Toxoplasmosis and Vision Impairment

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This paper examines the current literature about toxoplasmosis, a parasitic disease affecting approximately one third of the world’s human population. The disease causes a range of disorders, among them ophthalmic disorders. Case studies are used to describe the effect of the disease on functional mobility, and the type of orientation and mobility training provided.

Toxoplasmosis is a parasitic disease, which occurs as a consequence of the Toxoplasma gondii (T.gondii) infection, one of the most common parasites in the world. It is an obligate intracellular parasite estimated to have infected over one billion people throughout the world (Reynolds, Falco, Schechtman, & Pizzimenti, 2012). In humans, T.gondii can be acquired as well as congenital, the latter transmitted to the placenta through maternal infection. Congenital infection can result in spontaneous abortion, stillbirth, neurological disorders, and various ophthalmic disorders. There have also been several studies which have reported an association between the Toxoplasma gondii infection and the increased risk of schizophrenia (Niebuhr, Millikan, Cowan, Yolken, & Li, 2008; Selten & Kahn, 2002).

The focus of this literature review is to examine current research relating to ocular toxoplasmosis, including its implication for orientation and mobility (O&M), with an emphasis on the following aspects of the disease:

- the cause, diagnosis, and treatment of the parasite in the foetus and infant to minimise the damage to the retina
- ongoing treatment when the parasite is reactivated and the search for a cure to eliminate toxoplasmosis from cells within the human body

The toxoplasmosis parasite infects animals and birds although the sexual cycle of the parasite occurs in the small bowel of cats and as such cats play a major role in the spreading of infection in nature. The research presented reveals the presence of cats is significantly important in the transmission of the parasite (Brown, 2011; Mustafa, Yusof, Norma, Muthusamy, & Shoib, 2012). Cats transmit the parasite through their faeces which contain oocysts (eggs) that can continue to be active for up to 18 months in moist soil. As such a repository of the parasite can exist in the environment from which other animals can be infected.

Humans can consume water or food that has been directly contaminated or eat undercooked meat from previously infected animals (Brown, 2011; Ng & McCluskey, 2002). A concise outline of the way T.gondii
infects humans is provided by McLeod et al. (2006), whereby it is asserted that three main routes can transmit the parasite namely: (i) consuming infected or undercooked meat; (ii) ingesting the oocysts (eggs) of the parasite that cats pass on in their faeces, with contamination coming from cat litter or soil (the latter including eating unwashed vegetables and fruit, contaminated water, working in the garden); and (iii) a mother acquiring toxoplasmosis during a pregnancy and the infection flowing to the foetus.

Congenitally acquired toxoplasmosis is mostly not identified in pregnant women, especially if they are immunocompetent (have strong immune systems) as the presence of the infection in these cases is generally asymptomatic i.e., no apparent symptoms. Dr Rima McLeod, Professor of Ophthalmology and Visual Science and Paediatrics at the University of Chicago, Director of the Toxoplasmosis Centre and her cohort have conducted extensive research into the treatment of ocular toxoplasmosis, with reference also to studies in France, which are at the forefront of treatment of the disease in utero (McLeod et al., 2006; McLeod, Kieffer, Sautter, Hosten, & Pelloux, 2009; Phan et al., 2008).

On the basis of their research, recommendations include that there should be systematic screening for acquired toxoplasmosis for all pregnant women in the USA during prenatal visits. In addition, standard practice should include the testing of all newborn babies for congenital toxoplasmosis and that confirmation of laboratory test results and relevant counselling should be part of the process (McLeod et al., 2006). The physicians who collaborated on the National Collaborative Chicago-based Congenital Toxoplasmosis study identified that signs, symptoms, and recognisable risk factors were absent in more than 50% of the mothers of children with congenital toxoplasmosis. The clinical practise of a doctor asking questions and performing physical examinations would only have revealed half of the mothers who had acquired the disease during pregnancy; the other half would have been identified through blood test screening (McLeod, Boyer, Karrison, Kasza, Swisher, Roizen, Jalbrzikowski, Remington, Heydemann, Noble, Mets, Holfels, Withers, Latkany, & Meier, 2006). McLeod et al. (2006) referred to obstetric care in France and Austria where education about toxoplasmosis and screening for the parasite is part of the regular medical appointments for a mother during her pregnancy. As a result the rates of infection have decreased by more than half, with monthly blood tests assisting the early identification of any infection and timely treatment to help prevent the parasite infecting the foetus. Previously, infection rates in France were quite high as their food culture included eating undercooked meat, such as steak tartare. The authors maintain that an early diagnosis allows for timely treatment, which can decrease the chances of ophthalmologic or neurological damage. Reynolds et al. (2012) consider that there should be a range of serological testing, the primary test being the Sabin-Feldman dye test. They argue that comprehensive tests are required as the basic clinical presentation of ocular toxoplasmosis can be similar to that of other infections, including tuberculosis and syphilis.

