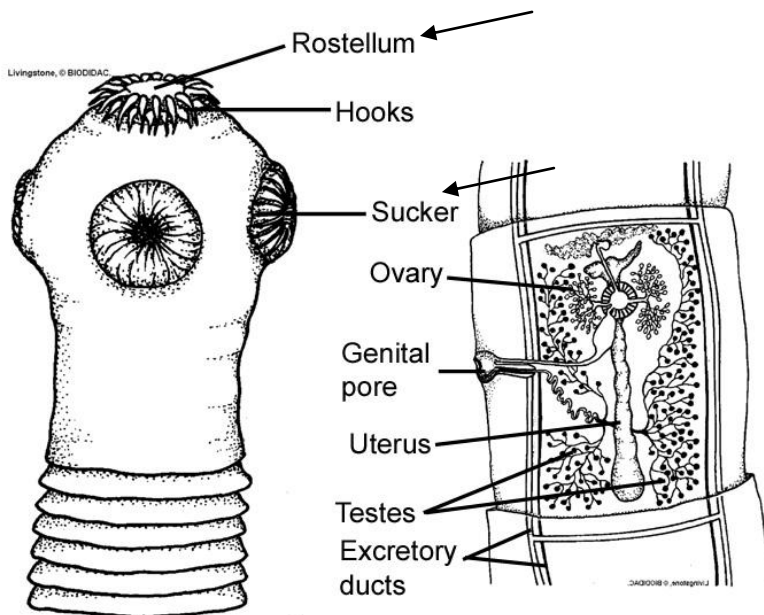
We don't take a blood sample since the microfilaria doesn't reach the blood. So what do we do is we take a slip of skin from the indurated and place it in normal saline for a few hours or overnight. The microfilaria will get out of the skin into the saline and so we examine the saline.

Tape worms

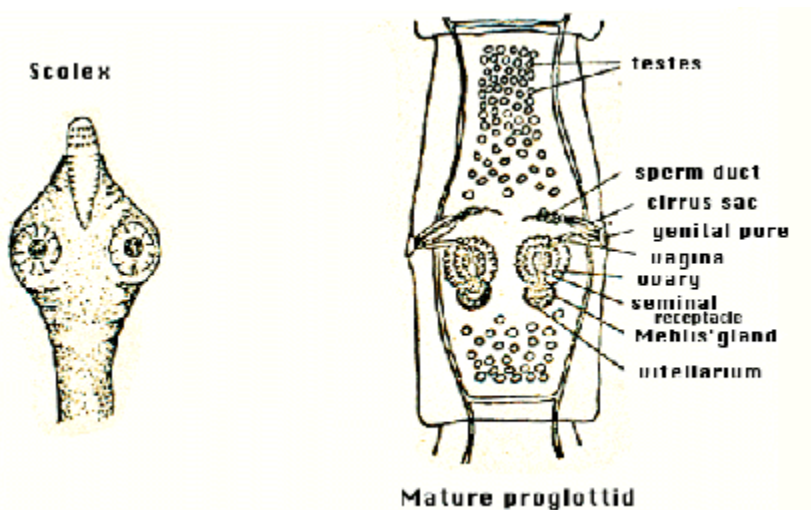
The other group of worms is the tape worms.

The general morphology we already have studied.

To refresh your memory very quickly:



This is the parasite which is in the intermediate host.



