

Lecture – 12

Malaria

Microbiology Team - 430



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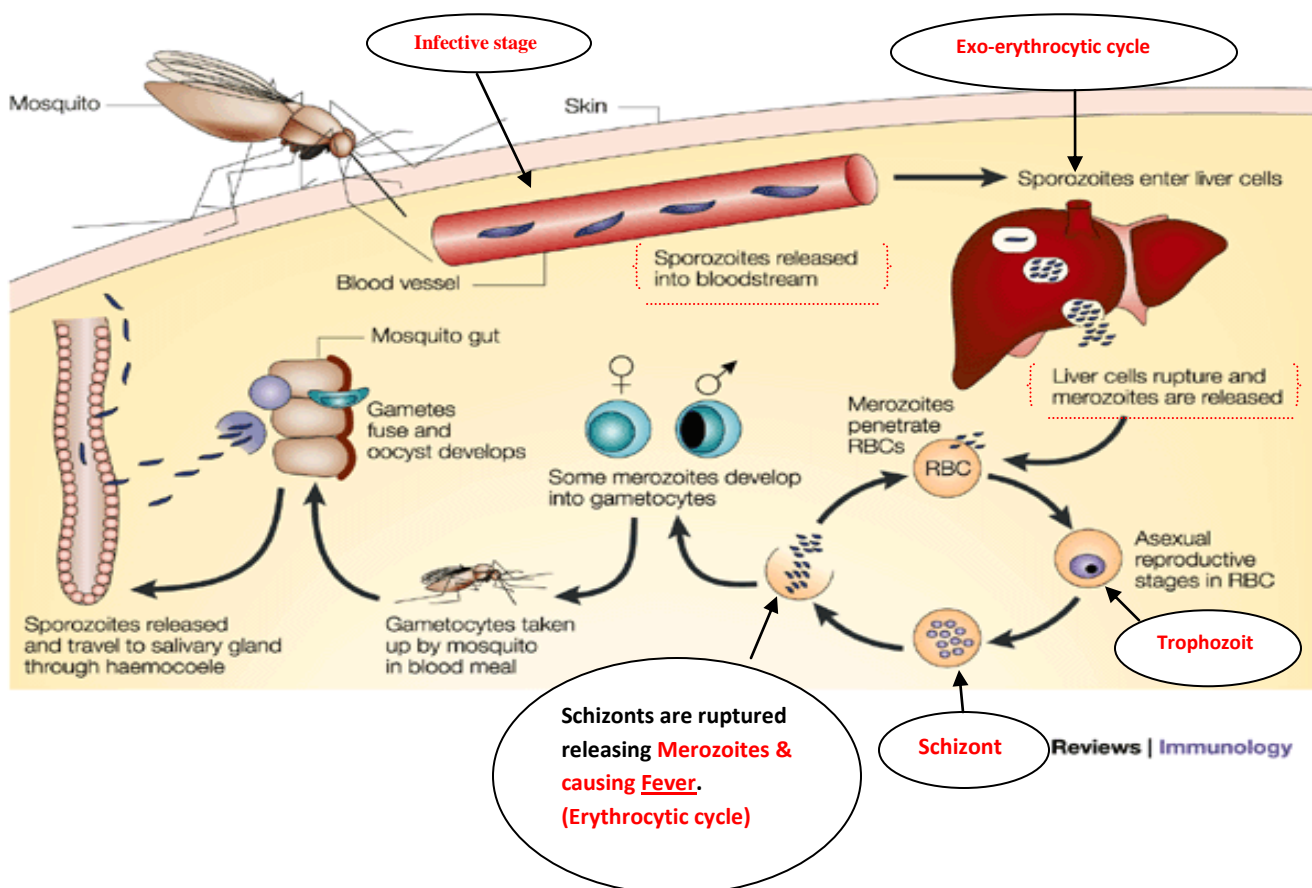
Khawla Alothman

❖ Malaria Species:

