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REVIEW ARTICLE

Toxoplasmosis: A Review

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Abstract

Toxoplasmosis one of the common human-animal diseases (Zoonotic diseases) caused by a parasite belongs to the group of coccidian, class of sporozoa known as the *Toxoplasma gondii*, an intracellular obligate parasite, especially in nucleic cells, as noted inside the nucleus.

Keywords: *Human-animal diseases; Zoonotic diseases; Parasite; Tissues.*

Introduction

This parasite affects the various tissues of all species, including humans and cats [1, 2]. The family of the Felidae is the final host of the parasite and sometimes the intermediate, while the birds and mammals represent intermediate host [3]. The incidence of toxoplasmosis was also recorded in marine mammals such as whales, dolphins, sea lion and seals [4].

The parasite is characterized by the presence of three contagious stages, the development of the oocyst, which is introduced to the external environment with the feces of infected cats, which contain the spores and later developed Tachyzoite, which is divided quickly into all the cells of the host and the middle and sometimes surrounded by the objects of this phase with an irregular cyst thin-wall known as Pseudocyst and Bradyzoite, which proliferate slowly in a thick wall cyst known as the tissue cyst, which is formed within the various organs of the host's body, this cyst varies in size and shape depending on age and location of the infection, as it is a form of elongated muscle and circular or oval Form in the rest of the organs [5].

The infection of parasitic *T. gondii* lesions accompanied by an inflammatory reaction and necrosis in the organs, leading to the emergence of symptoms, including anemia, headaches and the occurrence of fever and pain in the muscles, and may lead to complications resulting in the destruction of cells in the various organs of the host's body, eye, lungs, liver, heart and sometimes the central nervous system. The disease may become chronic, accompanied by the rapid replication of Tachyzoite and formation of tissue cysts that remain inside the tissues for several years without clinical symptoms [6]. In recent years, toxoplasmosis has received medical and research interests due to its widespread prevalence worldwide and its serious human-induced effects, especially those with acquired immunodeficiency syndrome, pregnant women and newborn [7].

The parasite causes abortions or stillbirths and is transmitted from mother to fetus during pregnancy. Even if the child is born after the completion of the pregnancy months, he or she has serious symptoms such as chorioretinitis, mental retardation, blindness, hydrocephalus or microcephaly [8]. The infection of the lymphatic system may result in enlargement of the liver and spleen Hepato-splenomegaly and high temperature [9].

Historical Review

The parasite that caused the debilitating disease was first discovered by Nicolle and Manceaux in 1908 in *Ctenodactylus gundi*, the parasite designation came from (toxon = arc, plasma= form) the crescent form of the parasite's tachyzoite stage at first detection [10]. The incidence of toxoplasmosis was first recorded in rabbits by Splender in 1908 [11].

The first case of toxoplasmosis in cats was not recorded until 1942 by Olafson and Monrox [10]. The parasite was identified as a pathogen for humans in 1923 by Janku in 1939 it was found to cause encephalitis and neural seizures, intracranial calcifications, hydrocephalus and chorioretinitis of newborns [12]. The entire life cycle was not discovered until 1970 when its sexual stage was discovered in the intestines of cats [13]. Hartley first described sheep in 1954 [14]. Spence in 1978 isolated the parasite for the first time from semen [15]. In 1989, Burg *et al*. first exposed the nuclear material of the parasite using PCR [16].

Classification of Parasite Causing the Toxoplasmosis

The classification of *T. gondii* depends on the morphological comparison between the different stages of the parasite and the most important of the sex stage, and below the final classification of the parasite [17]:

Kingdom: Protista

Phylum: Apicomplexa

Class: Sporozoasidae

Subclass: Coccidiansina

Order: Eimeriorina

Family: Toxoplasmatidae

Genus: *Toxoplasma*

Species: *Toxoplasma gondii*

Life Cycle

The parasite passes through its life cycle in two cycles: intestinal cycle and extra intestinal cycle (Fig.1)

Intestinal Cycle

This stage begins when cats are taken bradyzoite or tissue cysts consisting of organs of infected animals or oocysts. Once the intestine enters, the bags are degraded by the enzymes of the condition, thus doubling the role of the schizontes, and consist of 2-10 Merozoites in each cell and two weeks after the entry of the parasite into the host body begins to form the cells that generate called gametogony [18]. Microgametes move to unite macrogametes to form zygote, then enveloped in two envelopes to form oocysts that are raised with cat feces [19]. The cyst needs 1-5 days to become contagious and two sporocysts, each containing four sporozoites, are infectious at this stage [20].