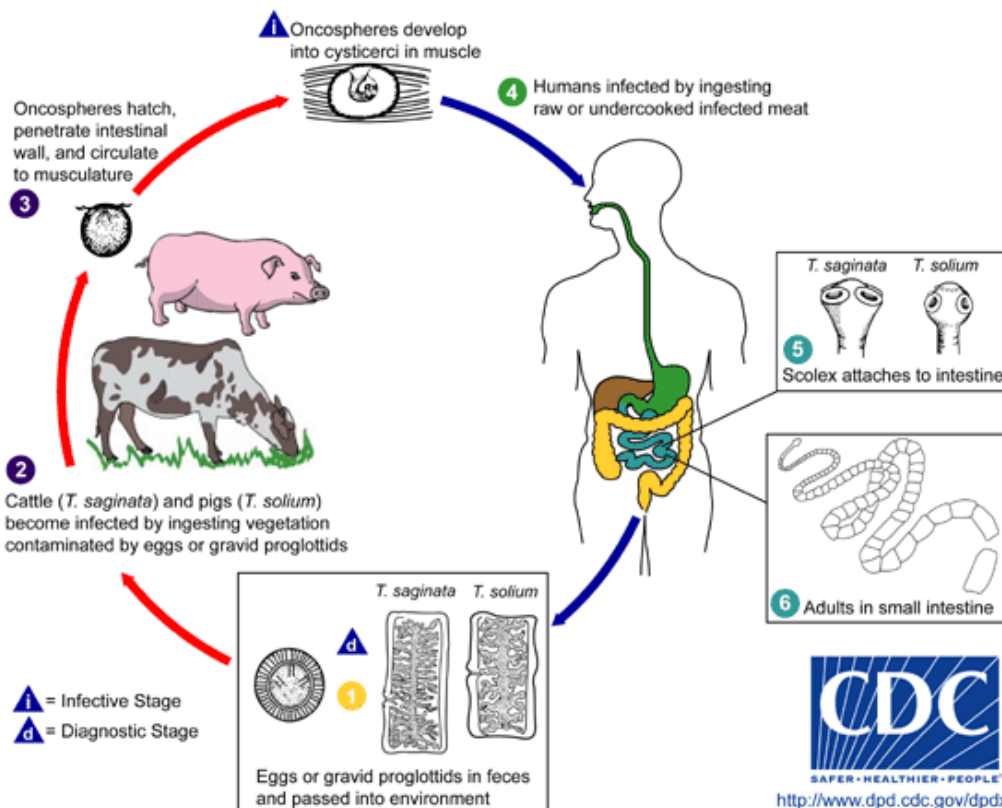
Mature proglottid means it has both male and female apparatus. The testes are full of granules and the uterus is full of eggs. Most of the tinia parasites have this morphology, circular and the outer border is striated, the inside of is the hexacanth which gives the embryo which has six *hooklets*.

Tenia Saginatum & Tenia Solium

Tenia solium is in pigs, the intermediate host. Tenia saginatum's intermediate host is the cow or sometimes, the camel can become an intermediate host.

Tenia saginatum is usually longer. T. solium is about 2 to 3 m and the T. Saginatum is about 5-6m. They usually live in the small intestines. There are morphological differences. T. saginatum doesn't have a rostellum, the proglottid is square in shape, while in the T. Solium it has a rostellum and its proglottis is rectangular in shape. Saginatum has a higher number of proglottids. The lateral branches of the saginatum are more than that in the solium. The egg is exactly the same; you cannot distinguish between their morphology. In the mature proglottids, we have 3 ovaries in the solium and 2 in the saginatum. These are the differences that allow the differentiation between them.

Life story:



Somebody picking up the worm and excreting the proglottids, which contain the eggs, then they are eaten by the intermediate host.

In the small intestines, the eggs disintegrate and release the hexacanth. The hexacanth has hooks so they attach to the walls of the small intestines, and penetrate their way to distribute in the whole body of the intermediate host. Wherever they settle

they change into cysticerci. The cysticercus is a balloon full of yellow liquid and inside it there is an evaginated scolex.

When you eat the raw and uncooked meat of the intermediate host, the cysticercus goes into your intestines, the scolex is evaginated outward and then it sticks to the wall of the intestine. It

starts proliferating and gives rise to new worms. Cooking the meat will kill the cysticerci and so does extreme freezing (-21C°).

Usually they live for many years, 10 years perhaps.

Very few symptoms are complained of. Sometimes there's a mild abdominal pain but they usually ignore it. Usually, the infection is noticed when the proglottids are passed into the feces. Because they are muscular, they can move and so the patients can see proglottids moving in their feces and then go to a doctor.

Diagnosis is by examining the feces.

There aren't a lot of serious diseases associated with them, but sometimes *T. solium* can cause serious problems. This happens when you become the intermediate host, how though? You are a primary host.

You have to eat the eggs of these parasites to become an intermediate host, through food contaminated by infected feces of another infected person, or when you have worms inside yourself and then you ingest the eggs through hand contamination.

So this happens from somebody else's worm or your own.

Eat eggs, they hatch in your intestine, the hexacanth is released and will go inside your body and distribute all over. They can grow in the tissue environment of your body because of the similarity of tissues between humans and pigs. As you know the closest animals to the human are the apes and monkeys then the pigs.

Now you are a dead end intermediate host since it is very unlikely that someone else will eat your meat.

However, the problem of being an intermediate host is that you will suffer a disease called cysticercosis. Wherever you have cysticercus in your body, you will suffer inflammatory lesions and the symptoms will be according to the location of the lesions.