- ***Plasmodium falciparum***: malignant tertian malaria
- ***Plasmodium vivax***: benign tertian malaria
- ***Plasmodium ovale*** : benign tertian malaria
- ***Plasmodium malariae***: quartan malaria

❖ **Life Cycle:**

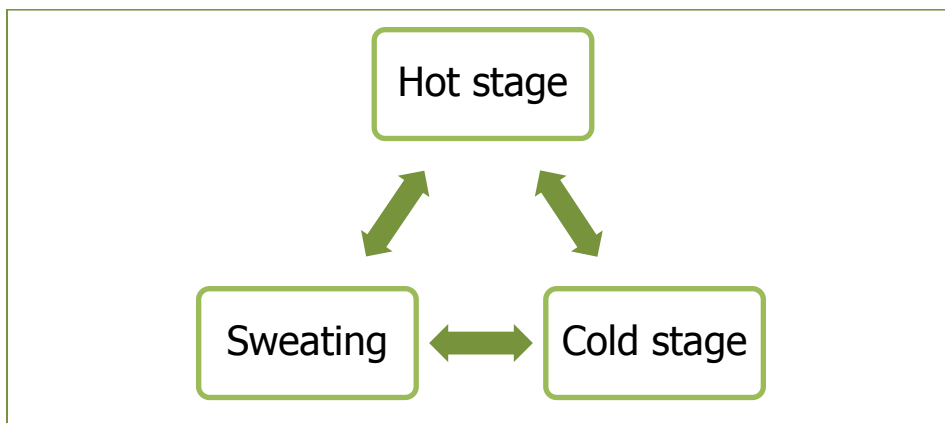
- Sporozoites are injected in human (**infective stage**) → go to the liver → in the liver cell, it divide & multiply there in a cycle called **Exo-erythrocytic cycle** → the hepatocytes rupture and release **Merozoites** → the Merozoites infect the RBCs → they grow into **Trophozoite** → become Schizont → rupture of Schizont releasing **Merozoites causing paroxysm (Fever and chills)**. This is called **Erythrocytic cycle**.
- Some of the Merozoites instead of taken by the RBCs, they grow to become **Gametocytes (male & female)** → taken by the Mosquito → fertilization occur inside the Mosquito → become Ookinete (outside the Mosquito) → grow to become Oocytes (**inside it you find Sporozoites**) (**infective stage**) → the Sporozoites released from ruptured Oocytes → Sporozoites get into the Mosquito → bites the mother person → this person become infected → repeat the cycle. This cycle is called **Sporogonic cycle**.
- This happen in all species but in Vivax & Ovale, some of the infected hepatocytes → will stay dormant (**Hypnozoites**) & won't be ruptured for several months → then it start to divide & multiply → this is causes relapse (return) of malaria. (**If someone is cured from Malaria, this will cause relapse.**)



❖ Components of the Malaria Life Cycle

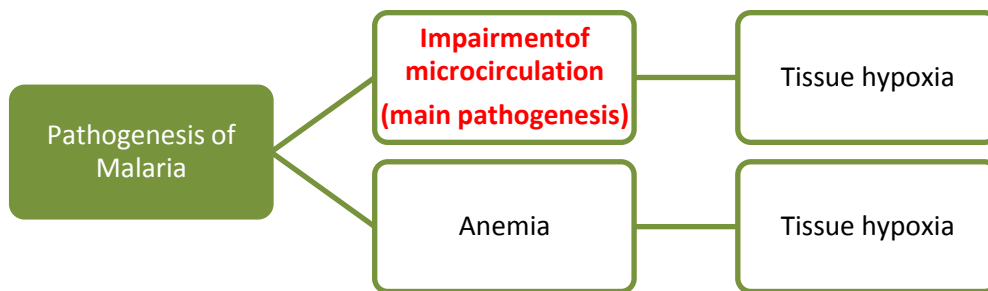
- Mosquito bites Gametocytemic person → Saprogenic Cycle → Infective Period. (This is the Mosquito Vector).
- Mosquito bites uninfected person → Prepatent Period (Parasites are visible) → Incubation Period (Symptom onset) → Clinical Illness → Recovery. (This is the Human Host).

