

Malaria

[Protozoan diseases]

Microbiology III

Introduction

- On a global scale, malaria is one of the most common infectious diseases of humans.
- At present the disease is widely distributed in Africa, Asia, and Latin America.
- It is caused by the protozoa *Plasmodium*, and transmitted by the *Anopheles* mosquito bites.

Causative agent:

- ***Plasmodium***: The four species that cause human malaria are *P. falciparum*, *P. vivax*, *P. malariae*, and *P. ovale*.
- ***P. falciparum*** causes the most serious form of the disease.
- Growth in laboratory:
- Thin layer of human **red blood cells** over which a complex **serum**-containing medium is slowly flowing.
- The protozoa are **microaerophilic** and grow best under atmosphere containing 3% oxygen and 1% carbon dioxide.
- Oxygen levels of 17-21% inhibit growth.

Transmission and Life Cycle of Malaria Protozoa.

- *Plasmodium* protozoa are transmitted to humans by mosquitoes of the genus *Anopheles*.
- **Sporozoites:**
- Are sickle-shaped infective forms of the protozoa
- Present in the **saliva** of the infected ***Anopheles*** mosquito
- When the mosquito bites a human, the sporozoites are injected into the **bloodstream** and quickly attack the liver.

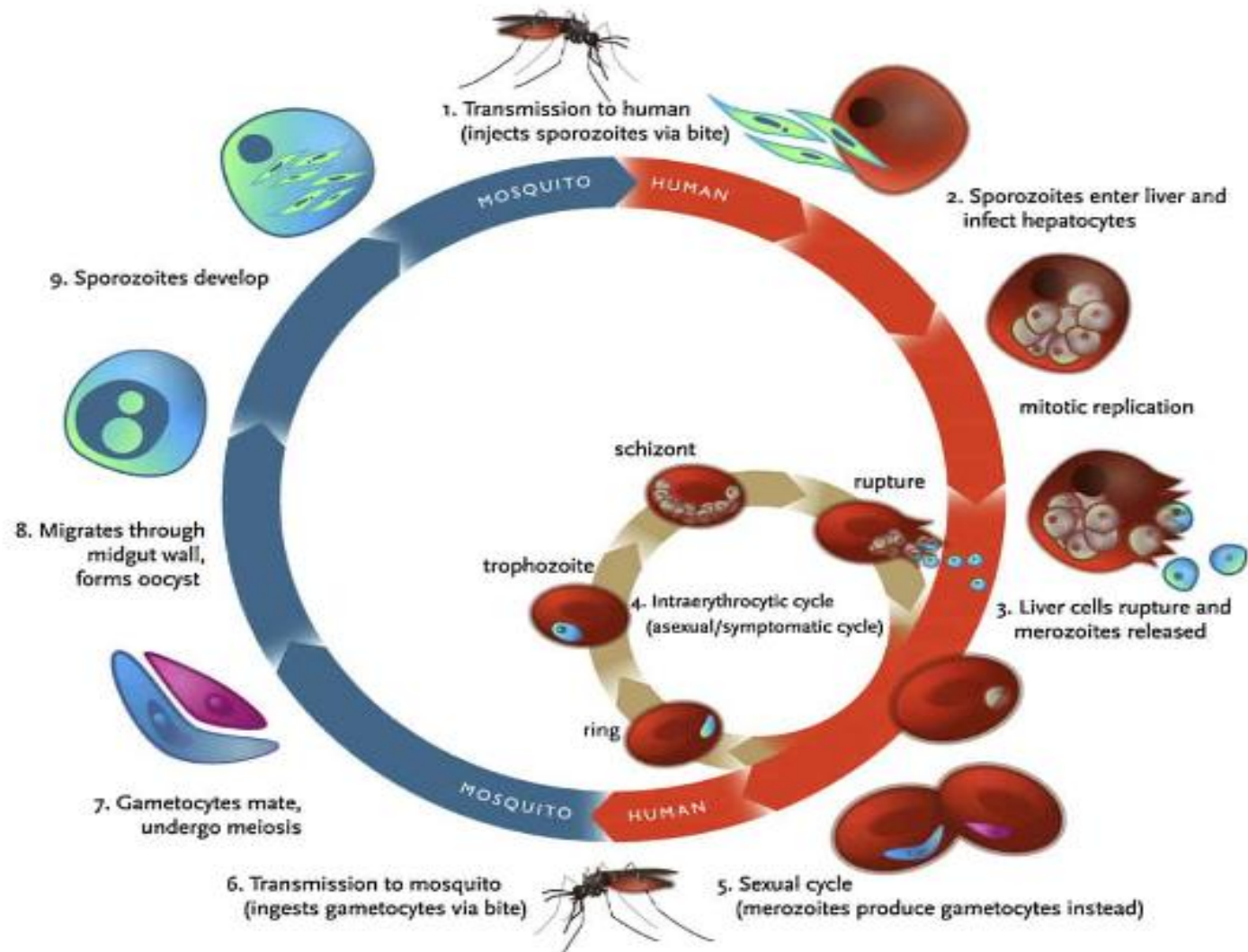
- **Merozoites:**
- They divide asexually inside the **liver cells** and give rise to numerous round daughter cells called ***merozoites***.
- As an infected liver cell disintegrates, the merozoites are released into the **bloodstream**, where they invade red blood cells.

