

The Skin and
MUSCULOSKELETAL
System



MICROBIOLOGY

SLIDES
SHEET
LECTURE # 1

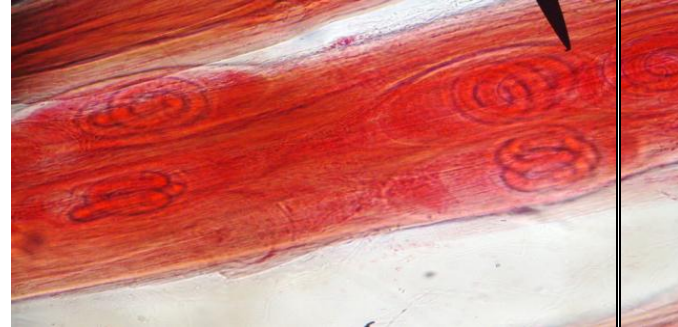
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Parasites affecting MSS

This lecture will be talking about parasites that affect the musculoskeletal system & by that we mean the parasites that are involved in the skin, muscles, & subcutaneous tissues.

1) TRICHINELLA SPIRALIS

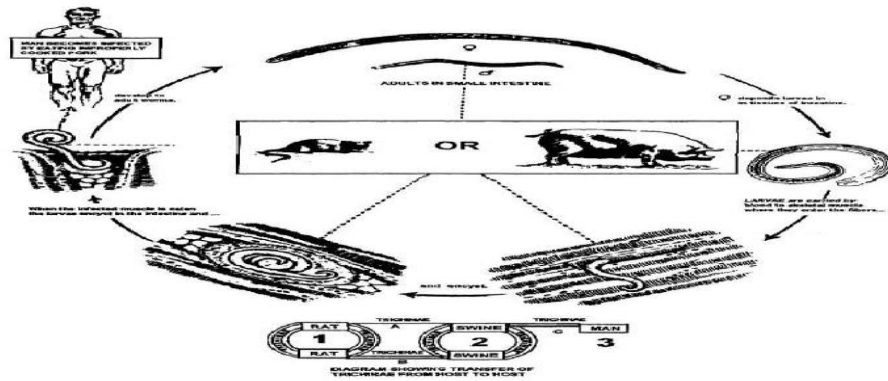
- involved in the muscles , it is called spiralis because it is spiral in shape
- its a nematode (round worms) which is a small worm that have separate sexes & Trichinella Spiralis measures only around 2-3 millimetres in length.
- unique point about this type of parasite : uses the same host as both an intermediate & a primary host. We know that parasites have 2 stages of existence as either primary host or intermediate host what's unique about this parasite is that it can exist in animals (and humans) as both primary host (mature nematode in the intestines)or intermediate host (larvae in the skeletal muscles) which is an exception that other nematodes .
- can be transmitted from one person to another usually by eating raw meat. (when the meat is cooked, or free the larvae will be destroyed, but when eaten raw, the infection could be passed on to another host)
- not specific to humans, it can infect many types of animals
- humans can be intermediate host but they are dead end intermediate host and the infection as far as the humans are concerned comes from eating pork or exotic meat which has not been cooked.



✓ THE LIFE CYCLE :

- ❖ The adult worms (males and females) are found in the mucosa of the intestinal tract, and as they are nematodes they must have separate sexes, then there will be pairing between males and females ,and the female will start laying after about 5 days and the male will go to the lumen of the intestinal tract then it will be excluded with feces leaving only the female attached to the GI tract mucosa but again there is another exception, in fact trichinella spiralis doesn't form eggs as other nematodes do, they form larvae immediately just like the microfilaria (tremadotes) but it is not classified as microfilaria it is a nematode indeed.

