

MALARIA

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History of Malaria

- The word is derived from '*mal aria*'('bad air' in Medieval Latin), which came from the Romans' belief that the disease came from the pestilential air of marshes.
- The English of the coastal marshes called it 'marsh fever' or 'tertian ague'.

| Contributing Scientist | Year | Output |
|------------------------|------------------|--|
| Laveran | 1880 | Identification of malarial parasite |
| Camillo Golgi | 1885 | Described the link between plasmodium and malarial fever |
| Mason | 1894 | Mosquito - malaria relation |
| Sir Ronald Ross | 20th August 1897 | Discovery of oocysts in the stomach wall of female anopheles mosquito; Detection of transmission of plasmodium from humans to mosquitoes biting the infected; Observing the presence of plasmodium in salivary glands of anopheles mosquito. |

- Sir Ronald Ross was Nobel Laureate for Medicine in 1902.
- 20th August is celebrated as world mosquito day annually.

Vector

Female anopheles mosquito is the vector of this disease.

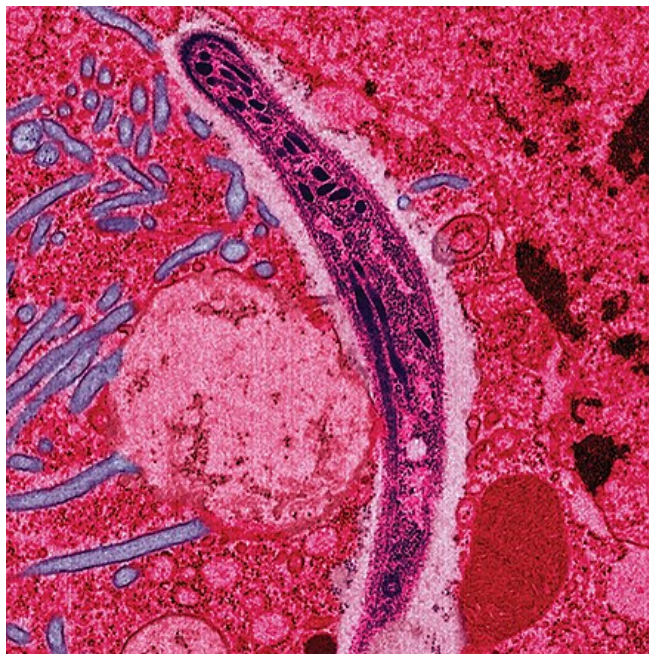


Causative Agent - Types

156 species of malarial parasites have been identified. The 5 important ones of those are:

| Species | Malarial infection | Incubation period | Fever recurrence |
|---------------------|--|-------------------|------------------|
| <i>P.falciparum</i> | falciparum malaria/ Malignant tertian malaria | 10 days | 24-48 hrs |
| <i>P.malariae</i> | Quartan malaria | 27-37 days | 72 hrs |
| <i>P.vivax</i> | Benign tertian malaria(fatal epidemic) | 10 days | 48hrs |
| <i>P.ovale</i> | Mild tertian malaria | 14 days | 48 hrs |
| <i>P.knowlesi</i> | Simian malaria | 9 - 12 days | 24 hrs |

