University of Jordan
Faculty of Medicine

Medical Committee
The University of Jordan

Introduction to

Microbiology

Title :

METAZOA

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: 30

- ○ Slides
- ○ Handout
- ● Sheet

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METAZOA

(Helminths, Worms)

Endoparasites are of 2 types

1.Protoza
2.Metazoa (Helminths /Worms)

Metazoa:

-They are multicellular organisms that's why they tend to be larger –remember that the largest protozoa was up to 100 microns, while metazoa range between (2mm – 10m) in length, because of the size they are all extracellular pathogens,unlike protozoa which some of them can be intracellular and others extracellular.
-They reside either in the Lumina of organs (Luminal parasite) or in the tissues (tissue parasites) depending on the worm.
-how do they reproduce?
Unlike protozoa, which multiply by primary fission where each one becomes two, the worms (metazoan) do not divide, instead they produce eggs, or in some varieties they don't produce eggs but lay larvae straight away (eggs and larvae are the means by which the infection is transmitted from one person to another).
-so, the load of worms remains static –maybe there are a few exceptions- inside the body (ex; if you ingest 10 larvae > they will not become 15 or 20 inside the body but they produce eggs which are transmitted outside the body to infect another person to carry on with the infection.
-some need an intermediate host while others can spread the infection directly.

Helminths Classification:
1.Nematodes (Nematohelminths, round worms)
2.Platyhelminths (Flat worms):
a.Cestodes (Tape worms) flattened and elongated (can be very very long)
b.Trematodes (Flukes) Flat and oval (leaf like shape) but their size is less than that of cestodes (can reach only 6-7 cm in length because they are leaf-like.

A. Nematodes:

-They are cylindrical worms like an earth worm, ranging in size between 2 mm (very small) and 1 m (very long) in length.

-Since they can't divide like protozoa, we can talk about a Life span (varies from one worm to another); some live as little as 8-10 weeks, others live longer 6-7 years (weeks to several years).protozoa can't have a life span; they are dividing.
-what differentiates them among Platyhelminthes is that they have separate sexes (i.e. male worms and female worms, usually female worms are larger than male worms). While in Platyhelminthes (cestodes and trematodes) such a thing does not exist they are hermaphrodites; the worm itself is a male and a female at the same time, has a male and female reproductive systems (more advanced).
-They are either tissue parasites or luminal parasites.

<u>-They reproduce by eggs or larvae:</u>

-Luminal nematodes (they live in small intestine, in the lumen); they usually produce eggs that are passed in the feces to the outside world, these eggs do not need and intermediate host; they Have to be eaten by someone else in order to perpetuate the infection, so the spread is feco-oral (food contaminated by feces containing eggs). In some worms the eggs are infective straight away, as soon as they enter the body they are ready to infect, while other species, the eggs as they come out of the feces are not infective (if eaten fresh from the feces they won't develop any further, they have to go first to soil, for example, under certain conditions to mature (4-6 weeks to mature) now if you eat the eggs (after maturation) you will be infected because now they are ready. In feco- oral route we are usually talking about eating food contaminated with feces recently, this is usually the case. But sometimes, with some of these eggs, passing feces at an uninfective stage (still need to mature in soil) and eaten, it won't cause disease (it's up to you to consider it oral-fecal or not) but if someone touched the soil after 6 weeks, he becomes infected. (feces can contaminate food or soil)

This is the importance of hygiene; all eggs go with feces in the sewage, they will be flushed off, disappear and won't have the chance to infect other people. But in bad hygiene practices, people defecating in soil, the infection will be spread.

-others produce larvae, most of the larvae are produced by tissue nematodes, those are collectively known as filarial worms (nematodes producing larvae), which are usually the tissue nematodes. The larvae produced are called microfilariea, baby filaria. Filarial worms are quite big; they can reach 6-7 cm or more sometimes. Microfilariae are a couple of hundred microns or so, usually we need an intermediate host for microfilaria because these filarial worms live in the CT and subcutaneous tissue under the skin, where they lay their larvae, and for these larvae to come out is through a vector/insect that sucks blood with

microfilariae with it (the normal usual way), except one case where it leaves through skin directly.

