Microbiology

Sheet number: 23

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* General overview of parasitic diseases:
* The study of parasites (Parasitology) is very important in a medical point of view, because it is wide-spread all over the world, not a lot of interest because it causes diseases only in developing world.
* It is really important, causes a lot of morbidity, infection tends to be chronic, it causes death in some cases as well.
* Sometimes they can go on and on for years without any symptoms because of the relationship between the parasite and the host.
* For example:

1. A disease caused by Schistosoma parasite almost 300 million people suffer from it in the world
2. Filarial parasite 200-300 million people suffer from it.
3. 1 billion people suffer from nematodes.
4. Malaria also infects several hundred people every year, and about 1 million children die every year because of it.

* Parasites are the 2nd common cause of blindness of infectious origin, as the leading cause of blindness is Chlamydia trachoma.
* A parasite is basically ‘something’ that feeds on ‘somebody’ else’s table.
* So the patient here is referred to as the host.
* Parasites have a very complex life cycle, unlike bacteria, they posses’ more than one morphology (two or three...) according to the stages of their development and according to the environment they exist in.
* They are specially adapted to the environment, sometimes they exist in one organ in the body because of its’ environment, or they exist in only one host because they are only adapted to the environment of that host.
* Usually, we refer to the host that the parasite feed on as the primary host. (mainly humans)
* Transmission from one person to another can be direct like bacteria and viruses, and it can be transmitted from one host to another directly. Occasionally the parasite has to pass through a medium between the two hosts… it pass through an animal or an insect, and this animal or insect is referred to as the intermediate host (aka a vector. And most probably it’s given to the insect.)
* Malaria is transmitted by mosquito bite this mosquito is the vector.
* Tape worm is transmitted in meat of cows or pigs, these are intermediate hosts.
* The actual pathology caused by parasites can vary, it could be asymptomatic for many years and on the other hand it could cause pathology if the parasite is in certain tissue causing mechanical damage and sometimes you may get some toxic effects or some hypersensitivity towards the parasite, an allergy that causes the disease.
* Diagnosis of parasitic diseases varies: sometimes you can actually see the parasite, or sometimes we look for some products of the parasite (eggs or cysts) and these usually are produced and excreted outside the body in various secretions or products for example in feces or urine, etc. so to detect the parasite we can test the feces, the urine, the CSF, the blood or the sputum.
* Serology: examination of blood or serum for antibodies.
* The ab that we look for is the IgE, it is involved in parasitic diseases. Because it can attach to parasites, and eosinophils have special receptors for IgE and they can attach to it and produce the basic protein onto the parasite that could kill it.
* So IgE main function is probably for parasitic diseases and not type 1 hypersensitivity. So IgE can be increased in total or increased specifically towards certain antigen determinant of the parasite.
* So, we look for eosinophilia, because we expect the number of eosinophils to increase more that the normal range which is about 3% of WBCs, sometimes it could reach 40-50%.
* There are also some skin-allergy tests; they are not very reliable and not very used.
* Treatment: there are effective treatments against all parasites. Some of them in some cases can be toxic, but in general treatments are available. Unfortunately there are no vaccines for them.
* Toxoplasma is a parasite that causes toxoplasmosis, the primary host here is a cat or a member of the Felidae family, they exist in the GIT of the cat, the eggs or the cysts are excreted in the feces of the cat, a rat for example eats it and now the rat is the intermediate host, after that the infection could spread to a human by interacting with the feces of a cat directly or indirectly, then the human is now the intermediate host. It is very rare to spread from the humans to a cat again, so we call it a dead-end intermediate host.
* Parasites in general:
* They have different classifications, one way to classify them is to:  
  -ectoparasites, and endoparasites.

-**Ectoparasites**: that live on your body, on the outside. Like lyse.

