Malaria

An Overview

of

Life-cycle,

Morphology

and

Clinical Picture

Dr MONA BADR

Malaria

Malaria is a life threatening disease .It`s typically transmitted through the bite of an infected Anopheles mosquito.

Malaria is the most important of all tropical parasitic disease ,causes death and debility and is endemic throughout the tropics and subtropics.

The main symptoms and signs are periodic fever, headache ,anorexia and anemia.

- **Four species of malaria infect humans:**

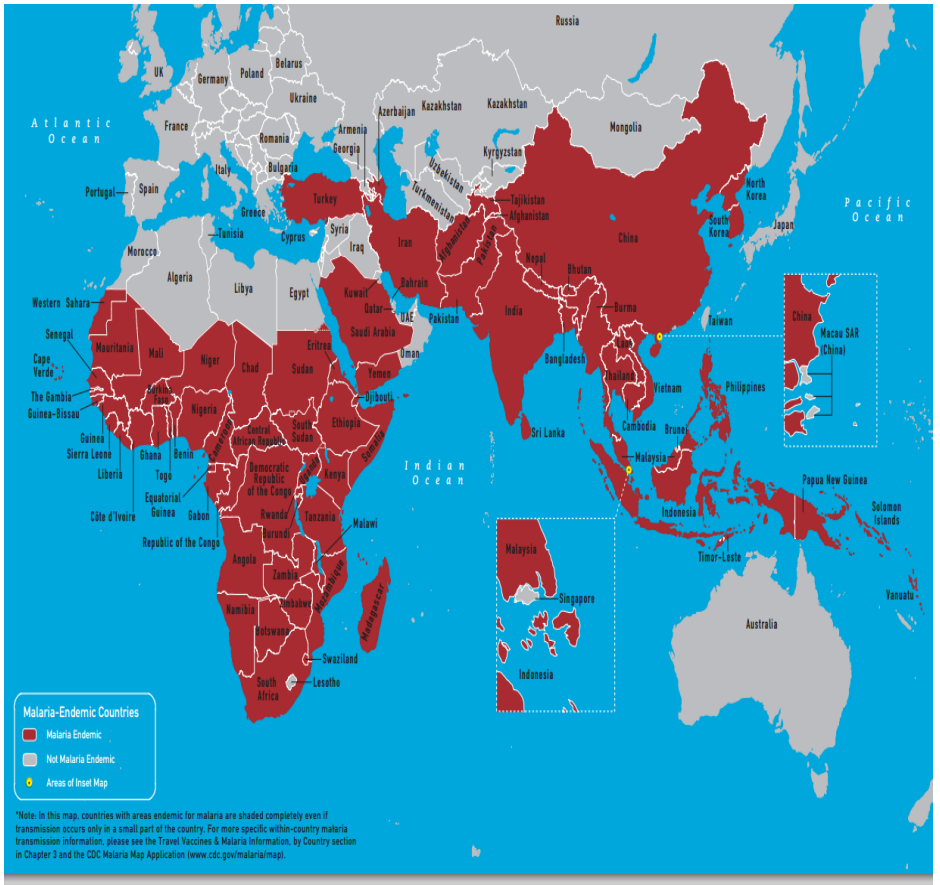
1-Plasmodium falciparum**malignant tertian.***

2-Plasmodium vivax(relapse ,tertian))

- ***3-Plasmodium ovale (relapse,tertian))***
- ***4-Plasmodium malariae ,quartan .***
- ***5-Plasmodium knowlesi***

Epidemiology of Malaria

The world health organization (WHO) reported 229 million malarial cases in 2019, down from 239 million cases in2010.
It is endemic in several parts of the world .
The African Region contributes most malaria cases (93%)followed by south east Asia(3.4%),and the Eastern Mediterranean region 2%.



Life cycle of Malaria

- **Asexual stage in human :**

sporozoites (infective stage for human)are injected by an infected **Anopheles Mosquito** into the blood of human and enter liver cells and will become schizonts then become Merozoites whish release in the circulation and penetrate **the Red Blood Cell** and cause the **main pathology** of the disease **hemolysis and anemia** . Some parasites develop into male and female **Gametocyte**

(the infective stage to mosquito) .

- **Sexual stage in female Anopheles mosquito:**

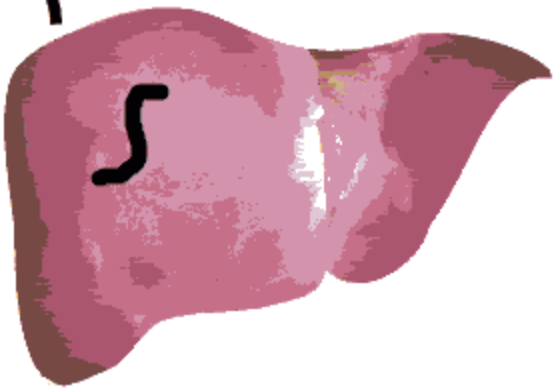
Male and female **Gametocyte** are taken up from the blood of an infected human .Further sexual development takes place in the mosquito gut to produce **SPOROZOITES.**

Human to human transmission can occur by blood transfusion or vertical transmission across the placenta.