Extra Intestinal Cycle

Also known as the Asexual phase, this phase occurs in intermediate hosts, including humans, cats and birds, by eating food contaminated with oocysts or Bradizoite, found in tissue cysts or in contact with soil contaminated with infected cat faeces, spores are released from oocysts and released into the intestine and penetrate the mucous layer to develop as Sporozoite begins to divide and differentiate to form Tachyzoite, which may be surrounded by a flexible and regular cyst known as Pseudocyst, which is formed by a decrease in immunity and acute infectin, after the multiplication of the tachyzoite inside the cyst is released, the trophozoite is released and then spread through the circulatory system and the lymph into tissues and visceral organs, where the lymph nodes reach the mesentery and then the liver and to the rest of the other tissues to proliferate inside the cells by endodygony, this reproduction results in the Bradyzoite phase, chronic infection occurs [21].

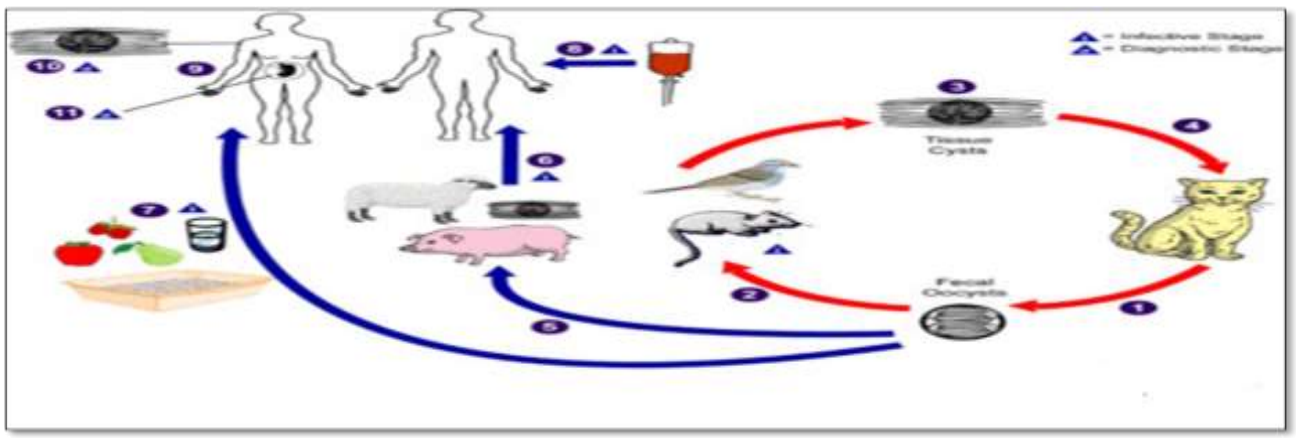

Fig. 1: Life cycle of *T. gondii*

Diagnosis

Diagnosis does not depend on the presence of clinical signs and symptoms, whether in humans or animals. The host may have no clinical sign or the symptoms of toxoplasmosis may be similar to many other diseases, there are two types of diagnostic methods used to detect the incidence of *T. gondii*.

Serological Tests

These tests are based on the diagnosis of antibodies, especially IgG, IgM and antagonists. The most important tests are:

- Sabin-Feldman dye test.
- Indirect heamagglutination test.
- Indirect fluorescent antibody test.
- Direct heamagglutination test.
- Modified agglutination test.
- Complement fixation test.
- Latex agglutination test.
- Enzyme linked immunosorbent assay.