So, theses microfilariae have to reach blood, so they are laid in the subcutaneous tissue and they wander in the bloodstream, and that's where the vector comes and picks them up.

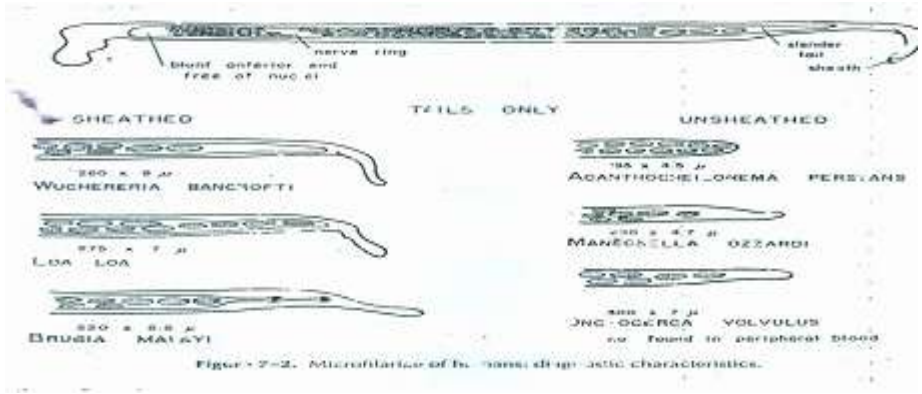
There is a kind of <u>periodicity/diurnal rhythm</u> (regarding the blood concentration) in this process (which reminds us of the secretion of certain hormones (cortisone) where it is higher in the morning to make us active and lower at night). This process depends on the <u>intermediate host;</u> mosquitos, for example, bite at night, so, you will find that the presence of these larvae in the blood is at night. If it was a fly; it bites in the afternoon, you will find that blood contains them in the afternoon.

<u>*Note</u>: this is important in diagnosis; because when you take a blood sample from the patient, you want it to contain microfilariae, so you should take it at the right time when they are present in the blood, according to the intermediate host of the parasite you are suspecting.

Microfilariae are observed under the microscope, and there are certain criteria:

1-having a sheath or not

2-the disposition of the nuclei; some extend to the end of the worm (the top right one), on the top left they don't extend all the way to end of the worm, in some cases you can find a couple of nuclei sticking to the end tail of the microfilariae (you don't have to know these details, only the criteria themselves).



Morphology of Nematodes;

- They are cylindrical in shape.

- on the outside, you will find a tough layer that is resistant to gastric juices present in GI tract called <u>*Cuticle*</u>; they need it to be protected against the noxious effect of the enzymes that are present in GI tract.

- They are quite well advanced so they have a *GIT, and it is complete. In the pictures you can see:* (mouth opening, pharynx, intestine, anal opening).

- What do they feed on?

Some of them suck blood from the wall of intestine feeding on blood cells, others suck fluids from the tissue or any fluids in the intestine, and the excrete.

- There is a rudimentary excretory system; above and below the intestines you can see these tubules (waste products go through them), then just towards the end, behind the pharynx, there is an opening/pore that collects the excretory stuff which are not required and releases them to the outside (waste products). (Tubules collecting waste from all over the body > opening pores > waste outside). Needed mainly for the waste resulting from anaerobic metabolism.

- *Rudimentary Nervous System* (a ring of nervous tissue ,a couple of ganglia black in color, around the pharynx with nerves bundles extending forward and others extend backwards). Allow the parasite to respond to noxious stimuli (it feels the pain; if pinched it retracts and it moves away upon putting something obnoxious).

-There is a reproductive system (remember that nematodes have two separate sexes). Male reproductive: contains vas deferens and a testes. The female reproductive system (remember that females are larger in size than males): uterus, ovary and vitelline ducts and so on.