Sporozoites in mosquito saliva

Mosquito bites uninfected human

Sporozoites enter bloodstream and migrate to liver, infecting hepatocytes



Mosquito bites infected human

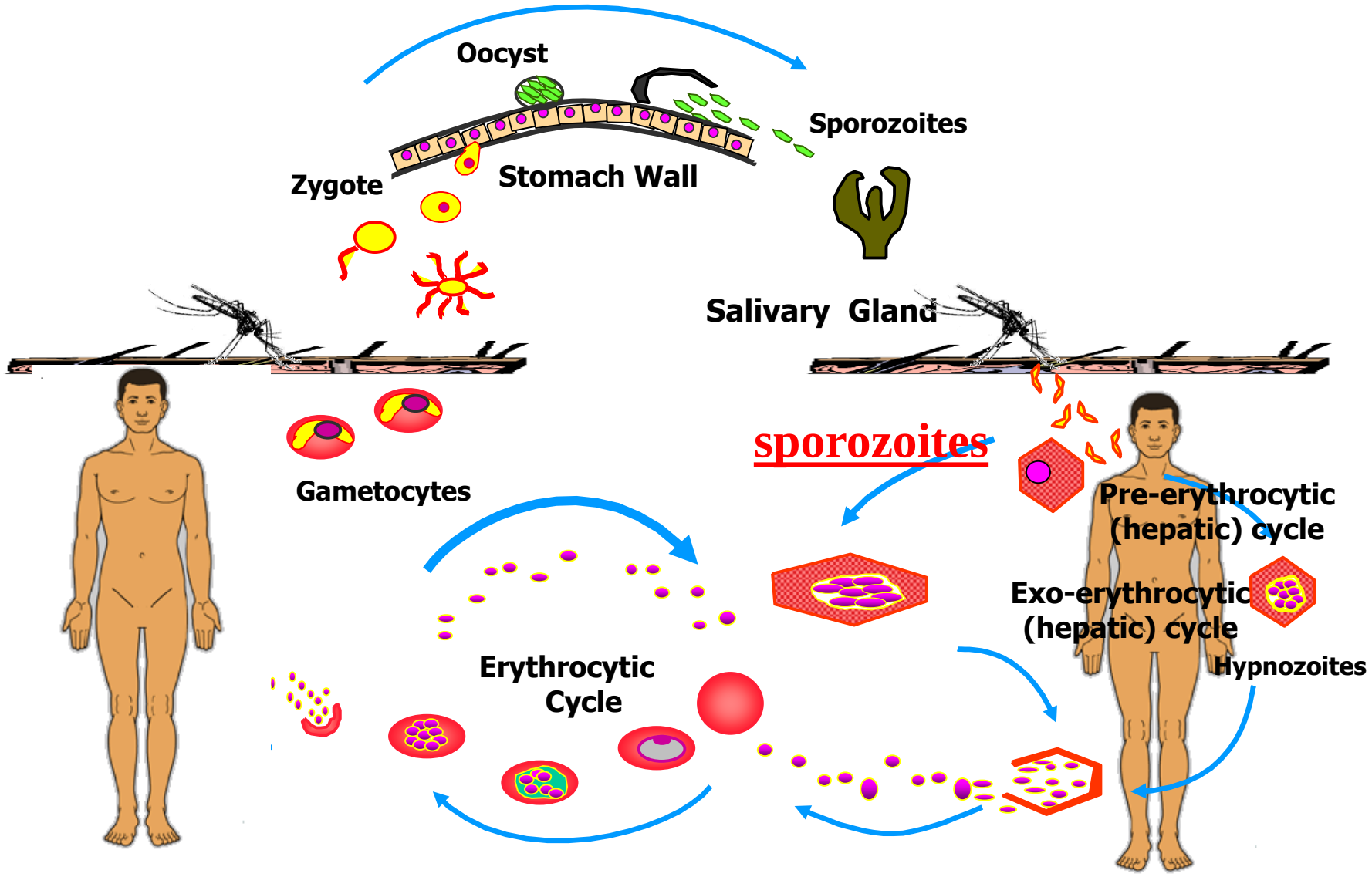
Symptoms occur

Fever due to rupture of blood schizonts

Merozoites released, infect erythrocytes (fever results from escape +reinfection of Merozoites)

Erythrocytes become

LIFE CYCLE OF MALARIA



What is the Pathogenesis of Malaria?

