HLS- Microbiology- Parasitology
Malaria – Lecture #2

We'll continue what we began with in the last lecture about malaria ,, we'll talk about diagnosis , treatment , and prevention. But fist let's remember the life cycle of malaria parasite :

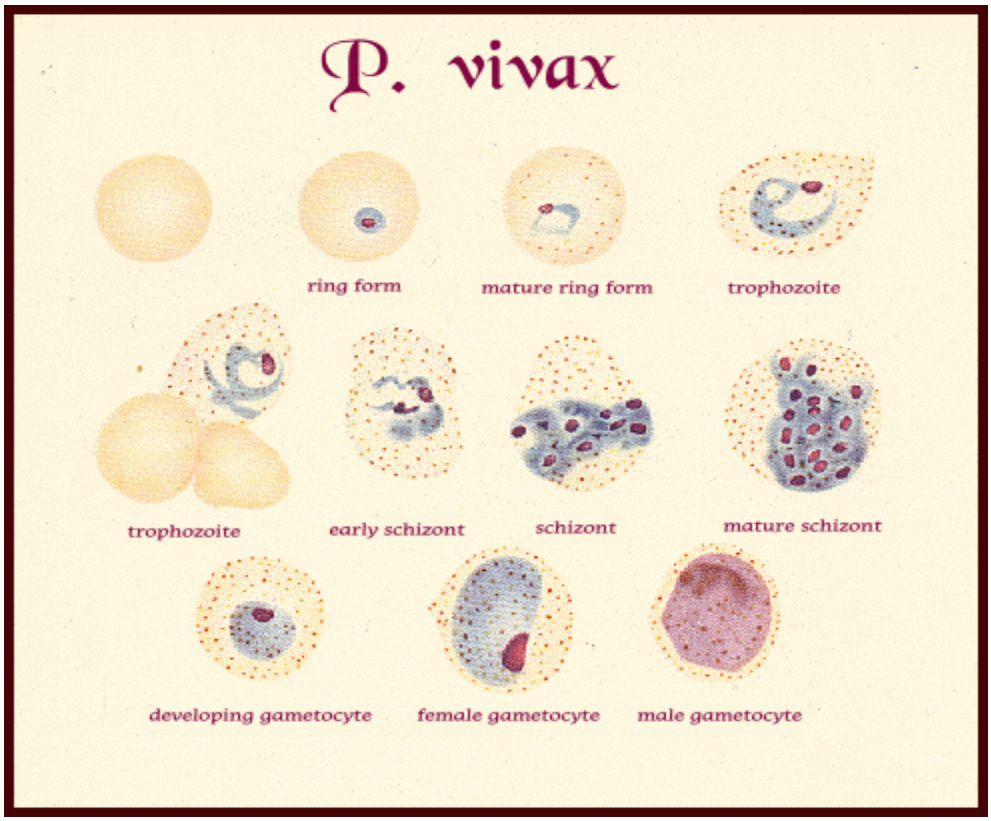
mosquito inoculates sporozoites into the human host→Sporozoites infect liver cells and mature into→schizonts which rupture and release→merozoites→ infect RBCs. (remember , in P. vivax and P. ovale a dormant stage [hypnozoites] can persist in the liver and cause relapses by invading the blood). the parasites undergo asexual multiplication in the erythrocytes of the human , and a sexual multiplication in the mosquito.
Remember:
**Falciparum is the most serious type. It infects a large proportion of RBCs, it may cause clump formation, which block small vessels (maybe in the brain) causing what we call cerebral malaria. It is characterized by convulsion, seizure, motor and sensory problems. There is no meningitis or encephalitis, but because they lack blood supply these symptoms will occur. If it was not treated it may lead to death.
**The small capillaries of the kidney may also be closed by these clumps, causing Acute nephritis and acute tubular necrosis.

