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TOXOPLASMOSIS: IN CATS AND HUMAN

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ABSTRACT

Toxoplasma gondii is a zoonotic protozoan parasite of warm-blooded animals that has a worldwide distribution. Felids are the only known definitive hosts for *T. gondii* and a recently infected cat can disseminate hundreds of millions *T. gondii* oocysts into the environment. When the parasite infects the rodent brain it removes the rat's innate fear of cats by gaining control over it's nervous system. Once in the environment, *T. gondii* oocysts can remain infectious for months or years under favourable conditions which can spread the infection to humans.. Toxoplasmosis is a significant public health concern and an issue of substantial importance to wildlife conservation, so the environmental transport and fate of *T. gondii*oocysts is an area of considerable scientific interest. *Toxoplasma gondii* is a ubiquitous protozoan parasite that can infect a wide range of animals including humans. *gondii* is the single known species of genus *Toxoplasma* and is considered as one of the most successful eukaryotic pathogens which is of major medical and veterinary importance. Effective vaccines may contribute towards preventing and controlling the spread of toxoplasmosis worldwide. Toxoplasma infection is highly prevalent throughout the world and causes disease in diverse populations. Effective treatment are available for each clinical entity of *Toxoplasma*, but problems of incomplete clinical efficacy, drug potency, drug safety and length of treatment remain. No well-controlled clinical trials in humans have been performed to evaluate the efficacy and safety of treatment.

KEYWORDS: toxoplasmosis, cats, human, *Toxoplasma gondii*.

INTRODUCTION

T. gondii was discovered in rodents in 1908 by Nicolle and Manceur in the North African rodent. In 1932, it was found to be an agent of disease in congenitally affected infants. In

1968, it was identified as a potential, fatal disease in immune-compromised adults. The different stages of *T. gondii* can be stained with different stains and can be observed under the microscope.

Stages

1) Oocyst – observed under the microscope in wet mount.
2) Tachyzoites- stained with giemsa stain.
3) Bradyzoites – stained with hematoxylin and eosin.

Structure of Toxoplasma

There are three infectious stages of *T. gondii*: the tachyzoites (in groups or clones), the bradyzoites (in tissue cysts), and the sporozoites (in oocysts).

Tachyzoites

The tachyzoite is often crescent shaped, approximately 2 by 6 μm, with a conoidal end (anterior) and a rounded posterior end. Ultrastructurally, the tachyzoite consists of various organelles and inclusion bodies including –

1) pellicle (outer covering)
2) conoid- anterior end
3) Rhoptries – excretory bodies
4) Micronemes- specialized secretory bodies responsible for the gliding motion of the cell.
5) Dense bodies- secretory organelles
6) Other eukaryotic organelles like mitochondrion, subpellicular microtubules, endoplasmic reticulum, Golgi complex, ribosomes, rough and smooth endoplasmic reticulum and nucleus. The nucleus is usually situated towards the central area of the cell and contains clumps of chromatin and a centrally-located nucleolus.

Bradyzoites

Bradyzoites differ structurally only slightly from tachyzoites. They have a nucleus situated toward the posterior end, whereas the nucleus in tachyzoites is more centrally located. The contents are dense, whereas those in tachyzoites are labyrinthine. However, the rhoptries in bradyzoites are usually electron contents of rhoptries in bradyzoites vary with the age of the tissue cyst. Bradyzoites in younger tissue cysts may have labyrinthine rhoptries, whereas, those in older tissue cysts are electron dense. Also, most bradyzoites have one to three rhoptries, which are looped back on themselves.

Oocysts (Sporozoites)

Oocysts are subspherical to spherical and are 10 by 12 μm in diameter. Under light microscopy, the oocyst wall consists of two colorless layers. Polar granules are absent, and the sporont almost fills the oocyst. Sporulation occurs outside the cat within 1 to 5 days of excretion, depending upon aeration and temperature.

Life cycle of *T. gondii*

*T. gondii*are intracellular spore forming parasites.

They exhibit two lifecycles –

1)Homogenous- requires only one host to complete life cycle.

2)Heterogenous- requires more than one host

Main host for T.gondii are domesticated and wild cats. Sexual reproduction occurs in cats, while, asexual reproduction occurs in intermediate hosts. Some examples of intermediate hosts includes humans, rats and other domesticated animals. The two stages are Enteroepithelial stage and Extraintestinal stage.

1) Enteroepithelial stage

Asexual stage-It occurs in cats. When cats ingests oocytes, sporozoites enter the epithelial cells. It undergoes schizogany (asexual reproduction) to form many daughter cells. These daughter cells are called merozoites. It bursts the epithelial cells and invade new cells. the bradyzoites stage enters the immune cells and grows more rapidly to form cysts.

Sexual stage-Some sporozoites enter intestine to form merozoites.