The commonest area for them to settle is your meat which is the muscles, so swelling in the muscles are present, which are inflammatory nodules in the muscles around the cysticerci. Problems happen when they settle in vital areas, such as the eye, which could give rise to chorioretinitis. Blindness or partial blindness may occur, according to the amount of damage caused to the retina.

Also problems may occur when they settle in the CNS, resulting in sensory and motor deficits. This leads to focal epilepsy commonly, convulsions on 1 area (e.g hand). It could be generalized epilepsy.

If there was an adult with first time focal epilepsy living in area of endemic *T. solium*, then you think of this in diagnosis, not tumor which also could produce the same thing. A scar tissue in the brain may also cause focal epilepsy. So this depends on the differential diagnosis.

It is very unlikely to develop any of these problems.

Diagnosis is done by taking a biopsy or a CT scan.

Diphyllobothrium

It is **the largest worm.**

Di: 2

Bothrium: suckers

So 2 suckers.

It has another name, fish tape worm since the intermediate host is fish. You also call the other pig tape worms and cow tape worms, but uncommon names.

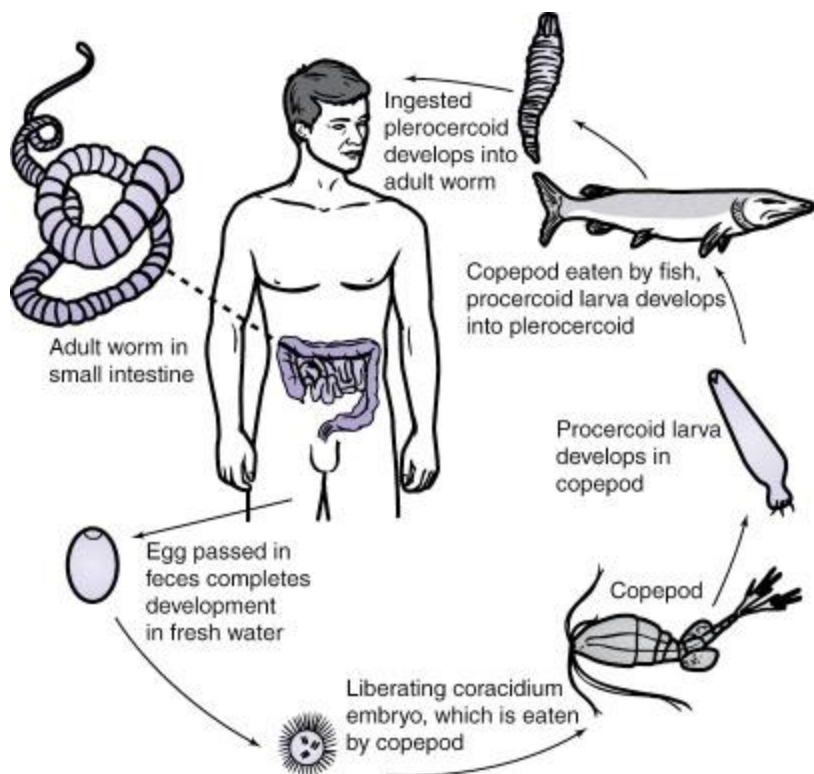
It is common in areas where people eat a lot of fish; like northern Europe and Scandinavian countries. Again, you must eat the meat raw and uncooked.

It is very big, can be up 20 m in length.

The scolex is usually elongated, and it has 2 longitudinal suckers. What we have seen before had cup shaped suckers.

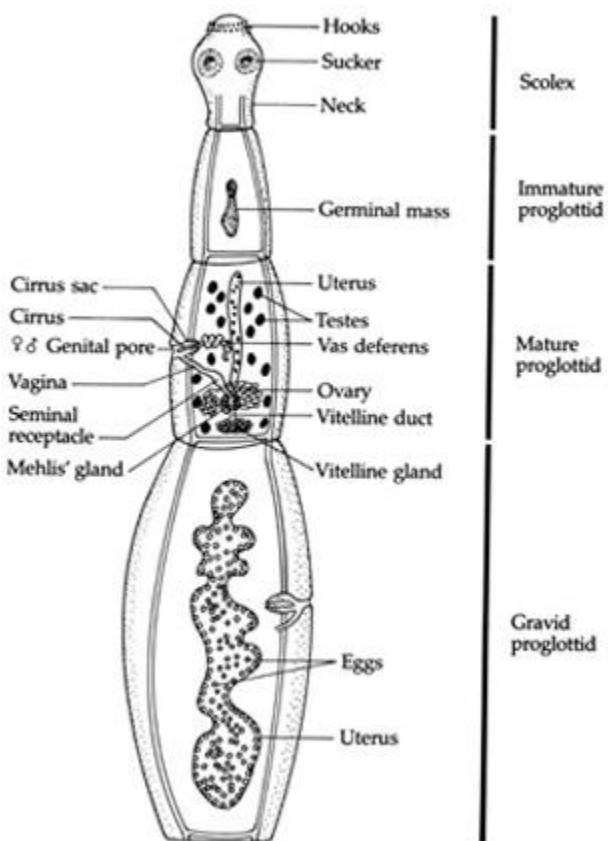
Neck region, it is of the same story; proglottid, mature and immature and at the end we have granulomatous.