-They don't have a circulatory system (heart or blood vessels), so the transmission of food etc., occurs by passive diffusion

- The metabolism: they use anaerobic metabolism (no oxygen in the intestines). Luminal parasites tend to be anaerobic.

-Luminal parasites also possess *some means for attachment to the wall of intestine lumen* (there is always a tendency to be washed out by: 1- the secretions and food coming down 2- peristalsis pushing the worm), so they adapted to these conditions by different mechanisms:

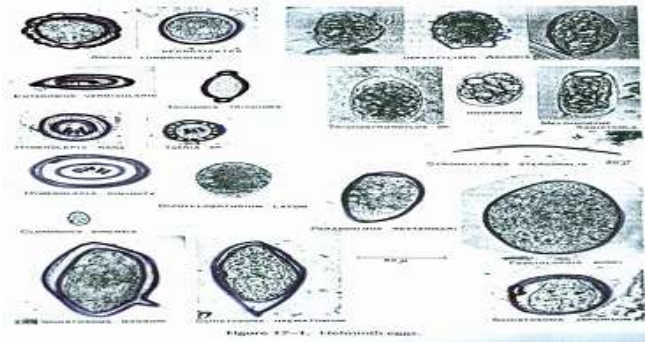
A. some have *teeth (more like hooks)* that clamp on the villus of intestines stabilizing the worm in place.

B. some inject themselves like a pin into the wall (you will find that the anterior end of the worm is very thin like a pin) → cause bleeding and iron deficiency anemia because it sucks blood. (Occult bleeding→ blood in feces that is microscopic, RBCs need to be seen by microscope for diagnosis)

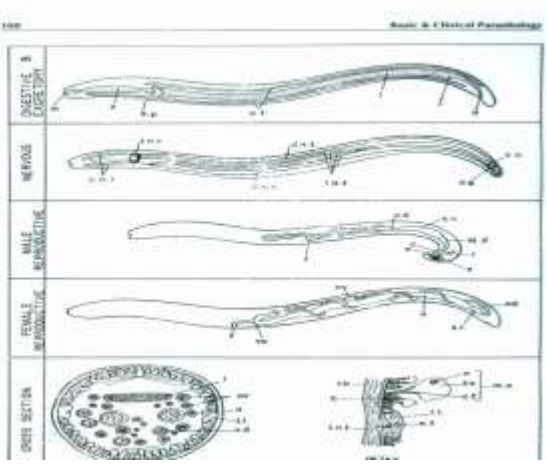
C. others are muscular: resist peristalsis and swim against the current, by pushing themselves against the rugae of small intestine (we can give drug that paralyze the muscles and so they get out alive in feces).

***note: blood in feces can be either red (normal) blood; from GI tract (in cases of dysenteriae, inflammation of large intestines), or from upper GI tract (stomach) so it is digested before excretion, black in color, called melena.**

***note: one of the ways we diagnose parasitic infection is through eggs (we look for them in the feces). Eggs have different morphologies (help in diagnosis); you don't have to know them now because they will be discussed later for each worm.**



***Microfilariae is a tube full of nuclei (laid by filarial worms in the tissue) if it remains in the body, it will not develop any further and eventually it will probably die, unless taken by vectors (intermediate host), it will develop inside the mosquito or the fly, this development leads to a change in morphology, so, it becomes infective. So, when larvae are first laid they are not infective, they have to undergo some development in the intermediate host so that when they move to a new host, they are infective and act as adult worms.**



2. Platyhelminths:

1- Cestodes/ Cestoda

-They are flattened; tape like worms, their size varies a lot; ranging from (1cm – 10 m) in length.

-their life span also varies largely (some live for few weeks or few months, others can live for 20 years).