- ❖ Then these larvae are deposited in the sub mucosa of the small intestine and the male disappears , (After fertilizing the females the males' job is done) , but the females stay in the sub mucosa of the intestine producing larvae .
 - ❖ These larvae will penetrate the wall of the small intestine and then get access to lymphatics then to the blood vessels, then they will go to the portal circulation reaching the liver ,they transverse the liver to the systemic circulation reaching the lungs then leaving the lung to be distributes to the whole body .
 - ❖ What's also special about these warms is that they can reach any tissue in the body (brain , heart ,liver etc) but they will only reach maturity in skeletal muscles .So the larvae that are found in tissue other than the skeletal muscles are not mature and they die because of inflammatory response but the one that settle in the skeletal muscle will mature by being surrounded by a **cyst** which is a fibrous tissue that is formed as a reaction from the muscles .
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- ❖ After 6 months -1 year these cysts will calcify and the larvae may still be alive for a few years in the cyst .
 - ❖ Remember that the presence of the larvae in the skeletal muscles is considered the intermediate host stage and the presence of mature worm in the GI tract is the primary host stage .They are transmitted to humans through eating Raw meat that contains that larvae ,cooking the meat will kill the larvae but if the meat is undercooked the infection will pass to humans .
 - ❖ This type of infection was first noticed in cannibalism (الكلية لحوم البشر) in southeast asia and Africa nowadays the infection is noticed in humans from eating raw meat of animals .
 - ❖ Trichinilla spiralis is not specific to humans it can infect many types of animals including polar bears , Rats , pigs .The infection spread from rats to pigs then to humans because pigs eat everything so they will eat dead rats infected by this warms then humans will eat undercooked pig's meat containing the larvae



- ❖ After eating the meat that contains the cyst it will hatch inside your small intestines and then the larvae will invade the mucosa of the GI tract and then within few days it will form a mature worm. Humans are considered mainly as primary host they can be an intermediate host in the case of cannibalism but we don't have it anymore. So as far as we are concerned humans are usually a **Dead end** primary host.

the clinical picture of the diseases acquired from this worm :

we will get transient symptoms when the larvae migrates through the body, for example if they reach the heart & settle in the myocardium, they could produce a form of myocarditis, if they reach the brain they will cause encephalitis, if they settle in the lungs they will also give you pneumonia, these are transit through the early stages of the infection & normally they settle on their own unless the infection is very severe & the amount of larvae is huge, it can cause death from severe inflammatory reactions in these organs which eventually leads to death but these are more likely to be transit rather than permanent.

Main symptoms caused by trichinella spiralis : mainly caused in the muscles, so the patient will complain of tenderness & swellings in the muscles felt or seen under the skin & if you take an X-RAY you might see calcification in them.

During the acute spread of these trichinella spiralis larvae in the blood it cause malaise & it might also cause fever which is rather unusual for worms as worms normally do NOT produce fever. (protozoa may produce fever but helminth or worms do not except trichinella spiralis as you can have fever in the early stages of the disease)

The presence of the mature worm in the intestines may causes GI tract symptoms like diarrhoea, abdominal pain ..etc

**Diagnosis :**

- from the **prevalence of the disease**, as far as we are concerned , in Jordan we don't have trichinella spiralis as we don't eat polar bears or pigs , so it's very very unusual & rare , almost non-existing in our country but it's common in Europe, the United States, Canada & America.
- **patient examination** : lumps in the muscles, acne, tenderness under the skin.
- fever maybe in the early stages
- encephalitis, endocarditis
- other indicators that are present as an example in the blood there will be a lot of **eosinophiles** which can exceed 40% of the WBCs.
- measuring the **enzymes of the muscles**, a rise in the number of skeletal muscle cell enzymes because there is damage in the muscles will occur for ex CK & LDH can be raised in these cases
- **muscle biopsy** taken from the muscles & examined under the microscope is the best means of diagnosis
- **serology** in which the patients develop antibodies against trichinella spiralis & they will be mainly from the IgE class or maybe also IgG. so you should look for specific IgE & IgG against trichinella spiralis.

*treatments not discussed here to be further explained later in pharmacology.