- After a mosquito takes a blood meal, and introduce the sporozoites into the blood stream ,the sporozoites will enter the hepatocytes **(liver phase)** within minutes and then emerge in the blood stream again after a few weeks as merozoites.
- Merozoites rapidly enter the erythrocytes**(red blood cells)** they develop into trophozoites and then into schizonts (contains large number of merozoites) **(erythrocytic phase).**Rupture of infected RBCs (contains schizonts) leads to release a huge number of merozoites in the circulation with fever ,Merozoites enter another RBCs and the process repeated leading to severe hemolysis and anemia.
- **Hemolysis of Red Blood Cells : with release of metabolites and pigments from Malaria parasite and severe hemolysis and anemia is the main pathology of malaria.**

Pathogenesis of MALARIA

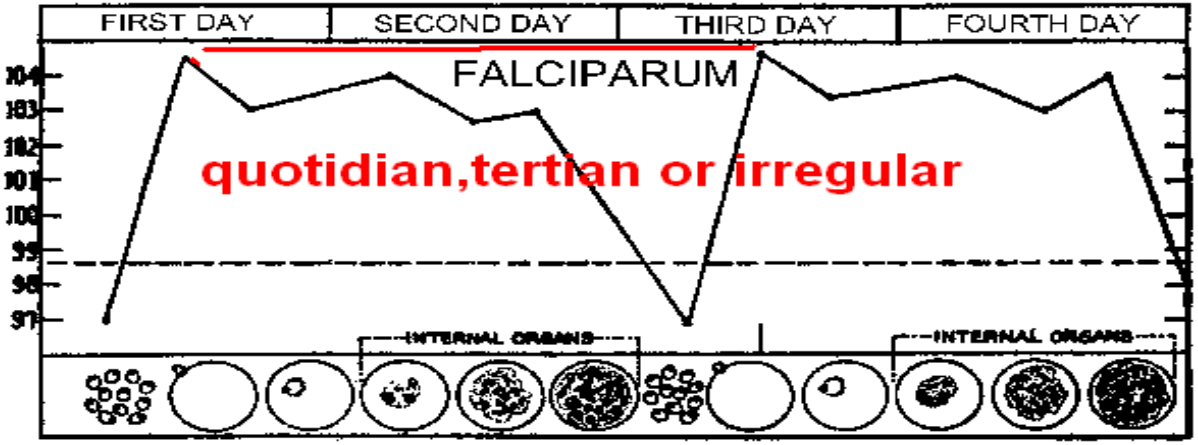
- Symptoms are due to:
- **Hemolysis of Red Blood Cells :** with release of metabolites and pigments from Malaria parasite.
- **Plugging of capillaries by parasitized erythrocytes :**
- In cerebral malaria there is sequestration of parasites in central nervous system capillaries.

