

# Toxoplasmosis

By Marie Wynan

Toxoplasmosis is a zoonotic disease caused by an intracellular protozoan parasite, *Toxoplasma gondii*. The feline is the definite host and the only species that produce and shed oocysts. It can infect all warm-blooded animals (including people) where they then act as an intermediate host.

## The microscopic *Toxoplasma gondii* parasite

### In the definite host, the cat,

the parasite (as sporulated oocysts) is ingested by the cat and invades the small intestinal cells where it multiplies via asexual reproduction resulting in male and female gametocytes. The gametocytes fuse together (sexual reproduction) and forms oocysts where each oocyst contains a zygote. This stage of formation of oocysts in the previously unexposed cat's intestinal cells only lasts a few weeks but produce millions of oocysts. Unsporulated oocysts (containing the zygote in each oocyst) are passed in the cat's faeces and after about three days under appropriate conditions, the zygote sporulates to become an infective oocyst now containing sporocysts and sporozoites. The infective oocysts are very resistant and can survive in the environment for many months and even years. After the first exposure, the cat's immune system usually prevents shedding of oocysts.

The cycle continues when previously unexposed cats ingest the sporulated oocysts and then produce unsporulated oocysts.

### In the intermediate host,

any other mammal (including people) can ingest the sporulated oocysts and will then become the intermediate host. After ingestion, the oocysts invade the intestinal cells where it forms tachyzoites (fast multiplication stage of zoites) (V.P Suddert, 2012). From the intestine, the tachyzoites moves throughout the body via blood and lymph to infect many different parts and type of tissues in the host. The most affected tissues include lymph nodes, liver, lung, brain/spinal cord, and eye. (Companion Animal Parasite Council, 2012) The tachyzoites multiply by asexual reproduction and cause tissue damage and death of infected cells causing possible clinical sign of the disease in the host. The fast dividing tachyzoites can also cross placenta in the pregnant host and infect the foetus. The tachyzoites can also pass to milk in lactating females. When the host's immune response starts, the asexual reproduction of the tachyzoites slows down and then forms dormant cysts within the tissue that is filled with bradyzoites which stays in the host for life. If the intermediate host with cysts (filled with bradyzoites) is eaten by another animal or person

the bradyzoites will invade the intestinal cells of the new host and again form tachyzoites in the new victim. However, no intermediate host can produce the infective oocysts.

If a cat as the definitive host eats an animal with cysts or an animal that has eaten another animal containing the cysts filled with bradyzoites, it again invades the intestinal cells and after asexual reproduction form unsporulated oocysts, which are shed in the faeces and then becomes infective.

**Unsporulated (coccidian) oocyst from a wombat**

**(not *Toxoplasma gondii*)**



photo by Marie Wynan

**Causes of the disease**

1. Ingesting the sporulated oocysts from the environment via soil, unwashed fruit and vegetables, contact with cat faeces, drinking oocysts contaminated water. The formation and then rapid multiplying tachyzoites destroy and kill cells and tissue in many different parts of the body.
2. An animal or human eating meat containing cysts filled with bradyzoites will invade intestinal cells and produce the rapid multiplying tachyzoites and destroy and kill cells and tissue.
3. When pregnant females of all species are infected for the first time the tachyzoites can pass the placenta and infect the foetus and result in severe abnormalities, abortion, still birth or very weak offspring.
4. Tachyzoites can pass into the milk in lactating mothers and infect the young, or caused by drinking unpasteurised milk.
5. Stress can cause a reactivation of cysts. When infected for the first time, the immune system produces antibodies. During stress/drought/malnutrition etc, cysts can be reactivated and cause toxoplasmosis especially in macropods and other marsupials that evolved without the cat as a native species.

