

Human Toxoplasmosis in the Sudan: A Review

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Abstract:

Background: *Toxoplasmosis is one of the most common parasitic zoonotic food borne diseases worldwide. Toxoplasma gondii, the causative agent is a facultative heteroxenous, polyxenous protozoon that has developed several potential routes of transmission within and between different host species including humans and their livestock. If first contracted during pregnancy, T. gondii tachyzoites may pass to the foetus via the placenta causing a great neonatal illness or foetal death. In the Sudan, there is a little information about human toxoplasmosis and detailed recent demographic data of groups at risk are missing.*

Objectives: *The present review is concerned with investigation of Toxoplasma infection among human his domestic and bet animals in the Sudan. Because of santiness of information on prevalence, distribution and magnitude of the disease among both human and animals in the Sudan, the current review is intended to covers the available information on the aspects of epidemiology, and diagnostic techniques elaborated for diagnosis of Toxoplasma gondii infection in man and animals in the Sudan.*

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Materials and Methods: *Different data sources including journals, books, annual reports, and conferences proceedings were consulted. Medical Centers and Hospitals Websites were visited as well as other internet search up to the year 2015 were also reviewed.*

Results: *The results showed that both serological and molecular techniques were used for detection *T. gondii* infection Sudanese patients. The prevalence rate of *T. gondii* infection in the Sudan is ranging from 20.2% to 70%. Most of the surveys were conducted in pregnant women from Khartoum and Gezira States.*

Conclusion: *It was concluded thought the current study revealed that all studies were done on limited area in the Sudan, toxoplasma gondii is quite prevalent among Sudanese citizen. More area-wide investigations concerning Toxoplasma infection in Sudan among different groups at risk from different areas of the country is recommended.*

Key words: Toxoplasma gondii, Seroprevalence, diagnosis, epidemiology, Sudan

Introduction:

Toxoplasmosis was discovered long time ago by Nicolle and Manceaux in 1908; they identified and named the parasite in a cricitine rodent. In 1909, Splender in Brazil noted identical forms in a laboratory rabbit. In 1937, congenital disease was discovered by Wolf and Cowen in Columbia by identification of parasite in central nervous system lesion of an infant which diagnosed by meningoencephalitis. In 1952, Wilder understand the role of chronic infection by identification of *Toxoplasma* in necrotic lesion of retina of eyes. In 1948, Sabin and Feldman did the first serological test assigned for determination of prevalence of disease using extracellular dye into live trophozoite by complement-fixing antibodies to *T. gondii* that led to the development of the Sabin-Feldman dye-test for serodiagnosis. The parasite was recognized as coccidian in 1970 by Frenkel *et.al* (1). after four laboratories independently

established the sexual cycle. In 1976, Ruskin and Remington recognized the role of reactivation of latent infections in the production of disease in immunosuppressed adults in outset of solid organ transplantation (2). In 1977, Levine divided genus of *Toxoplasma* into seven species which *T.gondii* considered the most important species (3). In 1983, Luft *et.al* discovered that the central nervous system reactivation with multifocal encephalitis was the major presentation of disease in patient with AIDS (4). Molecular analysis of genes of *T.gondii* showed that some genetic elements of the parasite may derived from member of the green algae, this was done by Fichera and Roos in 1997 (2).

Toxoplasma gondii infection has become a major public health concern in recent years due to the ravaging HIV/AIDS pandemic (5). *Toxoplasma gondii* is an apicomplexansingle-celled, obligate intracellular protozoan parasite. *T. gondii* is recognized as one of the most important zoonotic and food born pathogen worldwide (5 - 7). Over one third of human population is estimated to carry a *Toxoplasma* infection (8). The infection is most commonly acquired from contact with cats and their faeces or by ingesting tissue cystsin under-cooked, uncooked meat or unpasteurized milk (9). *T. gondii* infection is asymptomatic, with the most frequent clinical manifestation of lymphadenopathy or congenital disease causing abortion or severe damage to the foetus at birth or later in life (10- 11). *T. gondii* infection may result in congenital or fatal disease that may be prevented or reduced by early treatment (12 – 13). People with a weakened immune system, such as those infected with HIV or pregnant women, may become seriously ill, and infection can occasionally be fatal (14 - 15). The parasite can cause encephalitis and neurologic diseases and can affect the heart, liver and eyes. Seropositive women prior to pregnancy are protected from transmitting the infection to their foetuses. Exceptions to this rule have been reported in women with an immunocompromised state (16) and acute infection

