

CATS PREGNANCY BABIES and Toxoplasmosis

Background

Toxoplasmosis is the most publicised of the zoonotic diseases which people can get from contact with cats. Toxoplasmosis has been in the headlines with articles indicating that infection with this agent may affect human behaviour and implicating cats as the major source of infection. This article will explore the known facts on transmission and disease caused by this agent and reassure cat owners that they have little to fear from their cat!

What is toxoplasmosis?

Toxoplasmosis is disease caused by infection with *Toxoplasma gondii* (*T gondii*), a coccidian parasite. In immunocompetent people (people with normally functioning immune systems), toxoplasmosis may be mild and pass undetected or may cause symptoms such as fever and lymph node enlargement which can be confused with other diseases such as 'flu or glandular fever (infectious mononucleosis).

Toxoplasmosis is most severe in certain 'high risk' groups of individuals whose immunity is impaired. This group comprises:

- Developing fetuses
- Babies and young children
- Very elderly people
- Pregnant people (because of the risk to their baby)
- Immunosuppressed people: for example, those receiving anticancer therapy, those with acquired immunodeficiency syndrome (AIDS) and organ transplant recipients on immunosuppressive treatment to prevent organ rejection.

In this group of 'high risk' people, infection can be associated with severe illness including encephalitis (inflammation of the brain), abortion, stillbirth, birth defects (including mental retardation) and other problems affecting the nervous system and eyes.

Although infection with *T gondii* rarely causes disease in cats, signs of illness can sometimes be seen and include:

- General signs of poor health including fever, loss of appetite, weight loss, lethargy
- Pneumonia causing breathing difficulties
- Inflammatory eye problems
- Liver disease causing jaundice
- Neurological signs eg, tremors, seizures Less common signs of illness reported include
- Lymph node enlargement
- Vomiting and diarrhoea
- Muscle pain

Infection in a pregnant cat can cause severe signs of illness in the offspring such as fetal death, abortion, stillbirths and death of young kittens.

What causes toxoplasmosis?

Toxoplasmosis is caused by infection with *T gondii*, a parasite which is present throughout the world and can affect most mammals including cats and humans. Infection with this parasite is common although disease caused by *T gondii* is rare. In general, around 50 per cent of all cats are believed to have been infected with this organism at some point in their lives, although the prevalence of infection varies according to the cat's lifestyle.

The life cycle of *T gondii* is quite complex and involves two types of host: definitive and intermediate. Wild and domestic felids, including the domestic cat, are the

definitive host for *T gondii*, which means that the organism can only produce oocysts (eggs) when infecting a cat. Kittens can be infected in utero and by sucking their mother's milk but this is uncommon. Most cats are infected by eating meat containing *T gondii* cysts – this can include raw or inadequately cooked meat (eg, beef, lamb, pork) or, more commonly, prey species (eg, voles, mice). A few days after a cat has been infected for the first time it will start to shed millions of oocysts (eggs) in its faeces. The oocysts are only shed for a short period of time, typically less than 14 days, before the body's immune response stops oocyst production altogether. Although infected cats can start shedding oocysts again in the future, this is rare and when it does occur it usually results in a much smaller number of oocysts being shed. Even cats that are frequently re-exposed to *T gondii* probably rarely shed large numbers of oocysts after their first infection (Lappin 2001). Experimental studies have shown that drug therapy to profoundly suppress the cat's immune system is rarely effective in triggering re-shedding (Dubey & Lappin 1998).

Other animals, including humans, are intermediate hosts of *T gondii*. These hosts can become infected but do not produce oocysts. Oocysts passed in a cat's faeces are not immediately infectious to other animals and must first go through a process called sporulation which takes between one and five days, depending on the environmental conditions. Once sporulated, oocysts are infectious to cats, people and other intermediate hosts and can survive in the soil or water for prolonged periods (up to 18 months) even in extreme weather conditions. Intermediate hosts become infected through ingestion of sporulated oocysts, and this infection results in formation of tissue cysts (bradyzoites) in various tissues of the body. Tissue cysts remain in the host for life and are infectious to cats, people and other intermediate hosts if eaten. Dogs (and perhaps other animals) can also transport sporulated (infective) oocysts and spread these to other places if they eat the oocysts and then pass them in their faeces where they remain infective.

How common is *T gondii* infection in people?