❁ Diagnosis:

Of course you suspect for the clinical picture, and whether the patient lives in an endemic area or in area of malaria , and put this into consideration. Once you suspect malaria , then you ask for a blood smear because it's the way of diagnosis, you take a blood smear on 3 separate occasions on 3 successive days, or 3 samples in 2 or 3 days. Then you prepare two smears, a thick and a thin smear. Thick smear is prepared by having a small amount of blood on a glass slide → spread it by a stick → stain it → examine it under microscope . it's used to detect the presence of parasite in RBCs. You're more likely to detect them if you have a thick smear because you have a lot of RBCs. Then you prepare a thin smear by spreading the blood on a glass slide by another glass slide, so that you can see it bette r .It's used to look at the morphology for the diagnosis of species that actually cause the disease . it's better here to have a thin smear because RBCs are spread away from one another, so that you can detect morphology better.

Once you look at the thin smear then you can detect the features of different species.

●**1st we'll start with P.vivax**:

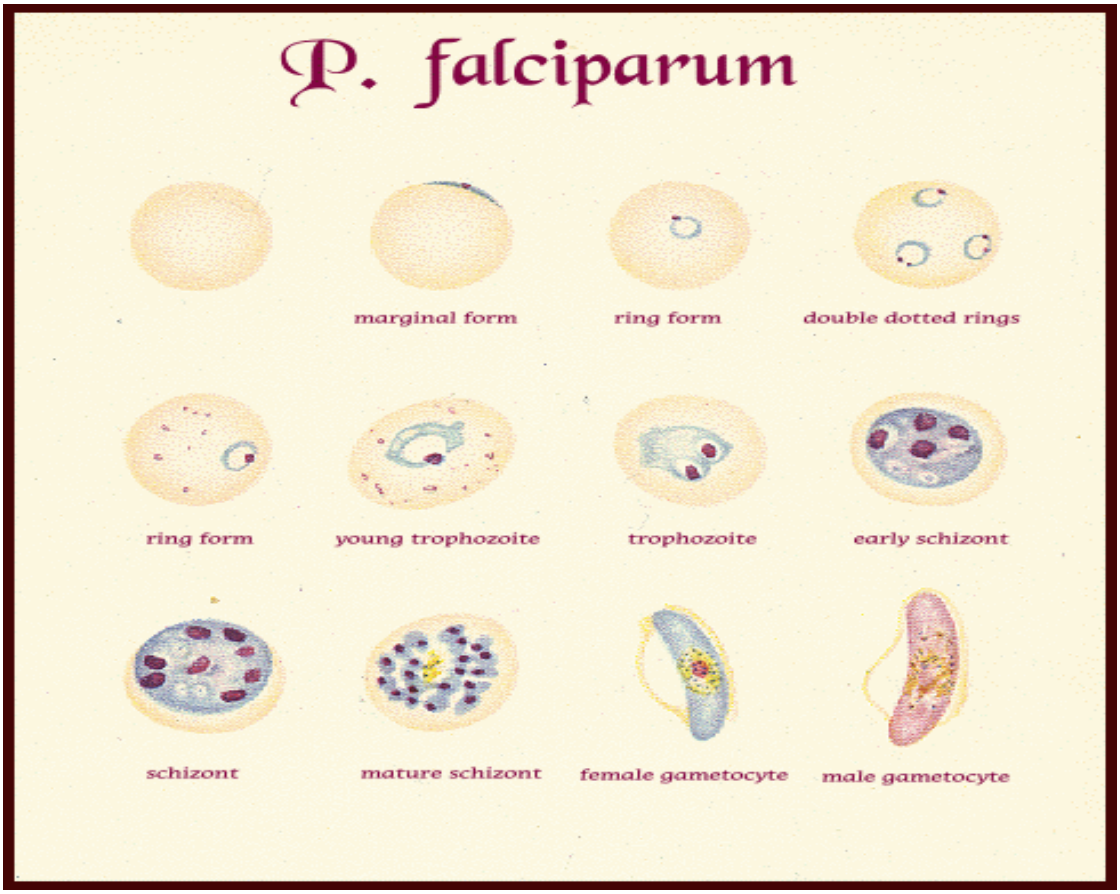


This picture above shows the different states of P.vivax. we can see the signet ring trophozoite. P.vivax tends to infect small RBCs. So the infected cells are larger than the other RBCs ,, why??! Because of the presence of the parasite inside these RBCs, and because they stay immature or relatively young RBCs . the reticulocytes are more likely to be infected by P.vivax.

