Microbiology
437

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MED437
KING SAUD UNIVERSITY

MALARIA

PARASITIC INFECTION OF GIT

Malaria

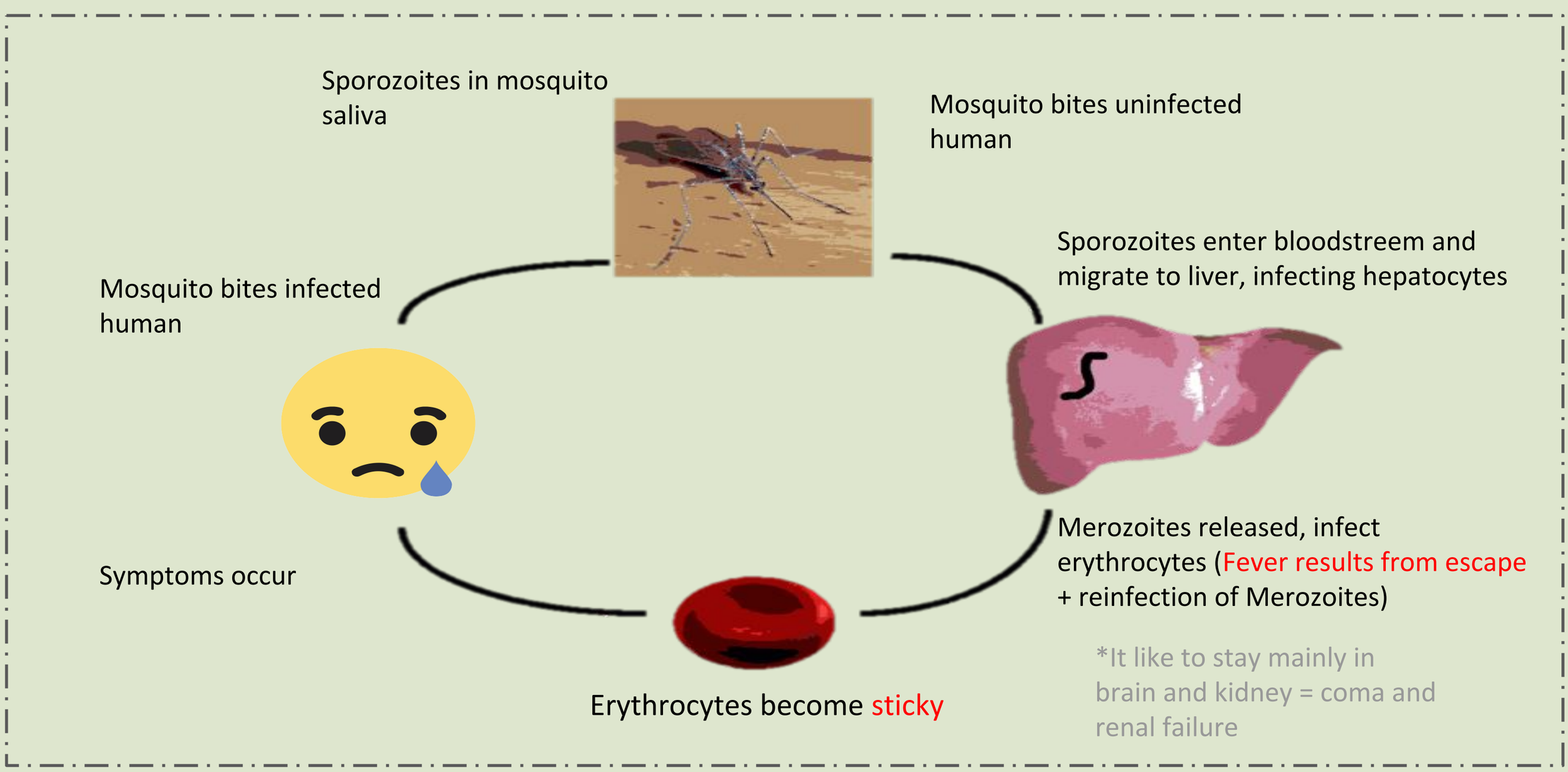
★ Malaria is the most important of all tropical parasitic disease ,causes death and debility and is endemic throughout the tropics and subtropics. The main symptoms and signs are periodic fever, headache ,anorexia and anemia.

