

Malaria

Malaria is a disease that is transmitted by the bite of female *Anopheles* mosquito. Malaria is caused by protozoa of the *Plasmodium* species. There are four species which infect both humans and animals:

1- *Plasmodium vivax* (benign tertian malaria). The developmental cycle in the blood lasts approximately 48 h.

2- *Plasmodium ovale* (ovale tertian malaria). The developmental cycle in the blood lasts approximately 48 h.

3- *Plasmodium malariae* (quartan malaria). The developmental cycle in the blood lasts approximately 72 h.

4- *Plasmodium falciparum* (malignant tertian malaria or falciparum malaria or black water fever). The developmental cycle in the blood lasts approximately 48 h.

Plasmodium requires two hosts, the definitive invertebrate host (**vector**), and intermediate host vertebrate host (**mammals, birds and lizards.**)

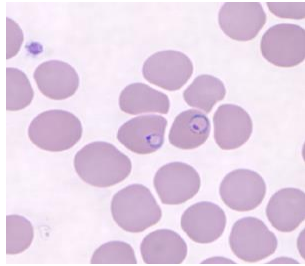
Infective stage: **sporozoite**

Morphology of *Plasmodium* species

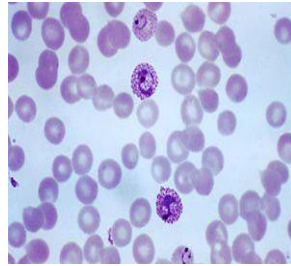
1- *Plasmodium vivax*:-

- Infected RBC enlarged, Small Trophozoites (**Ring form**) has large chromatin dots and develop to form trophozoite stage or amoeboid stage which has irregular shape.
- *P. vivax* **trophozoites** show amoeboid cytoplasm, large chromatin dots,. Schüffner's dots (reddish granules) may appear more fine in comparison to those seen in *P. ovale*.
- Chromatin divided forming **schizont** within 48 hr and produce 12-24 merozoites (usually 16). may cause rupture of RBC.
- **Gametocytes** are Round to oval shape fill the RBC. Microgametocyte or male gametocyte has distributed chromatin

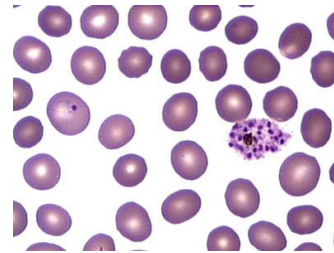
granules ,whereas the macrogametocyte or female gametocyte has compact chromatin usually peripheral in distribution .



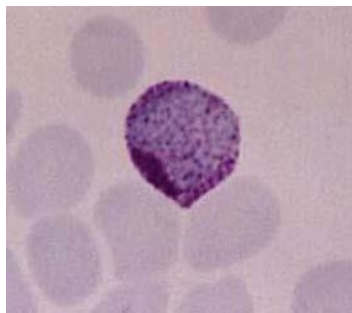
Ring stage



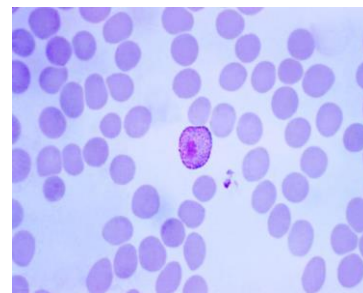
Amoeboid stage



schizont



Macrogametocytes



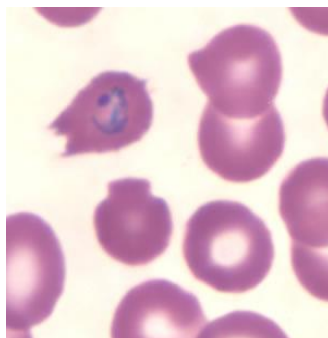
Microgametocyte

2-Plasmodium ovale:-

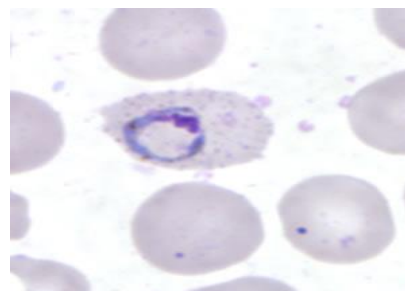
Similar to *P. vivax* , red blood cells (rbcs) can be normal or slightly enlarged, may be round to oval and contain ring form.