Causative Agent - Physiology

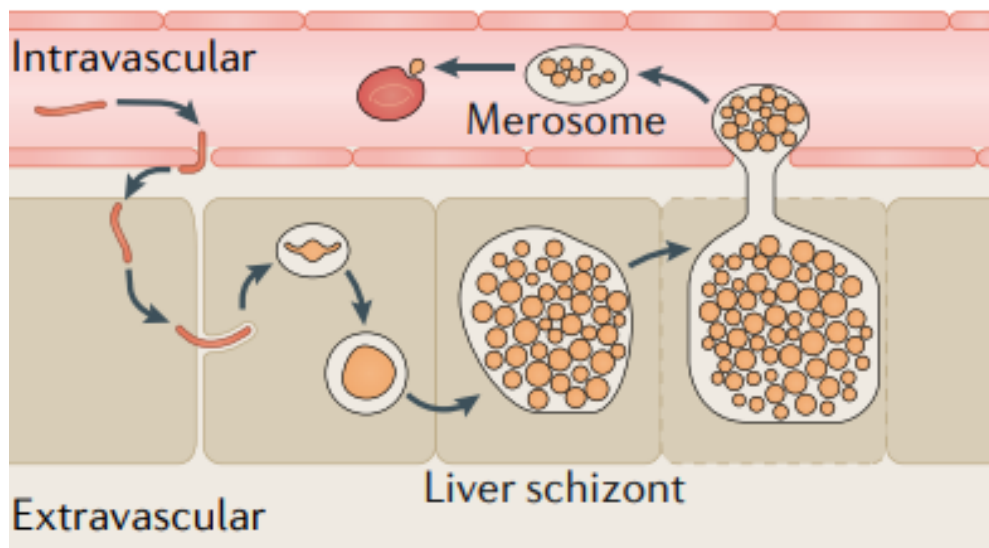
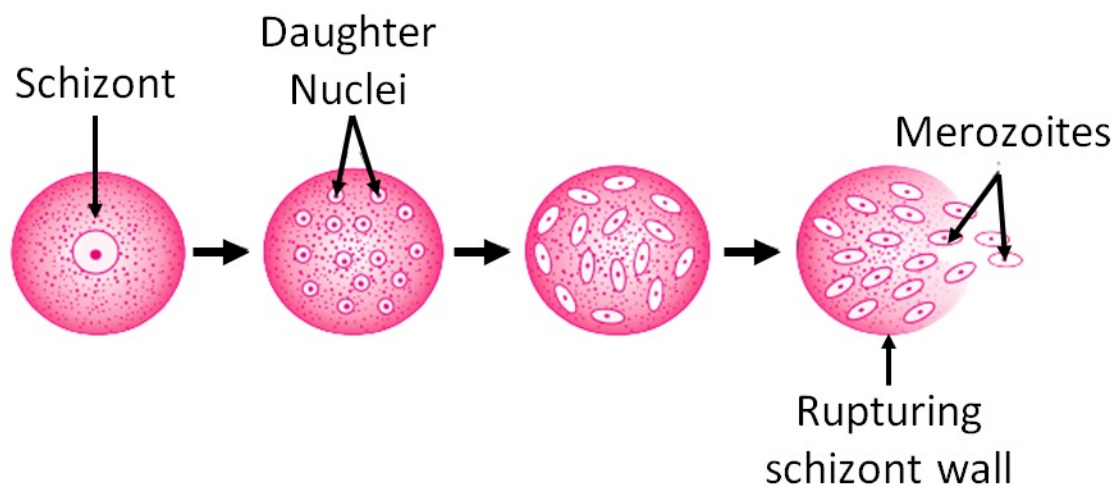


- Plasmodium is a protozoan - an obligate endoparasite of vertebrates and insects.
- Reproduction by multiple fissions
- Sickle-shaped and bent body, covered by pellicle(protein sheath).
- Gliding motility - by actomyosin microtubules
- Bulb-shaped rhoptries are found at the apical end, containing parasitic proteins for invading host cells and manipulating them upon entry.
- Adjacent to the rhoptries are smaller micronemes that contain parasite proteins required for motility and identifying and attaching to host cells.

Life Cycle Phase I _ Pre- Erythrocytic Cycle (Golgi_Cycle)

1. The bite of a female anopheles mosquito releases a parasite into our blood. it is called sporozoite (responsible for liver infection) at this stage.
2. Sporozoite activity results in the Crypto - schizont stage of malarial infection. They feed on hepatic (liver) cells and fill the entire cell.
3. Sporozoites reproduce asexually by schizogony (multiple fission) and form liver schizonts, containing thousands of crypto - merozoites (merozoites).
4. Merozoites can have two pathways:
a) again invade new hepatic cells to produce more merozoites
b) Infect the erythrocytes (red blood cells).
- 5 This is an asymptomatic stage of the life cycle, lasting 7-17 days.

MULTIPLE FISSION



#Note: What is this merozome? It is a membrane-bound structure made of hepatocytes that contain merozoites. It is formed to evade immune cells, known as Kupffer cells, located in the liver.