★ Five species of malaria infect humans:

- ➔ Plasmodium falciparum
- ➔ Plasmodium vivax
- ➔ Plasmodium ovale
- ➔ Plasmodium malariae
- ➔ Plasmodium knowlesi

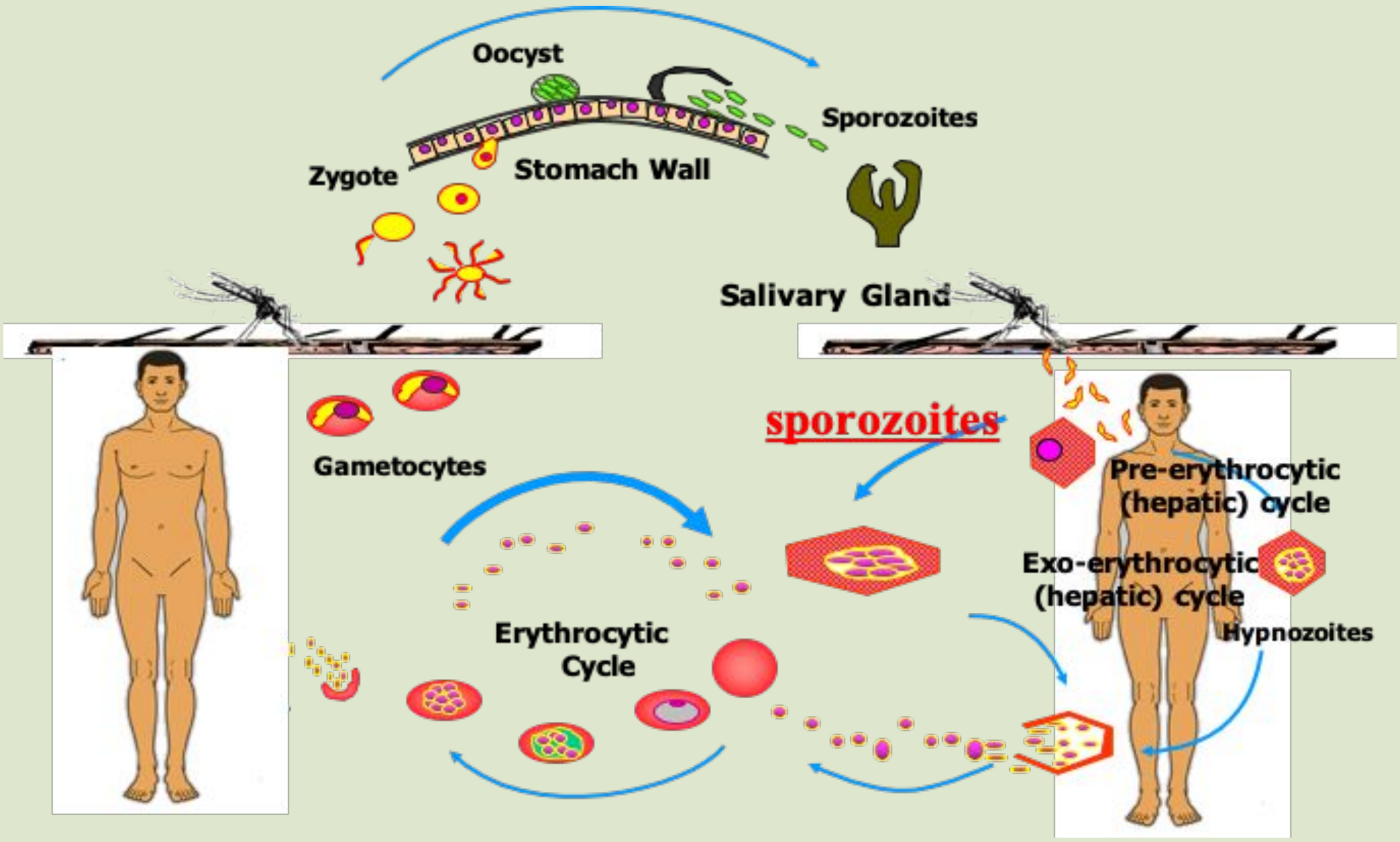
Epidemiology	
Asexual Stage	**sporozoites** are injected by an infected **Anopheles Mosquito** into the blood of human and enter liver cells and will become schizonts then become Merozoites whish release in the circulation and penetrate **the Red Blood Cell** and cause the **main pathology** of the disease **hemolysis and anemia** . Some parasites develop into male and female **Gametocyte**
Sexual Stage	male and female **Gametocyte** are taken up from the blood of an infected human by biting mosquito .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.



