3.12.1 HARMFUL PROTOZOA

1)Plasmodium vivax (malarial parasite)

****SYSTEMATIC POSITION-**

Kingdom-Protista

Subkingdom-Protozoa

Phylum –Apicomplexa

Class- Sporozoa

Subclass- Coccidia

Superorder- Eucoccidea

Order- Haemosporida

Suborder- Aconidina

Family- Haemosporidae

Genus-*Plasmodium*

Species-*vivax*

Geographical Distribution

- They are found in all countries, tropical zone is the endemic home of all malarial parasite.

Habits & Habitats-

- Plasmodium vivax is an intracellular parasite in red blood corpuscles of man.
- it occurs in the form of its mature adult condition called **Trophozoite.**
- The species of plasmodium infect wide variety of birds, reptiles and various mammals.

HOSTS-

Two host man & Anopheles culex

Structure-

- The mature adult parasite of plasmodium is called Trophozoite, which lives in red carpuscles in the man.
- The ultra structure of plasmodium observed by Granham (1966)
- Trophozoites feed on hemoglobin of R.B.C. digestion is intracellular.
- Reproduction is by both type.

Life cycle-

- It is digenetic. Asexual life cycle completed in man called Schizogony.
- The sexual life cycle completed in female anopheles mosquito by gametogony, syngamy, & Sporogony.

****Asexual cycle in man****

- Asexual cycle starts of plasmodium starts with the introduction of Sporozoites in the body of man. when infected female anopheles bites man to suck the blood, then along with its saliva it inject Sporozoites stage in to human blood. This is called inoculation.

- There is no protective covering on the body of infective Sporozoites as they always remain in the body of one of the two host.
- The Sporozoites is minute measuring about 11 to 12 micron in length and 0.5 to 1 micron in width.
- It is sickle shape cell with an oval nucleus.
- Female mosquito inoculates thousands of Sporozoites in the blood of man.

Ultra structure of Sporozoites

- The body of Sporozoites is covered with elastic pellicle. Which is helpful in gliding movement of the Sporozoites.
- At the anterior end is apical cup made up of three or more concentric rings. a pair of elongated organelles called secretory organelles open into the apical cup.
- These are supposed to secrete lytic juice to facilitate penetration in to the liver cells.