Life story: The transmission to the intermediate host is by defecating into the water since that's where the intermediate host is. The eggs are eaten by the host. The eggs are different; they are big, oval in shape, and have an operculum (lid). The embryo is not a hexacanth, it is a ciliated embryo since it needs to swim (coracelium), then it's eaten by the first intermediate host. **This worm has 2 intermediate hosts.** The first intermediate host is copepod, part of the shelled sea creatures like the shrimps. They are very small you can hardly see them with the naked eyes. Fresh water fish feed on these copepods, and become the 2nd intermediate host, the embryo will be inside the meat of the fresh water fish and to get it, we need to eat uncooked fish.



Because it is so big and it likes B12, it will take up your B12 and cause a deficiency for infected patient. This leads to macrocytic anemia\megaloblastic anemia. Not pernicious anemia, which is an autoimmune disease, when antibodies are against parietal cells or intrinsic factor affecting the absorption of B12. It is megaloblastic anemia but because it's an Autoimmune we have another name, the mechanism is different. Sea water is not Fresh water.

Enterococcus Granulosus



Tape worm in dogs, the primary host is the dog or any member of the canine family (wolves, foxes...etc.)

Shepherds are usually more in contact with dogs than other people. If they gave the dogs raw uncooked meat infected, the dog will get the disease.

Worm lives in the small intestine of the dogs.

It has 3 proglottids; mature, immature and gravid proglottids. It is really small; only measuring about 1 cm in length. Also it has a scolex, suckers and rostellum. Has typical eggs; circular and striated outer border.

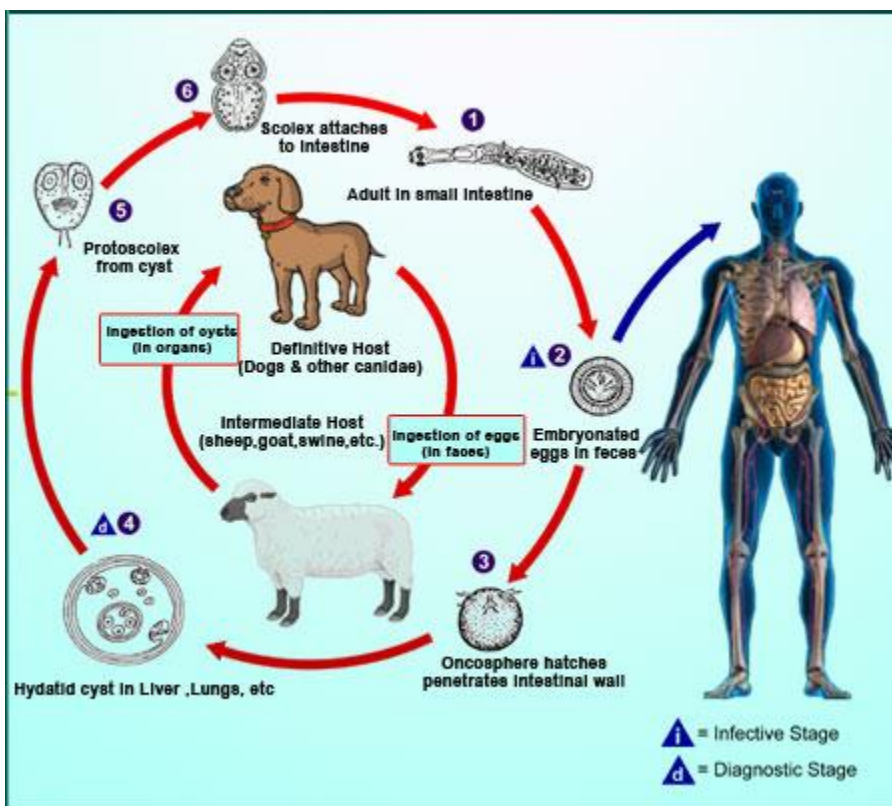
The intermediate host is usually a herbivore (cows, sheep, goats...etc.)