Life Cycle of Malaria:

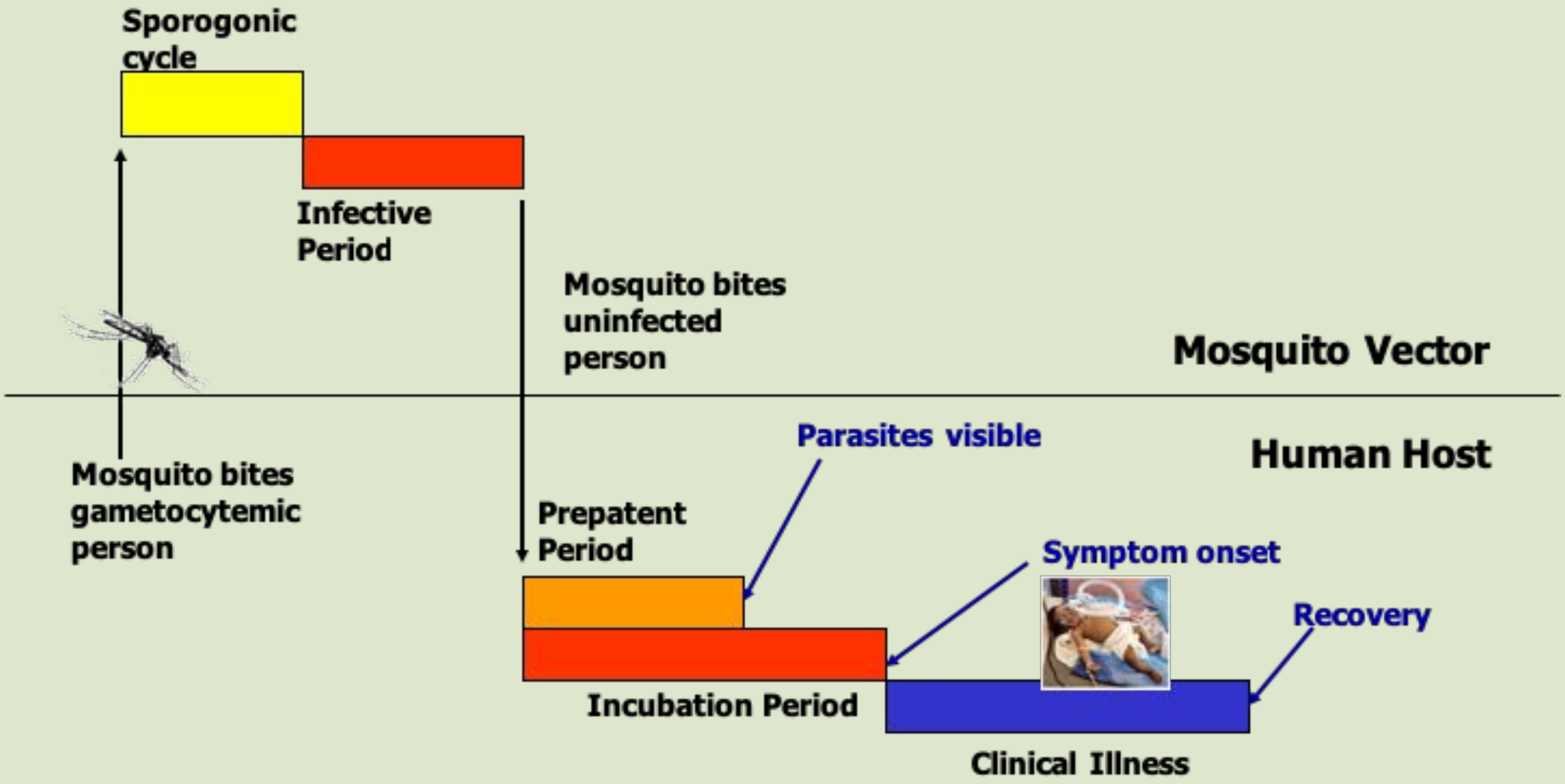
This video was shown by doctor mona so we advise you to watch it :)



