Sporozoa—II(Eimeriida)

- **Order Eimeriida contains five genera:** *Toxoplasma, Cryptosporidium, Cyclospora, Isospora* and *Sarcocystis*

- *Toxoplasma* is an intracellular parasite that can cause congenital infections and also opportunistic infections (encephalitis) in HIV (human immunodeficiency virus) infected patients

1. *Toxoplasma gondii*

Toxoplasma gondii is an obligate intracellular parasite affecting a wide range of mammals and birds including humans.

A) Morphology

It exists in three morphological forms—two asexual forms (tachyzoite and tissue cyst) and a sexual form (oocyst).

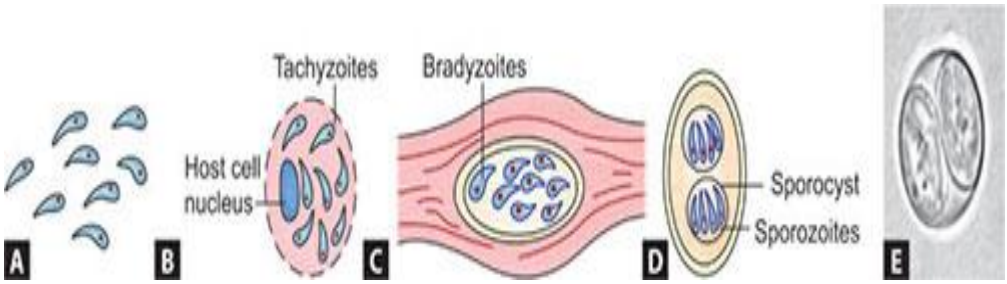
1. Tachyzoite

- It is an actively multiplying form (trophozoite), usually seen in acute infection.
- **Crescent shaped**, having a pointed anterior end and a blunt posterior end.
- They can infect all mammalian (nucleated) cells except red blood cells (RBCs)
- the tachyzoites contain special organelles like rhoptries, and micronemes which are crucial for the adhesion and invasion into the host cell (Fig. 7.1A)

- Inside the host cell, tachyzoites are surrounded by a parasitophorous vacuole within which they divide asexually by a

process called as **internal budding** or **endodyogeny** by which daughter trophozoites are formed within the parent cell.

- Host cell becomes distended by the proliferating tachyzoites and appears as **pseudocyst**. (Fig. 7.1B).
- Later on, the host cell ruptures releasing the tachyzoites that infects other cells.



Figs 7.1A to E *Toxoplasma gondii* (schematic diagram); (A) tachyzoites; (B) pseudocyst; (C) tissue cyst; (D) sporulated oocyst; (E) sporulated oocyst in cat's feces (saline mount).

2) Tissue cyst :

- It is the resting stage of the parasite, usually seen in chronic infections.

- The parasite multiplies within the host cells and produces a round to oval cyst containing many crescent shaped slowly multiplying trophozoites called as **bradyzoites**, surrounded by a cyst wall.

3) Bradyzoites:

- Measure 7 µm in length and 1.5 µm in breadth

- More slender, crescent shaped with a nucleus situated posteriorly
- Multiply slowly

- Seen in chronic infection
- More resistant to gastric juice
- Conversion of the tachyzoites to bradyzoites can be triggered by many factors like interferon-g (IFN-g), nitric oxide (NO), heat shock proteins, pH, and temperature changes
- Most common site of the tissue cysts-muscles and brain
- They appear spherical in the brain and oval inside the muscle tissue

4) Oocyst:

Oocyst is the sexual form of the parasite found in cats.

Life Cycle (Fig. 7.2)

Host: The life cycle involves two hosts:

1. **Definitive hosts** are cat , where the sexual cycle takes place

2. **Intermediate hosts** are man and other mammals (goat, sheep, pig, cattle and certain birds); where the asexual cycle takes place.