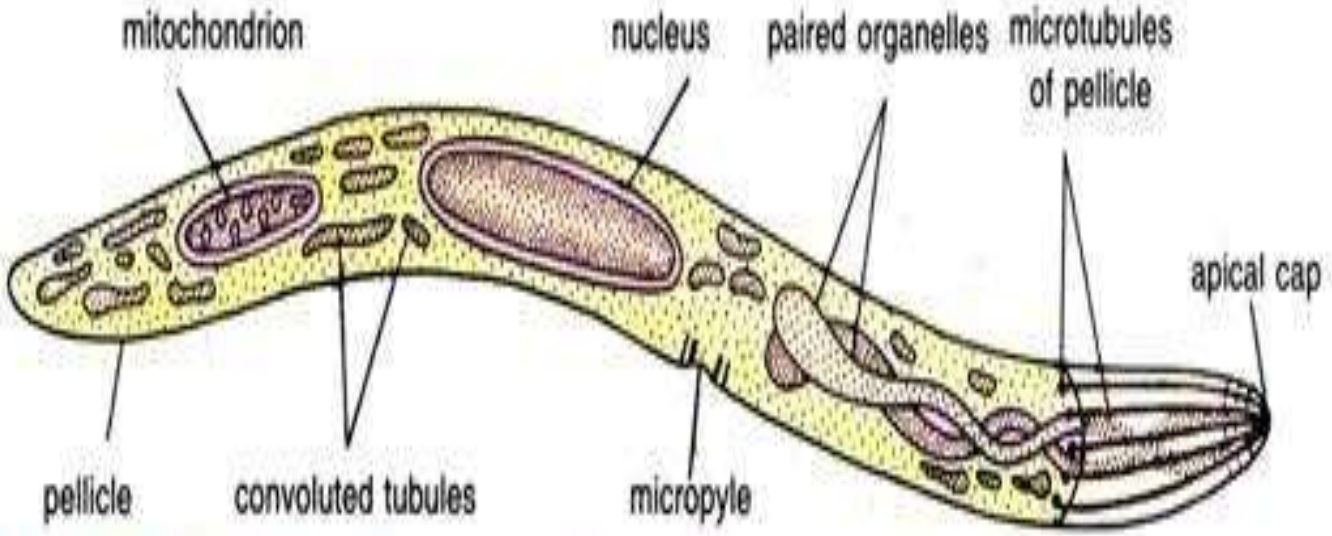

Fig. 19.2. *Plasmodium.* Ultrastructure of sporozoite as seen under electron microscope.

********pre- erythrocytic Schizogony (Schizogony in liver cells)

- **Sporozoites does not directly enter in to red blood carpuscles to start its erythrocytic Schizogony but undergoes a developmental phase inside the tissue of man. this phase is called pre-erythrocytic Schizogony.**
- **In about half an hour after incubation of Sporozoites they leave the blood and enter hepatic cells. where they undergo at least two Schizogony cycles.**

- **Sporozoites rapidly grow in size in liver cells by absorbing nourishment. they become large round and non pigmented structure called *schizonts.***
- **They measure about 10-40 microns in diameter.**
- **The Schizonts divides by multiple fission to form large number of uninucleated small spindle shape cell called merozoites. And this multiple fission is known as Schizogony.**

- **The merozoites normally invade fresh liver cell and undergo Schizogony similar to previous one producing enormous number of metacrypozoites.**
- **These are of second generation forms and this asexual multiplication is known as an *exo-erytrocytic Schizogony.***

Pre-patent period and incubation period

- **The period of biting of mosquito to man and entry of merozoites in blood is called pre- patent period.**
- **It varies species to species being of 8 days in p. vivax, 6 days in p. falciparum & 9 days in p. ovale. The period between infection and the appearance of the first malarial symptoms is called incubation period.**
- **In case of p. vivax it is about 14 days on an average ranging from 10 o 17 days.**

Erythrocytic Schizogony

- After their release from liver cells the micro metacrypozoites invades red blood carpuscles or erythrocytes.
- Inside the red blood carpuscles or erythrocytes ,the parasite assumes a rounded from and start growing at the expense of red blood corpuscles, During the growth period is called trophozoite.
- Trophozoite is become rounded and assume amoeboid shape ,this full grown trophozoite is known as Schizont

- **It shows yellowish brown pigments granules of haemozoin derived from the iron of hemoglobin of erythrocyte , which lies scattered in the cytoplasm.**
- **At this time enlarged erythrocytes cytoplasm shows small red eosinophilic granules which are known as *Schuffenes dots.***
- **The large Schizonts makes the erythrocytes to become very large. In about 36 hours the schizonts is ready for multiples fission , to form 12 to 24 oval shapes merozoites. This phase of Asexual multiplication is called erythrocytic Schizogony.**

Post- Erythrocytic Schizogony-

- **The merozoites may again go form the blood to the liver cells and invade them to undergo another phase of multiplication which is called post erythrocytic Schizogony.**