***Plasmodium falciparum*:**

Malignant ,tertian,irregular

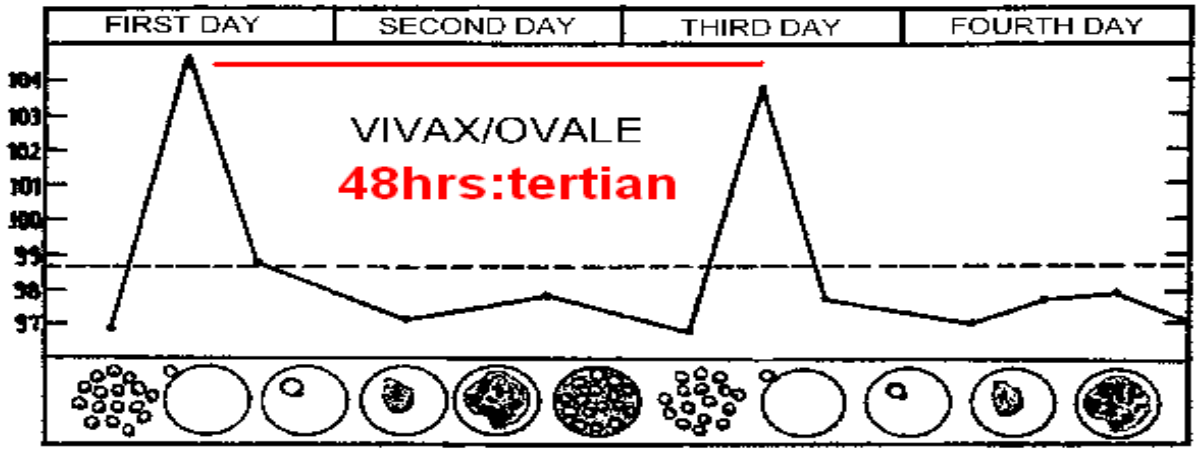
Complicated

malaria

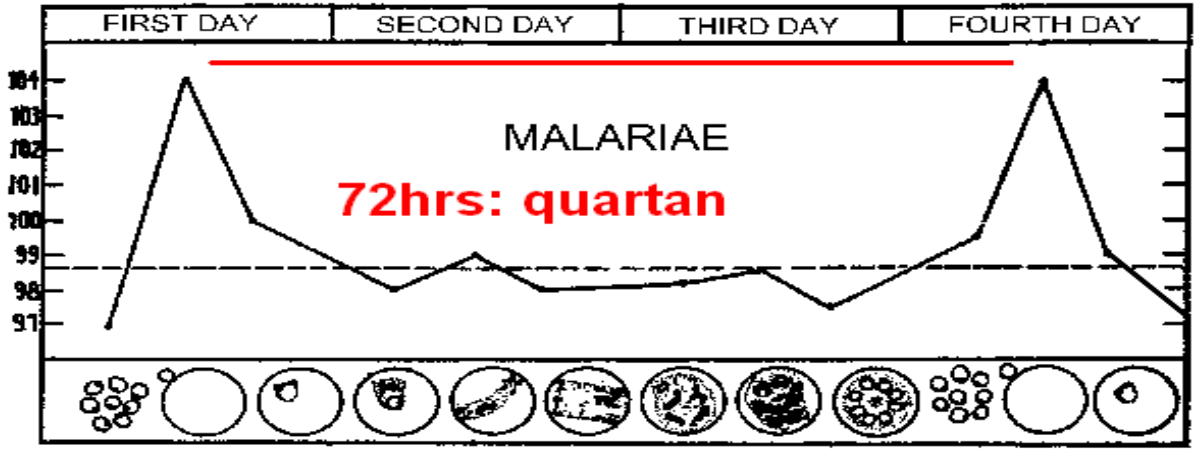


Plasmodium vivax,relapse,terian

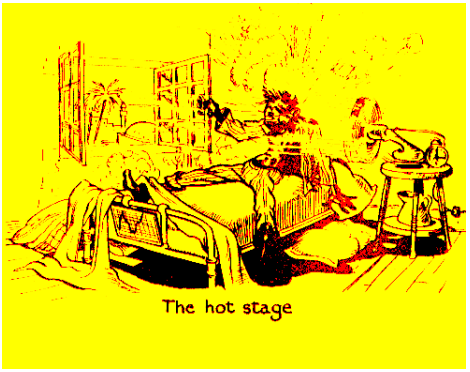
Plasmodium ovale



Plasmodium malariae,quartan\:



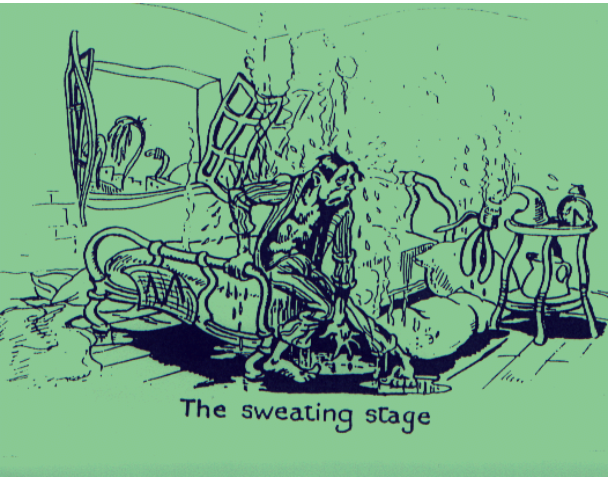
CLINICAL SIGNS & SYMPTOMS OF MALARIA

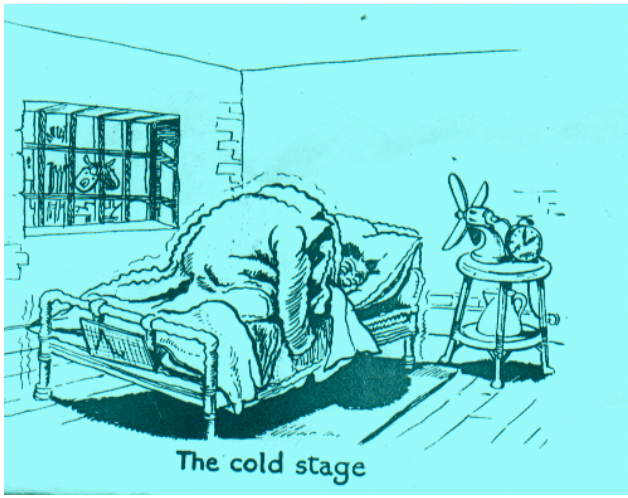


Fever

Chills

Sweating





Malarial Paroxysm

cold stage

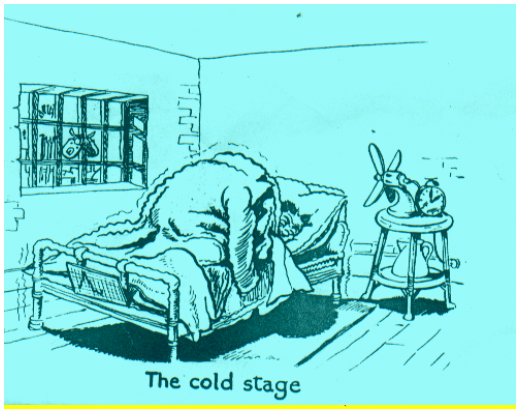
- •feeling of intense cold
- •vigorous shivering
- •lasts 15-60 minutes

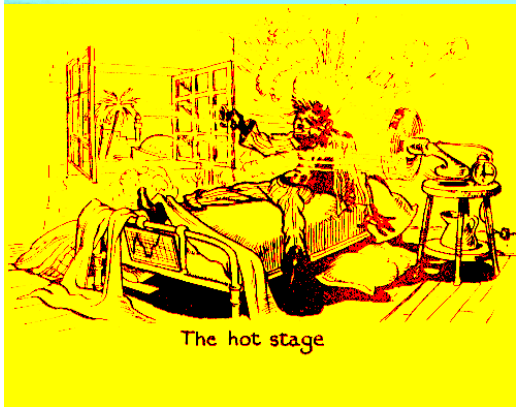
hot stage (fever) due to rupture blood schizonts.