❖ Clinical Signs & Symptoms:



These symptoms appear every 3 days.

❖ Pathogenesis of Malaria:



P. falciparum → surface changes in RBCs → Adherence of RBCs to endothelium → Decreased in the microcirculation. → Tissue hypoxia.

Anemia is due to:

- 1- Metabolism of hemoglobin by the parasite → anemia.
- 2- Formation of Ag – Ab binding → immune mediated → lysis of infected cells → anemia.

❖ Tissue hypoxia leading to Cerebral malaria complications:

- Adrenal → shock.
- Bacterial sepsis.
- Cerebral coma or hyperpyrexia.
- Gastrointestinal → dysentery.
- Hepatic → jaundice.
- Pulmonary → Edema.
- Renal failure → Anuria.

❖ Patterns of Fever

Plasmodium falciparum	Plasmodium vivax & Plasmodium ovale	Plasmodium malariae
Fever is quotidian (every day), tertian or irregular.	Fever appears every 48hr (tertian).	Fever appears every 72hr (quartan).

❖ Clinical Picture:

- **Acute Disease:** (in non-endemic area → non-immunized Pt)
 - Non-severe → Acute febrile disease → Cerebral Malaria → Death
- **Chronic Disease:** (in endemic area → immunized Pt)
 - 1- Chronic Asymptomatic Infection → Anemia → Developmental Disorders, Transfusions of the disease to other people → Death.
 - 2- Infection During Pregnancy → Placental Malaria → Low Birth weight → Increased Infant Mortality.

❖ Severe malaria:

- Symptomatic malaria in a patient with *P. Falciparum* asexual parasitaemia with one or more of the following complications:
 - **Cerebral malaria** (*unrousable coma not attributable to other causes*).
 - Generalized convulsions (*> 2 episodes within 24 hours*)
 - **Severe anemia** (*Ht<15% or Hb < 5 g/dl*)
 - **Hypoglycemia** (*blood glucose < 2.2 mmol/l or 40 mg/dl*)
 - Metabolic acidosis with respiratory distress (*arterial pH < 7.35 or bicarbonate < 15 mmol/l*)
 - Fluid and electrolyte disturbances
 - **Acute renal failure** (*urine <400 ml/24 h in adults; 12 ml/kg/24 h in children*)
 - **Acute pulmonary edema** and adult respiratory distress syndrome
 - Abnormal bleeding
 - Jaundice
 - Haemoglobinuria
 - Circulatory collapse, shock, septicemia (algid malaria)
 - **Hyperparasitaemia** (*≥10% in non-immune; ≥20% in semi-immune*). (Semi-immune pt. Is a Pt who lives in an area where *P. Falciparum* is spread wildly)

❖ Uncomplicated malaria:

- Symptomatic infection with malaria parasitaemia without signs of severity and/or evidence of vital organ dysfunction.

❖ Complications of malaria (Cerebral malaria):

- **Opisthotons** is an unrousable coma. The CSF cell count is normal.

❖ Malarial Paroxysm :- “sudden attack”

- Cold stage
 - feeling of intense cold
 - vigorous shivering
 - lasts 15-60 minutes
- Hot stage:
 - intense heat
 - dry burning skin
 - throbbing headache
 - lasts 2-6 hours
- Sweating stage:
 - profuse sweating
 - declining temperature
 - exhausted and weak → sleep
 - Lasts 2-4 hours.