-**Endoparasites**: the ones that live within the body, could be divided into:

1. Luminal parasites.   
 2. Tissue parasites.

* We can also divide them into 2 groups:

1. **Unicellular (protozoa)**
2. **Multi-cellular (helminths)**

* **Protozoa in general:**
* Many in number, unicellular organisms (made of one cell only), usually exist in two forms. One form that’s active and feeds, divides and causes disease and this form is known as trophozoite.
* The trophozoites vary in size, some of them will be about 3 microns in diameter, so small they can exist inside cells (so they can be intracellular parasites). And there are some other types that are very large in size that can be about 100-150 microns.
* We said that the form that actually divides, the true living form of the protozoa is called the trophozoite, they can only exist inside the body because of its environment (nutrition, temperature…) outside the body very rarely they can only survive for few hours or less before they die, so this is a problem if you need to have a transmission of the parasite from one person to another is has to be done in a special medium, for example amoeba if it got excreted in stool it will die in few hours. So here we must have an intermediate host to transmit the parasite, in case of malaria or filarial it is an insect. Usually in most protozoa the intermediate host is an insect (a mosquito or a fly). There is no problem here because the intermediate host is alive and provides good environment for the survival of the parasite.
* In case of amoeba there is no intermediate host so what really happens is that the parasite changes its morphology before it comes out.
* Here the parasite before it comes out of the body it covers itself by a protective layer and becomes a **cyst**. Not a spore, bacteria forms spores but parasites become cysts.
* These cysts can be passed to the environment by feces and can survive there long enough until it is ingested or passed on to somebody else.
* So basically, if there is no intermediate host we need another form of the parasite to be transmitted so the protozoa changes into a cyst and the cyst comes out by feces which infects someone else by oral-fecal route then it goes into the intestine and hatches there and releases trophozoites.
* This is the normal life cycle of the cyst.
* Multiplication of protozoa is by division (binary fission). So they increase in number in the host, which is not found in the helminths ( helminths don’t increase in number or multiply in the host) this is why diseases of protozoa are more serious, because the can multiply and increase in number.
* Protozoa is classified into:

1. Rhizopoda (Amoeba) the ones that move by means of pseudopodium.
2. Flagellates: posses’ flagella. Some of them can be luminal or tissue parasites.
3. Ciliates. They have cilia.
4. Apicomplexa (aka coccidia) they are so cold because they have a complex organ on the apex which allows it to go inside the cells. (intracellular)

* Multiplication as we mentioned is done by binary fission, there are the schizogony and endodyogeny; these are really forms of division.
* Multiplication is either sexual or asexual, asexual means that there is no gametogeneses, there are also cases of sexual multiplication i.e some of these parasites develop into gametocytes (male and female) these are joined together to form a zygote. That divides further and gives a new cell.
* So in protozoa, we have some species that multiply by binary fission so in asexual means. But we have other protozoa that have both; sexual and asexual multiplication.
* Protozoa don’t have a thing called a life span, but helminthes do. Because protozoa divide continuously.
* **Helminths in general:**
* Helminthes can be divided into two groups:

1. Nematodes / round worms / Nemathelminthes.
2. Platyhelminthes / Flattened worms. These are flat like a paper.

* Platyhelminths are further divided into:

1. Cestoda / Cestodes: tape worms.
2. Trematodes (Flukes): these are shaped like a leaf.

* Nematodes in general:

1. Multicellular organisms, always extracellular because they’re large in size.
2. Luminal or tissue parasites.
3. some of them are as small as 2-3 mm. or long up to 1 meter.
4. Lifespan depends on the worm itself, some of them live only for 10 weeks others can live up to 5-6 years.
5. Nematodes have separate sexes (male and female). Usually female worms are bigger that male worms.
6. Worms cannot divide, but they produce fertilized eggs that can go out of the body through feces or urine or blood, etc. depending on the worm, and then they are transmitted to another person causing disease.
7. Some of these worms like filariae, don’t lay eggs, they lay larvae straight away, and it has to be transmitted through an intermediate host.
8. Morphology of nematodes:
9. Round, they have a cuticle on the outside, which is a protective layer to protect it from the surrounding environment like the intestinal environment as it’s considered a hostile environment, because of the digestive enzymes.
10. They also have gastrointestinal tract with oral opening-pharynx- esophagus- intestines-anal opening.
11. There is also a nervous system composed of a ganglia and a nerve extending forward and backward.
12. Also they have an excretory system.
13. As there are separate sexes, the male has testes and seminal vesicle, and sometimes a spicule. The female will have ovaries and a uterus.
14. Adaptation forms for the anchorage of the worm in the organ it is living in: teeth that attach in the intestinal walls or muscles that helps them move deeper into intestinal folds, etc.

Good Luck.

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