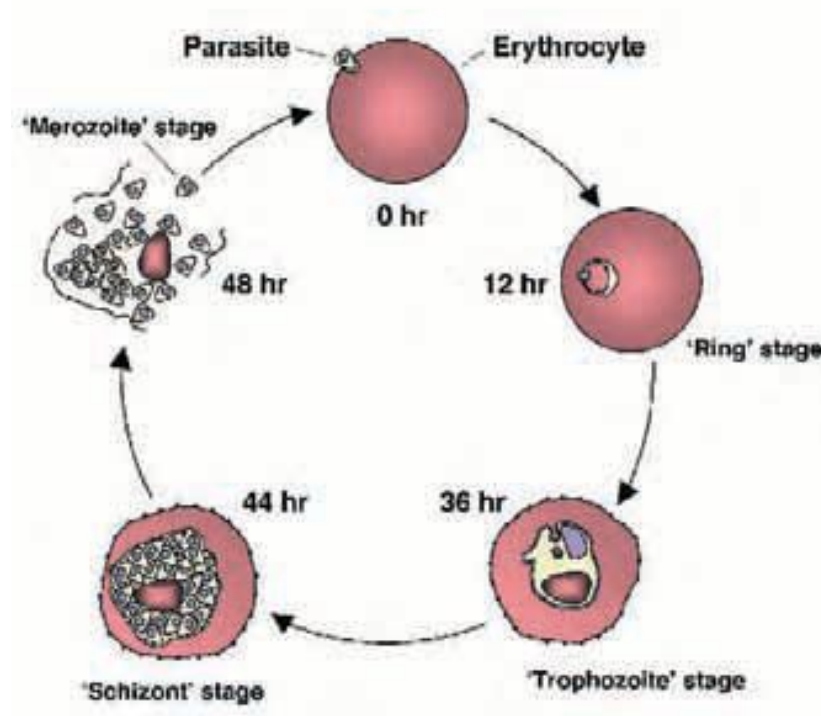
Life Cycle Phase II _ Erythrocytic Cycle

1. Merozoites feed on haemoglobin in erythrocytes, breaking them down into haematin and globin. Haematin results in the formation of brown-coloured granules called haemozoin. Haemozoin is toxic and causes malarial fever.
2. Merozoites are initially ring-shaped in appearance. They grow to form big trophozoites.
3. Trophozoite then matures to form schizonts.
4. Repeated division of schizonts forms 6-24 merozoites. These merozoites again invade new erythrocytes.

#Note that schizonts are formed in both the liver and erythrocytes.

5. After a few cycles of this, trophozoite develops into two gametocytes:
 - a) Macrogametocytes
 - b) Microgametocytes

#Note that gametocytes are diploid and undergo gametogenesis to form haploid cells.