In Australia there appears no evidence in literature that advice provided by the Department of Health in the various States and Territories with regard to pre natal
testing includes screening for the presence of the toxoplasmosis parasite as part of the recommended standard blood tests. Given the increasing presence of domestic cats and wild cats in urban and regional areas, the collection of water samples from various locations such as dams, rainwater tanks, and soil samples from locations of high food production may provide data useful in increasing our understanding of the way toxoplasmosis parasite is transmitted in Australia.

A diagnosis of toxoplasmosis in infants can often be delayed if its presence is asymptomatic. Also if infants are pre-verbal then they are unable to describe their vision. Where symptoms exist they can include eye pain, inflammation, and reduced vision, often described as “headlights in a fog” (Brown, 2011). The clinical features may include retinochoriditis (i.e., creamy white lesions adjacent to scars on the retina), scotomas (i.e., diminished visual acuity) or floaters which are opaque spots floating in the vitreous fluid. Major vision impairment can be evident from lesions on the macular, while lesions in the periphery may not have an obvious impact on vision. Delair et al. (2011) recommended the use of an Amsler Grid on a daily basis for those with retinal scars for early detection of any reactivation of the parasite; although this test may not be useful for detecting new lesions outside of the central vision. A recurrence of ocular toxoplasmosis is common in those who have congenital toxoplasmosis, especially if untreated as an infant, and often occurs during adolescence (Phan et al., 2008). The reactivation of the infection can also be experienced if a person is immunocompromised i.e., their immune system is in a weakened state such as patients with HIV or undergoing chemotherapy.

There appears to be general agreement in the research literature as to the current drug treatment for the parasite when detected early. Further, McLeod et al. (2009) published additional data from their National Congenital Toxoplasmosis Study (McLeod et al., 2006) indicating that treatment during gestation and within the first year of life, reduced the potential damage caused by the parasite and prevented many adverse consequences arising from congenital toxoplasmosis. Ng and McCluskey (2002) contend that the requirement for treatment and its duration needs to be assessed on an individual basis, determined by factors such as the potential threat to vision, state of vision in the other eye, and the state of the patient’s immune system at the time.

A combination of drugs is often used to achieve a rapid result, with the use of pyriemethamine, sulfadiazine, and corticosteroids being a common approach (Delair et al., 2011). Therapy can range from four to six to 12 weeks in patients with a competent immune system, but patients with a compromised immune system, such as those receiving organ transplants or who have HIV infection may require longer term treatment. The use of Bactrim (sulfamethoxazole and trimethoprim) for a four to six week period appears to be a safe yet effective alternative for the common approach described (Reynolds et al., 2012).

The desired clinical result is evident when the retinal scars are no longer white and fluffy in appearance, the vitreous clears, and the existing scars on the retina develop sharp margins (McLeod et al., 2009). Generally, if a person is immunocompetent,
i.e., they have a healthy immune system, the toxoplasmosis parasite can be kept in a dormant cyst state, although reactivation can still occur often without apparent symptoms, or symptoms which resemble a flu.

**Toxoplasmosis and O&M**

**CASE STUDY A**

Sarah*, 22 years of age, was diagnosed with toxoplasmosis at age five. Sarah’s mother noticed she would sit down when going down stairs, frequently bump into table corners or doorways, and turn her head to the side even though she was reaching for objects in front of her. An ophthalmologist confirmed that as a result of toxoplasmosis, Sarah experienced central vision loss in both eyes, blurred vision that was more pronounced in her right eye, though her peripheral vision remained unaffected. Reflecting this diagnosis, functionally Sarah experienced depth perception issues, had difficulty recognising faces, would look down when walking, and slow down considerably when walking from the sun into shade or vice versa. Sarah was referred to a mobility organisation for O&M training. Sarah initially received long cane training that assisted her to: look up when walking; use her peripheral vision to scan the environment; increase her confidence to walk on uneven surfaces and descend stairs; walk confidently despite the presence of sun and shade. Sarah currently uses a long cane together with a Miniguide. Sarah particularly uses the Miniguide at night when her vision is significantly reduced to assist in the location of objects above waist height. Currently, Sarah uses the Miniguide of an evening to locate overhanging tree branches and fence shorelines on her three kilometre (two mile) walk from work to home.

