Should We Rethink Toxoplasmosis?

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Historically, acute infections by Toxoplasma gondii (T. gondii) were not considered problematic in children and adults. Congenital infections caused concern due to effects on the developing foetus. Unless severe, symptoms such as chorioretinitis often only appeared later with periodic reactivation of chronic infection. Current thinking about the role of T. gondii has changed substantially. Researchers now believe that acute infections in children and adults, and their periodic reactivation once the condition is chronic, may be responsible for a much larger percentage of eye disease than was previously thought, and may play a role in other systemic illnesses. Added to this, congenital T. gondii infection has recently been implicated in schizophrenia, which makes it timely for a reappraisal of this condition, its prevention and the implications for Orientation and Mobility (O&M) instructors.

Toxoplasmosis is a systemic illness caused by the protozoan parasite Toxoplasma gondii (T. gondii). Enlarged lymph nodes are frequently observed, and fever, fatigue, muscle pain, sore throats and headaches may be present. This mimics other infectious diseases (Hill & Dubey, 2002), so may go undiagnosed. Prevalence data from the USA estimate 23.6% of the population over 12 to be antibody positive (Jones, Kruszon-Moran, & Wilson, 2003) and an estimated billion people are infected worldwide (Vallochi, Nakamura, Schlesinger, Martins, Silveira, Belfort, & Rizzo, 2002).

Orientation and Mobility (O&M) instructors work closely with the vision impaired population and could be an important community resource for helping reduce infection rates through public education. The purpose of this paper is to give O&M instructors up-to-date information regarding Toxoplasmosis, both clinical and practical, so that their recommendations are based on current thinking. The most recent estimates of congenital infection are 1 in 10,000 live births in the USA (Jones, Lopez, Wilson, Schulkin, & Gibbs, 2001). A small percentage will have noticeable ocular involvement immediately, but most develop it later, often as teenagers or young adults (Rothova, 1999). Until recently it was widely held that most Toxoplasmic chorioretinitis in older children and adults was due to reactivation of latent congenital infection (Hayde & Pollak, 1999; Hill & Dubey, 2002; Rothova, 1999), but there is mounting evidence that postnatally acquired infection may be an important cause of ocular disease (Gilbert & Stanford, 2000; Holland et al., 1999; Rothova, 2003; Smith & Cunningham, 2002).

Life cycle of T. gondii

The life cycle of T. gondii is complex, and humans can acquire the infection through
multiple forms, but only sexually reproduces in the intestines of cats. Infected cats shed up to ten million oocysts in their faeces after an initial infection, which sporulate within a few days. Warm wet conditions favour persistence over dry or colder conditions, which impacts on geographical prevalence. Oocysts persist in soils for months or even years under ordinary conditions (Frenkel, 1999) and can be mechanically spread by flies, cockroaches, dung beetles and earthworms and even carried onto food (Hill & Dubey, 2002). The oocysts are ingested by birds and mammals, which along with humans are intermediate hosts.

T. gondii firstly assumes a rapidly multiplying form, the tachyzoite, within intermediate host cells, which is responsible for initial tissue destruction. With an immune response and antibody development, the parasite forms cysts within host tissues as the slowly multiplying bradyzoite, the latent form of chronic infection (Frenkel, 1999).

Given that T. gondii reproduction in cats is sexual, new strains of the organism are constantly emerging. This means that those already infected can be re-infected with potentially more virulent strains at any time, further complicating their retinal health. O&M instructors can be instrumental in encouraging recommended hygiene practices that may minimise this possibility during regular contact with clients and their families.

**Common transmission routes**

Ingestion accounts for most infection, either as oocysts from cat fecal contamination, or as tissue cysts in meat (Hill & Dubey, 2002). T. gondii is not resistant to freezing, but household freezers cannot be relied upon due to variable performance. Cooking meat to an internal temperature of 66°C in a conventional oven kills cysts, but microwaves have not been shown to be reliable (Dubey, 1999). Once consumed, digestive enzymes break down the cyst wall, but viable bradyzoites survive long enough to infect the new host.

**Reactivation in the immune compromised**

Initial infection in immunocompetent adolescents and adults may go unnoticed or follow a mild course. Immunosuppression caused by AIDS, chemotherapy, following transplants and for lymphoproliferative disorders can all result in reactivation of pre-existing T. gondii infections (Jones, et al., 2001; Smith & Cunningham, 2002). Additionally, elderly members of the population have been identified as at risk of aggressive disease (Smith & Cunningham, 2002). If O&M instructors are aware that a client is immunosuppressed, they can not only act as an information resource, but should take care that their own hygiene does not compromise that of their client.

**Congenital or acquired?**

Current evidence suggests that at least two thirds of ocular Toxoplasmosis may be caused by postnatal infection (Gilbert & Stanford, 2000). In the past, the ‘typical’ chorioretinal scars were often what pointed to a diagnosis but atypical presentations are being reported more commonly (Smith & Cunningham, 2002), and intraocular inflammatory reactions have been reported in the absence of old scars (Holland, Muccioli, Silveira, Weisz, Belfont, Jun, & O’Connor,
1999). According to Rothova (2003), those acquiring ocular Toxoplasmosis in the acute stage of infection are mostly elderly, and additional complications can disguise the original lesion, making correct diagnosis difficult.