Non-serological Tests

- Direct microscopic examination.
- Skin test (Toxoplasmien test).
- Isolation of the parasite.
- Tissue culture.

Histologic Diagnosis

- Diagnoses by computerized tomography (CT) scan.
- Magnetic resonance imaging (MRI).
- Molecular diagnosis.

Pathogenicity

The disease depends on the duration of the infection, the type of the host, age, the parasite and the severity of the infection. Host sensitivity and host immunity and genetic information play a significant role in increasing the sensitivity of the host to the parasite [22]. Toxoplasmosis is a serious health problem especially in newborns and immune suppressed people as well as the incidence of infection during early pregnancy or the first half of it is more harmful than it is during the second half of pregnancy [23]. *T. gondii* is more opportunistic parasites, is characterized by its ability to cause infection in all animals with warm blood, in humans, the infection is asymptomatic but may lead to serious complications in individuals with immune deficiency [24]. The pathology of the parasite is divided into three phases:

Acute Stage

The stage is fast-growing Tachyzoite It is the main pathogen in this phase which causes host cell crash speeds exceed the cell's ability to regenerate [25]. Rapid phase reproduction is divided into each phase 12-15 and that about 16-32 stages of them are sufficient to destroy host cells [26]. The increase in parasite numbers in acute cases leads to Jaundice, Encephalitis, Meningitis, and Painless lymph nodes in the neck, clavicle, and region of the ligaments Inguinal region.

These symptoms automatically disappear within weeks or months and may be companied by fever, headache and muscular pain and fatigue and ulceration of the pharynx with anemia and sometimes pulmonary complications and fetal death in the mother's womb if pregnant and may develop infection in cases of non-immune to dangerous cases such as Myocarditis, Encephalitis and Retinochorioditis, which causes blindness and sometimes collects fluid in the head hydrocephalus or calcification inside the brain [27, 28].

Sub-acute Stage

This phase occurs when the immune system responds as cells break down causing necrosis lesions in different organs such as liver, heart, lung, brain and eye and symptoms are more severe in the central nervous system than in other organs because of the lack of immune immunity in these tissues [28].

In this phase the immunoglobulin IgM begins in the first and second weeks after the infection, then decreases its level and increases the immunoglobulin IgG rises to the highest concentration after two months and remains for a long time, these antibodies help to eliminate the rapid growth stages in the lymph and blood and the complications that appear during this phase is the calcification of the brain or its small size,

retinal inflammation, meningitis, placental and retinal inflammation [29].

Chronic Stage

The immune response during this phase will be at the required level to inhibit the propagation of rapid phases followed by the formation of slow-growing bradyzoite stages or what is known as tissue cysts which are placed in the various tissues of the host's body and are characterized by their ability to survive for life [24]. The cysts may break down and release their contents, most of them. They are killed by immunohistochemistry developing events and yet have a number of them may create new tissue cysts, while the death of Bradyzoite will result hypersensitivity which if taken in the brain these sites will gradually replace nodules of glial cells and the occurrence of this condition in the retina may cause blindness sometimes [30].

Transmission Methods

Methods of transmission of toxoplasmosis vary among different countries depending on culture those countries and their eating habits also vary depending on the nature of the housing, age and climate, the most important methods of transport are:

Oral Transmission

Wild and domestic cats and other felidae play an important role in transmitting the infection to humans as the final host of the parasite, as contact with cats or with their feces lead to contamination of hands with those cysts [31]. Women, especially pregnant women, also clean houses and a place for cats is a major factor in the incidence of infection and transmission of the disease to the fetus [32]. In addition to eating raw meat or non-cooked well, especially in European countries is one of the causes of the disease, some surveys in many countries of the world have found that 30-60% of the infection result from this route [33]. The lack of care in the use of kitchen utensils, especially knives in cutting meat is a source of infection, in addition to the process of tasting the infected flesh during a cook is a source of infection [34].

