Tissue Apicomplexa *Toxoplasma gondi*  • Like most of the Apicomplexa, *Toxoplasma* is an obligate intracellular parasite. Its life cycle includes two phases called the intestinal-enteric and Extraintestinal phases.

- The intestinal phase occurs in cats only (wild as well as domesticated cats) and produces "oocysts."
- The extraintestinal phase occurs in all infected animals produces "tachyzoites" and, eventually, "bradyzoites" or "tissue cysts."
- The disease toxoplasmosis can be transmitted by ingestion of oocysts (in cat feces) or bradyzoites (in raw or undercooked meat).

# **Transmission**

- 1. Accidental ingestion of oocysts passed in cat feces through contaminated soil or handling of cat litter
- 2. Ingestion of tissue cysts with raw or undercooked meat (lamb, pork, beef), drinking unpasterized milk, contaminated water, or unwashed fruits or vegetables
- 3. Transplacental transmission. Tachyzoites multiply within the placenta and spread to the fetus.

- Two different kinds of host are needed in the sexual and asexual generations present in the life cycle of T.gondii.
- Sexual development or Gametogony occurs in the epithelial cells of the small intestine of cats(intra-intestinal phase).
- The binary fission and endodyogeny (process of internal budding in which two daughter cells are formed within the body of the mother cell that dies when the progeny are released) of the asexual development takes place in various nucleated cells outside the intestine of many spp. Of mammals and birds.

# Morphology

Toxoplasma gondii exists in three forms:

- tachyzoites (trophozoites).
  tissue cysts (bradyzoites).
- 3. oocyst.











There are 5 morphologically different stages:

- Trophozoite: or Tachyzoite is crescent or banana shaped with a pointed end and a bluntly round end.
- In the acute stage of the disease, trophozoites are usually scattered in the blood, cerebrospinal fluid and various pathological exudates arranged in pairs or singly.
- The trophozoite community is within a host cell parasitophorous vacuole not surrounded by a cystic wall. Hence they are also known as a pseudocyst (usually a swelling macrophage with a several parasites).
- The trophozoites within a pseudocyst are Tachyzoites.

- Tissue cyst: is round and oval in appearance and the cystic wall created by the parasite is thin, but firm and elastic.
- The protozoa multiply in the tissue cyst slowly and repeatedly.
- The trophozoites in the cyst are called Bradyzoites, which are similar to the Tachyzoites, but smaller than them.



# Tissue cysts of *Toxoplasma gondii* filled with bradyzoites

- Schizont: can be found in the small intestinal mucosa of the infected cat.
- Schizonts contain about 4-40 merozoites.
- Gametocytes are also found in the small intestinal mucosa of the cat.
- Male gametocytes produce 12-32 male gametes, crescent in shape.
- The female gametocyte develops into a female gamete.

- Male and female gametes fertilize to form a zygote that dvelops into an oocyst.
- An oocyst is round or elliptic and covered with a smooth transparent cystic wall consisting of two layers.
- Each mature oocyst contains two sporocysts with each sporocyst containing 4 sporozoites.

#### Life Cycle

The life cycle of the parasite consists of 3 stages as follows (a)Tachyzoites, the multiplying that which invade and multiply within cells,

- (b)Bradyzoites,the slowly multiplying inside tisssue cysts, seen during latent and chronic infection.
- (c)Sporozoites inside oocysts, which are shed in cat feces and remain in the environment.
- In cats, which are definitive hosts. both schizogony and gametogony takeplace in the epithelial cells of the small intestine (*enteric cycle*). Cat is infected either by ingestion of oocyst shed in its faeces or by eating flesh of other animals or birds containing tissue cysts
- The oocysts produced by gametogony are shed in faeces. They develop into infective forms in soil or water.

When ingested by other animals, birds or human. which are intermediate hosts. The oocysts release sporozoites which infect the intestinal epithelial cells. Here, they multiply by endodyogeny to form tachyzoites. The host cell ruptures releasing numerous trophozoites which spread through blood and lymph infecting any type of nucleated cell in various tissues and organs. This is known as the *exoenteric cycle*. Primary infection with the parasite may be asymptomatic, acute or chronic. In chronic infections tissue cysts are produced within muscles and other tissues.