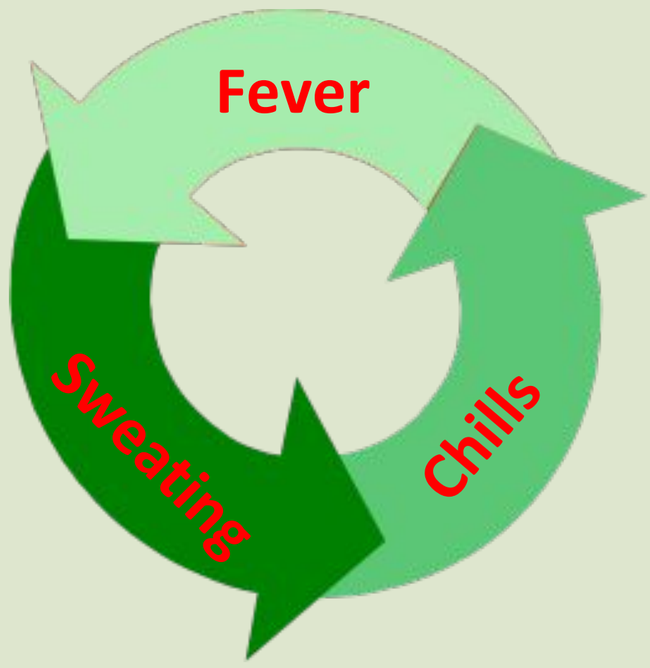
*Time when rupture happens and the infected person starts to get FEVER

Plasmodium Malariae	72hrs quartan because at the fourth day they will have fever
Plasmodium Vivax & Plasmodium Ovale	48hrs tertian
Plasmodium Falciparum	Quotidian, tertian or irregular (could have fever every 3 or 4 days or could be irregular)

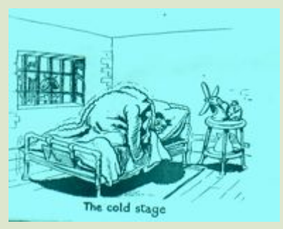
Components of the Malaria Life Cycle:



Clinical Signs & Symptoms



Malarial Paroxysm	
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

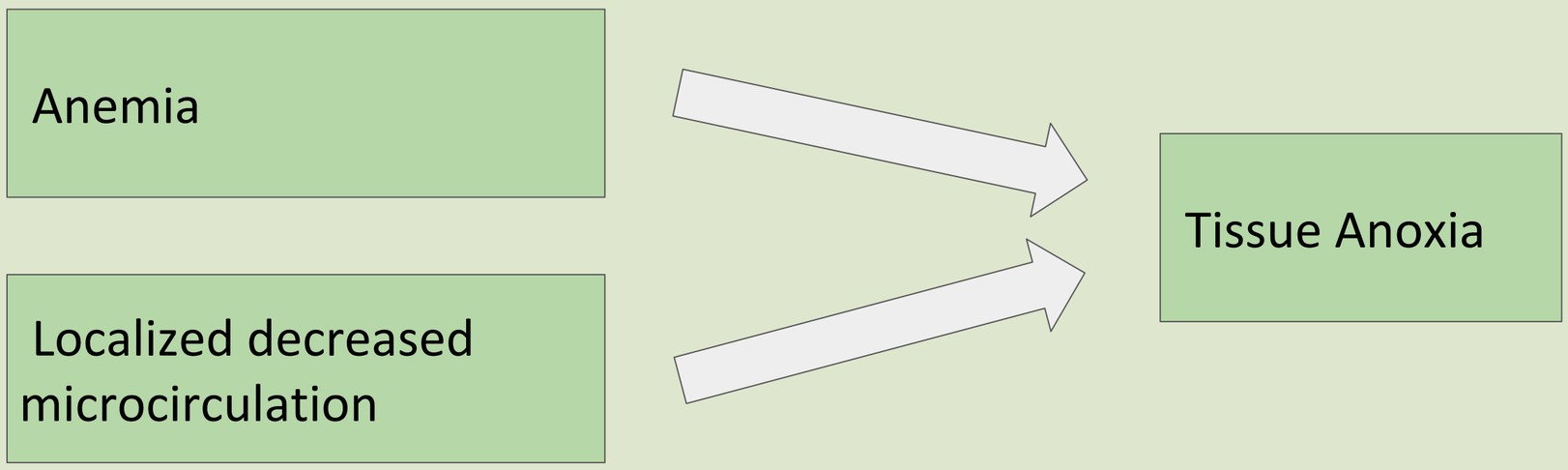


Pathogenesis of Malaria

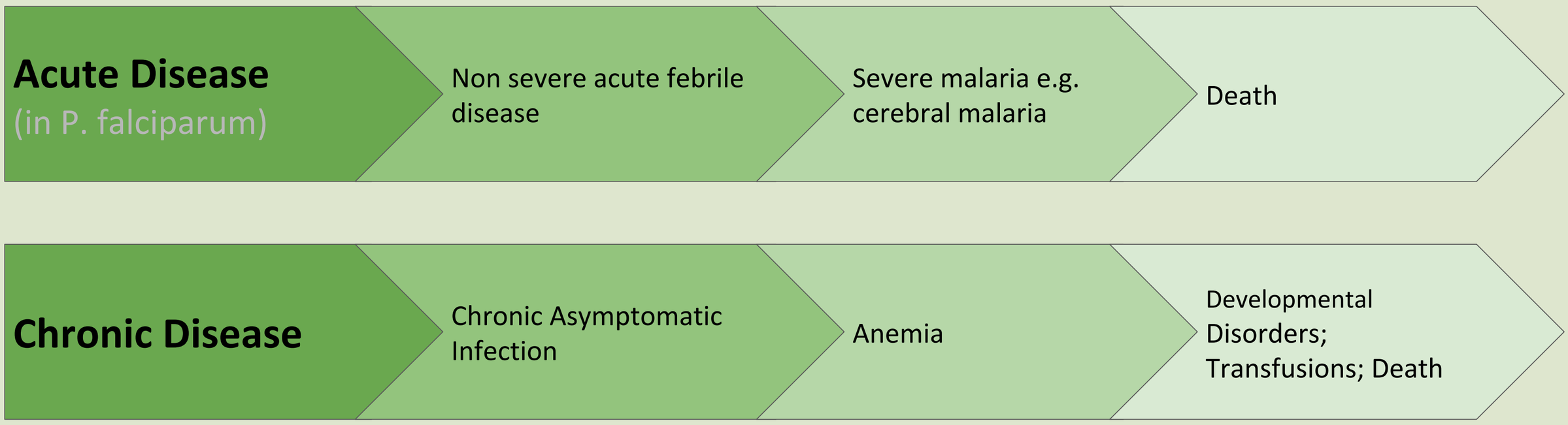
Symptoms are due to:

- **Hemolysis of Red Blood Cells :**
  with release of metabolites and pigments from Malaria parasite.

- **Plugging of capillaries by parasitized erythrocytes :** in P. falciparum
  In cerebral malaria there is sequestration of parasites in central nervous system capillaries.



Clinical Picture






Complications of Severe Malaria

Severe malaria is defined as symptomatic malaria in a patient with P. falciparum with one or more of the following complications:

Complication	Description
Cerebral Malaria	- Generalized convulsions (> 2 episodes within 24 hours) - Severe normocytic anemia (Ht<15% or Hb < 5 g/dl) - Opisthotonos in an unrousable comatose child with cerebral malaria. The CSF fluid count was normal
Hypoglycemia 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 (Black water fever)	- Acute pulmonary edema and adult respiratory distress syndrome - Abnormal bleeding - Jaundice - Haemoglobinuria (uncommon and malarial hemoglobinuria usually presents in adults as severe disease with anemia and renal failure). - Circulatory collapse, shock, septicaema (algid malaria) - Hyperparasitaemia (>10% in non-immune; >20% in semi-immune)
Tropical Splenomegaly	-
Severe Malaria Anemia	- It can present with other complications (Such as acidosis and respiratory distress) or alone with no other malaria complications - Usually seen with children?

Uncomplicated malaria is defined as: symptomatic infection with malaria parasitemia without signs of severity and/ or evidence if vital organ dysfunction.




Diagnosis of Malaria

Two common methods are used which are

1. **Light microscopy (thin & thick film)**

- Thick film ⟶ for screening
- Thin film ⟶ for identifying the type It is the gold standard for diagnosis of Malaria
- Parasite density
- Species diagnosis
- Monitoring response to treatment

2. **Rapid diagnostic Tests (RDTs)**

- It is used to detect malaria antigens and there are number of different formats of this test:
- Plastic Cassette
- Card
- Dipstick
- Hybrid Cassette-dipsticks

