Multidisciplinary

Review: studying nurses' views on the education program against toxoplasmosis in pregnant women

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Abstract

Toxoplasma gondii is a common protozoon in nature, and felines are usually the main hosts. While acute T. gondii infection does not cause a significant problem in adults with normal immune systems, it can lead to serious fetal infections in pregnant women due to congenital toxoplasmosis. Acute T. gondii infection in a pregnant mother can be fatal to the fetus. Transmission of toxoplasmosis to the fetus may occur in pregnant women who contract the disease during pregnancy. Women who are infected before becoming pregnant are not at risk. The important point to note here is toxoplasmosis during pregnancy. Toxoplasmosis is considered a serious epidemic in Takkar Governorate, Iraq. This is why the importance of this study emerges. This study aimed to evaluate the opinions of nurses working in the Tikar province of Iraq regarding the training program implemented to improve their knowledge and attitudes towards toxoplasmosis in pregnant women. Thus, it is planned to strengthen the knowledge of nurses in Tikar about this disease that causes serious fetal infections in pregnant women, to increase their awareness through a training program on protecting pregnant women from toxoplasmosis and effectively treating pregnant women exposed to T. gondii. Results of the congenital toxoplasmosis program in Londrina, Parana, Brazil, show a reduction in the number of pregnant women and children referred to toxoplasmosis treatment facilities. Additionally, the development of protocols is important in establishing security standards.

Keywords: toxoplasma, risk factor, transmission of toxoplasmosis, pathophysiology

1. Introduction

Toxoplasma gondii is a single-celled parasite responsible for toxoplasmosis in humans and animals. This intracellular protozoan can take many shapes. Tachyzoite is the rapidly dividing half-chromosomal form of T. gondii as shown in Figure 2.1. The cysts are found primarily in the muscles and brain, appear largely invisible to the immune system, and are resistant to antibiotics. Healthy individuals are rarely affected by T. gondii infection, as the immune system quickly recognizes and eliminates any parasites that differentiate back into tachyzoites. Nevertheless, T. gondii causes severe degeneration of the central nervous system in immunocompromised patients who are unable to extinguish resurgent infection. Intranasal transmission of tachyzoites also results in death for infected fetuses and newborns. Approximately 25% of the human population in the world infects T. gondii, which is among the most successful human parasites (Laliberte and Carruthers, 2008; Yucesan *et al*., 2021; Babür *et al*., 2021) [33, 3].

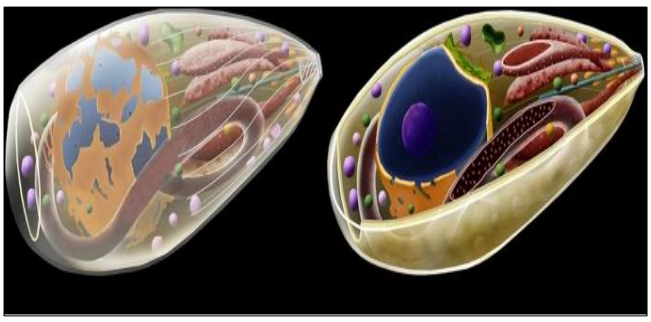

Fig 1: T. gondii parasite (Remington *et al*., 2001) [41]

Vertical transmission of the T. gondii parasite can cause sequelae characterized by significant morbidity and mortality in the fetus and newborn and long-term functional and tissue impairment in children and adults (Remington *et al*., 2001) [41]. Congenital toxoplasmosis occurs primarily in children of women exposed to primary T. gondii infection during pregnancy. Congenital disease is almost never seen in women who have been infected in the distant past and before pregnancy. However, latent T. gondii infection may be reactivated during pregnancy due to immunosuppressive conditions (e.g., AIDS). Therefore, women with chronic infection should also be followed in case of pregnancy (Remington *et al*., 2001) [41].

More than 90% of pregnant women who acquire primary T. gondii infection during pregnancy are asymptomatic, and approximately 85% of children born with congenital toxoplasmosis do not initially show any signs of disease. However, the parasite has the potential to cause long-term damage in the infected newborn. However, toxoplasmosis imposes great social and economic burdens on parents, the immediate environment and society. Laboratory analysis performed during pregnancy and at birth is useful and functional in identifying mothers-infants and infected newborns at risk of congenital toxoplasmosis (Remington *et al*., 2001) [41].

Congenital toxoplasmosis is a preventable and treatable disease (Remington *et al*., 2001) [41]. The first infection with T. gondii during pregnancy may cause different clinical manifestations depending on whether it occurs during pregnancy, at birth or later. T. gondii infection can be prevented or alleviated with

early diagnosis and treatment. In their 2019 study, Bobic *et al*. examine the nature of the problem, prevention methods, the consequences of national prevention programs, and the economic costs and gains of prevention for the community and health systems. In this context, the primary protection method is education programs, which are the subject of our study. It is possible to prevent the disease by including pregnant women who have not been exposed to the parasite in training programs. These training programs are based on reminding and teaching pregnant women about behavioral risks that may cause them to be exposed to parasites during pregnancy. In addition, serological screening programs can be applied as a second method. In addition, successful results are obtained in laboratory diagnoses for infected women (Bobic *et al*., 2019) [8].