Trophozoites assume ameboid structure متشعّب(variable). Also, At the surface of the RBCs you can see spots(dots) or granules which are red in color, they're called schuffner granules. It's important in diagnosis of P.vivax. you also might be able to see a pigment in the RBCs of a brownish-yellowish color but not very clearly . they are left over from the metabolism of hemoglobin , and known as hemozoites (left overs of Hb metabolism). The protein (globin) is used but the iron is left as a pigment in the RBCs.

Trophozoites as we know mature becoming schizont which rupture releasing merozoites, which infect the RBCs. Also as we know some Trophozoites may develop into gametocyte (macrogametocytes or females, and microgametocytes or males). They stay in the RBCs 'till a mosquito comes and takes them while feeding on the blood, they continue their sexual cycle inside the mosquito.

● **2nd commonest is the P.falciparum:**



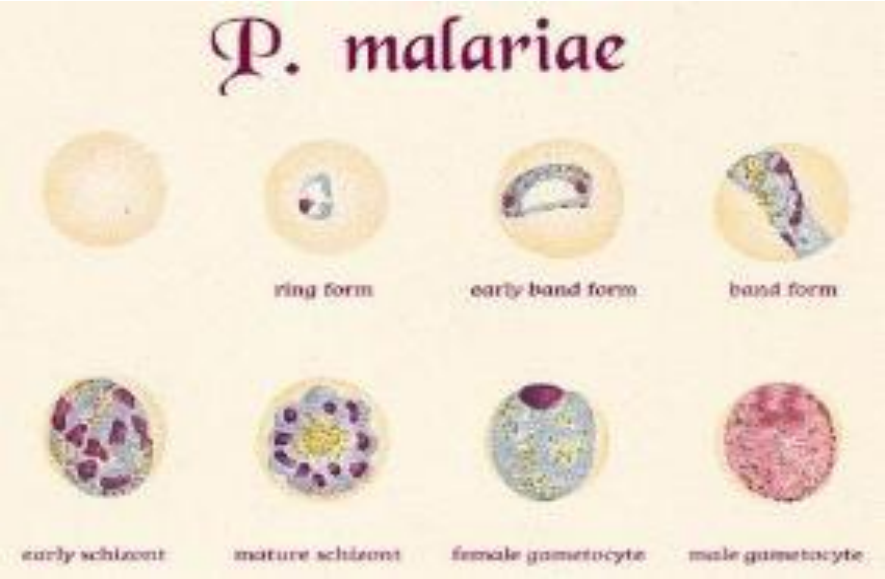
We can see the signet ring Trophozoite, which can have 2 dots of chromatin. very often with falciparum you get multiple infections (mainly Double infection) with 2-3 trophozoites within the RBC. In the RBC you may see dots but not as numerous as in P.vivax. They are elongated with comma shape and called (morodots) which are distinctive for for P.falciparum.

As we know : Trophozoite → schizont → merozoites → further infection.

Micro & macro Gametocytes of p.falciparum are distinctive because they look like a sausage or a banana, curved and elongated. And this is also a distinctive feature of P.falciparum.

Note : It infect all RBCs (not specialized neither for old nor young RBCs)

● **3rd commonest is P.malariae :**



We can also see the signet ring Trophozoite. It infects small or old RBCs, so the infected cells are going to be smaller or as the same size of other RBCs, and not like the RBCs infected by P.vivax which are larger than others. Trophozoites sometimes make double infection. And the distinctive feature of P.malariae is the band form of the parasite , which means that the parasite appear as a long band across the RBC.