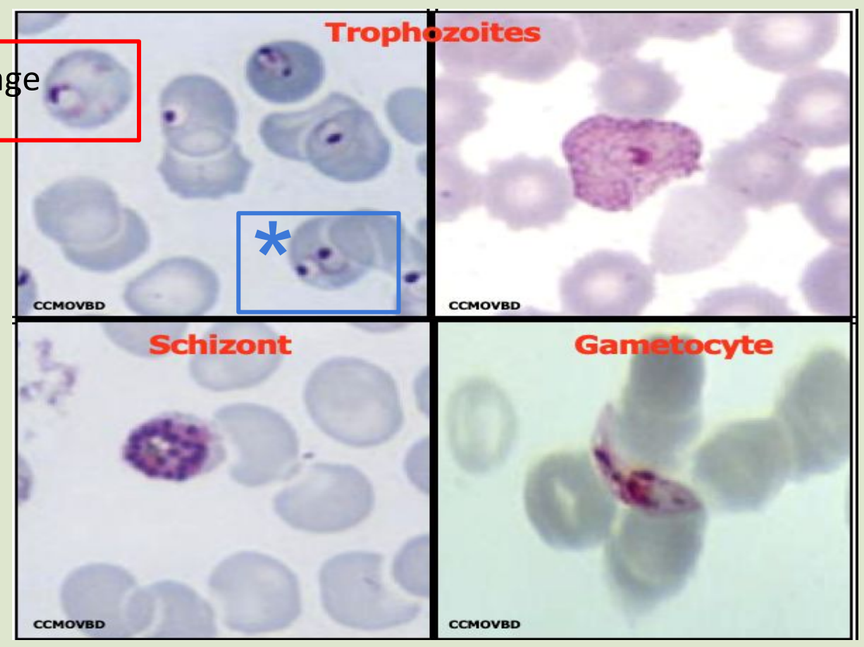
The Malaria Parasite

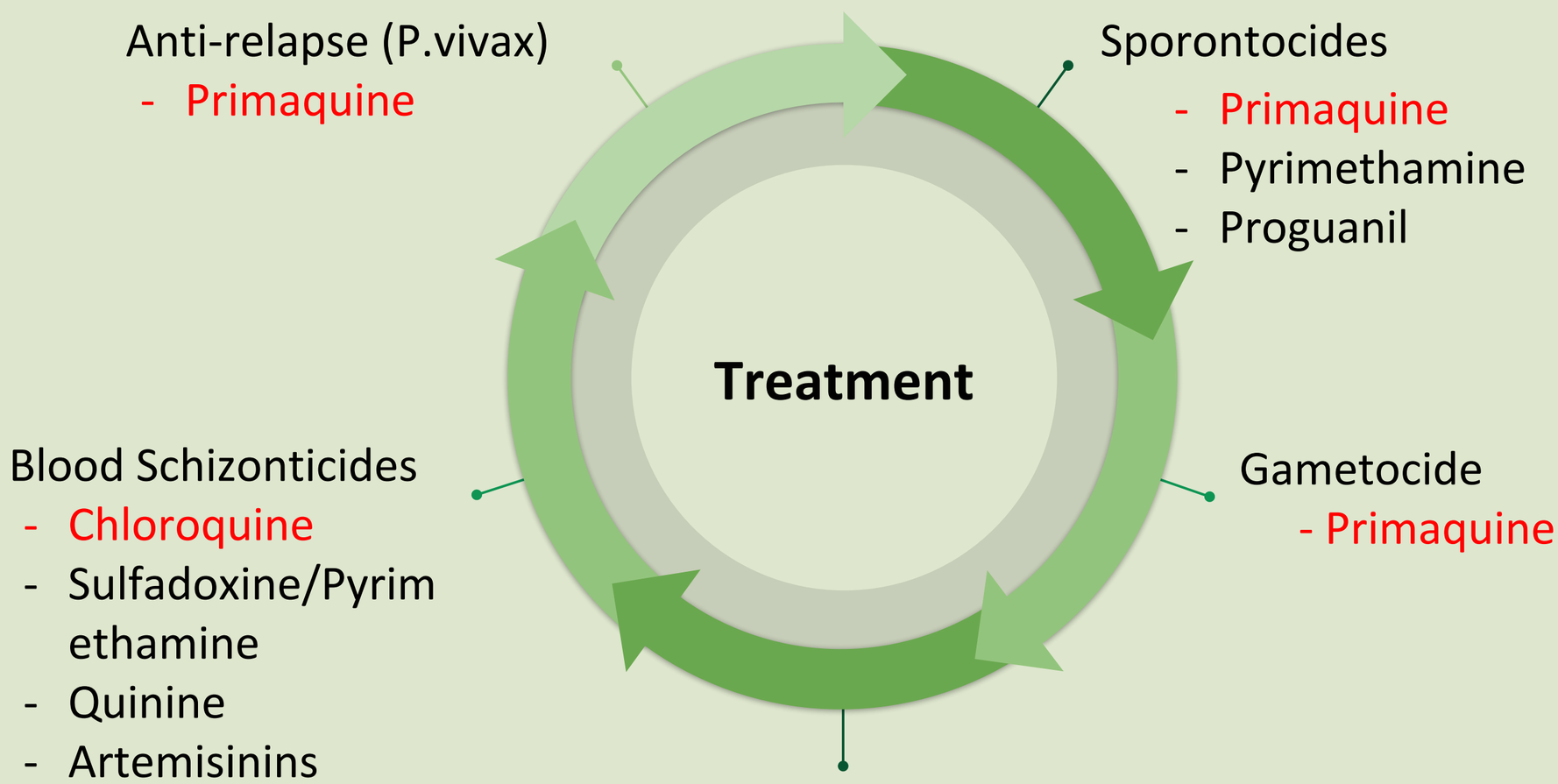
Three development stages seen in blood film:

1. Trophozoite (merozoite)
2. Schizont (a cell full of merozoite)
3. Gametocyte (male and female sitting in the RBCs)

* When we have two ring stages inside one RBC this means its P. falciparum

This is the ring stage





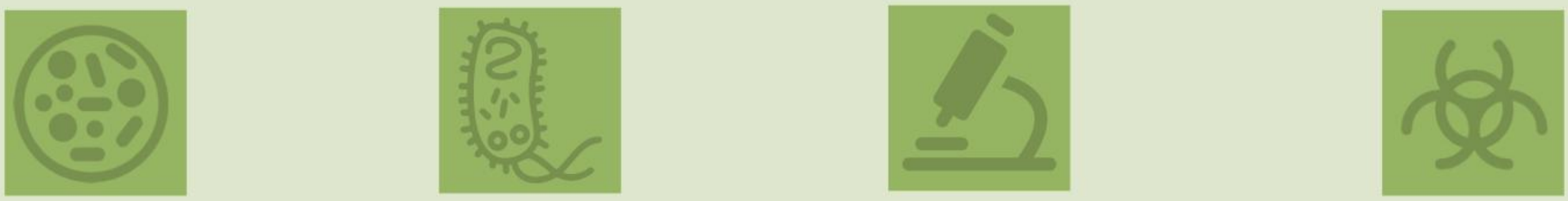
Anti-relapse (P.vivax)
- Primaquine

Sporontocides
- Primaquine
- Pyrimethamine
- Proguanil

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

Gametocide
- Primaquine

Tissue Schizonticides
- Primaquine
- Pyrimethamine
- Tetracycline
- Proguanil



Doctor's Notes

- There are 5 species of malaria and plasmodium falciparum has the most severe clinical picture, the most severe complications and the most fatal one.
- It's caused by a protozoa so it's unicellular
- The mosquito has the ability to drink as much blood is it want when it bite a human **bc it has anticoagulant**
- Main pathology of malaria? RBCs
- The sporozoites are found in the salivary gland of the mosquito
- **Main transmission?** mosquito bite but it could occur by blood transfusion and human to human
- **Infective stage for human?** Sporozoites
- **Infective stage for anopheles?** Gametocyte
- **Vector?** Female anopheles mosquito
- **Stages:**

1. asexual stage (intermediate hots) → human
   a. After getting a bite from the mosquito it will introduce sporozoites into the human blood → they immediately go to the liver → become schizonts then multiplied to become merozoite → the merozoite go to the circulation and attack RBCs and make them undergo hemolysis and causes anemia
      i. Inside the RBCs the merozoite will divide till it rupture the cell (this process takes 48 hours in P. falciparum, P. vivax & P. ovale / 72 hours in P. malariae / 24 hours in P. knowlesi)
      ii. Why this process is important? Bc in case of P. falciparum, every 2 days the RBCs will rupture and here is when the person will start feeling the fever
      iii. Some sprotozite would hide in the form of hypnozoites in the hepatocytes for 10 months then get activated and invade the RBCs (relapse)
      iv. In case of P. falciparum the RBCs filled with merozoite would get attached to the capillaries of specific organs mainly kidney and brain → this cause sequestration and the blood won't be able to reach the kidney so result in renal failure & in case of brain it will result in coma and death
         - Also in P. falciparum the replication is very fast and infect more RBCs
      v. Some merozoite will become gametocyte (male & female) within the RBCs
2. sexual stage (definitive host) → anopheles mosquito
   a. When another uninfected mosquito bite someone who's infected → it will take gametocyte from the blood and become infected