## **Susceptibility**

1. It is thought to be one of the most common human infections throughout the world, but is usually asymptomatic. Infection is usually only clinically significant in immunocompromised individuals or in congenital infection. (RSPCA Australia Knowledgebase, 2013). Under normal circumstances, the immune system will easily destroy any bradyzoites that escape the cysts and tachyzoites killing cells, but a person or animal with lowered immunity may not be able to fend off an attack. The parasites can greatly increase in number and cause a variety of serious illnesses, including infection of the brain. (Department of Health , 2013).
2. All pregnant females of all species including people infected for the first time are more susceptible to cause serious illness or death in their foetus.
3. Marsupials are highly susceptible to infection with the parasite *Toxoplasma gondii*. (Andrew Thompson, 2010). *Toxoplasma* becomes clinically significant if animals are stressed, which can happen to them in captivity. (Andrew Thompson, 2010). It is indicating greater diversity of genotypes than previously envisaged. Two isolated shows lethal to marsupials were avirulent to mice. The data support the conclusion that Australia's isolation may have favoured the persistence of non-archetypal ancestral genotypes. (Andrew Thompson, 2010). "I think this *Toxoplasma* strain was introduced when European settlers colonised the world. I could imagine that this *Toxoplasma* strain originated from Europe and was introduced 300-400 years ago with the introduction of felines to Australia," quoted by Michael Johnson (Andrew Thompson, 2010). " I think it could be the intermediate host generating the diversity in Australia – with such a range of marsupials, some strains of *Toxoplasma* might be more suitable for some species than others and, so, natural selection results in the appearance of a diverse array of drifted Type II or unusual strains," quoted by Michael Johnson, (Andrew Thompson, 2010).
4. All species of warm blooded animals including birds and people are susceptible to be infected. The majority who are exposed to *Toxoplasma gondii* develop a lifelong immunity.

## **Clinical signs**

Human symptoms:

Only 10-20% of toxoplasmosis cases in adults and children are symptomatic. (Hökelek, 2013). Human symptoms may be similar to flu-like symptoms such as; swollen lymph nodes, headache, muscle aches, fever, fatigue and sore throat.

Toxoplasmosis is a serious and often life-threatening disease in immune deficient patients. (Hökelek, 2013). Symptoms of people with HIV, AIDS or other immune deficient disorders may have symptoms such as; headache, confusion, poor coordination, blurred vision, seizures, lung problems that resemble tuberculosis or pneumonia. (Mayo Clinic Staff, 2011).

Congenital toxoplasmosis is most severe when maternal infection occurs early in pregnancy. Infected newborns have anaemia, thrombocytopenia, and jaundice at birth. Affected survivors may have mental retardation, seizures, visual defects, spasticity, hearing loss or other severe neurologic development. (Hökelek, 2013). Only a small number of babies who have toxoplasmosis show signs of the disease at birth. Often, infected children don't develop signs and symptoms — including hearing loss, mental disability or serious eye infections — until their teens or later. (Mayo Clinic Staff, 2011).

### Mammals

Clinical signs are more common in cats than dogs, Majority of cats do not show any symptoms from the invasion of the parasite but cats with suppressed immune systems, feline leukaemia virus (FELV), feline immunodeficiency virus (FIV) or young kittens may show symptoms such; loss of appetite, lethargy, abdominal pain, diarrhoea, pyrexia, dysphagia, respiratory distress, retinitis, blindness, incoordination, personality changes and seizures.

Clinical signs are similar in most species with more severe forms in immune suppressed animals.

### Macropods

*Toxoplasma gondii* affects the macropod's brain, spinal tissue, heart, lungs, liver, kidney eyes and muscle. Clinical signs may show; lethargy, depression, anorexia, incoordination, runny nose, respiratory distress, neck and back arch, retinitis, blindness, diarrhoea, heart failure, seizures, coma and death. The unborn foetus may be still born, born with severe deformities or abort.

## **Diagnostics**

Toxoplasmosis is usually diagnosed by history and clinical signs.

The diagnosis of toxoplasmosis can be confirmed by the presence of *Toxoplasma gondii* in the blood, body fluids, or tissue using serologic testing. A test that measures immunoglobulin G (IgG) is used to determine if a person has been infected. (CDC, 2013). The parasites can also be isolated from blood or other body fluids but this process can be difficult and requires considerable time. (CDC, 2013). Molecular techniques that can detect the parasite's DNA in the amniotic fluid can be useful in cases of possible mother-to-child (congenital) transmission. (CDC, 2013).

A faecal sample from a cat can reveal shedding of unsporulated oocysts but has limited clinical relevance because most cats shedding oocysts are sub-clinically infected. (Companion Animal Parasite Council, 2012).

Serological testing results take too long for use in macropods and acute clinical signs and death may occur before the antibodies are produced.

### **Treatments**

Most cats that have toxoplasmosis can recover with treatment. Treatment usually involves a course of antibiotic, Clindamycin or (Sulfadiazine and Pyrimethamine acting together).