- **Trophozoite:**
- A merozoite develops inside a red blood cell to give rise to a trophozoite, the **active feeding stage**.
- The trophozoite in turn divides asexually to produce more merozoites.
- As the host red blood cell disintegrates, the merozoites are liberated to attack more red blood cells.
- They produce merozoites that attack more red blood cells, and so on - ***erythrocytic cycle***

- **Gametocytes:**
- Some of the merozoites that infect red blood cells develop into male and female sexual cells called ***gametocytes***.
- When an uninfected *Anopheles* mosquito bites a person with malaria, it ingests blood containing the gametocytes.
- the gametocytes develop in the stomach of the **mosquito** into:
 - free male gametes - whiplike *sperm* cells
 - female gametes—*egg* cells

- **Oocyst:**
- After fertilization the zygote develops outside the stomach lining into encysted form called an ***oocyst***.
- Sporozoites develop within the oocyst
- They mature & migrate to the mosquito's salivary glands
- They can be injected by a mosquito bite into the blood stream of a new victim to begin the cycle all over again

Life Cycle of the Malaria Parasite



Pathogenicity

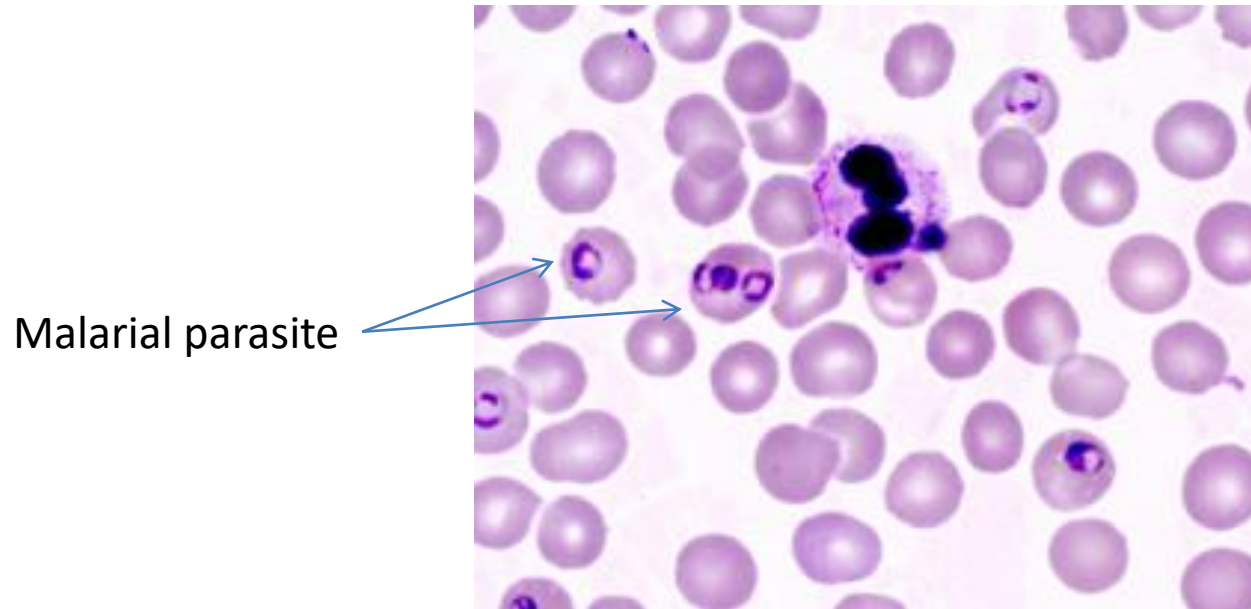
- Symptoms of malaria occur during the asexual **erythrocytic cycle**
- Caused by release of **pyrogen** – fever inducing substance from the injured cells
- Symptoms begin 10 to 16 days after infection
- **Symptoms include:**
 - Bed-shaking chills
 - Recurrent fevers
 - Sweating
 - Headache
 - Muscular pain
- The cycles of fever vary according to the *Plasmodium* species causing the infection.

- Symptoms last fewer than 6 hours
 - **Spleen** becomes enlarged and tender
 - Patient becomes weak and exhausted
 - **Anemia** – destruction of the red blood cells by *Plasmodium* merozoites
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- **Benign malaria:**
 - The pattern of periodic illness interspersed with periods of well-being.
 - Subsides spontaneously and recurs at a later date.

- **Malignant malaria:**
- It is caused by *P. falciparum*
- Fever and symptoms are more persistent
- Tissue swelling – brain and lungs
- Blockage of kidney activity
- High fatality rate if not treated promptly.

Laboratory Diagnosis

- Presence of the parasite in **blood smears** from patients
- Detection of specific antibodies in a patient's blood serum - after the second week of infection.



Treatment

- Quinine
- Chloroquine
- Primaquine

- **Prevention of Malaria:**
- Elimination of the insect vector that transmits the protozoan
- Destruction of mosquito breeding areas
- Killing of the larval stages and adults