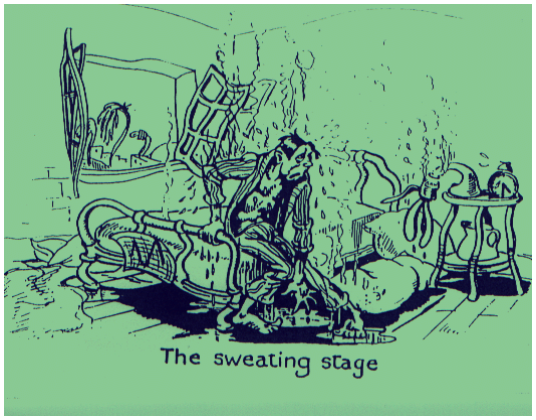
- •intense heat
- •dry burning skin
- •throbbing headache
- •lasts 2-6 hours

sweating stage

- •profuse sweating
- •declining temperature
- •exhausted and weak → sleep
- •lasts 2-4 hours







CLINICAL PICTURE

Acute Disease

Non-severe Acute Febrile disease

Severe malaria e.g. Cerebral Malaria

Death

Chronic Disease

Chronic Asymptomatic Infection

Anemia

Developmental Disorders; Transfusions; Death

Infection During Pregnancy

Placental Malaria

Low Birth weight

Increased Infant Mortality

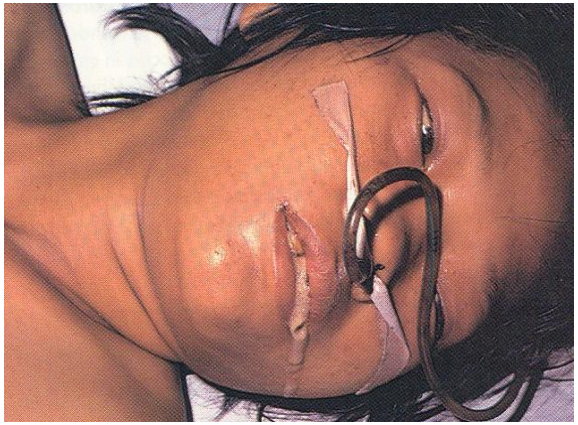
Complication of Severe MALARIA

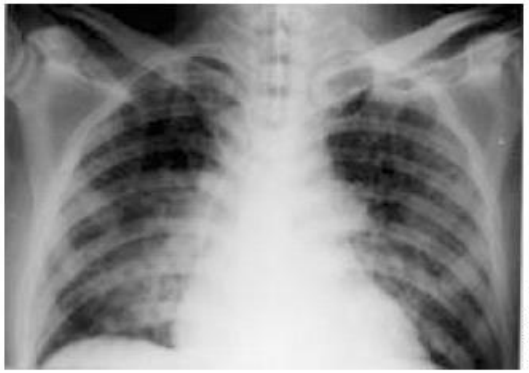
- **Severe malaria is defined as symptomatic malaria in a patient with *P. falciparum* (malignant malaria) with one or more of the following complications:**
  - **Cerebral malaria**
  - Generalized convulsions *(> 2 episodes within 24 hours)*
  - Severe normocytic anemia *(Ht<15% or Hb < 5 g/dl)*
  - **Hypo-glycaemia *and pulmonary edema in pregnancy can lead to abortion ,stillbirth seen in tropical Africa.***
  - Metabolic acidosis with respiratory distress *(arterial pH < 7.35 or bicarbonate < 15 mmol/l)*
  - Fluid and electrolyte disturbances
  - **Acute renal failure *(blackwater fever)***
  - Acute pulmonary edema and adult respiratory distress syndrome
  - Abnormal bleeding
  - Jaundice
  - Hemoglobinuria
  - Circulatory collapse, shock, septicemia
  - Hyper-parasitaemia (*≥10% in non-immune; ≥20% in semi-immune)*
  - ***Tropical splenomegaly.***