occurring shortly before conception (17 - 19). The growing AIDS epidemic and the emergence of drug-resistant HIV strains are a disturbing reminder that opportunistic infections such as toxoplasmosis, even at low prevalence, remain a major potential threat to human health. Latent *T. gondii* infection may reactivate in HIV-infected man or women and result in fatal or congenital transmission; these infected children usually have HIV as well (20). About 20-90% of adult population in different of the world was reported to be exposed to *T. gondii* infection (21). A study conducted by Jones *et al.* in 2001 showed that the seroprevalence in the USA varied from 29.2% in the northeast to 20.5% and 17.5% in the South-Midwest and west, respectively (22). Santos *et al.* (2009) reported seroprevalence of 97.4% (113/116) in Brazil (23). In Southern Turkey anti-Toxoplasma IgG and IgM antibody was found to be 52.1% and 0.54% respectively (24). Nissapatorn *et al.* in 2003 found significant differences in *Toxoplasma* seroprevalence rates among the races where: the highest rate was in the Malaysia (55.7%), followed by the Indian (55.3%) and the Chinese (19.4%) populations (25). The geographical variation observed in other parts of the world is very similar in Africa. The prevalence rate in Africa was ranging from 7% up to 80% (26 - 29).

Toxoplasmosis in animals as a source of human toxoplasmosis is well studied in the world including the Sudan (5, 6, 7, 14, 30, 31). However, scientific reports on Human toxoplasmosis in the Sudan are very few. Though few, most of them are in pregnant women. However, nowadays toxoplasmosis in man becomes a serious infection with the emerging of several causes of immunosuppression, particularly AIDS. Basic data is important to develop an appropriate control strategy for prevention and treatment of toxoplasmosis. Such data is sparse in the Sudan. Therefore, the present paper was planned to review the available reports on human toxoplasmosis in the Sudan.

For the current review, more than 50 sources including journals, books, annual reports, and conferences proceedings were consulted. Medical Centers and Hospitals Websites were visited as well as other internet search during the year 2015.

Current knowledge of Human toxoplasmosis in the Sudan:

Toxoplasmosis was reported in the Sudan since 1966 when Carter and Fleck (32) investigated 461 samples of patients in hospitals from Kordofan, Darfur, Northern Province and Southern province of the country. They reported an overall seroprevalence of 61% and prevalence rates of 22% and 70% in the above mentioned regions. The authors considered the different prevalence rates were according to the regions and the people's habits. This finding was supported by El-Hassan and his colloquies in 1991, where high rates of toxoplasmosis were related to consumption of raw or partially cooked liver, viscera and undercooked meat (33). For this reason, some researchers recommended investigation of toxoplasmosis in normal healthy people from different regions of the country (32). Recently, Khalil *et al.*, 2013 investigated 1146 samples from the blood bank and Sudanese preparing to travel abroad and reported a prevalence rate of 43.6% (34).

In Sudan, IgG anti-toxoplasma antibodies sero-positive rate was reported to be 20.2% (35). In other study conducted by Khalil *et al.*, in 2013 at Kharoum State, showed that the seroprevalence for toxoplasma infection was 43.6% with higher percentages found among HIV patients (75%), aborted women (58.3%), and suspected cases (55.5%) (34). As for Gezira state, the prevalence of toxoplasmosis is considered 41.7% (36).

Toxoplasmosis in Sudanese Women:

Antibodies against *T. gondii* were detected in the blood of pregnant women in different hospitals of Khartoum State by (12, 37, 38). These authors reported prevalence rates of

30.1%, 34.1% and 20.2% respectively. In the Gezira State (34, 36,39, 40) reported prevalence rates of 41.7%, 37.2%,18.9% and 65.5%, in pregnant women. In the Red Sea State, Musa in 2008 reported 68% seropositive pregnant women in Port-Sudan city (35). After that, Siddig reported 44.4% prevalence rate of Toxoplasmosis in the same area (41). Another recent data (42) collected from private Medical diagnostic laboratories in the same city, indicated over all seroprevalence of 78% of *T. gondii* infection in pregnant women during 2006 to 2010.

Toxoplasmosis in groups at risk in the Sudan:

Seroprevalence rates of 27.5 and 13.6% were reported in Sudanese children by Bilal and Elshibly (2012) and Khalil *et al.*, (2013) respectively (35, 43). Elnahas *et al.*, (12) reported 18.1% intra-uterine death. Khalil *et al.*, (2013) observed higher prevalence rate (58.3%) in women with abortion (35). However, Maha *et al.*, (2012) reported higher prevalence rate (39.4%) in women with no abortion (39). As stated by Elsheikh (2015), strong correlation prevalence of toxoplasmosis and risk factors specially eating undercooked meat (71%), consumption of raw meat (68.1%), and contact with cats (52.1%)(40).the same author also observed that sero prevalence of toxoplasma infection was higher in rural women (69%) than urban ones (67%) (40).