2)FILARIA

- Round worms (tissue nematodes)
- Always require an intermediate host for transmission which is usually an insect (vector)
- they vary in length, might be very long or small.
- they live in the subcutaneous tissue , skin , or the lymphatics.
- affect lots of people in the world , up to 5% of the world population can be affected by filaria worms
- they don't lay eggs, they produce larvae known as microfilaria which is 200 micrometer in length filled with nuclei .
- the study of the diagnosis of filaria is through the microfilaria
- it is very rare to encounter microfilaria in Jordan



shapes of microfilaria

there are many features of microfilaria that can help with diagnosis of the type of filarial worm the person is infected with, these features include :

- 1- Some of these microfilaria have a sheath extending from them
- 2- Some of the microfilaria have low amoybt of nuclei in that sheath ,some don't have nuclei at all and some have many nuclei in the sheath



Life cycle of filarial worms

these worms could live for up to 5 years and as we said they live in the subcutaneous tissue , skin , or the lymphatics then they produce the microfilaria which will wander in the blood or lymphatics and they are mostly going to be present in the blood because the intermediate host is an insect. these insects are blood sucking which will feed on the blood of the patient so the blood should contain these microfilaria which will then go to the gastrointestinal tract of the insect , then they will develop there & become known as infective microfilaria. If this insect grows & bites somebody else , it sucks the blood but at the same time it lays these microfilaria on the side of the punctual root, it does not inject it straight away. unlike malaria (protozoa) which the mosquito injects the infective agent directly in the blood as it feeds ,so the infective efficiency of the microfilaria is not as good as malaria./ in malaria once you are bitten you certainly will get infected because the infective agent is injected right inside the punctual root but in microfilaria they are laid around it so the probability of getting the infection is lesser unless you scratched it , *depends on your luck* ..

Pathology of filaria worms

((2 manifestations of the disease))

in the first case we have a balance between the parasite & the host in endemic areas where there is a lot of the disease , we will find that patients will have some sort of **tolerance** especially children. so what happens is that you add the filaria worms in the tissues and very little reactions, no inflammation, but they will produce a lot of microfilaria and these microfilaria of course will be used to spread the infection to other people. so here both are benefiting , the patient is benefiting because there is only little inflammation , he doesn't suffer. the parasite also benefits because it produces large numbers of microfilaria which will be passed on by insects to other people. / this is one variety in which the patients have some sort of tolerance towards the parasite.

in other cases , you will find that the patients will form a kind of allergy (allergic reactions to the worms & microfilaria) so there is inflammation & the number of microfilaria will be very very little , hardly present. Some of the people , in minority of the cases (only around 5-10%) these allergic reactions can progress & lead to tissue damage and may cause obstruction in the lymphatics known as obstructive disease but usually its not common and only a few cases would result in excessive allergic inflammatory response that results in destruction of tissues especially in the lymphatics leading to obstruction.

examples of filarial worms :

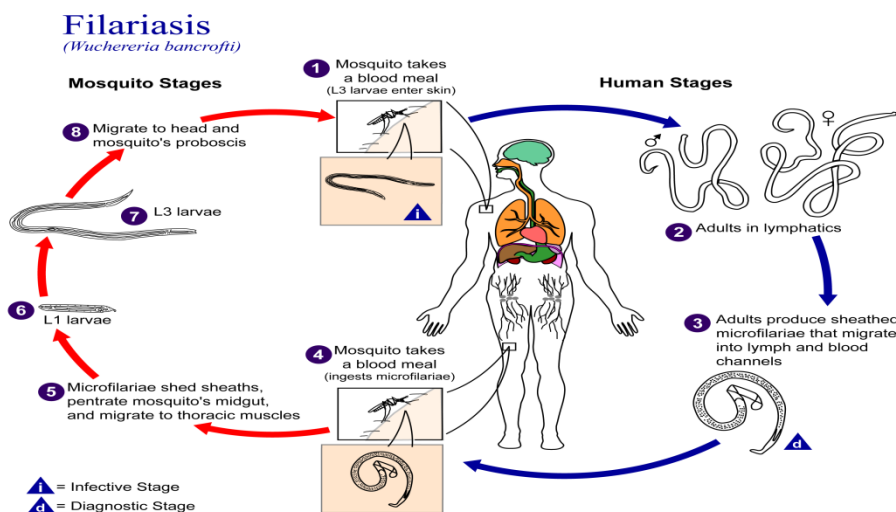
a) *Wuchereria bancrofti*

They are worms that measure about 5 or 8 cm in length & usually lives in the lymphatics and produce microfilaria which can reach the blood and the intermediate host in this case is the mosquito, which usually flies and bites people at night so this means that the microfilaria will appear in the blood at night not at day . This is called the Diurnal rhythm (which means that something becomes more at certain hours of the day) The microfilariae mostly appear at night and not during the day because the intermediate host is a mosquito and mosquitoes tend to bite at night . This point is important for diagnosis to take the sample of the blood at night not during the day because you are more likely to have microfilaria in the blood at that time of the day.