While frozen meat under -20 °C of is not dangerous factors, the freezing kills tissue cysts and the incidence of salty meat is lower [35]. Also eating fruits and vegetables that are not well washed is a source of the infection in addition to the soil and water contaminated with oocysts raised with the feces of infected cats [36].

Placental Transmission

Congenital toxoplasmosis occurs as a result of the passage of the parasite from the mother with acute infection to her fetus through the placenta [37]. Causing serious damage to the tissues of the fetus and may lead to abortion in severe cases [38]. The parasite reaches the fetus a disease causing different degrees of severity depending on the ferocity of the parasite reaches the fetus a disease causing different degrees of severity depending on the ferocity of the parasite [39]. The infection is more serious if in the early period of pregnancy while the risk is less if the infection occurred in the last three months of pregnancy due to the integration of fetal growth in this period [40].

Others Transmission Methods

There are other methods for the transmission of the disease to humans, including transfusions; four cases were recorded as a result of blood transfusions from infected people as well as infection by transplantation of organs and tissues while rarely occurring through skin lesions [41]. Much research has also suggested that unpasteurized milk is a source of disease transmission, especially in rural areas [42]. In addition to the role played by insects such as flies and cockroaches in the transfer of oocysts from cat feces to food or may be transmitted to laboratory workers [43].

Treatment

The appropriate treatment should have the effectiveness of penetrating the placenta and concentration, as it has the ability to eliminate the parasite in various stages and infiltration of parasite oocysts in addition to the prevalence in the main sites of infection in the fetus and must be non-toxic and does not cause deformities [44]. Prenatal treatment does not reduce the risk of neonatal transmission but can reduce the severity of birth infection, treatment is determined depending on whether or not the fetus is infected.

In the case of a mother infected and not infected the fetus uses spiramycin to protect the fetus as it works to prevent the spread of parasite through the placenta from the

mother to the fetus is concentrated in the placenta, but does not pass easily, either when confirmed fetal infected, pyrimethamine and sulfadiazine are used for treatment and is important in reducing the severity of the disease but cannot be used in the first months of pregnancy because it is likely to cause fetal deformity [45]. Sulfachloropyrazine also has the ability to affect the tachyzoite and bradyzoite of the parasite [46].

Vaccination

There is considerable interest in the development of a vaccine against parasite and that the effective vaccine should provide protection in both acute and chronic infections, and that the ROP2 antigen reflects the tachyzoite and bradyzoite which has been proposed as a vaccine against toxoplasmosis [47]. The development of vaccines that prevent cats from putting oocysts is still ongoing and to rely on live parasite is limited to the use of its risk to humans dealing with the vaccine. It appears that the toxoplasmosis in sheep has been effectively controlled with live vaccine, which is applied three weeks before the mating season [48].

Prevention and Control

Prevention of toxoplasmosis is through the dissemination of health and cultural awareness and alert the dangers of the disease, especially in areas where it is spread [49], and make sure to cook the meat well at a temperature of 66 °C and for 20 minutes to eliminate the live stages of the parasite, wash your hands with soap and water after touching the meat while preparing for cooking or after touching stool of cats containing the oocysts of the parasite [50] as well as pasteurized milk cow and goat before eating and not eat fruit and vegetables non-washed, gloves should also be when working in gardens or seam with soil that may be contaminated, health institutions must have a role in monitoring restaurants and other food production places to prevent infection [51]. Control and prevent cat feeding especially domestic cats from prey of carriers and treatment of cat feces with boiled water or formalin and iodine. Get rid of loose cats and fight mice as they are the most affected by the disease [2]. Pregnant women should also periodically check for parasites antibodies IgA, IgM which appear a few days after the infection occurs and give treatment for the purpose prevention and minimizing the risk of infection [21].

Due to the role played by cats in the infection of animals, herbivores, especially sheep therefore, precautions should be taken to reduce the contamination of pastures with the faeces of those cats and other animals cat litter should not be used in the manure of the gardens [52]. In addition to the use of insecticides to eliminate them because they are carriers of parasites, especially flies and snails [41].

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