2. Problems

This study is the first study conducted in Nasiriyah, Iraq. It is likely that there is a lack of studies measuring actual seroconversion to the occurrence of toxoplasmosis and problems in Nasiriyah city-Tikar province. Health education approaches need to make clear that although this topic may help reduce the risk of congenital toxoplasmosis, this topic requires additional research using an educational program for nurses. If nurses do not have sufficient awareness, T. gondii may be overlooked in counseling services for pregnant women. It is desired to increase this awareness through the education of nurses.

3. Toxoplasma gondii and its life cycle

Toxoplasma gondii is an obligate intracellular protozoan found in three forms in nature. The following are natural forms of this parasite (Rigoulet *et al*., 2014) [42]:

- Oocyst
- Tissue cyst
- Tachyzoite

Oocysts are produced exclusively in the small intestines of members of the cat family and are excreted in the feces over a period of 7 to 20 days (More *et al*., 2017) [40]. More than ten million oocysts can be shed in cat feces in a single day and, depending on temperature and oxygen levels, they undergo sporulation within twenty-one days. can become contagious (More *et al*., 2017; Blanchard *et al*., 2015) [40, 7]. Tachyzoites are crescent or oval in shape and require an intracellular environment to develop and multiply. Tachyzoites live and multiply in vacuoles inside their host cells. Most phagocytic and non-phagocytic cells, including placental cells, can be infected. The presence of tachyzoites in human fluids or tissues can be used to distinguish between recurrence of acute infection and a latent infection (Bobic *et al*., 2019) [8].

When bradyzoite differentiation occurs in cell culture after infection with tachyzoites, all available markers of bradyzoite formation, except p21 (mAb T84G10), can be detected within 24 hours of infection. This includes those associated with cyst wall formation and bradyzoite surface antibody markers. When cats are evaluated, culture does not produce adult/functional cysts for at least six days. When cells are infected with bradyzoites, differentiation into tachyzoites and the appearance of tachyzoite-specific antibodies (SAG1) occur 15 hours before cell division occurs (Gale *et al*., 2015) [22].

A tissue cyst forms within a host cell, and the size of the cyst can vary from a few bradyzoites to thousands of bradyzoites. The central nervous system, eyes, skeletal system, smooth muscle and heart muscle are the most commonly infected areas. This can be observed in histological sections. The presence of cysts does not always mean that the infection is newly acquired or clinically relevant (De Barros *et al*., 2017) [14].

The parasite goes through two cycles. The first is an enter epithelial sexual cycle in the small intestines of members of the cat family, and the second is an extraintestinal asexual cycle in infected mammals, including humans. Cats shed oocysts after ingesting any of three forms of the parasite. Humans usually become infected by ingesting and ingesting tissue cysts or oocysts (in soil or vegetables contaminated with cat feces). Information on this subject is given in Figure 2.2. The outer walls of cysts or oocysts are disrupted by intestinal enzymatic degradation and the parasites are released into the intestinal lumen. Bradyocytes released from tissue cysts or sporozoites released from oocysts become tachyzoites and can spread to invade almost all cells and tissues of the human body (De Barros *et al*., 2017) [14].

4. Transmission and epidemiology

Toxoplasmosis is a common zoonosis throughout the world. Oral ingestion or transplacental transfer of the parasite to the fetus are the two most common modes of infection in humans. Ingestion of undercooked or raw meat that harbors tissue cysts, as well as water or food contaminated with oocysts, causes acute illness. Transplantation of an infected organ or transfusion of contaminated blood cells is a less common form of infection. Transmission may also occur when exposed to parasites through open lesions or mucosal surfaces, infected needles, or medical equipment. Coprophagous invertebrates such as cockroaches, flies, worms, snails, and slugs can still serve as carrier hosts for oocysts to enter the gastrointestinal tracts of animals or humans (Karen *et al*., 2016) [29].

The prevalence of infection in humans increases with age and varies by geographic region (Cook *et al*., 2015) [12]. Differences in the epidemiology of T. gondii infection between different geographic locations and population groups within the same region may be explained by differences in exposure to sources of infection. Indeed, certain epidemiological studies indicate that water can be a source of T. gondii infection in both humans and animals (Bouchut *et al*., 2015) [10].

Fig 2: Mode of transmission in the epidemiology of T. gondii infection (Attias *et al*., 2020).

T. gondii infection was found to have an age-related seroprevalence of 15.8% (Knoll *et al*., 2019) [30]. However, approximately 85% of women of reproductive age are seronegative and are at risk of contracting T. gondii infection during pregnancy. Additionally, rates of congenital toxoplasmosis are estimated to range from 1 to 10 per 10,000 live births (Yan *et al*., 2016) [53]. However, approximately 85% of women of reproductive age are seronegative and are at risk of contracting T. gondii infection during pregnancy. Additionally, rates of congenital toxoplasmosis are estimated to be between 1 and 10 per 10,000 live births (Elmore *et al*., 2010) [16].