Sexual stage(gametogany) produces macrogametocytes which forms oocytes.Oocysts appear in cat feces from 3 to 5 days of infection.

2) Extraintestinal stage

This stage occurs when any mammal ingests oocysts. It contains sporozoites which enters intestinal cells and undergoes schizogany. When they are proliferating rapidly, they are called tachyzoites. They are spread through blood, to invade many tissues.

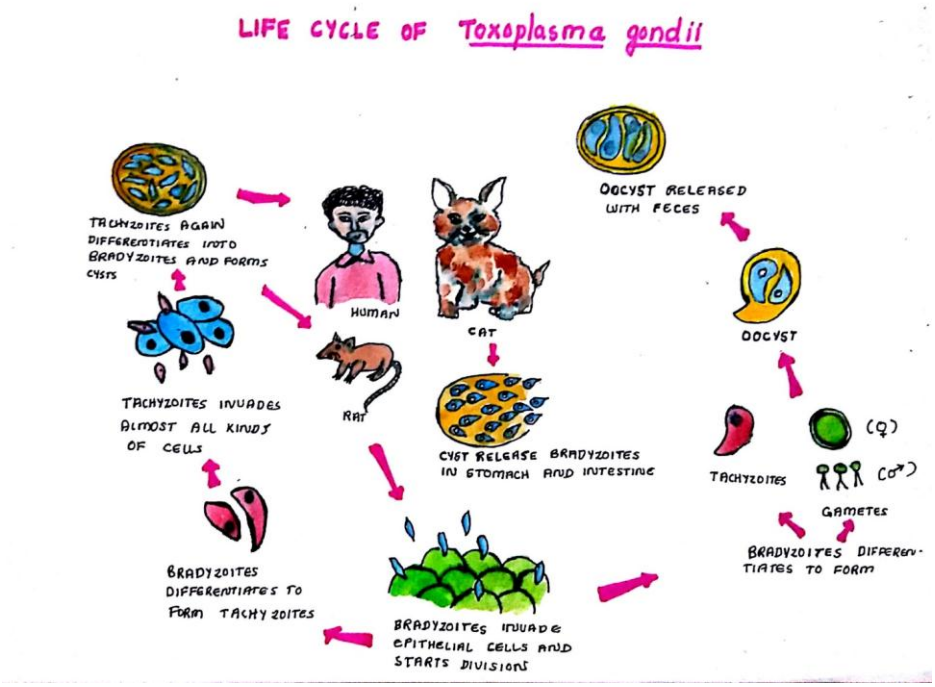

Fig. 1

Reference: Life cycle of *Toxoplasma gondii.* (Author: LadyoHats.)

Toxoplasmosis in cats

Toxoplasmosis is a parasitic disease which affects all warm blooded animals. Cats are the primary living host in which this parasite completes its life cycle and from this cat the infection is spread through faeces which is shed into environment.

How is cat infected with this parasite? When cat ingests infected prey or comes in contact with faecal matter of another infected cat. This parasites enters the body of cat where it multiplies in the intestine, cats are only the definitive hosts, it means that this parasite replicates in cats and produce oocysts (eggs) which then shed in the faeces. Once the cat get infected with *T. gondii* it start to shed millions of oocysts (eggs) in its faces. Intermediate hosts become infected but never produce oocysts. Intermediate hosts become infected by ingestion of an oocyst passed in cat's faeces. When intermediate hosts are infected, the organism initially spreads through the body as tachyzoites that is rapidly dividing form of organism and then on immune response will result in the formation of tissue cysts. Rats are also one of the examples of intermediate host. Rats infected with the parasite *Toxoplasma*, lose their fear of cats. Stanford researchers have discovered that the brains of those infected fearless male rats show activity in the region that normally triggers a mating response when

they meet a female rat. When a male rat senses the presence of a fetching female rat, a certain region of its brain lights up with neural activity, in anticipation of romance. Now, Stanford university researchers have discovered that, in male rats infected with the parasite toxoplasma, the same region response just as strongly to the odour of cat urine.

Symptoms in cats

Fever, weight loss, depression, seizures, vomiting, diarrhea, jaundice.

Diagnosis in cats

Measurement of IgG and IgM antibodies to *T. gondii* in the blood can help diagnose toxoplasmosis. If there is presence of IgM antibodies to *T. gondii* then it suggests an active infection. Whereas, presence of IgG antibodies suggest that the cat has been previously infected and now is most likely immune and not excreting oocysts.

Can toxoplasmosis be treated?