**CASE STUDY B**

John*, age 18 years, was diagnosed at age nine months with congenitally acquired toxoplasmosis. John experienced significant scarring on the retina in his right eye with a visual acuity recently measured at 6/60. John’s left eye had some scarring in the periphery of vision, which did not appear to impact on his vision. John led an active childhood on a property in a rural location, riding motorbikes, and bicycles, trampolining etc. He enjoyed reading and was able to read books with normal size print. In his early teenage years he experienced a significant growth spurt during a twelve month period, at which time the toxoplasmosis parasite reactivated, presumably due to his immune system being under pressure during a time of intense growth. Despite the use of the appropriate medication, pyriemethamine, sulfadiazine, and corticosteroids, scarring to the retina resulted to the lower right of his central vision with his acuity in that eye recently measured at 6/9.

From an O&M perspective, John appears to have no mobility issues, using his vision in his left eye effectively. He satisfies the vision requirements to retain a driver’s license in NSW and drives a motor vehicle in a safe manner, scanning to the left and right in particular. In a classroom setting John prefers to sit toward the front of the class so that he can read the blackboard. John, although able to read size 12 font, finds it easier to read enlarged text on his laptop screen. John is aware that he needs to maintain a healthy immune system and be conscious of any changes in his vision, as prompt action may limit any further
damage arising from a reactivation of the toxoplasmosis parasite.

* Name changed for privacy.

**Treatment for Toxoplasmosis**

Medications to treat reactivations of toxoplasmosis although effective are too toxic for long-term use, with side effects prevalent and some patients becoming hypersensitive to them. The parasite endures throughout a person’s life and although research for a cure is ongoing, there is currently no treatment, which can eliminate it from the human system, nor an available vaccine. Dr Rima McLeod and her team of researchers at the University of Chicago, however, have been seeking to develop a successful approach using strands of DNA with a small peptide, inserted into cells which contain the parasite, in an attempt to disrupt genetic signals (Lai et al., 2012). The new treatment was tested in tissue culture containing infected cells and in live mice, artificially infected with the parasite. It was able to significantly reduce the production of a number of distinct proteins and it is anticipated that it will eliminate the parasite’s genes.

The epidemiology, existence, and treatment of ocular toxoplasmosis continue to be researched in a number of studies and the search for a definitive cure is ongoing. Different drug combinations are being tested in order to find a safer option than conventional therapies, which can be too toxic over extended periods (Reynolds et al., 2012). Given cats are the primary host of the *T. gondii* infection, spreading the parasite via the eggs in their faeces, further research is required to develop a vaccine to prevent infection in cats and livestock, thereby reducing a significant amount of infections in humans, acquired both post natal and in utero. In addition, systematic screening for acquired toxoplasmosis for all pregnant women during prenatal visits, would contribute to early diagnosis and hence treatment, thereby reducing the potential damaging effects of this disease, as evident by the example of improved education and standardised prenatal tests in France for the presence of the toxoplasmosis parasite.

The dissemination of the research arising from a review of the literature would be useful if presented in an easy to read leaflet format, communicating the important aspects of the toxoplasmosis parasitic disease for prospective parents. This could include the methods to minimise risk of exposure to the parasite, an outline of the prenatal test and making the request to your doctor and current treatments for parents to seek out should their child experience a reactivation of the ocular disease. As a parent of a teenager with congenital ocular toxoplasmosis who experienced a reactivation of the disease at age 14 years, easily accessible information as to the ongoing management of the parasite and the signs to look for which are associated with a reactivation may have produced a better outcome for my son.

The information contained in this literary review will form the basis of an information resource, which will be helpful to those affected by ocular toxoplasmosis.

**References**

Clinical manifestations of ocular toxoplasmosis. Ocular Immunology & Information, 19(2), 91-102.