Doctor's Notes

- How to differentiate between TB and malaria from the symptoms? TB doesn't cause chills before the fever
- **What's the pathogenesis of malaria?** Symptoms occur when the RBCs rupture
- **What's the most affected organ?** RBCs
- **The main complication of P. falciparum?** Renal failure or black water fever
- **Diagnosis:**
  - In light microscopy: first we take a blood sample and by using the thick film we will be able to tell if this person has malaria or not → then we will use the thin film on the same sample to identify the type




Summary

Malaria					
Infective stage	Human: sporozoites Mosquito: Gametocyte	**Vector: (definitive host)**	Female Anopheles Mosquito	**Intermediate host**	Human
Main pathology	1-Hemolysis of RBCs 2-Plugging of capillaries by parasitized erythrocytes (mainly in P. falciparum)	**Life cycle:**	Sporozoites are injected into the blood and enter liver cells and will become schizonts → Merozoites penetrate the RBCs and → hemolysis and anemia. Some develop into male and female Gametocyte → they are taken up mosquito → Further sexual development in the mosquito to produce sporozoites.		
Symptoms	Malarial Paroxysm (feeling of cold followed by heat then sweating) **periodic fever**, headache ,anorexia and anemia.				
Species	Plasmodium falciparum	Plasmodium vivax	Plasmodium ovale	Plasmodium malariae	Plasmodium knowlesi
Type of fever	Quotidian, tertian or **irregular**	**48h (tertian)**		72h quartan	-
Clinically	**Acute Disease**		**Chronic Disease**		
	Severe malaria: symptomatic malaria caused by P. falciparum with one complications or more	Non-severe Acute Febrile disease	Infection during Pregnancy lead to placental malaria →Low Birth weight →Infant Mortality		Chronic Asymptomatic Infection lead to anemia
Complications	• Acute renal failure (blackwater fever) • Cerebral malaria • Hypo-glycaemia and pulmonary edema in pregnancy can lead to abortion • Tropical splenomegaly.	-	-	-	-
Diagnosis	• Light microscopy: (gold standard) -Thin film: for different spices identification. -Thick film: for screening. • Rapid diagnostic tests (RDTs). • serology • PCR				
Treatment	Primaquine - Chloroquine				




MCQs:

1- What is the main organ affected in malaria infection?
A- Liver.
B- kidney.
C- RBCs.
D- intestine.

2- Patient comes to the ER complaining of headache, fever that comes and goes every 3 days. She most likely have which of the following pathogen?
A- Plasmodium falciparum.
B- Plasmodium malariae.
C- Plasmodium vivax.
D- Plasmodium ovale.

3- Sporozoites when injected into the human skin it migrates to?
A- Hepatocytes.
B- Intestinal wall.
C- Macrophages.
D-Lymphocytes.

4- Which of the following could lead to blackwater fever ?
A- P.knowlesi.
B- P.malariae.
C- P.falciparum.
D- P.vivax.

5-What is the gold standard method to diagnose malaria ?
A- RDTs.
B- Light microscope.
C- PCR .
D- Serology.

6- Which of the following cause malaria infection to human and mosquito ?
A- Sporozoites only.
B- Sporozoites,Gametocyte .
C- Gametocyte ,Sporozoites.
D- Gametocyte only.

1-C 4-C
2-B 5-B
3-A 6-B

SAQ:

- A patient presented with hemoglobinuria, convulsions and respiratory distress. Microscope examination show schizont.

1- What is your diagnosis?
Malaria

2- What is the pathogen ?
P.falciparum

3- How do you confirm which type of pathogen?
By light microscope using thin film

4- Mention other test you could do to confirm your diagnosis?
Rapid diagnostic tests (RDTs).
serology
PCR

5- mention other complication?
Acute renal failure (blackwater fever) - Tropical splenomegaly - Acute pulmonary edema

6- Treatment ?
Primaquine - Chloroquine




THANK YOU!

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