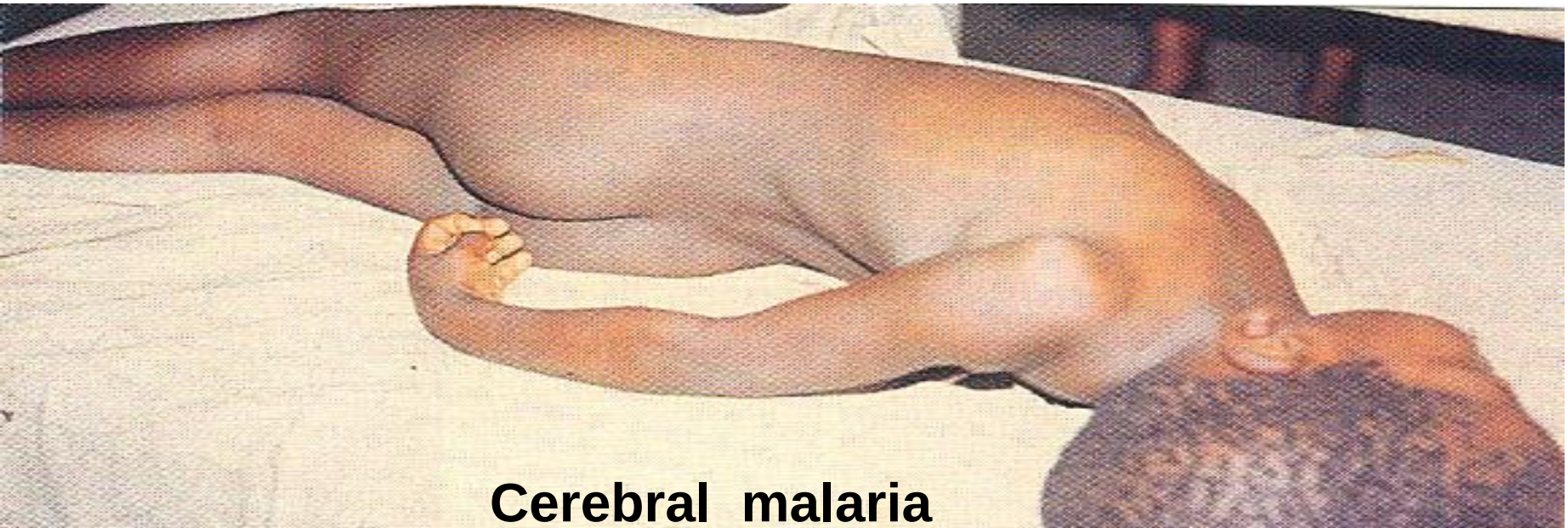
Severe Complications of malaria :

P. falciparum

Hypo glycaemia *and pulmonary edema in pregnancy*





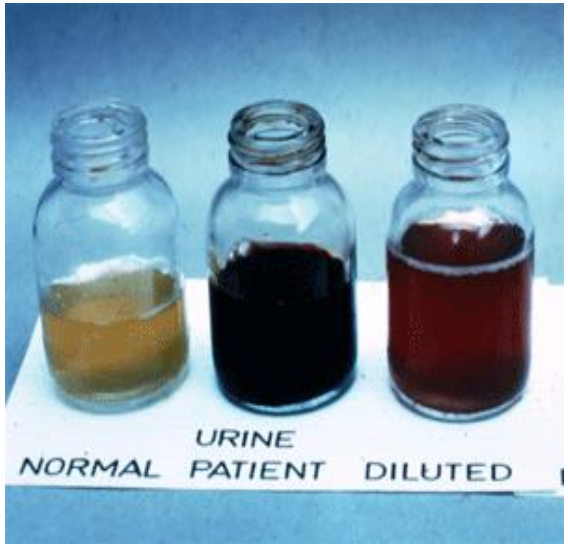


Cerebral malaria

P. falciparum

Child with severe malaria anemia in conjunction with acidosis and respiratory distress

Malarial haemoglobinuria



P. falciparum

Clinical Picture :

Hemoglobinuria associated with malaria (**"blackwater fever**") is uncommon and malarial hemoglobinuria usually presents in adults as severe disease with anemia and renal failure.

Complications of malaria :

anaemia

Child with severe malaria anaemia and no other malaria complication

Common two methods for parasitological diagnosis of malaria

1: Light microscopy

Thin film&thick film

Gold standard

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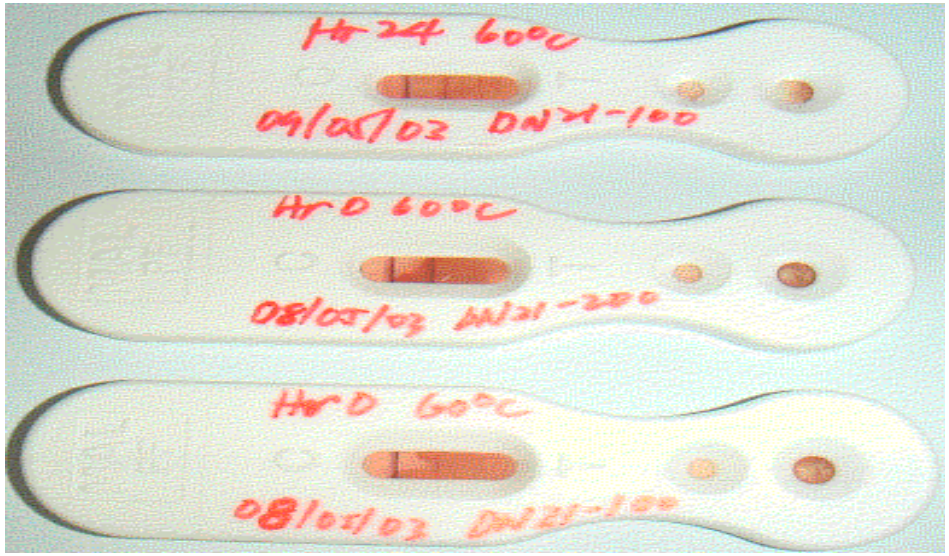
2: Rapid diagnostic tests (RDTs)

To detect the malarial antigen.