A) Asexual Cycle or Exoenteric Cycle (The Human Cycle)

1.Transmission and infective form:

a. Ingestion of sporulated oocysts (infective form) from contaminated soil, food, or water (most common route)

b. Ingestion of tissue cyst containing bradyzoites (infective form) from undercooked meat

c. By blood transfusion, needle stick injuries, organ transplantation, transplacental transmission or laboratory accidents. Tachyzoites are the infective form.

2.Transform into tachyzoites: In the intestine, sporozoites are released from sporulated oocyst and bradyzoites are released from the tissue cyst. They invade the intestinal epithelium and transform into tachyzoites.

3.Transform into tissue cyst: Tachyzoites multiply actively by endodyogeny and spread locally to the mesenteric lymph node. Subsequently, they also spread to distant extraintestinal organs like brain, skeletal and cardiac muscles, eye, liver, etc. where they transform into bradyzoites which multiply slowly to form tissue cysts.

B) Sexual Cycle or Enteric Cycle (The Feline Cycle)

- Cat (definitive host) acquire infection by ingestion of tissue cysts in the meat of rodents and other animals.

- Bradyzoites are released from the tissue cysts, which invade the intestinal epithelium, undergo several cycles of asexual generations (schizogony) before the sexual cycle begins

- the parasite differentiates to form male and female gametocytes
- Fertilization of male and female gamete results in formation of zygote which later gets surrounded by a thin, resistant rigid wall to form oocyst

- Oocysts are released in cat's feces which are unsporulated and noninfective. The maturation takes place 2–3 days later, in the humid environment.
- The mature sporulated oocyst containing two sporocysts is infectious to man for about 1 year (Fig. 7.1 D)