-They are really primitive worms (compared to nematodes); not a single worm, but consisting of repeated units called proglottids, each unit acts as a separate entity or a worm (producing eggs and passing them). These proglottids vary in no. ; the smallest one consists of 3 proglottids, while the largest (10 meters in length) have 3000 proglottids.
-They are either tissue parasites or luminal parasites.
-they don't produce larvae. All of them produce eggs which spread the infection.
-They are hermaphrodites (each proglottid has both male and female reproductive organs at the same time).
-They reproduce by eggs in the uterus of the proglottid and proglottids get separated and deposited in feces.
-All of them, except for one type, require an intermediate host

Morphology:
-They have an *anterior end (scolex)* (not true head because it doesn't contain a mouth), which has specialized apparatus for anchorage to the wall of intestines; this is done by means of *suckers* on the anterior end can vary 2-4 suckers (rounded or elongated). Some of them have –beside the suckers- hooks (rostellum); a row of hooks can be single or double.
-*Neck* region is where proglottids proliferate, they start coming from the neck region and as they go down the length of the worm, they develop and mature, so at the beginning ,near the neck region, they are immature proglottids (fewer organs), later they become mature (having both male and female reproductive system in the same proglottid)
And at the ends you can see graved proglottids containing dilated uterus with lateral branches full of fertilized eggs.
Example: the smallest tapeworm Echinococcus, has 3 proglottids, the first one is immature, 2nd is mature, 3rd is gravid. (Other larger worms also are mostly divided as thirds into immature (1st third), mature (2nd third) and gravid (3rd third)).

- In the picture below, the top right scolex, has 4 suckers, so does the top left one, the difference in the rostellum on the top left one (ignore the one in the middle). If you move down you can see the proglottids, we can tell that they are mature; because they have the male and female reproductive systems; (in the proglottid on the right side of the picture) the elongated structure in the middle is the uterus, then there are two ovaries in the middle, there is also a testes. (Mature proglottid).

Testes produce sperms that fertilize eggs produced by ovaries; the fertilized eggs go to the uterus, the uterus becomes bigger and bigger and develops lateral

branches (gravid proglottid) large and branched uterus filled with fertilized eggs, black in color you can't see other structures (uterus fills the proglottid) .

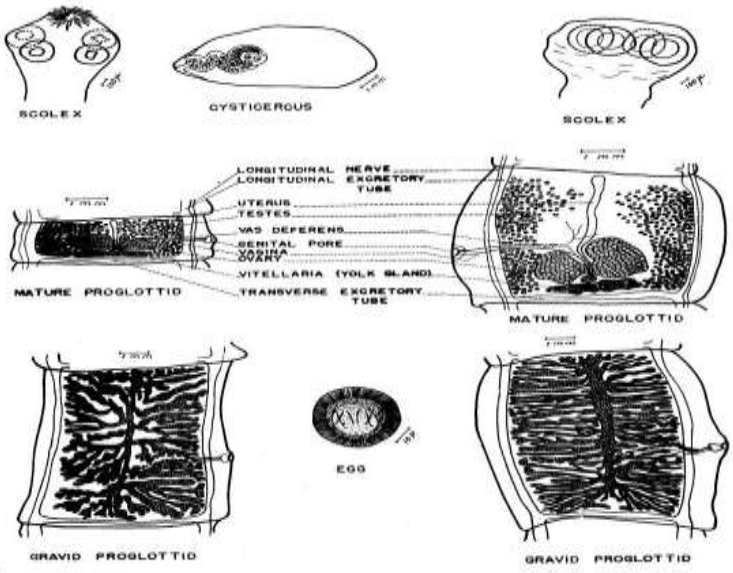


Figure 9–5. *Taenia solium* and *T. saginata*—a diagrammatic comparison.

In medical terms "gravid" means pregnant (primigravida: pregnant for the first time. Multigravida: many pregnancies before, not first time).

The eggs are not released normally like the nematodes, here there will be a separation of multiple of proglottids (10-20) and get out by feces, eventually eaten and carry out the infection. These proglottids are big in size; some can be seen with the naked eye, especially when they are present in groups. They are also motile; they have muscle fibers.

Eggs of cestodes –you can see it in the picture above- (2 or 3 exceptions) have similar structure, there is a border on the outside, the embryo has 6 hooks (3 pairs) and that's why it is known as hexacanth (embryo inside the egg of cestodes).

Canth: hooks

Sorry for any mistakes or any information that I didn't mention…