CHAPTER 10
MALARIA

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Malaria parasite (plasmodium)

- Pathogen of malaria
- *P. vivax* ; *P. falciparum* ; *P. malariae* ; *P. ovale*
- *P. vivax* ; *P. falciparum* are more common
- Plasmodium is a wide distribution in many tropical or subtropical regions of the world
Morphology

Wright’s stain---reddish nuclei; bluish cytoplasm and yellowish brown malarial pigment

1. Morphological features of *P. vivax*
   - Early trophozoite (ring form)
     1 red nucleus on the ring-like light blue cytoplasm; single infection in a cell.

*infected RBC like normal RBCs.*
**Late trophozoite**

It is irregular shape like ameboid form with pseudopodia; within cytoplasm, brown pigment granules (malarial pigment—haemozoin) appear. *Infected RBCs are pale in color, and have Schuffner’s dots in it (fine red granules).*
♦ **Immature schizont**

  oval in shape, nucleus divided into 2-4 or more, malarial pigment begins to concentrate in a mass.

♦ **Mature schizont**

  nucleus divided into 12-24; and cytoplasm also divided, each nucleus surrounded by a portion of cytoplasm to form merozoites, malarial pigment clumped.
♦ **Male gametocyte**

   oval in shape; 1 loose nucleus in centre of it; malarial pigments diffuse.

♦ **Female gametocyte**

   oval in shape; 1 compact nucleus not in centre of it.
2. Morphological features of *P. falciparum*

♦ Early trophozoite (ring form)

1 or 2 red nuclei on the ring-like light blue cytoplasm; multiple infection in a cell. 

*infected RBC like normal RBCs.*

*P. falciparum:*

*only can the early trophozoites and gametocytes be seen in the peripheral blood.*
♦ **Male gametocyte**
  Sausage in shape; 1 loose nucleus in centre of it; malarial pigment diffuse.

♦ **Female gametocyte**
  Crescentic in shape; 1 compact nucleus in centre of it.
Life cycle

♦ In mosquito (final host)

Gametocytes (♀ ♂) — gametes (♀ ♂)
(blood—stomach) (stomach of insect)

Union of zygote

Rupture/release rounds up into

Sporozoites (Salivary glands) Motile ookinete (the body cavity side)
In human body
1. Exoerythrocytic stage

   *bite/inject into*

   **sporozoites** → exoerythrocytic schizonts
   
   (mosquito → blood) → (hepatic cell)

   *rupture/release*

   exoerythrocytic sporozoites
   
   (blood)
There are two forms of sporozoites: tachysporozoite and bradysporozoite. They are genetically distinct at the time of maturation when they enter the hepatic cells at the same time. Tachysporozoite grow in the hepatic cell and multiply to form exoerythrocytic schizonts and then invade RBCs to clinic malaria. Bradysporozoite is the cause of relapse of malaria. Bradysporozoite stay in the hepatic cells and will multiply later.
2. Erythrocytic stage

- Early trophozoite → Later trophozoite
  - *P.f* / 36-48hrs
  - *P.v* / 48hrs

- Merozoite → Immature schizont → Mature schizont

*The process from trophozoite to merozoite is called schizogony.*
3. Gametogenesis

---After completing a few schizogonic cycles, some merozoites develop into sexual cells, the male and female gametocytes. They continue their development in the mosquito.
Characteristic of life cycle

- Intermediate host: human
- Final host: mosquito
- Infective stage: sporozoite
- Infective way: mosquito bite skin of human
- Parasitic position: liver and red blood cells
- Transmitted stage: gametocytes
- Schizogonic cycle in red cells: 48 hrs/P.v
- Sporozoite: tachysporozoite and bradysporozoite
Pathogenicity

Paroxysm (attack of malaria)

**mechanism**

---- liberation of merozoites and malarial pigment; RBC debris into the blood stream.

**symptoms (in a typical case)**

---- p.v. attack occurs once every other day (48 hours); P.f./36 to 48 hrs; P.m./72 hrs
process

----to shows a succession of 3 stages

(1). The cold stage (chill), lasting for 30 min to 1 hr.

(2). The hot stage (fever), 1 to 4 hrs.

(3). Sweating stage 1 to 2 hrs.

Characteristic

----(1). periodic

(2). repeated

(3). regular
• Splenomegaly and anemia

----Rupture of the infected RBCs and destruction of normal RBCs enhance phagocytosis—stimulate phagocytes to grow in number and enhance in function. Finally, lead to anemia and enlargement of the spleen.

Question: Which reasons are there in the anemia of malaria?
• Relapse

----a specific attack that it is up to months or even years after the primary attacks.

----The bradysporozoites in the liver spend a rest and sleeping times of months or even years, then they start develop in exoerythrocytic stage and erythrocytic stage. At this time, the patient occurs paroxysm, showing as periodic fever like the primary attacks, it is called relapse.

----Relapse only occurs in P.v.
• **Malignant malaria**

Malaria caused by *P.f.* is more severe than that caused by other plasmodia.

----The serious complication of *P.f.* involves cerebral malaria (involving the brain); massive haemoglobinuria (blackwater fever) in which the urine becomes dark in color, because of acute hemolysis of RBC; acute respiratory distress syndrome; severe gastrointestinal symptoms; shock and renal failure which may cause death.
Laboratory diagnosis

----laboratory diagnosis of malaria is confirmed by the demonstration of malarial parasites in the blood film under microscopic examination.

♦ Thin film
♦ Thick film

Question: Which stages are there in the blood film of P.v. or P.f.?
Treatment

♦ **Chlorquine and quinine** — anti-erythrocytic stage drugs. (question: Which stage of plasmodium can these drugs kill?)

♦ **Primaquine and pyrimethamine** — anti-exoerythrocytic stage drugs.
Prevention

♦ Chemoprophylaxis

-----Chloroquine / pyrimethamine

used for

prophylaxis of malaria

-----Chemotherapy: 1 week before entry into the endemic area; for 4 weeks after returning from the endemic area.
♦ Mosquito control

(1). Reconstruction of environment: eradicate the breeding places of mosquitoes.

(2). Spry insecticides: DDVP and so on.

(3). Use mosquito nets, screen, or mosquito repellents to protect the person from mosquito bites.