- When other intermediate hosts ingest these tissue cysts, the asexual cycle is repeated. When cats ingest the tissue cysts they become infected and in them both asexual and sexual cycles are repeated
- Artificial methods of human infection are laboratory contamination, blood transfusion and organ transplantation. Congenital infection also occurs When food or water contaminated with *T.gondii* oocyst or animal body containing cysts, pseudocyst ingested by a feline, sporozoites, bradyoites or Tachyzoites are released in the small intestine.These parasites invade the epithelial cells.





## **Clinical Features**

Most human infections are asymptomatic. Clinical toxoplasmosis may be congenital or acquired.

#### Congenital Toxoplasmosis

Congenital toxoplasmosis results when infection is transmitted transplacentally from mother to foetus. The risk of foetal infection rises with the progress of gestation, from 25 per cent when the mother acquires primary infection in the first trimester, to 65 per cent in the third trimester. Conversely the severity of foetal damage is highest when infection is transmitted in early pregnancy. Mothers with chronic or latent Toxoplasma infection acquired earlier do not ordinarily infect their babies, but in some women with latent or chronic infection may be to babies.

the tissue cyst may be reactivated during pregnancy and liberate trophozoites which may reach the fetus *in utero*. Most infected newborns are asymptomatic at birth and may remain so throughout. Some develop clinical manifestations of toxoplasmosis weeks, months or even years after birth. The manifestations may be chorioretinitis, strabismus, blindness, deafness, epilepsy or mental retardation. A few are born with manifestations of acute toxoplasmosis, which include fever, jaundice, diarrhoea, may hydrocephalus, microcephaly, cerebral calcifications, cataract, glaucoma, chorioretinitis, optic atrophy, lymphadenitis, pneumonitis, myocarditis and hepatosplenomegaly.

#### Acquired Toxoplasmosis

Infection acquired postnatally is mostly asymptomatic. The most common manifestation of acute acquired toxoplasmosis is lymphadenopathy, Fever, headache, myalgia and splenomegaly. The illness may resemble mild 'flu' or infectious mononucleosis lymphadenopathy may persist. In some there may be a typhuslike, with pneumonitis, myocarditis and meningoencephalitis, which may be fatal. Another type of toxoplasmosis is ocular. Approximately 35 per cent of cases of chorioretinitis.

Toxoplasmosis primarily involving the central nervous system is usually fatal and often found in AIDS, severely in the immunodeficient, brain involvement is common.

Host defence against toxoplasma infection involves both humoral and cellular responses. Specific IgG antibody can lyse extracellular trophozoites. But activated T cells and natural killer cells appear to be more important in containing the infection and preventing clinical disease.

### Diagnosis

Laboratory diagnosis may be made by microscopic demonstration of the parasite,by its isolation or by serological tests. Giemsa stained impression smears of lymphnodes, bone marrow, spleen or brain may occasionally show the trophozoites, which can be readily identified by their morphology.

The most common method of laboratory diagnosis is by serology. Several serological tests are available. Indirect immunofluorescence, indirect haemagglutination, complement fixation ,ELISA and PCR.

The standard test used now is ELISA, separately for IgM and IgG antibodies. The presence of IgM antibody in the absence of IgG denotes current infection, IgM antibody with high titre IgG suggests infection in the recent past; Negative IgM with positive IgG indicates past infection. This is subject to individual variation. In some cases IgM antibody may persist up to 18 months. Serial ELISA provides better information than a sinlge test.

- Treatment:
- For Congenital toxoplasmosis (symptomatic or nonsymptomatic and disseminated disease in immunocompromised individuals: Combination of Sulfadiazine and pyrimethamine.
- Spiromycin and clindamycin have also been used
- Prevention:
- Cook meat thoroughly to kill the cysts.
- Avoid proximity to cats.