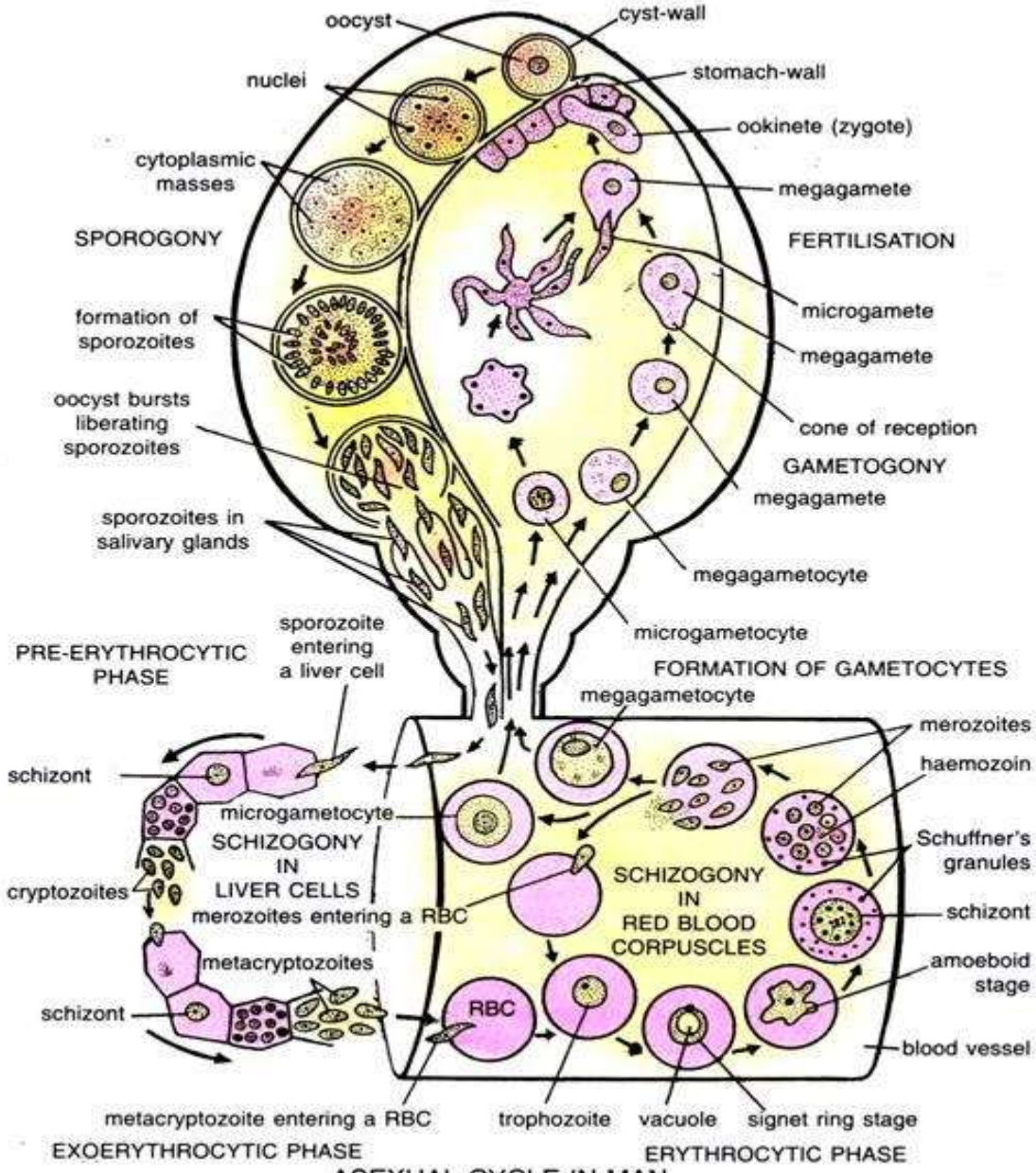

Fig. 19.3. *Plasmodum vivax.* Life cycle.

*Formation of gametocytes or gametogony

- **It begins in man & is completed in mosquito. after a number of repeated erythrocytic *Schizogony.***
- **The merozoites do not proceed ahead with erythrocytic cycle. but after entering the erythrocyte , increase in size to become rounded gametocyte. These are of two types, the male or micro gametocytes and female or macro gametocytes .**
- **Gametocytes appears in the peripheral blood at various intervals after the onset of fever.**

- They remain inactive when they are in human blood.
- The macro gametocytes are round with food laden cytoplasm and a small eccentric nucleus.
- The micro gametocyte have clear cytoplasm and a large central nucleus.
- Both of them contain large amount of haemozoin and they enlarge the erythrocytes.

Sexual cycle in mosquito-

- When the female Anopheles mosquito sucks the blood of malaria patients containing gametocytes in erythrocytes, they reach the stomach where red blood corpuscles are digested and the gametocytes are set free.
- There are many species of anopheles but all the species do act as intermediate hosts.
- During the blood meal both sexual and asexual forms of parasite are ingested by mosquito ,but only the mature sexual forms are capable of development.
- The rest die off immediately.