Most healthy people do not require treatment but for acute Toxoplasmosis, Pyrimethamine and Sulfadiazine can be used together to inhibit *Toxoplasma gondii* reproduce. Antibiotic treatment in pregnant women may lessen the severity of the disease, but it can't undo any damage that's already been done. (Mayo Clinic Staff, 2011)

### **Nursing requirements**

The symptoms are dependent on the tissues involved and therefore supportive nursing is specific to the symptoms. Some nursing requirements may be by medicate as per prescribed by Veterinarian, reduce fever, endotracheal tubing may be necessary if respiratory distress, palatable food, ensure adequate fluid. High priority of hygiene and barrier nursing is necessary when nursing cats with Toxoplasmosis. Correct hand washing technique and the use of PPE when handling and nursing the patient should be applied. Correct PPE and disinfectant when cleaning cages, bedding food bowls and emptying cat litter should also be appropriate following clinic's protocol. Disposal of waste should be handled and disposed of in correct manner using "medical waste" bins. Bedding and reusable washing should be placed and handled as per clinical protocol and placed in "contaminated washing".

### **Vaccination/Prevention/Advice to owners**

There is currently no vaccine to prevent Toxoplasmosis in human. However, vaccine development to prevent feline oocyst shedding is ongoing, mostly with live vaccines. The S48 strain Toxovax is a live vaccine originally developed for use in sheep, but when used in cats inhibits sexual development of *T. gondii*. This vaccine is used in sheep to reduce tissue cyst development. The T-263 strain of *T. gondii* is a live mutant strain designed to reduce or prevent oocyst shedding by cats by developing only partial infection in the feline intestinal tract. (National Centre for Biotechnology Information, 2012)

Especially pregnant women and immune deficient people need to take extra precaution to prevent Toxoplasmosis by;

- Wash hands before eating and after handling raw meat.
- Cook/eat meat well-done.
- Do not drink unpasteurised milk.
- Wash vegetables to remove particles of soil.
- Wear gloves when gardening.
- Get someone else to empty and handling cat litter and clean daily.

Additional to protect children;

- Make sure the child always washes hands before eating.
- Cover sandpit

To protect the household cat;

- Keep the cat indoor
- Do not feed the cat raw meet
- Discourage stray cats
- Do not allow the cat to hunt

## **Outcome**

The majority of healthy humans and animals will not even know if they have been infected and when they have, they develop lifelong immunity and rarely cysts will become a problem as antibodies will kill any escaping/dividing bradyzoites from the cyst.

In immune suppressed people and animals the outcome can be severe and life threatening.

Congenital toxoplasmosis may be severe and fatal.

In Marsupials toxoplasmosis is often severe and fatal.

## **Treating the environment**

It is impossible to eliminate the organism as it lives in the soil and can survive for many months and possible years. The parasite is very hardy and can survive high heat and thrives in wet/high rainfall area. It is resistant to colder climates and exists worldwide. It is possible to take precautions in the home and backyard by cleaning cat litter daily and discourage stray cats to limit the amount of sporulated oocysts in the immediate environment.

## Bibliography

Andrew Thompson, M. J., 2010. "Nonarchetypal Type II-like and atypical strains of *Toxoplasma* . *The Australias Society for Parasitology*, 21(3), p. 12.

CDC, 2013. *Parasites - Toxoplasmosis*. [Online]  
Available at: <http://www.cdc.gov/parasites/toxoplasmosis/diagnosis.html>  
[Accessed Feb 2014].

Companion Animal Parasite Council, 2012. *Toxoplasma*. [Online]  
Available at: <http://www.capcvet.org/capc-recommendations/toxoplasma>  
[Accessed Feb 2014].

Department of Health , 2013. *Better Health*. [Online]  
Available at:  
[http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Toxoplasmosis\\_reducing\\_the\\_risks](http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Toxoplasmosis_reducing_the_risks)  
[Accessed Feb 2014].

Hökelek, M., 2013. *Toxoplasmosis Clinical Presentation*. [Online]  
Available at: <http://emedicine.medscape.com/article/229969-clinical>  
[Accessed Feb 2014].

Mayo Clinic Staff, 2011. *Mayo Clinic, Toxoplasmosis symptoms*. [Online]  
Available at: <http://www.mayoclinic.org/diseases-conditions/toxoplasmosis/basics/symptoms/con-20025859>  
[Accessed Feb 2014].

National Centre for Biotechnology Information, 2012. *Development of Toxoplasma gondii vaccine*. [Online]  
Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23111123>  
[Accessed Feb 2014].

RSPCA Australia Knowledgebase, 2013. *What is Toxoplasmosis*. [Online]  
Available at: [http://kb.rspca.org.au/What-is-Toxoplasmosis\\_515.html](http://kb.rspca.org.au/What-is-Toxoplasmosis_515.html)  
[Accessed Feb 2014].

V.P Suddert, C. G. D. B., 2012. *Saunders Comprehensive Veterinary Dictionary*. 4th ed. USA: Elsevier Saunders.