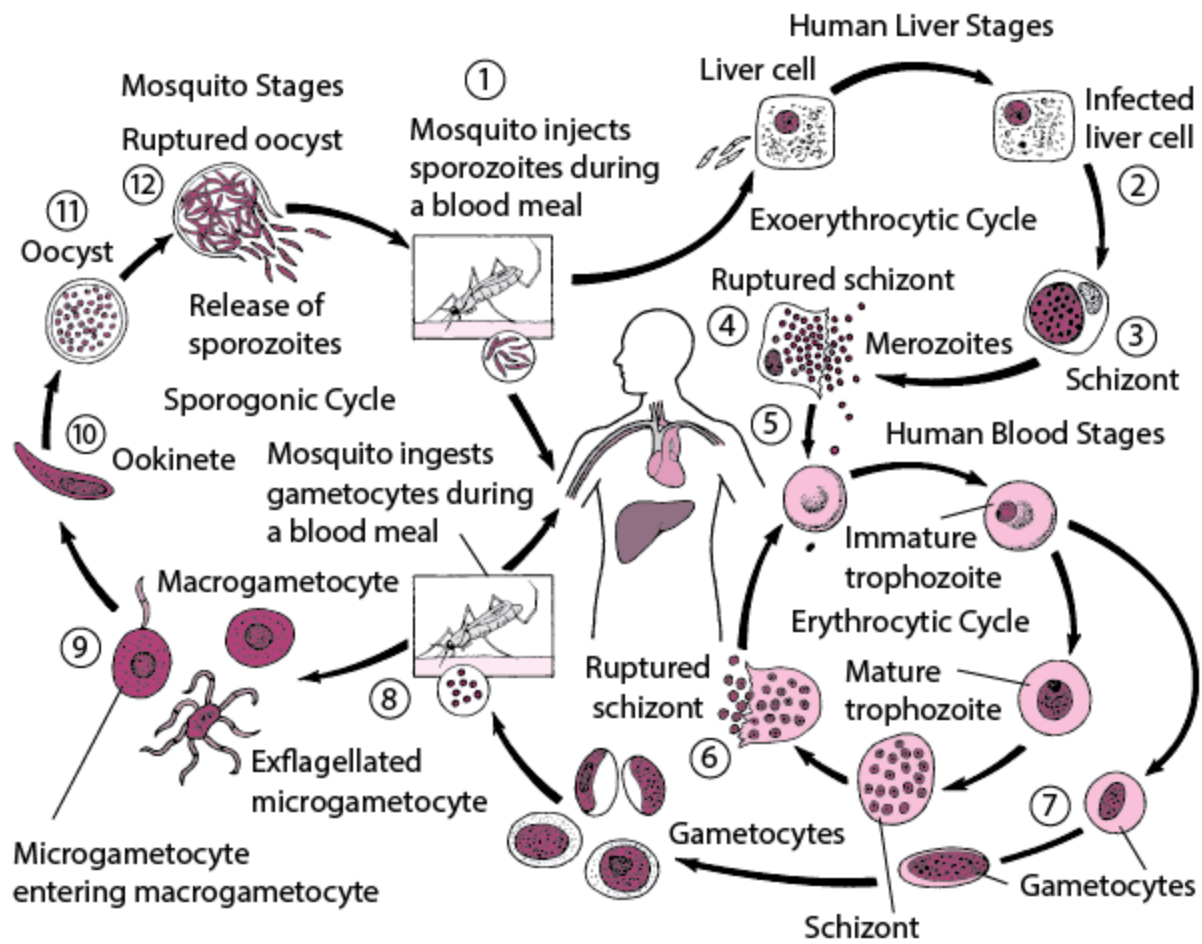
#Let me get this even clearer. The merozoite gets a small vacuole that grows in size, pushing the nucleus and cytoplasm into the periphery.

Now the plasmodium looks like a finger ring. Hence this stage is called

the signet ring stage . Soon it loses the vacuole, develops pseudopodia and becomes the amoeboid stage. With the help of pseudopodium, it actively feeds on the content of the R.B.C. and increases in size. As a result, the R.B.C. grows almost double the size. This process is called hypertrophy. The malaria parasite digests the globin part of the ingested haemoglobin and converts the soluble haem into insoluble Haemozine. It is called malaria pigment. Now the parasite loses the pseudopodia and increases in size finally it occupies the entire R.B.C and becomes schizont. It undergoes schizogony and produces 12-24 erythrocytic merozoites. They are arranged in the form of roses hence this stage is called the rosette stage. Finally, merozoites are released along with .haemozine into the blood.

Life Cycle Phase III _ Cycle of Ross

1. This stage has been named so to honour Sir Ronald Ross's work.
2. Along with blood, the mosquito sucks in gametocytes.
3. In the midgut(the equivalent of the human intestine), the following events occur:
 - a) Macrogametocytes forms macrogamete(ovum)
 - b)Microgametocyte forms microgamete(sperm)
 - c)The fusion of these two forms a zygote, which forms sporozoites.
4. The sporozoites then move into the salivary glands of anopheles mosquito, so that the next time it bites someone, the saliva is injected first as anticoagulant and the sporozoite reaches the bloodstream.



Symptoms of Malaria

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The early symptoms of malaria include a cold, headache, and a high temperature with chills. In addition, the following are the malaria fever symptoms:

- Feeling very tired
- Difficulty in breathing
- Nausea and vomiting
- Increased bowel movements
- Cough
- Abdominal pain
- Joint pain
- Bloody urine (dark-coloured)
- Seizures
- Yellow discolouration of eyes and skin (Jaundice)

Malaria symptoms during pregnancy

- Increase in body temperature
- Headache
- Nausea
- Vomiting
- Muscle pain



Some other ones:

- Enlargement of spleen
- Extreme sweating