Trophozoites of *P. ovale* have sturdy cytoplasm, large chromatin dots, and can be compact to slightly irregular, show Schüffner's dots and fimbriated appearance of edges of infected RBCs.

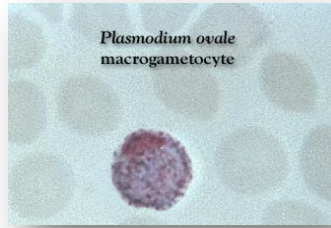
Schizonts have 6 to 12 merozoites, usually 8 with large nuclei clustered around a mass of dark-brown pigment.



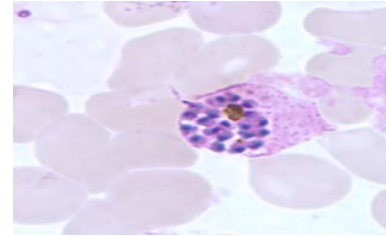
Ring form



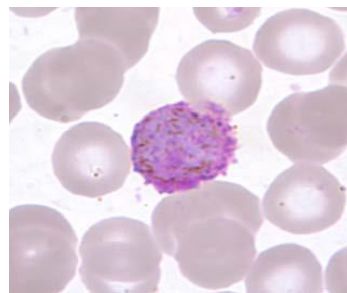
Trophozoite



Macrogametocytes



Schizonts



Microgametocyte

Gametocytes are round to oval and may almost fill the red blood cells.

3- *Plasmodium malariae*:-

- Early trophozoites / **ring forms**, compact rings containing one mass of chromatin.
- **The trophozoite** growing and forms band shape across the RBC.
- Through 72 hours growing to schizont, which has a rosette with 8-10 oval merozoites.
- **The gametocytes** are resembled to *P. vivax* but smaller.

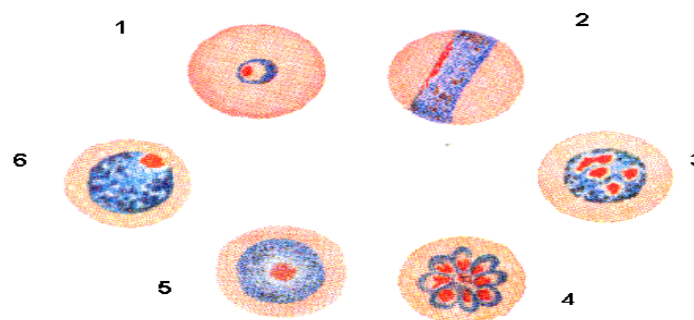


Illustration 9-9. Diagrammatic illustration of the morphology of the different stages of the *Plasmodium malariae* life cycle in thin blood films. 1) Early trophozoites / ring forms, compact rings containing one mass of chromatin. 2) Developing trophozoites, small and compact (often band forms) with an inconspicuous vacuole. 3) Immature schizonts, compact and almost fill the red blood cell which contains scattered pigment. 4) Mature schizonts, almost fill the red blood cell. 5) Microgametocytes, low numbers appear after 7-14 days. 6) Macrogametocytes, low numbers appear after 7-14 days.

4- *Plasmodium falciparum*:-

- We can see only early (**ring-form**) and gametocytes in the peripheral blood.
- More than one ring form in RBCs or double chromatin dots.
- **Schizont** seldom found in the blood and it resemble to *P. vivax* and have 8-24 merozoite.
- **The Gametocytes** have banana shape, so called crescent.
- The female form, or macrogametocyte, is usually more slender and somewhat longer than the male. The nucleus is small and compact, The male form, or microgametocyte, is broader than the female sausage shaped. and the nucleus, which less compact than in the female,
- Presence of Maurer's dot In RBC , which are often seen in older ring