The infected dog defecates on the grass, excreting

eggs along with feces. The grass is eaten by herbivores; its meat is infested with typical morphological organism in the intermediate host.

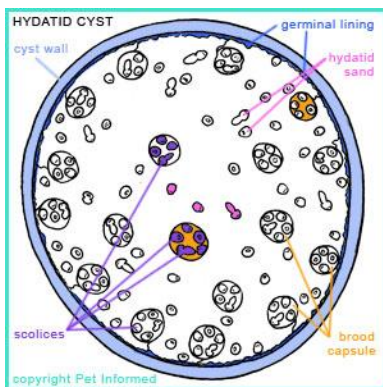
In the intermediate host, the eggs are different they are known as hydatid cysts. Cysts then disseminate to all body tissues of the intermediate host, in comes a normal dog and feeds on the meat of an intermediate host and becomes infected.

Man is an accidental intermediate host. It is very unlikely that you'd eat infected grass. So the transmission to man happen from direct contact with the dog. Since the feces of the dog is contaminated, the dog cleans itself by licking its anal region which is contaminated with eggs. Eggs move from anal region to tongue and mouth, and then by licking the face of its owner it transmits the eggs, or even when the owner kisses its dog.



Children are likely to be infected if they're around infected dogs.

So they eat the eggs, the hexacanth is released and distribute around the body. **Most common place of infection is the liver**; the eggs in the small intestines, travel to the liver via mesenteric vein and produce cysts in the liver. It can disseminate to other places: lungs, kidneys, brain, muscles skin...etc. the cyst can go there.



The lesion in this case is known as the hydatid cysts. The cyst starts as very small, less than 1 cm, and enlarges. They actually can become 10 cm in diameter; they are like a tumor, a space occupying lesion.

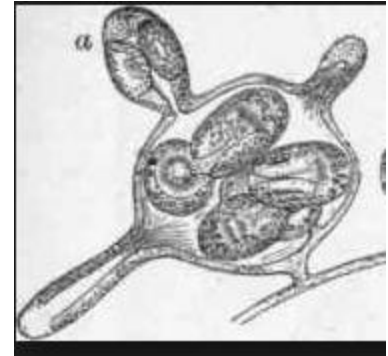
The outside of it consists of laminated (layered) membrane and is acellular. But in the inside, there is a cellular layer; the germinal

layer. From the germinal layer you will get proliferation of cells giving rise to more cysts.

Where the hexacanth had sat there is a cyst. Inside the cyst we will have more cysts. The large origin cyst is called the mother cyst, next is the daughter cyst, then granddaughter cyst produced inside the daughter cells.

This is like the neoplastic phenomenon; it enlarges and increases in number.

Eventually we will have a brood capsule, which is a germinal epithelium without laminated layer. It has small heads poking out like a scolex. They breed from the germinal epithelial. The scolex may have suckers and rostellum. This is like a tiny scolex, called protoscolex.



If seen under the microscope, they will look like sand particles and so are called hydatid sand.

If this capsule explodes, the sand particle-like structures will spread to other areas, and each particle will give rise to cysts. This is like a neoplastic procedure and metastatic.

These will present as space occupying region, a tumor. if it was in the brain we will have neurological problems. Children and shepherds usually are the ones who get the disease, the hydatid cyst disease. It is present in Jordan.

CT scans and a test can be used for diagnosis.

This test is called Casoni test, antigen of the worm is injected below the skin. If there's an allergic reaction and hypersensitivity then that person is suffering from the disease. The problem here is that we can have false positives. If the results were negative the person isn't suffering from it. **If it was positive, there's an 80% chance for him to be infected and 20% of false positivity (not infected).**

Treatment:

You can give drugs to kill the cysts, but sometimes you have to do surgery. And when you remove it you must be careful, since if it was poked during the removal it will spread to all the body and produce many more cysts. Also, you can get anaphylactic shock because you have IgE's produced against it, by you giving huge amount of antigen in small amount of time, the hypersensitivity reaction will be sever leading to anaphylactic shock.

THE END