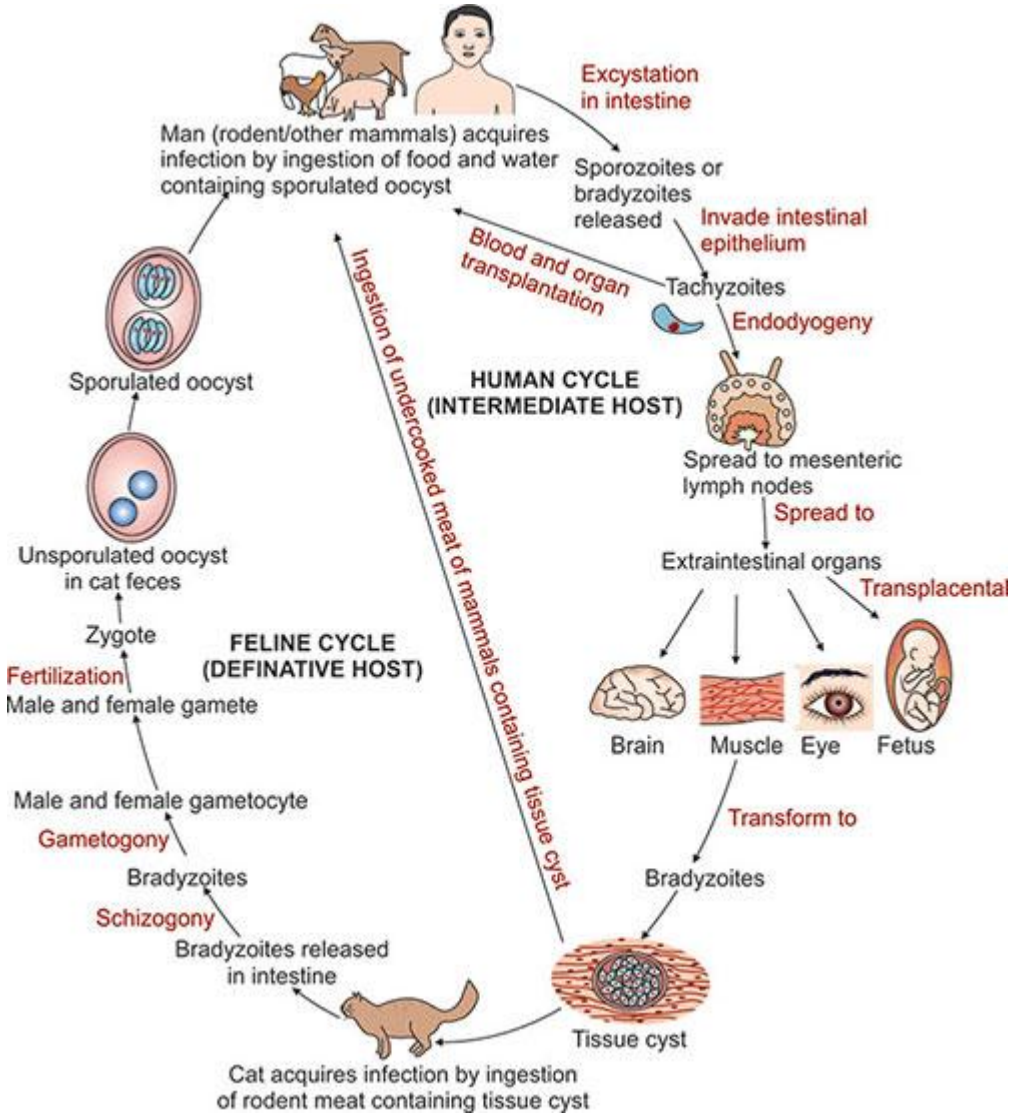


Fig. 7.2: Life cycle of *Toxoplasma gondii*

- **Pathogenicity and Clinical features**

Toxoplasmosis is one of the most common parasitic zoonotic infections affecting a wide range of mammals and birds. Its prevalence in humans varies from 5–75% and depends on various risk factors like:

a. **Age:** It commonly affects older age and fetus
b. Exposure to cat and cat's feces
c. **Food habits:** Ingestion of uncooked cat and other animal meat (seen in countries like France)—at higher risk.
d. The geographical area (cold area, hot arid climatic conditions, high altitudes are associated with a low prevalence).

Congenital Toxoplasmosis

a. Mother acquiring *Toxoplasma* infection in pregnancy is usually asymptomatic. However she can transmit the infection to the fetus.

b. **Gestational age** is the main factor influencing the fetal outcome. As the gestation proceeds, the chance of transmission increases but the severity of the infection declines

c. If the mother becomes infected during the first trimester, the incidence of transplacental infection is lowest (15%), but the disease in the neonate is most severe .

d. If maternal infection occurs during the end third trimester , the incidence of transplacental infection is maximum (65%), but the infant is usually asymptomatic at birth.

e. **Ocular involvement:** Most frequently it causes chorioretinitis leading to profound visual impairment.
f. Other ocular manifestations include blurred vision, scotoma, photophobia, strabismus and glaucoma.

Laboratory Diagnosis

direct Microscopic Examination

- **Specimens:** The specimens frequently examined are peripheral blood, body fluids, lymph node aspirate, bone marrow aspirate, cerebrospinal fluid (CSF) and broncho-alveolar lavage for HIV infected patients, biopsy material from spleen, liver and brain
- These specimens are stained with Giemsa, silver stains, immunoperoxidase stain

- **Direct fluorescent antibody test (DFA):** Tachyzoites can be detected by using fluorescein conjugated antibody against *T. gondii* surface antigens

Antibody detection:

- **IgG avidity test:** The avidity of IgG antibody with its antigen increases with time and this can be useful in differentiating recent and past infection.
- Low IgG avidity indicates recent infection where as a strong avidity indicates past infection
- **Detection of IgM in serum:** It indicates acute infection.

Detection of Toxoplasma Antigens :

- ELISA is available to detect specific *Toxoplasma* antigens in blood or body fluids or amniotic fluid.
- Detection of antigen indicates acute infection. This is also useful to diagnose congenital infection.