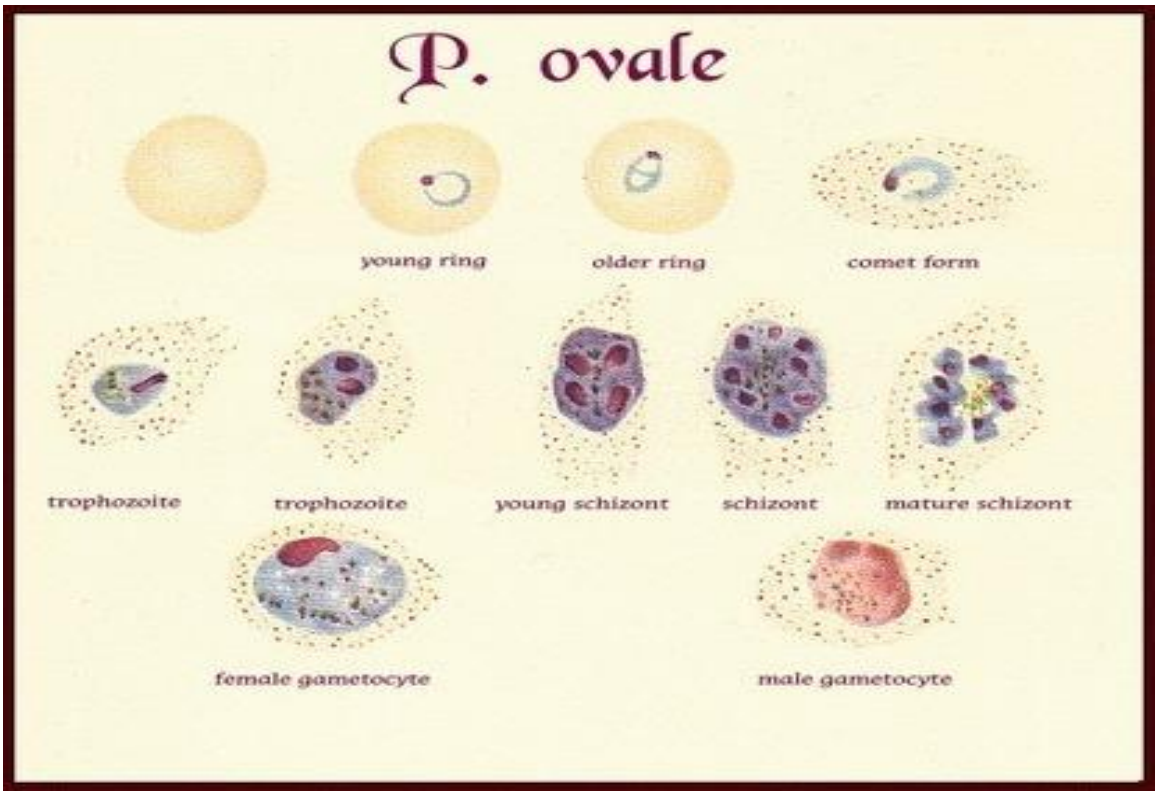
Schizont → merozoites , sometimes the division and production of merozoites give a very distinctive feature which is the rosette appearance. In center of it , there's the hemozoites.

In the pic we have, here we have 8 merozoites around the periphery and in the middle we have a hemozoin, it really looks like a flower :P This is known as Rossete form (it's a feature of plasmodium malaria.
Note That this type doesn't have schuffner granules or morodots.

●the least common is P.ovali :

It infects young RBCs which then become bigger, easily distorted and oval, so they are called P.ovali. We can see signet ring Trophozoite also here. the outlines have projections caused by distortion of RBCs . these are distinctive features of cells infected by P.ovali.

Another distinctive feature is the presence of red dots or granules which can be seen in P.vivax and P.ovali (schuffner granules). they are things that occur in the membrane of the RBCs but the significance of them is not really known.