This worm is not significant but sometimes causes excessive allergic reactions which leads to obliteration of the lymphatics & this obstructive flow of lymph will cause swelling of organs , might cause elephantiasis as the lymphatics of the inguinal region are blocked & the leg swells up & the scrotum is most often involved & reach massive proportions because of this. so this is mainly the disease caused by *Wuchereria bancrofti*.

Diagnosis :

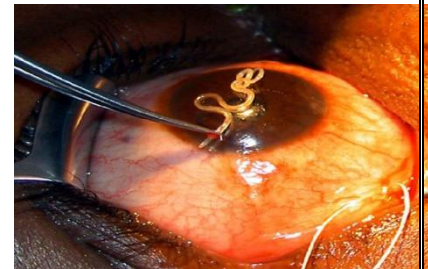
by taking blood samples at night and looking for the distinctive microfilariae.



b) *Loa Loa*

- a filarial worm that lives in subcutaneous tissue & produces microfilariae that travels to the blood and then they are taken up by the intermediate host which is an insect called the mango fly. the mango fly feeds in the afternoon, so when taking blood samples to diagnose *Loa Loa*, you should take it in the afternoon because you are most likely to find the microfilaria in the blood at that time.
- do not cause serious diseases because it just wanders under the skin in the subcutaneous tissues and very rarely produces pathology. you may have allergic reactions where the worm passes and these manifest themselves as swellings which can last for about 5-6 days which later disappear on the road, & These swellings can be very large reaching the size of a hen's egg known as calabar swelling.

occasionally they might wander and reach the eye and can be present under the conjunctival tissue of the eye which can be felt as a foreign body in the eye. It will not produce any blindness, but is very irritating and has to be removed surgically. other than this the *Loa Loa* fly is not very significant.



c) *Onchocerca volvulus*

- second main cause of blindness usually called river blindness.
- present in tropical regions of the world and usually associated with fast flowing rivers.
- Their intermediate host is the black fly. This disease is only associated with fast flowing rivers, as they are the most suitable areas for the black fly to breed. Therefore, people living by the banks of fast flowing rivers or near to it within 2-3 miles are more likely to be infected more than people living 5 km away.
- They live in subcutaneous tissue under the skin, but do not wander. Instead, they settle in one area of the skin, with some inflammatory reaction formed around the site of infection, and result in swelling in that area. They produce microfilariae, which do not reach the bloodstream, but may wander in the skin.

so ..

- *Wuchereria bancrofti* \longrightarrow affects the lymphatics
- *Loa Loa* \longrightarrow wanders everywhere
- *Onchocerca volvulus* \longrightarrow stay in their places

you might get indurations which are not very serious but the problem with the *onchocerca volvulus* is that they can wander and settle in the retina of the eyes and the choroid layer of the eye and produce inflammation which leads to blindness by damaging the optic nerve (river blindness).

Dracunculus medinensis (guinea worm)

- its a worm of animals but sometimes it could affect humans.
- between 50cm till 100cm in length



- lives under the skin
- its anterior end reaches areas where there is a contact with water like the legs for example .

Life cycle :-

1. At the anterior end position swelling occurs and then ulceration .
2. When the ulcer goes in contact with water the worm will release the larvae into the water.
3. In water the Cyclops (tiny creatures which are shrimp like structures) will eat the larvae and the larvae will develop in them (intermediate host) .
4. So when someone drinks the water , the Cyclops will enter the GIT and the larvae will penetrate the wall of small intestine and migrate to the subcutaneous tissue and continue its life cycle where it will develop into the adult worm .

diagnosis : ulcers**treatment** : drugs(mostly used) and surgical methods by pulling the anterior end by using of forceps slowly so you won't detach it (the anterior end) from the rest of the worm .you have to do that carefully to prevent the worm from cutting which will lead to inflammatory reaction .

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