Human infection is more common in some countries than others. For example, in the UK around 20 to 30 per cent of people are infected at some point in their lives, whereas approximately 80 per cent of French and German people are infected. People who have been infected with *T gondii* develop antibodies to the organism and these can be detected on a blood test. The fetuses of women who have not been infected prior to pregnancy are vulnerable to *T gondii*-induced disease if the mother is infected when pregnant. In around 20 to 50 per cent of these women, the fetus will be infected and may be lost or suffer from birth defects. Effects of infection are most severe when infection occurs between months two and six of gestation. If a woman has been infected with *T gondii* before she becomes pregnant (and thus already has developed antibodies), there is no risk that the infection can be passed on to the fetus. This can only occur if a woman contracts toxoplasmosis for the first time during a pregnancy.

What are the sources of infection for people?

In most cases, people become infected via one of two routes:

- Ingestion of oocysts from the environment eg, through contact with soil containing sporulated oocysts. This can also occur indirectly through eating contaminated fruit or vegetables.
- Ingestion of meat containing tissue cysts. Fresh meat is most risky since freezing meat for several days will kill most tissue cysts.

Other routes of infection are less commonly implicated but include:

- Ingestion of sporulated oocysts through contact with contaminated water
- Ingestion of raw (unpasteurised) goats milk can transmit the organism
- Inhalation of sporulated oocysts on dust particles (extremely rare)

Does contact with a cat increase the risk of infection?

Recent research indicates that contact with cats does not increase the risk of *T gondii* infection of people. These studies have shown that:

- It is rare to identify cats shedding oocysts in their faeces. Thus, a recent survey found that while 24 percent of 206 cats had antibodies to *T gondii* indicating prior infection with this agent, oocysts were not found in the faeces of any of these cats (Hill et al 2000).
- Veterinary surgeons working with cats are no more likely to be infected with *T gondii* than the general population including people not in contact with cats (Behymer et al 1973, Sengbusch & Sengbusch 1976, DiGiacomo et al 1990).
- Contact with cats has no influence on the probability of people having antibodies to *T gondii* (antibodies develop following infection) whereas consuming raw meat significantly increases the risk of acquiring this infection (Flegr et al 1998).
- Stroking a cat will not spread infection from cats to people
- Even when cats are shedding oocysts in their faeces, oocysts cannot be found on their coat (Dubey 1995).
- Studies performed in dogs have shown that oocysts do not sporulate on their fur (Lindsay et al 1997) and it is likely that the same is true in cats.
- Cat ownership does not increase the risk of toxoplasmosis in people suffering from AIDS (Wallace et al 1993). Although people with AIDS are generally at an increased risk of clinical disease relating to *T gondii* infection, this results from reactivation of previous infection rather than acquiring new infection from their cat or other sources.
- The risk of infection from cats is very low except in young children playing in soil contaminated with sporulated oocysts. Most people are infected through ingestion of undercooked meat – especially goat, mutton and pork (Wallace et al 1993).
- It is generally believed that infection cannot be transmitted by a bite or scratch from an infected cat.
- Studies suggest that previously infected cats needing treatment with immunosuppressive drugs at standard doses, do not start shedding oocysts in their faeces (Lappin et al 1992).
- Studies also indicate that cats previously infected with *T gondii* do not re-shed oocysts in their faeces if they become immunosuppressed due to infection with feline immunodeficiency virus (FIV) or feline leukaemia virus (FeLV) (Lappin 2001).
- Furthermore, cats with FIV or FeLV that are subsequently infected with *T gondii* do not appear to shed oocysts for any longer or in any greater numbers than other cats (Lappin et al 1996, Dubey & Lappin 1998).
- Newer strains of *T gondii* have been identified that are highly infectious with infection being efficiently passed between intermediate hosts (species other than cats). Consequently, some scientists think that cats are becoming less important in the spread of this infection.

How can the risk of transmission of toxoplasma from a cat to its owner be reduced?

Toxoplasmosis is particularly severe in certain 'high risk' groups of individuals (see 'What is toxoplasmosis' section). Although the risk of transmission of infection from a cat to its owner is very low, this can be reduced further and/or its consequences minimised by adopting the following recommendations:

1. People in 'high risk' groups should not have contact with the cat's litter tray. Where possible, only non-pregnant and immunocompetent people (ie, not those people with diseases or drug therapy suppressing their immune system) should handle cat litter trays (following all of the guidelines below).