Most cats that have toxoplasmosis can recover with treatment. Treatment usually involves the use of an antibiotic called clindamycin. Other drugs that are used include, pyrimethamine and sulfadiazine, which acts together to inhabit *T. gondii* reproduction. Treatment must be started as soon as possible after diagnosis and continued for several days after signs have disappeared. In acute illness, treatment is sometimes started on the basis of a high antibody titre in the first test. If clinical improvement is not seen within two to three days, the diagnosis of toxoplasmosis should be questioned. No vaccine is as yet available to prevent either *T. gondii* infection or toxoplasmosis in cats, humans or other species.

Toxoplasmosis in humans

Effect of toxoplasma on human behaviour

Prevalent of human infections is latent infection with *T. gondii* is asymptomatic with an exception of congenital transmission. Studies have shown differences in infected and non-infected adults with respect to some behavioural changes which includes its effect on dopamine and on testosterone and reduced psychomotor performance. The dormant form of the *T. gondii* is found in nervous and muscle tissue in infected host. The individuals who have anamnestic antibodies to *T. gondii* are assumed to have a latent infection.

1. Psychomotor Performance

Tests were carried out and individuals affected with latent infections, they performed significantly more poorly and appeared to lose their concentration more quickly.

2 Effect on personality

Behavioural changes were observed which were different in men (included disregard rules, more expedient, suspicious, jealous and dogmatic) women (included higher warmth and higher superego strength).

Thus, latent toxoplasmosis influence the behaviour of rodents host as well as humans. Toxoplasma infected subjects have high level of testosterone which is associated with lower cellular immunity (weak immunity, Roberts c w, Walker w J,Alexander sex associated hormones and immunity to protozoan parasites, clean microbial revised, 2001 volume. 14 page 476, 488 and Schuster JP, Schaub GA experimental Chagas disease the influence of sex and psychomotor immunological factors, Parasitol 2001 volume 87 page 104.)

Toxoplasma gondii parasite is one of the world's most common parasites infections caused by:

1) Consumption of undercooked contaminated meat.
2) Exposure from infected cat faeces.
3) Mother to child transmission during pregnancy (congenital).
4) Receive an infected organ transplant or transfuse blood[rare]

Symptoms

- Mostly healthy people infected have no signs or symptoms and are in a while that they are infected.
- Some symptoms are similar to those of the flu-body ache, Swollen lymph nodes, Headache, Fever, Fatigue.
- Several signs and symptoms are seen in patients infected with HIV or AIDS receiving chemotherapy, recently had an organ transplant are collectively said to have weakened immune system.

Resemble tuberculosis or Pneumocystis jirovecipneumonia(common people with AIDS.).

- **In babies**

Many early infection end in still birth or miscarriage.Infant who survive suffer serious problems- Enlarged liver and spleen, Jaundice and severe eye infections.Only a small number of babies who have toxoplasmosis show signs of this at birth. Usually, infants who are infected don't develop signs including hearing loss, mental disability or serious eye infections until their teens or later.

- **Severe toxoplasmosis symptoms**

Blurred vision-can lead to blindness, confusion, loss of coordination, and encephalitis.

Prevention

1) Wear gloves when you handle soil.
2) Do not eat raw or undercooked meat.
3) Wash kitchen utensils thoroughly.
4) Wash all fruits and vegetables.
5) Don’t drink unpasteurized milk.
6) Avoid contact with stray cats or kitten.
7) Clean cats litter box carefully (wearing gloves).
8) Keep a check on your cat’s health.

Diagnosis

1) Pregnant women and infants are not routinely screened for toxoplasmosis.

- **Testing during pregnancy-**

If suspicious, blood tests that check for presence of antibodies to the parasite.Confirmatory test is done to confirm all the positive results.

- **Testing for infants**

If pregnant and have a current toxoplasmosis infection, test is done for testing for infection in the baby.

1. **Aminocentesis**

This procedure is performed after 15 weeks of pregnancy. Small amount of amniotic fluid is tested for evidence of toxoplasmosis.

2. Ultrasound scan

Detailed ultrasound can't diagnose toxoplasmosis. It can however, Show whether the baby has certain signs, such as fluid buildup in the brain (hydrocephalis). However, negative ultrasound does not rule out the possibility of infection. for this reason, newborn is examined for infecton during the first year of his life.

3. Testing in Severe case

In life threatening cases such as encephalitis, these tests are performed-

1) Magnetic resonance imaging

2) Brain biopsy -in rare cases, when patient does not respond to treatment, brain tissue is analysed in laboratory for toxoplasmosis cysts.

Treatment for Toxoplasmosis

Pyrimethamine and Sulfadiazine with Folinic acid (leucovorin) an alternative is Pyrimethamine with clindamycin (Cleocin).

- **Treating pregnant women and baby**

If infection occurs before 16th week of pregnancy, antibiotic spyramycin is prescribed which will reduce babies risk of neurological problems from congenital toxoplasmosis. If infection occurs before after 16th week of pregnancy, and the unborn child has toxoplasmosis pyrimethamine and sulfadiazine and Folinic acid is given. This treatment is also given to infants suffering from toxoplasmosis.

