



Toxoplasmosis: A Forgotten but Still Relevant Disease

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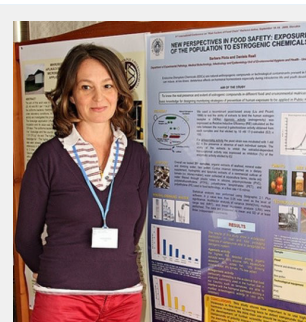
If you ask people, what they do know about *Toxoplasma*, many respond “Yes, I know it. It’s a parasite you may be exposed to when you have a cat, and it is dangerous to pregnant women”. This is certainly true, but it is not all the truth (1). This is the most common misperception that people make when referring to this parasite, and it is probably because most people becoming infected are unaware of it and have no symptoms at all (2). Indeed, the postnatally acquired *Toxoplasma gondii* infection in immunocompetent patients is generally mild or asymptomatic; therefore, latent toxoplasmosis has been usually considered clinically insignificant. Despite being considered a neglected parasitic infection, toxoplasmosis is a cosmopolitan zoonotic disease that causes remarkable economic losses in animals and still has a serious public health impact on humans in several countries (3). *T. gondii* can infect almost all warm-blooded animals, including humans, and ranks 4th among the 24 most significant global foodborne parasites listed by the World Health Organization/United Nations Food and Agriculture Organization (2014).

So far, *Toxoplasma* is estimated to infect approximately one-third of the human world population, with a prevalence up to 90% of the old population even if it varies according to different areas, being related to several risk factors such as sanitation conditions and socioeconomic levels (4). Although the seroprevalence in Europe has declined during the past decades, a high prevalence is still observed in many countries, and the morbidity of congenital toxoplasmosis due to the infection acquired during pregnancy is significant, causing abortion or fetal abnormalities (5).

The main risk factor for humans is not the cat, at least directly. Humans can be infected mainly by the consumption of raw or undercooked meat containing bradyzoites, the ingestion of oocysts from contaminated water and food, and vertical transmission to the fetus during pregnancy, but other routes such as organ transplantation or blood transfusion emerged important as well. The recent development of a serological test to distinguish oocyst versus meat-induced infections showed that in some countries, the former may represent

Author’s Biosketch

Doctor Barbara Pinto is working at the Translational Research, New Technologies in Medicine and Surgery Department of the University of Pisa, Italy. Her experience covers the main topics of public health, from epidemiology to parasitology, the main issues of activity being Hygiene, Microbiology, Toxicology, and recently Parasitology. In parasitology, the main research interests are in toxoplasmosis and trichinellosis, specifically the epidemiological surveys and the underlying mechanisms of inflammation. She has worked in various types of teams from research teams to government committees. In addition to numerous scientific papers, she has published some book chapters, the most recent of which are: Matrix metalloproteinases in parasitic infections, in book: Pathophysiological Aspects of Proteases- (31 p), and a chapter on *Enterobius vermicularis*, “De Carneri” University textbook for the students of the degree course in Medicine and Surgery. She is a member of the Scientific Committee of the International Conference on “Risk Factors of Food Chain”, organized by the Slovak University of Agriculture in Nitra (SK).



a more important source of infection compared to the ingestion of the infected meat (6,7).

Currently, the known spectrum of *Toxoplasma*-associated illnesses in immunocompetent persons include postnatally acquired ocular and neurological disease, as well as rheumatoid arthritis and fatal pneumonitis. Encephalitis or disseminated diseases are frequently observed in immunosuppressed individuals. Interestingly, the growing evidence indicates that *T. gondii* can alter personality in both animals and humans, causing behavioral and mood disorders possibly representing a risk factor for some mental health disorders, in particular schizophrenia. Recently, some authors linked aggression and impulsivity with the latent chronic *T. gondii* infection, which manifested in an increased risk of suicidal behavior even if not all scientists agree on linking the infection



Received: August 4, 2021, Accepted: September 15, 2021, ePublished: October 1, 2021

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with behavioral impairments. Whatever the level of association, it is quite intriguing. The tropism of *T. gondii* for the neural tissue in which it forms cysts, leading to immunological and inflammatory manifestations, has also suggested that this parasite can alter the biology of the central nervous system. Recent studies support the evidence of an association between the *T. gondii* infection and the risk of glioma (8).

Basic science has been recently implemented both in the development of diagnostic methods and the study of mechanisms by which *T. gondii* modulates the inflammatory host response through transcriptome analysis. The development of new drugs such as tetrahydroquinolone JAG21, which can eliminate the parasite in the tissues, is also a field of research. Active research on *Toxoplasma* is ongoing, spanning from the study of the parasite biology mechanisms of the infection to possible therapeutic applications (9). The idea of using parasites to modulate the immune response in cancer patients, which has been postulated since the late 1970s, has now found new emphasis. Recent results obtained in animal models have confirmed that this type of approach could be of benefit for some human diseases, and evidence has increased, indicating that *Toxoplasma* infections could help in the cancer treatment, thus opening new horizons of study for this protozoan and other parasites (10).

In summary, when dealing with *T. gondii*, basic research and surveillance programs should include an integrated approach, the so-called One Health approach.

Conflict of Interests

None.

Ethical Statement

Not applicable.

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