2. Empty litter trays daily so that oocysts do not have sufficient time to sporulate (become infective) while in the litter tray.
3. Wear gloves when handling cat litter and wash hands thoroughly after cleaning the litter tray.
4. Use litter tray liners if possible and periodically clean the litter tray with detergent and scalding water (which kills oocysts) eg, fill the litter tray with boiling water and leave for five to 10 minutes before emptying.
5. Dispose of cat litter safely. For example, seal it in a plastic bag before putting it with other household waste.
6. Cover children's sandpits when not in use to prevent cats using them as litter trays.
7. Feed only properly cooked food or commercial cat food to your cat to avoid infection.
8. Washing hands after contact with a cat (especially before eating) is a sensible hygiene precaution.
9. If very concerned, ask your vet to check your cat's toxoplasma titre (antibody test for exposure to *T gondii*):
 - Cats with a positive titre have been infected in the past and will not be a source of infection in the future as they have completed their period of oocyst shedding.
 - Cats with a negative titre have not been infected with *T gondii* in the past and are likely to shed oocysts in their faeces for a short time if they become infected in the future.
10. The risk of acquiring infection can be minimised by:
 - Avoiding feeding raw meat to the cat to reduce the risk of *T gondii* infection (see point 7 above).
 - Keeping the cat indoors to prevent hunting and access to intermediate hosts such as voles and mice.

How can the risk of transmission of toxoplasma from other sources be reduced?

These measures are essential in all 'high risk' groups of people (see above) and are also sensible routine hygiene precautions:

1. Gloves should be worn when gardening and hands thoroughly washed after contact with soil which may contain sporulated (infectious) oocysts.
2. Gloves should be worn when handling food to prevent exposure to oocysts and tissue cysts. Hands should always be washed thoroughly afterwards.
3. Fruit and vegetables should be thoroughly washed before eating to remove any oocysts present on their surface.
4. All food preparation surfaces and utensils should be cleaned with detergent in warm water before and after use to inactivate any tissue cysts.
5. Meat should be cooked to a minimum of 58°C for 10 minutes or 61°C for four minutes to kill the tissue cysts (Dubey et al 1990). Microwaving is not a safe way to kill tissue cysts as the heating is uneven. *T gondii* oocysts can remain infectious when stored in a refrigerator (4°C) for up to 54 months (Dubey 1998).
6. Freezing meat at -12°C to -20°C for three days kills tissue cysts as does curing or smoking (Dubey 1988, Lunden and Ugglå 1992).
7. Gamma irradiated food is free from any risk of infection.
8. If drinking a non-mains water supply, boil or filter before drinking to remove oocysts.

Why is toxoplasmosis in the news so much at the moment?

Over the past 10 years, much research has centred on the possible behavioural effects of *T gondii* on infected people and animals. Some of these studies have involved psychomotor tests on people, whereas others have looked at experimental

infection of rodents in the laboratory. The human studies have yielded some interesting results but these should be interpreted with caution because of the often small numbers of people studied and their different backgrounds. All of the studies have compared people who have been exposed to *Toxoplasma* with those that have not and have used this as a basis for explaining any differences between the two groups of people. However, other factors may well have been responsible for some of the changes. For example, one study involving 857 Czech military conscripts (Flegr et al 2003) reported decreased IQ and verbal intelligence in *T gondii*-exposed individuals whereas a second study found that *T gondii*-exposed pregnant women were more intelligent (Flegr & Havlicek 1999). These conflicting results raise the question as to whether *Toxoplasma* exposure was responsible for any of the documented behavioural changes.

T gondii infection has also been implicated as a cause of slower reaction times (Havlicek et al 2001) making individuals more at risk of road traffic accidents (Flegr et al 2002). Both of these studies involved relatively small numbers of people and results should be interpreted cautiously. The authors reported that:

- *T gondii*-infected people had slower, more prolonged reaction times and were more likely to have an accident than uninfected people.
- The risk of having a car accident was highest in those people with the highest *T gondii* antibody titre.

Behavioural changes have been documented in mice infected with *T gondii* (Hrda et al 2000, Webster 2001) although changes reported in animals cannot necessarily be extrapolated to humans.

- Infected mice are less active and this is most noticeable when infection is at its peak (peak of development of tissue cysts in the brains of the mice). These behavioural changes may make affected mice more vulnerable to predation by cats thus passing the infection on.
- The behavioural changes identified were transient – disappearing by week 12 post-infection.

Infected mice have increased levels of dopamine in their brain and toxoplasmosis has been suggested as a possible cause of schizophrenia in man (Flegr et al 2003) although evidence that this is the case is currently lacking.

Conclusions

The risks of acquiring toxoplasmosis from a cat are extremely small and most people are infected through other routes (such as eating undercooked meat). Simple everyday hygiene measures can be taken to reduce the risks of infection (from cats and other sources) making it safe to own and enjoy owning a cat.

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Other useful sources of information:

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