***Popular Article***

# Emerging Public Health Significance of Toxoplasmosis and Diagnosis

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## Introduction

The word Toxoplasma is derived from Toxan (Arch), Plastos (shaped) crescent shaped organisms that are enclosed in a parasitic membrane to form a cyst measuring 10-100 µ in size. Toxoplasma gondii is an obligate intracellular protozoan parasite with worldwide distribution in the genus Toxoplasma. The organism was first described in Tunis in 1908 by Charles Nicolle and Louis Manceaux within the tissues of the Gundi (Ctenodactylus gund, A North African rodent). In the same year it was also described in Brazil by Alfonso Splendore in rabbits.The definitive host of *T. gondii* is the cat, but the parasite can be carried by many warm-blooded animals (birds or mammals, including humans).

## History

Although *T. gondii* was first observed in rodents by Nicolle and Manceaux in 1908, it was not identified as an agent of infectious disease until 1932.Case of toxoplasma encephalitis occurred in a congenitally infected infant reported in 1939. The parasite is known to cause congenital disease and abortion both in human and livestock.

Worldwide, over 6 billion people have been infected with *T. gondii.* Seroprevalence, measured by IgG against *T. gondii,* varies worldwide, being reported to be 6.7% in Korea, 12.3% in China, 23.9% in Nigeria, 46% in Tanzania and 47% in France (rural area)] and can be as high as 98% in some regions.

## Infectious stages

The disease is caused by an obligate intracellular protozoan parasite *Toxoplasma gondii.*_The parasite shows four infectious stages for both intermediate and definitive hosts are Oocyst, Tachyzoites, Bradyzoites and Tissue cysts.

1. Sporozoites contained in oocysts are released in the feces. They are ingested by intermediate hosts and undergo divisions leading to tachyzoites.
2. Tachyzoites, rapidly multiplying organisms leading to acute infection.

3. Bradyzoites, slowly multiplying organisms that are released and form tissue cysts leading to chronic infection.
4. Walled structure, often found in the muscles and central nervous system (CNS), containing dormant *T.gondii* bradyzoites.

## Epidemiology and Public health significance

The different species of warm blooded animals live in cold environments and have adapted in many ways to survive the harsh climate and conditions. They can survive in the harsh cold climate because of their thick fur, short extremities, adipose tissue and many other adaptive features.

**Global epidemiology of Human Toxoplasmosis**

| Country | Prevalence rate(population) |
|---|---|
| • Alaska | • 28% (general population) |
| • Brazil | • 84.8% (adult population) |
| • Columbia | • 43-53% (various population) |
| • France | • 50% (children <10 years) |
| • India | • 18% (eastern India population)<br>77% (women of Sub-Himalayan area)<br>28.6% (antenatal clinic, delhi )<br>70% (goats and sheep butchers,delhi)<br>37.8% (general population,Maharashtra) |
| • Indonesia | • 71% (males) |
| • U.S.A | • 14.9% (women) |

(Sastry, 1995)

- High proportion of human are or have been infected with this parasite throughout the world.
- Infections are most common in cats, sheep, goats and swine.
- Lower infection rates are seen in dogs, horses and cattle seem to be resistant to infection.
- Cats are the only species to shed the infectious stage in their feces.

One third of humanity has been exposed to this parasite. Although asymptomatic in immunocompetent adults, and can cause severe disease manifestation and even death in immunocompromised patients.

Toxoplasmosis continues to be a significant public health problem in the United States (US). It is estimated that 1,075,242 persons are infected with *Toxoplasma gondii* and approximately 2,839 persons develop symptomatic ocular disease annually. Recent publications have linked suicide and schizophrenia to Toxoplasma infection. *T gondii*– infected mothers had a relative risk of self-directed violence compared with noninfected mothers, and the risk seemed to increase with increasing IgG antibody level.

Persons at high risk are pregnant women, cat owners, Veterinarians, abattoir workers, children, cooks, butchers. Prevalence increase up to age of 20 years after which it remained steady. High prevalence of infection in pregnant women of child bearing age. Epidemiologic studies from various parts of world indicate that the ingestion of uncooked meat is an important mean of transmission of *T.gondii*.

Poor hygiene observed in India during handling of meat from slaughter house to kitchen can be a source of *T. gondii*

infection. Heart and other organ transplantation recipient are at risk for developing Toxoplasmosis because of lowering of host resistance by immunosuppressive medication. Toxoplasmosis is one of the opportunistic infections in AIDS patients.

Geographic area, age, and socioeconomic factors influence the prevalence of the disease. The prevalence is highest in tropical regions and lowest in cold regions of the world. Toxoplasma antibodies of up to 60% in pregnant women and up to 77% in blood donors. Among female patients, the prevalence of Toxoplasma antibodies was higher among female blood donors than among pregnant women.

Two outbreaks of acute toxoplasmosis involving eight adult patients in Korea were recorded. All patients developed acute systemic toxoplasmosis after consumption of uncooked pork.In the first outbreak, three patients developed unilateral retinochoroiditis within 3 months of eating a meal consisting of raw spleen and liver of a wild pig. In the second outbreak, 5 soldiers who ate a meal consisting of liver roll of domestic pig developed lymphadenopathy.