**Systemic and behavioral effects of T. gondii infection**

Increasingly, non-ocular manifestations are coming to light. There have been reports of cysts found among tumor cells in pituitary adenoma (Zhang, Li, Hu, Cheng, & Huang, 2002), researchers in Turkey found a significantly higher incidence of T. gondii seropositivity among patients with cirrhosis of the liver (Ustun, Aksoy, Dagci, & Ersoz, 2004), and research on mice in Brazil “suggest that infection with T. gondii accelerates atherosclerotic development” (Portugal et al., 2004, p. 3571).

Researchers in the UK looked at the ability of T. gondii to manipulate the behaviour of intermediate hosts in order to increase the likelihood of predation by its definitive host, thereby ensuring the completion of its life cycle. Rats usually avoid areas where there are signs of a cat’s presence, but the researchers found that infected rats had an altered perception of cat predation risk, and in some cases their aversion turned into attraction (Berdoy, Webster, & Macdonald, 2000). These results may help provide a partial explanation for altered brain function in infected humans.

Laboratory studies have shown that latent Toxoplasmosis prolongs reaction times, a study in the Czech Republic finding that subjects with latent T. gondii infection have a significantly increased risk of traffic accidents compared to non-infected subjects (Flegr, Havlicek, Kodym, Marek, & Zbynek, 2002). O&M instructors should be aware of these slower reaction times in clients with Toxoplasmic lesions, and slowing down the pace of instruction and expectations in complex environments is recommended.

Not only may reaction times be affected. Torrey and Yolken (2003) relate three cases in which schizophrenia was first diagnosed, being retracted later when further neurological symptoms developed. Brown et al., (2005, pp. 771-72) demonstrated that “elevated maternal IgG antibody to Toxoplasma is associated with an increased risk of schizophrenia and other schizophrenia spectrum disorders” for the developing foetus in adulthood in a study of a large birth cohort born between 1959 and 1967.

Many studies have indicated that schizophrenia has its origins in earlier stages of brain development even though symptoms may not manifest until late adolescence or early adulthood (Torrey & Yolken, 2003). In cell cultures, T. gondii selectively affected glial cells, especially astrocytes (Creuzet et al., 1998, cited in Torrey & Yolken, 2003) and postmortem studies of schizophrenics report glial cell abnormalities, including reduced numbers of astrocytes (Doyle & Deakin, 2002, cited in Torrey & Yolken, 2003).

France has a high rate of T. gondii infection, and is reported to have 50% higher first-admission rates for schizophrenia (Van Os, Galdos, Lewis, Buurgeois, & Mann, 1993, cited in Torrey & Yolken, 2003). Likewise, rural Ireland has high seropositivity and a high prevalence of schizophrenia (Halonen, Lyman, & Chiu, 1996, cited in Torrey & Yolken, 2003). T. gondii is known to have an affinity for neural tissue, and infection
becomes chronic after a short acute illness, providing a capacity for long-term illness starting in early life (Torrey & Yolken, 2003).

**Public health prevention**

Transmission of *T. gondii* is largely oral, so simple hygiene measures are currently the most effective preventive strategy. Dubey (1999) recommends washing hands and implements thoroughly with soap and water after handling meat. Rare and raw meats should be avoided, and meat should be cooked to 66°C throughout in conventional ovens, as microwaves are unreliable. Gloves should be worn when gardening and vegetables washed thoroughly before eating.

Cats should only be fed dry, canned or cooked food because they usually only become infected from eating infected tissues. Gloves should be worn when handling cat litter, which should be emptied daily. Garbage cans should be covered to prevent scavenging when not in use to minimise fecal contact with children. Feral cats are a major reservoir of the infection, so cats should be spayed to control the feline population, and dead carcasses on farms should be removed promptly to prevent scavenging (Dubey, 1999; Thulliez & Romand, 1999).

Additionally pregnant women should make arrangements with someone else to change cat litter trays if possible and hands should be washed thoroughly after contact with cats, soil and raw meat. Raw fruit and vegetables should also be washed thoroughly before consumption and avoided when eating out if this cannot be confirmed (Thulliez & Romand, 1999). Although not universally implemented, blood tests and screening are available, so Toxoplasmosis can be discussed with a General Practitioner. Enlarged lymph nodes in the neck area should not be ignored. O&M instructors should familiarise themselves with these recommendations so that they can act as a resource for clients and their families and for the wider community when appropriate situations arise.

**Conclusion**

The cost-benefit of mass screening is still being debated worldwide, but Austria implemented antenatal screening in 1975, and France followed in 1978. Establishing the recency of infection is important during pregnancy in order to minimise damage to the fetus, and there is not one clear test that can do this at present (Hill & Dubey, 2002). Prenatal drug regimens do reduce the severity of sequelae among infected infants, but they do not influence congenital transmission rates (Jones et al., 2001) and 50% of those diagnosed develop recurrences of ocular infections within 3 years regardless of treatment given (Rothova, Meenken, & Builenluis, 1993, cited in Ambrose-Thomas & Peterson, 1999).

Given all of this, the public health message needs to be reclarified and rebroadcast in the light of emerging findings. Increasingly atypical ocular presentations are being reported in the literature, and concern regarding a possible role for *T. gondii* in schizophrenia and other illnesses has been raised. The contribution of Toxoplasmosis to ocular, systemic, neurological and psychiatric diseases, whether by congenital or acquired routes, needs to be established with some urgency. There are huge medical, economic, and public health consequences,
the seriousness of which may be currently underestimated.

References