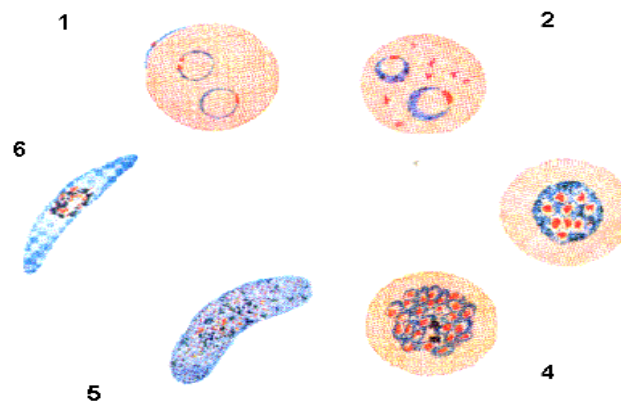


Illustration 9-6. Diagrammatic illustration of the morphology of the different stages of the *Plasmodium falciparum* life cycle in thin blood films. 1) *P. falciparum* early trophozoites / ring forms. 2) Developing trophozoites (rarely seen in peripheral blood). 3) Immature schizonts (rarely seen in peripheral blood). 4) Mature schizonts, almost fill the red blood cell. 5) Microgametocytes, large numbers appear after 7-12 days. 6) Macrogametocytes, large numbers appear after 7-12 days.

Transmission of malaria

- Female Anopheline mosquito
- Blood transfusion .
- Mother to child .

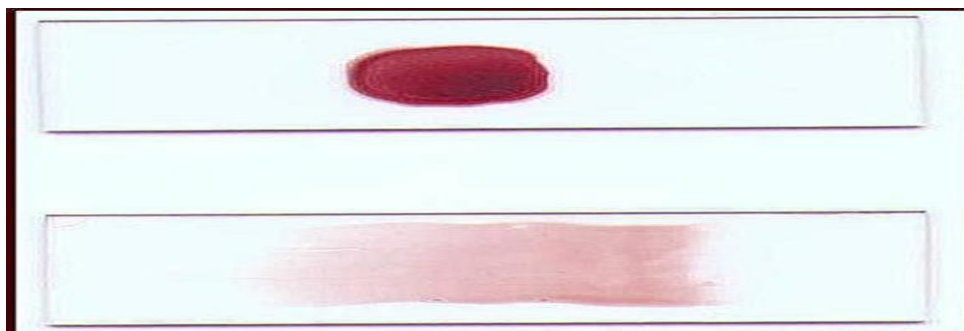
Clinical Manifestations

The pathology and clinical manifestations associated with malaria are almost exclusively due to the asexual erythrocytic stage parasites. Plasmodium infection causes an acute febrile illness which is most notable for its periodic fever paroxysms occurring at either 48 or 72 hour intervals.

The malarial paroxysm will usually last 4-8 hours and begins with a sudden onset of chills in which the patient experiences an intense feeling of cold despite having an elevated temperature. This is often referred to as the cold stage, or rigor, and is characterized by a vigorous shivering. Immediately following this cold stage is the hot stage. The patient feels an intense heat accompanied by severe headache. Fatigue, dizziness, anorexia, myalgia, and nausea will often be associated with the hot stage. Next a period of profuse sweating will ensue and the fever will start to decline. The patient is exhausted and weak and will usually fall a sleep. Followed by splenomegaly and anemia

Laboratory Diagnosis

The definitive diagnosis of malaria infection is still based on finding malaria parasites in blood films. In thin films the red blood cells are fixed so the morphology of the parasitized cells can be seen. However, malaria parasites may be missed on a thin blood film when there is a low parasitemia. Therefore, examination of a thick blood film is recommended.



Class: coccidia,
Family: Sarcocystidae

Toxoplasma gondii

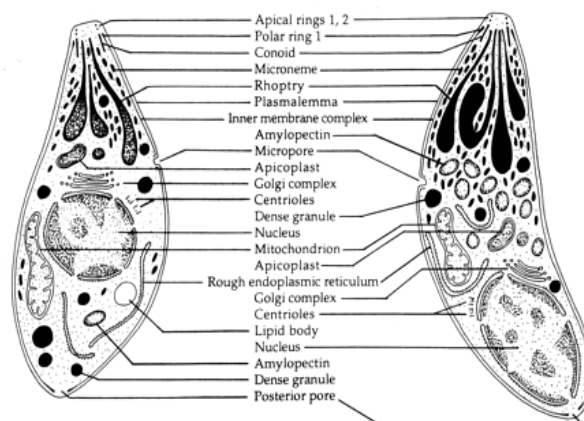
It is the causative organism of toxoplasmosis, Congenital Toxoplasmosis it can cause severe damage and even death of the fetus. It occurs in three forms; trophozoite, tissue cyst and oocyst. The trophozoite and tissue cyst represent stages in asexual multiplication (Schizogony). While the oocyst is formed by sexual reproduction (gametogony or Sporogony).