These parasites normally don't want to kill the host, because as long as the host is alive, they are alive, and when the host dies, they will die.

**Remember :
Vivax and Ovale : infect young RBCs.
malariae :infect Old RBCs.

❀ Treatment:

Now, once you make the diagnosis ,then you can treat them. We already took that in the pharmacology, but remember that in case of P.vivax or P.ovali we should give primaquine, chloroquine, or doxycycline because of hypnozoite state which may be present in the liver cells. Also, recrudescence is reactivation of low parasitemia in case of P.malariae. so ,recrudescence happens in a way that is different from relapse.

There's no vaccine for malaria though a lot of work has been done, but generally ther's no vaccine for parasites of any type.

The doctor said that a plant called the Kina (*Eucalyptus)* that helps in fighting malaria.

Still, we can avoid acquiring malaria by many ways , here are some of them :

1- Eradication of mosquitos by draining swamps or standing water because these are the leading sites of mosquitoes, so, if we drain them we can get rid of the disease.
2- Try to kill the mosquitoes by insecticides which is not a very effective method, also it's expensive and difficult.
3- Avoid mosquitoes and avoid being bitten by them. If you sleep at night in areas having mosquitoes cover up yourself properlyand wear a long sleeve so that you'll not get bitten. Use insects repellant sprays, and mosquito nets (curtain covers your bed when you go to sleep which doesn't allow mosquitoes to go in >> bed net).
4- If you go to an area where there's malaria you should take a prophylactic treatment of antimalarial drugs . you should take a drug a week or 2 before you go to Nigeria ,for example, or middle Africa or any area which is endemic for malaria. You should carry on taking the drug while you are there, and when you come back you should continue taking the drug for about 4 weeks. So, you can kill the parasite before it gets the chance to multiply within your body. Soldiers have this prophylactic treatment when they go into endemic areas of malaria.

֍ there are a few diseases associated with endemic areas of malaria and gives a protection against it which are : G6PD deficiency, thalassemia, and sickle cell anemia.

It doesn't mean you don't get the disease , you can be infected but less severely than others because there's a protective element and that's why these diseases last in humanity. This is applied to the heterozygote state because homozygotes usually die.

Why there's a protection element in these diseases ?! there's many explanations , but here are some:

1- Duffy antigen which is the receptor for P.vivax isn't there on RBCs , so they can't be infected by P.vivax.
2- In sickle cell anemia, once the cell is infected by a parasite it sickles, once it's sickled it's taken by spleen to be destroyed.
3- In G6PD deficiency , the accumulation of oxidative molecules and free oxygen radicles is n ot only harmful to the RBC alone , but also for the parasite because they kill parasites.
4- In thalassemia the Hb is distributed to many cells so that cells have a low amount of Hb but with normal RBCs count , so when you lose RBCs, you don't lose a lot of Hb, so the loss is less.

Life cycle of the parasite within the RBC is 2 days, so the protection element is not due to the short life span of the RBC in these diseases, because even if it's short but it doesn't reach 2 says to inhibit the parasite from multiplying inside the RBC.

Recently, In sickle cell anemia, esp. in P.falciparum by which we have export of molecules to the surface which produce moben , which produces stickiness, so RBCs stick together and close up vessels in brain and kidney producing cerebral malaria and acute nephritis. When The presence of parasite inside the sickles cell , there are production of CO in the RBCs which prevents the molecules of the parasite to be exported to the surface, so they tend not to stick preventing cerebral malaria and acute nephritis.

These ways of protection generally against all species of malaria , but especially to P.falciparum which is the most dangerous.

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معركةاليومبلاأملٍبالنصر،وأنتتقاتلكيلاتخجلمننفسكْ، كيتجرؤأنتنظرفيعينيإبنكْ، كيلاتغرقكالأحلامالمخزية،وكيتبقىانسان ...
ممدوح عدوان

❀خديجة أبوزيد