For screening



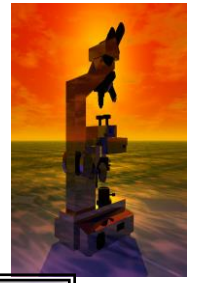
The Malaria Parasite

Trophozoites,merozoite ring stage

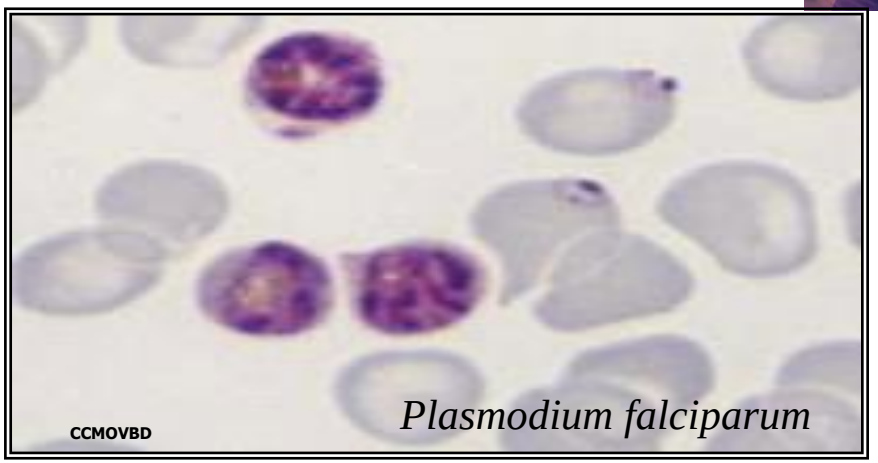
Three developmental stages seen in blood films:

1. Trophozoite ,Merozoites (ring stage)
2. Blood Schizont
3. Gametocyte

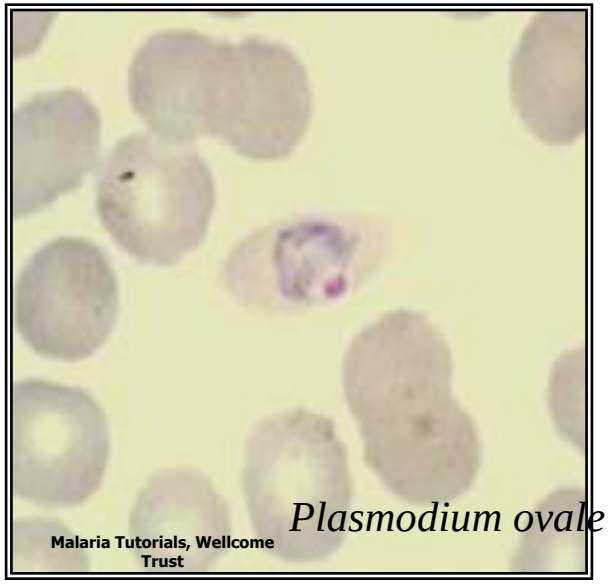
Microscopy is the gold standard for diagnosis of malaria



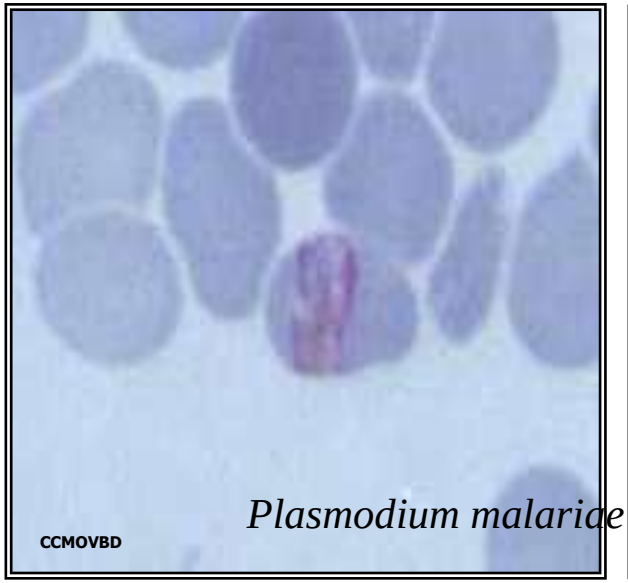
- Parasite density
- Species diagnosis
- Monitoring response to treatment