❖ Malarial Haemoglobinuria:

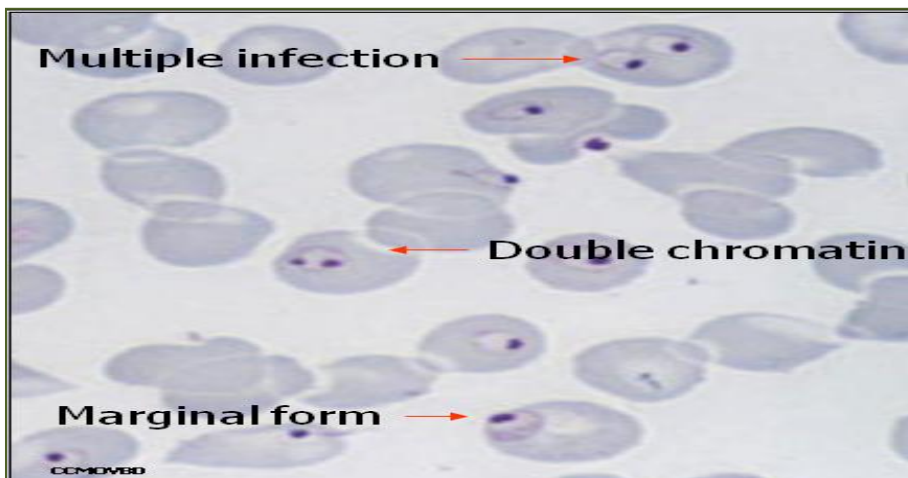
- Patients with glucose-6-phosphate dehydrogenase (G6PD) deficiency may develop intravascular haemolysis and Haemoglobinuria precipitated by Primaquine and other Oxidant drugs, even in the absence of malaria.
- Haemoglobinuria associated with malaria ("**black- water fever**") is uncommon and malarial Haemoglobinuria usually presents in adults as severe disease with anemia and renal failure.

❖ Diagnosis Of Malaria:

- The two methods common in use :
 1. Light microscopy (Is the gold standard for diagnoses of malaria)
For :
 - Parasite density.
 - Species diagnosis.
 - Monitoring resapons to treatment.
 2. Rapid diagnostic tests (RDTs). → Could be Plastic cassette, Card, Dipstick or Hybrid cassette-dipstick

❖ *Plasmodium falciparum* (trophozoite stage):

- **Diagnostic Points:**
 - Small, regular, fine to fleshy cytoplasm
 - Infected RBCs not enlarged
 - Numerous, multiple infection is common
 - Ring, comma, marginal or accolé forms are seen; often have double chromatin dots
 - Maurer's dots not clearly visible



❖ Summary

- 1- The infective stage of malaria is when Sporozoites enter the human body. Then, it divides & multiplies in the liver in a cycle called **Exo-erythrocytic cycle**.
- 2- The Malarial Paroxysm occurs after the rupture of Schizont releasing Merozoites and other substances in the infected RBC which cause mediate the clinical picture.
- 3- Malarial Paroxysm is presented with **chills** and vigorous **shivering** at first (**Cold stage**). Then the patient feels an intense **heat** accompanied by **severe headache** (**Hot stage**). Next a period of profuse sweating & the **fever will start to decline**. The patient is exhausted and weak and will usually **fall asleep** (**Sweating stage**)
- 4- Hypnozoites in **P.Vivax & P.Ovale** causing relapse.
- 5- Complications of malaria are mostly caused due to P.falciparum because it causes impairment of microcirculation (main pathogenesis) & anemia leading to tissue hypoxia.
- 6- The main complications of malaria are **cerebral malaria** (causing Opisthotons which is an unrousable coma), **severe anemia, pulmonary edema, hypoglycemia, renal failure, shock, dysentery & Jaundice**
- 7- The pattern of fever in **P.falciparum** is usually **quotidian** (at the start). However, in **P.Vivax & P.Ovale** the fever appears every **48 hrs** & in **P.Malaria**, it appears every **72hr**
- 8- Haemoglobinuria associated with malaria causes **black-water fever** and it is uncommon.
- 9- Haemoglobinuria associated with malaria may present in **adults** as severe disease with **anemia & renal failure**, it could be precipitated by drugs. People with G6PD deficiency treated with primaquine may suffer from acute hemolysis.
- 10- Light microscopy is the gold standard for diagnoses of malaria. But using Rapid diagnostic tests RDTs is also an option.