1-Trophozoites:-

The trophozoite is crescent – shaped, with one end pointed and the other end rounded. It is measured approximately 2-3 μm by 4-7 μm . The nucleus is ovoid and located near the blunt end of the parasite, there is no cilia, flagella or pseudopodes. Trophozoites proliferate by endodygony or internal budding, they found in tissues during acute stage of infection and invade any nucleated cell of all mammalian cells except non nucleated erythrocytes. The rapidly proliferating trophozoites in acute infection in any cell of the intermediate host are called **tachyzoites**.

2- Tissue cysts :

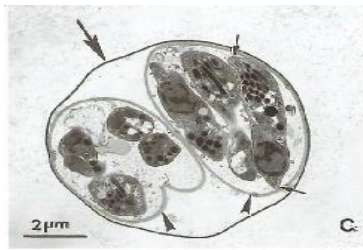
They are formed during the chronic phase of the infection and can be found in the muscle and various other tissues and organs, especially brain, skeletal and cardiac muscles and can persist, inactivated, in the body for a very long time. It range from 10-20 μm may contain several thousands of organisms. The slowly multiplying parasite within the cyst during chronic infection are called **bradyzoites**. They have nucleus situated toward the posterior end whereas the nucleus in tachyzoite is more centrally located.



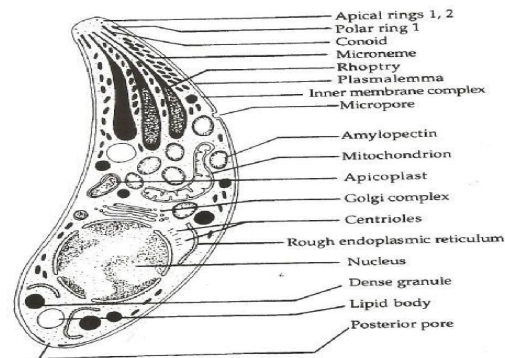
The tachyzoite (left) and a bradyzoite (right) of *T.gondii*

3-Oocysts:

These develop only in definitive hosts of (cats and other felines). It is spherical or ovoid, about 10 to 12 μm in size. Cat shed millions of oocysts per day in faeces for about two weeks during the primary infection. It becomes infectious only after development in soil or in water for a few days to form mature. Oocyst which contains two sporocysts, each one consist of four sporozoite is the infective form.



The Oocyst of *T.gondii*



The sporozoite of *T.gondii*

Definitive host is cats (any members of the feline family), in which sexual reproduction (gametogony or Sporogony), is occur to form oocyst.

Intermediate hosts is humans , mouse and others, in which asexual multiplication (Schizogony) is occur to form the trophozoite and tissue cyst.

So the infective stage of *Toxoplasma gondii* are:

1-Oocyst with contaminated food and drunk.

2-Tissue cyst within uncooked meat.

Toxoplasmosis appears to be transmitted by:-

1-consuming raw or undercooked meat containing *T. gondii* tissue cysts.

2-ingesting water, soil, vegetables, or anything contaminated with oocysts shed in the feces of an infected animal

3-blood transfusion or organ transplant

4-transplacental transmission from mother to fetus,

Laboratory Diagnosis:-

1- Serological Tests:

-Direct agglutination test,

-Complement fixation test (CFT).

-Enzyme linked immunosorbant assay (ELISA)

-Indirect fluorescent assay (IFA).

2-Demonstration of trophozoite in brain biopsy, bone marrow aspiration, CSF and amniotic fluid.

3-Demonstration of cysts in placenta and tissues of newborn.

4-Histopathology of lymph nodes.

5-Polymerase Chain Reaction (PCR).