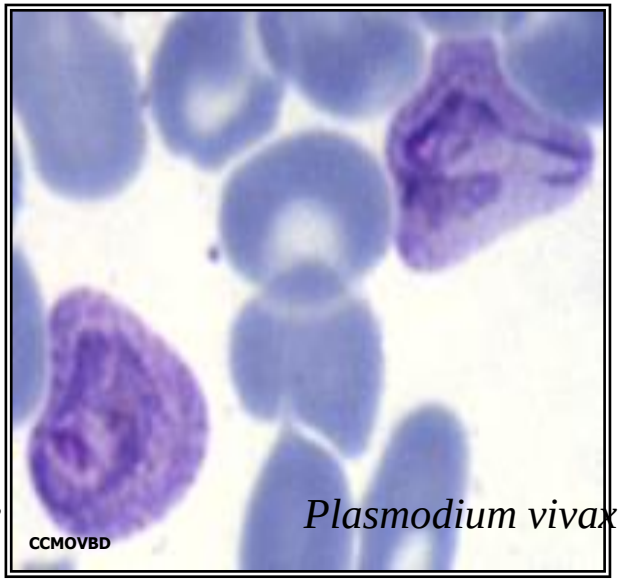
Plasmodium falciparum



Plasmodium ovale



Plasmodium malariae



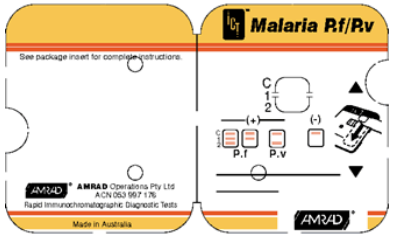
Plasmodium vivax

Laboratory diagnosis of malaria

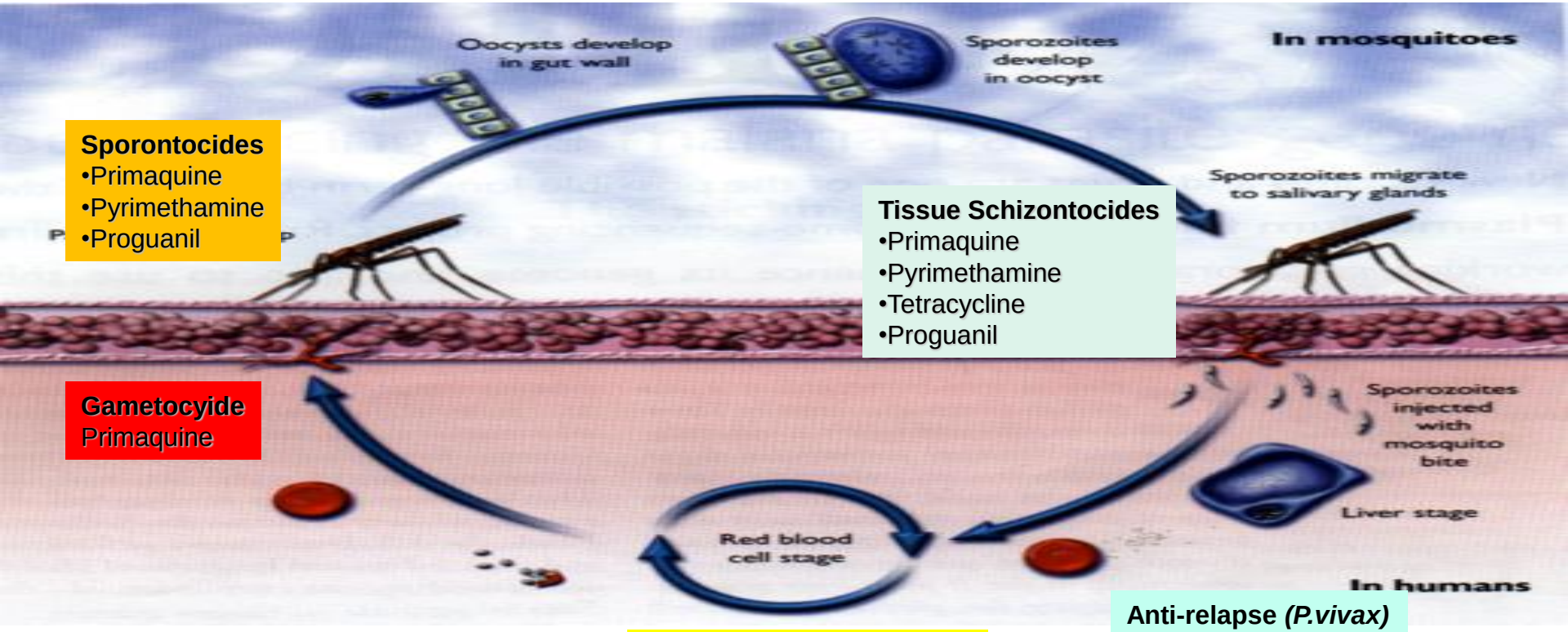
Rapid diagnostic tests detect malaria antigens

The products come in a number of formats:

- Plastic cassette
- Card
- Dipstick
- Hybrid cassette-dipsticks



ACTION OF ANTIMALARIAL DRUG IN THE DIFFERENT LIFE STAGES OF THE MALARIA PARASITE



Sporontocides
- Primaquine
- Pyrimethamine
- Proguanil

Tissue Schizontocides
- Primaquine
- Pyrimethamine
- Tetracycline
- Proguanil

Gametocyide
Primaquine

Anti-relapse *(P.vivax)*
- primaquine

Blood Schizontocides
- Chloroquine
- Sulfadoxine/Pyrimethamine
- Quinine
- Artemisinins