In Nigeria, the prevalence of toxoplasmosis among 606 women of childbearing age was observed. The mean percentage of positive antibodies to *T. gondii* was 43.7%, ranging from 25% in the 15- to 18-year age group to 71.4% in the 39- to 42-year age group. Their study demonstrates a progressive increase in the prevalence of positive antibodies to T. gondii with age.

Outbreak of ocular toxoplasmosis in Coimbatore, India also reported. A total number of 402 sera samples were collected for screening of ocular toxoplasmosis from January 2001 to February 2005. Of these, 249 samples were collected and screened from September 2004. Out of these 249 cases tested during the outbreak, 178 cases had high titres of both IgM and IgG antibodies and 4 cases showed presence of IgM antibodies alone. All age groups were affected but a majority of them were above 20 years of age.

## Diagnosis

1. Microscopic examination
2. Animal inoculation
3. Serological tests
4. Polymerase chain reaction.

### Microscopic examination

Diagnosed by direct observation of parasite in the tissue,electron microscopy is also used.In cases of cerebral toxoplasmosis C.T. techniques are helpful. Fecal flotation method is used for diagnosis of active infection

**Animal inoculation**

Isolation of parasite by intra-peritoneal inoculation into mice or tissue culture. Mice should be tested for the presence of toxoplasma organism in peritoneal fluid 6 to 10 days after inoculation.

**Serological tests**

It includes Antibody detection tests like Indirect fluorescent antibody test , Indirect haemagglutination test , Latex agglutination test , Direct agglutination test , Enzyme linked immunosorbent assay can be used. Antibodies are detected by numerous serological tests using commercially available kits to detect T. gondii specific IgG, IgM, IgA or IgE antibodies.

- **Sabin–Feldman dye test** is a Serological test to diagnose for toxoplasmosis. The test is based on the presence of certain antibodies that prevent methylene blue dye from entering the cytoplasm of Toxoplasma organisms. Method for the detection of antitoxoplasma antibody in serum, based on the finding that Toxoplasma gondii cells (from peritoneal exudate in mice) are fairly well stained with alkaline methylene blue, whereas organisms in a serum that contains specific antibody have no affinity for the dye.
- **Polymerase Chain Reaction**

  PCR technique can be helpful for detecting Congenital Toxoplasmosis. *T.gondii* can also be isolated from muscle, brain, or other body fluids , using cell culture or mouse inoculation. PCR has allowed detection of *T.Gondii* DNA in brain tissue, cerebraospinal fluid, vitreous and aqueous fluid, bronchoalveolar lavage fluid, urine, amniotic fluid and peripheral blood.

## Prevention and control

- No vaccine is available for toxoplasmosis in humans. *T. gondii* infection is an important cause of abortion and mortality in sheep and goats throughout the world.
- A live vaccine using a nonpersistent strain of *T. gondii* is available in New Zealand, the United Kingdom, and Europe. The vaccine prevents abortion caused by *T. gondii* infection in sheep.
- A live vaccine using a mutant strain of *T. gondii* (T-263) is being developed in the United States to reduce oocyst shedding by cats.
- Tachyzoites are also inactivated at pH <4 or Freezing at -12°C, cooking to an internal temperature of 70°C, or using gamma radiation (5 kGy) kill tissue cysts in meat
- Several agents have been shown to be effective against the tachyzoite of *T. gondii*, but there is no chemotherapeutic agent that is

effective against the encysted form (bradyzoite) of the parasite.

- Disinfection by iodine, formalin and ammonia can resist the oocysts.
- Pregnant women should avoid nourishing the cats as well as avoid contact with cats and raw meat and raw milk should not be drunk.

## Treatment In Human

**Congenital Toxoplasmosis:** Treatment in human are as under follow.

- Congenital toxoplasmosis can be treated with Pyrimethamine, 1 mg/kg/d orally once every 3 day
- Sulfa-diazine, 50 mg to 100 mg/kg/d orally in two divided doses for 3 wk
- Corticosteroids for vision-threatening lesions: 1 mg/kg/d orally in two divided doses; the dose should be tapered progressively and later discontinued.

**Ocular Toxoplasmosis (Adult):**

- In ocular Toxoplasmosis Pyrimethamine, 75 mg orally for 2 consecutive days followed by 25 mg orally daily for 4 weeks
- Sulfadiazine, 2 g orally as a loading dose followed by 1 g orally four times daily for 4 weeks
- Corticosteroids to be used only when vision is threatened: prednisone, 1-1.5 mg/kg/d,
- Clindamycin has been shown to be effective treating ocular toxoplasmosis in humans and animals as a therapeutic alternative to Pyrimethamine used @ 900 mg/day.

## Drug Therapy in Pregnancy

- For women who acquire the infection during pregnancy, Spiramycin, a macrolide antibiotic.
- Decreases the incidence of congenital toxoplasmosis when administered early in the course of the disease at the dose rate of 1 g evey 8 hrs.

**Treatment in animal**

- Oocyst shedding in Toxoplasma infected cats was reduced with combination of Pyrimethamine @1 mg/kg and Sulfadiazine @ 129 mg /kg body weight.
- Clindamycin has shown activity against acute and chronic toxoplasmosis.