DISCUSSION

The clinical significance of toxoplasmosis was first discovered in the 1920s in congenitally infected children presenting with hydrocephalus retinochoroiditis and encephalitis. In humans, toxoplasmosis has been found in all parts of the world. It is estimated about one-third of the world's population is infected with latent toxoplasmosis. However, underdeveloped countries have higher incidence of toxoplasmosis than developed countries. Toxoplasmosis plays an important part in ruminants which is related to abortion and perinatal mortality. Toxoplasmosis affects the farm animals, but it has importance in its association with abortion and neonatal disease in sheep. Toxoplasmosis has importance in high-risk groups. The above review gives an idea about the life cycle of *Toxoplasma gondii*, the effect of *T. gondii* on cats and the behavioural changes that takes place in humans who are infected

with *T. gondii*. The symptoms, diagnosis, treatment and preventive measures are provided, so that, the contact of *T. gondii* with humans can be prevented. Furthermore, research and studies has to be done for detailed study of the organism and newer treatments for humans and the cats. Vaccines for toxoplasmosis are currently not available for humans.

REFERENCES

1. Toxoplasmosis by Alison Keith(http://www.austincc.edu/microbio/2993r/tg.htm).
2. "Image Library: Toxoplasmosis." Centers for Disease Control and Prevention. National Center for for Zoonotic, Vector-Borne, and Enteric Diseases: Division of Parasitic Diseases. Anon. Updated: 7/20/2009. http://www.dpd.cdc.gov/dpdx/HTML/ImageLibrary/Toxoplasmosis_il.htm 2/28/2010.
3. Dubey JP, Lindsay DS, Speer CA. Structures of *Toxoplasma gondii*tachyzoites, bradyzoites, and sporozoites and biology and development of tissue cysts. Clinical microbiology reviews. Apr 1 1998; 11(2): 267-99.
4. Life cycle of *Toxoplasma gondii*. Author: LadyoHats. (fig.1).
5. Hill D, Dubey JP. *Toxoplasma gondii*: transmission, diagnosis and prevention. Clinical microbiology and infection. Oct 1 2002; 8(10): 634-40.
6. Dubey JP. The history and life cycle of *Toxoplasma gondii*. *Toxoplasma gondii*. Jan 1 2007; 1-7.
7. Flegr J. Effects of Toxoplasma on human behavior. Schizophrenia bulletin. Jan 11 2007; 33(3): 757-60.
8. www.mayoclinic.org
9. "Parasites and Foodborne Illness." United States Department of Agriculture. Anon. Updated: 5/2001. http://www.fsis.usda.gov/fact_sheets/parasites_and_foodborne_illness/index.asp#5 2/28/2010.
10. "Parasites and Health: Toxoplasmosis." Centers for Disease Control and Prevention. National Center for for Zoonotic, Vector-Borne, and Enteric Diseases: Division of Parasitic Diseases Anon. Updated: 7/20/2009. http://www.dpd.cdc.gov/dpdx/HTML/Toxoplasmosis.htm 2/28/2010.
11. "Pregnancy and Toxoplasmosis." WebMD, LLC. Reviewed by Mikio A. Nihira, MD on December 20, 2009. http://www.webmd.com/baby/toxoplasmosis 3/1/2010.

12. "Report of the WHO Working Group Meeting on Toxoplasmosis Vaccine Development and Technology." Dr. Marie-France Cesbon, et al. 7/2/1992. http://whqlibdoc.who.int/hq/1993/WHO_CDS_VPH_93.114.pdf 3/8/2010.
13. "The risk for schizophrenia from childhood and adult infections." Brown, A.S American Journal Psychiatry. Jan 2008; 165(1): 7-10. http://www.ncbi.nlm.nih.gov.lsproxy.austincc.edu/pubmed/18178749 3/12/2010.
14. "Toxoplasmosis: Toxoplasmosis and HIV." Carlos S. Subauste, MD, Case Western Revere University. Posted on the University of California, San Francisco Website. 3/2006. http://hivinsite.ucsf.edu/InSite?page=kb-05-04-03 3/1/2010.
15. "Toxoplasmosis." MedlinePlus. Review provided by VeriMed Healthcare Network. Updated by: Kenneth M. Wener, M.D., Department of Infectious Diseases, Lahey Clinic, Burlington, MA. Updated: 11/1/2007. http://www.nlm.nih.gov/medlineplus/ency/article/000637.htm 2/28/2010.
16. Ibrahim N. Review on Toxoplasmosis and Its Zoonotic Importance.(Review on Toxoplasmosis and its Zoonotic Importance by Nuraddis Ibrahim*. Jimma University, School of Veterinary Medicine, Jimma, Ethiopia).