Fertilization

- The macrogamete now gives out a small Cytoplasmic projection called cone of reception or fertilization cone.
- Microgamete make active lashing movement and approach macro gamets.
- The nucleus of the macrogamete also come to lie near the receptive cone.

- When microgamete comes in contact with macrogamete's, is enters in to the female gamete at the point of fertilization cone and finally complete fusion of nucleus and cytoplasm of two gametes occurs, this is called fertilization or syngamy resulting in the formation of a zygote or synkaryon.
- This fusion is called anisogamy because here the gametes are dissimilar or anisogametes.

Ookinete-

- The zygotes formed remain rounded and motionless for 24 hours, but they elongate to become worm like and motile,The zygote now called Ookinete or vermicules and they perform gliding movement.
- Mitochondria and ribosome's in Ookinete.
- Ookinete are motile.

Encystment-

- Then the Ookinete become spherical and secrete a thin elastic membranous cyst.
- The cyst is also partly secreted by surrounding tissue of stomach.
- The encysted Ookinete or zygote is called **oocyst.**
- the oocysts grown in size & they are seen on the outside of midgut as transparent rounded structure. they are also called **sporont.**
- These may be 50 or more in number.
- The Ookinete which are unable to penetrate the wall of stomach, pass out from mosquitoes body with fecal matter.

Sporogony

- Each oocysts enter in a phase of asexual multiplication known as **Sporogony.**
- Nucleus is divide by meiosis and then mitosis several times, forming an enormous number of small haploid nuclei .
- Each daughter nucleus get surrounded by a mass of cytoplasm, the resulting cell is known as **Sporozoites.**
- Each oocysts contain 10,000 Sporozoites.
- Each Sporozoites is spindle shape with tapering end and broad middle part containing nucleus.

- **The oocysts burst and sporozoite are liberated in to haemolymph of Mosquito.**
- **The Sporozoites are motile, so they move to various organs but majority migrate in to salivary glands.**
- **The Sporozoites will infect a human host when female mosquito bites.**

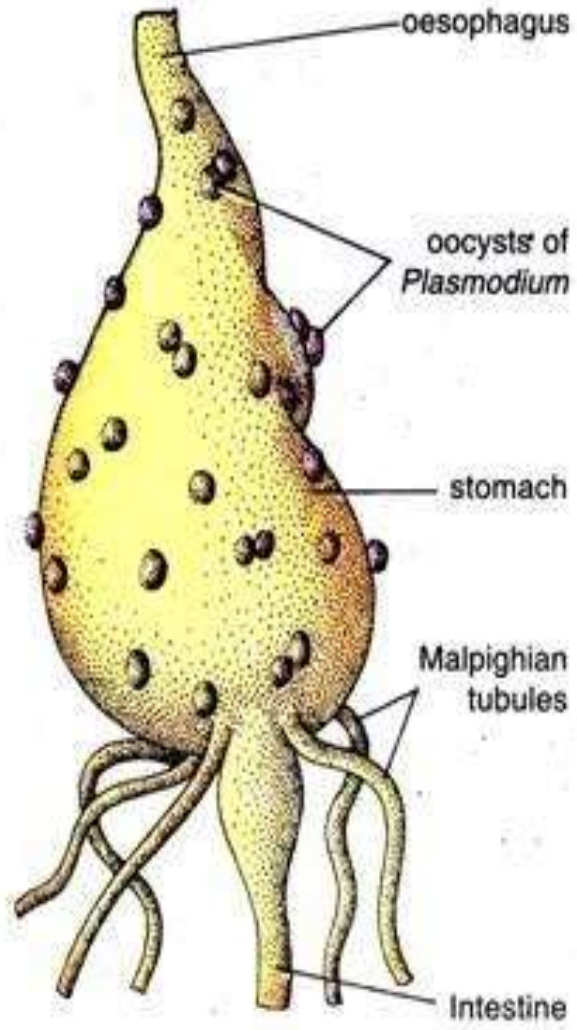

Fig. 19.4. Stomach of an infected female *Anopheles* with oocysts of *Plasmodium*.

Thank you