The following three variables are directly related to the occurrence of congenital toxoplasmosis in newborns: (Shapiro *et al*., 2019) [44].

- The period of pregnancy during which the disease passes to a pregnant woman.
- Public health initiatives designed and implemented to prevent, identify and treat infection in pregnancy.

Transmission of infection occurs roughly 15% of the time in the first trimester, 30% of the time in the second trimester, and 60% of the time in the third trimester. Spiramycin is reported to reduce the incidence of prenatal infection by approximately 60%. If the infection is acquired in the first two weeks of pregnancy, the risk of fetal infection can be reduced to zero if spiramycin is taken throughout the pregnancy (Shapiro *et al*., 2019) [44].

5. Pathophysiology

Toxoplasma gondii has three species throughout its life cycle. Oocysts are newly produced in the small intestine of the cat, which digests the parasites, which typically multiply asexually in raw meat. Within two weeks after infection, oocysts proliferate in the cat's small intestines and body. After accumulating in the cat's body for one to five days, oocysts become infectious (Lau *et al*., 2016) [34].

Tachyzoites are the rapidly dividing and proliferating results of asexual reproduction that occurs in macrophages after sporozoites consisting of oocysts and bradyzoites consisting of tissue cysts invade the host's intestinal wall. Over a period of seven to 10 days, macrophages serve as a vehicle for hematogenous dissemination of tachyzoites in an intermediate host until an appropriate immune response occurs. T. gondii differentiates into bradyzoites within protozoan tissue cysts when an immune response develops. These tissue cysts can remain latent in various tissues, including lymph nodes, muscle, brain, retina, heart, lungs, and liver throughout the life of the intermediate host. If compromised by immunosuppressive drugs or disorders such as acquired immunodeficiency syndrome, Bradyzoites begin to divide and hematogenously form tachyzoites. It may continue to spread (Shapiro *et al*., 2019) [44].

Human infections with T. gondii can occur in three ways. The first is the consumption and digestion of tissue cysts found in contaminated, raw meat. Bradyzoids are found in significant amounts in cattle, pigs and lamb (Boillat *et al*., 2020) [9]. Cooking or freezing any edible meat at a temperature above 67°C before eating destroys bradyzoites and eliminates the danger of infection (Berghold *et al*., 2016) [5].

Second, infective oocysts can be transmitted through fecal-oral contact. Third, although very rare, blood transfusions can cause infection if transmission occurs from an infected patient with circulating tachyzoites to a non-immune recipient (Martini *et al*., 2020) [36].

In congenital toxoplasmosis, tachyzoites can be transmitted to the fetus trans placentally. This form of infection occurs only if a pregnant woman has a primary infection with a normal immune system. People who are already sick rarely become infected again because their immune systems are strong enough. As previously mentioned, the probability of congenital toxoplasmosis infection from a woman with primary toxoplasmosis increases throughout pregnancy from 0% to 60% from the first trimester to the third trimester (Martini *et al*., 2020) [36].

6. Risk factors

As a result of extensive research, Bobic *et al* (2019) [8] made six estimates for T. gondii seroconversion during pregnancy. These prediction results can be listed as follows (Bobic *et al*., 2019) [8]:

- Consuming raw or undercooked mutton/lamb,
- Not washing utensils after preparing raw meat before touching another food item
- Cleaning cats' litter boxes
- Consuming raw or undercooked processed meat
- Consumption of raw or undercooked pork
- Consumption of unwashed vegetables and fruits.

Contact with undercooked meat, which allows tissue cysts to be directly ingested, is one of four of these risk factors. If the cat has been infected within the last two weeks, cleaning the litter box will bring the human into contact with oocysts. To prevent fecal-oral transmission, those exposed to contaminated cat litter should not touch their mouths. Since stray cats bury their feces in the garden soil, eating unwashed vegetables and fruits may cause fecal-oral contamination (Smereka *et al*., 2018) [46].

While feeding a cat is not typically considered a risk factor unless there is contact with cat litter, eating undercooked or raw meat is known to be responsible for approximately 80% of all cases (Zakari *et al*., 2020). Another study found that the biggest risk factor for T. gondii transmission was eating undercooked meat and unwashed raw vegetables, and feeding cats had no significant effect (Fenta, 2019) [20]. Another European study investigated independent risk factors for T. gondii infection during pregnancy and found that eating raw or undercooked meat and contact with soil were the most effective risk factors, respectively (Nogareda *et al*., 2013).

- Increasing age,
- Being born in another nation (a different geographical region),
- Low education level,
- Living in a crowded area,
- Working on land related projects

In studies on T. gondii seroconversion during pregnancy, habits such as gardening, eating infected vegetables and fruits without washing them, and eating undercooked meat have been identified as direct risk factors. Although raw meat products may contain infective tissue cysts, contact with soil is a less well-known risk factor (Nasiru *et al*., 2020).

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