Prevalence rates of 42.4% and 75.0% were reported in cancer and HIV/AIDS patients examined from Gezira State respectively (35). The later author detected Antibody against *T. gondii* in the ten (100%) camel herders investigated in his study (35).

Diagnostic Techniques used for human toxoplasmosis in the Sudan:

Globally, the Main laboratory diagnostic tools utilized for *Toxoplasma. gondii* infection are serologic tests, molecular biology, histological demonstration of the parasite and/or its

antigens (immunoperoxidase stain) and isolation of the organism. Other rarely used methods include demonstration of antigenemia and antigen in serum and body fluids, a toxoplasma in skin test, and antigen-specific lymphocyte transformation (44). Molecular methods give an excellent diagnosis of Toxoplasmosis, especially in cases in which inadequacy of conventional methods is confronted with deteriorating and potentially severe clinical outcome (45), these techniques can detect the parasite's DNA in the amniotic fluid or women peripheral blood in cases of congenital infection (45, 47).

Other reliable and simple test is latex agglutination test that show 94.4% agreement with Sabin-Feldman dye test (48). The latex particles are coated with inactivated *T. gondii* soluble antigen. The test detects all immunoglobulin classes. The test does not require heat inactivation of serum samples. The test has advantage of detecting a high seropositivity compared to other serological tests (49).

Cobas modular platform is an immunoassay used for in vitro determination of IgG and IgM antibodies to *Toxoplasma gondii* in human serum or plasma. This done by using both IgM and IgG antibodies screening test in a part of TORSH that diagnosed group of pathogens known to cause hazardous congenital infections like syphilis, hepatitis, Cytomegalovirus (CMV) and Herpes simplex virus.

Serological detection of antibodies against *T. gondii* was used in all of the reviewed papers documented for toxoplasma infection in Sudan. Tow third (66.7%) of the investigators (12, 34, 37, 38, 39, 43) used Enzyme Linked Immuno-sorbent Assay (ELISA). Latex Agglutination Assay (LAT) was used by 22.2% of the authors (34, 36). Immunosorbent Agglutination Assay (ISAG) was used by Khalil *et al.*,(2013) (34).

All the available studies used detection of IgG or both IgG and IgM (12, 34, 38, 39, 40). The prevalence rate of anti-toxoplasma IgM antibodies was ranging from 5.9% to 69%. In

the Gezira and Khartoum States reported a prevalence rate of 6.8% and 30.0% of anti-toxoplasma IgA antibodies respectively (34). Likewise, Elsheikh in 2015, investigating pregnant women attending Wada Madni Maternity hospital in Gezira state, gave a sero-prevalence rate of 67.6% and 52.6% for IgM using Latex and Cobas respectively (40).

PCR technique only appears in the work of Maha *et al* in 2012 where they detected a prevalence rate of 20.7% from pregnant women (38).

Concluding remarks:

Human toxoplasmosis has well been studied worldwide including Africa. The parasite, *Toxoplasma gondii*, that causes the disease which belongs to the phylum Apicomplexa, is considered to be of most important pathogen that emerges recently especially after proving its role in modulating the immune status of infected persons with HIV virus and other immunocompromised patients. Although human toxoplasmosis in the Sudan was recorded since 1966 (32), there are very few reports available (34). However, few, most of these reports were on pregnant women from hospitals of Khartoum (12, 34, 37, 38, 50), Red Sea (35, 41, 42) and Gezira States (34, 36, 39).

The estimated average seroprevalence of 32.05% in the present paper is comparable to many other reports from exposed groups in Africa (29, 51) and Asia (52, 53). The prevalence rate of human toxoplasmosis in the Sudan is higher than that reported in South Africa (28) and lower than that reported in Kenya (54), Tanzania (27), Jordan (55) and Turkey (24). This difference may be because most of the results in the Sudan are collected from a single group (pregnant women) in almost a single area (Khartoum State). Moreover, a low prevalence means that more previously unexposed people are at risk of acquiring an acute infection, which may cause congenital

disease in pregnant women, or which, in reactivation form, may ultimately be life-threatening in HIV/AIDS patients.

Human toxoplasmosis in the Sudan maybe more than expected because People in our community believe on eating raw or partially cooked Liver, viscera and undercooked meat as well as drinking unpasteurized milk. Based on this review, the prevalence rate of *T. gondii* infection is increasing in the Sudan (12, 34, 37, 39). The only area wide study was that of Carter and fleck (1966), although their population sampled consisted of hospital patients only (32). Therefore, more area wide studies in different groups at risk and normal healthy Sudanese are recommended for building sustainable control strategy.

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