

RISK OF TOXOPLASMOSIS FROM CATS

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ABSTRACT

Toxoplasmosis is a zoonotic disease caused by *Toxoplasma gondii*, there are two hosts, cats play an important role as definitive hosts, cattle, sheep, goats and human may play as intermediate hosts. Humans be infected by eating tissue cysts from Not cooked flesh and eat contaminated feed or water with oocytes shed in the faecal of infected cats. diagnosis of *T. gondii* itself is affirmation the infection but difficult, so many laboratories use serological methods to detect immunoglobulins which specific to *T. gondii*: latex agglutination (LA) test, Enzyme Linked Immuno Sorbent Assay and indirect fluorescent antibody test (IFAT) those methods was differ in specificity and sensitivity there is no systematic review that can perform the state of toxoplasmosis in the definitive host. Therefore the aims of the current existing review was to decided the risk factor of *T. gondii* infection and demonstrated the epidemiological form of infection in cats in Iraq.

Key words: Cat, Toxoplasmosis, Risk, Epidemiology, host.

INTRODUCTION

Toxoplasma gondii is an obligatory intracellular parasite, belongs to the phylum Apicomplexa, *T.gondii* infects warm-blooded animals (Flegr, 2013).

Cats play critical role for *T. gondii* as final hosts, and definitive hosts that reproduce oocytes in their faecal, which contaminate sand, feed and water (Cenci-Goga *et al.*, 2011). final host shed oocytes for a limited interval of time (7–14 days), up to 1000000 of oocytes possibly shed oocytes which stay as infective stage for up to one month and

resist to low temperature, dryness, and sensitive to heat, which destroyed at 70 °C for 10 min (Dubey and Jones, 2008)

Infection of definitive and intermediate hosts occurs through ingest of tissue cysts or oocytes. cats shed oocytes followed by ingest tissue cysts, a cat take it at least 1000 oocytes so as to improve an infection, taking it a one bradyzoite is sufficient for a cat to adequate to infection (Dubey *et al.*, 2008)

Life cycle.

The life cycle of this parasite is intricacy, which include asexual stage of intermediate hosts and a sexual stage which occur in the definitive hosts (Edwards and Dubey, 2013).

Toxoplasma gondii has two-host (Fancourt and Jackson, 2014). For *T. gondii*, cats can

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act as a definitive host (Dolores and Dubey, 2016),. after the ingest of tissue cysts by the cats, organisms excyst as bradyzoites which penetrate the epithelium of intestine (Alonso Aguirre *et al.*, 2019). Initiation of sexual reproduction which development into oocysts Within epithelial cells when bradyzoites transform into male and female gamonts. Toxoplasma oocytes are released into the intestinal lumen, and subsequently passed in faeces (Joanne, 2012)

Intermediate hosts are infected by ingest contaminated food, water or soil with oocytes/sporocysts (Hill and Dubey 2002). mammals is a intermediate hosts of *T. gondii*, in the alimentary tract of the intermediate host, sporozoites excyst from oocysts/sporocysts and penetrate the intestinal epithelium. Sporozoites infect epithelial cells and develop to tachyzoites which multiply rapidly. infected cell with *T.gondii* tachyzoites cause cell lysis, then tachyzoites released which infect other epithelial cells The infection then distribute to other organisms through lymph and blood stream (Uzal *et al.*, 2016). When the immune system suppressed the transformation of tachyzoites into bradyzoites and the development of tissue cysts. in muscle and neurological tissues , Cysts still in the organs of the intermediate host for life, but may reactivate if the host becomes immunosuppressed (Ferguson *et al.*, 1989). The lifecycle is complete when the definitive host consumes tissue cysts from an intermediate host.

Transmission

Toxoplasma gondii is transmitted to cats by ingestion of infected tissue by bradyzoites in infected tissues or by consumption of oocytes.

There are four main routes of *T. gondii* transmission to intermediate hosts occurs by:

- * By the consumption of oocysts
- * Congenital or vertical transmission (Parameswaran *et al.*, 2009)

* horizontal transmission between intermediate hosts following the consumption of bradyzoites

* sexual transmission via bradyzoites in sperm (Dass *et al.*, 2011).

consumption of contaminated food, water or soil with oocyte is the main source of infection in humans

Clinical signs

There are two forms of infection of *Toxoplasma gondii*, acute and chronic. Acute form results from the multiplication of tachyzoites in the intermediate host (active parasite) these form cause cell lysis, tissue necrosis and inflammation, then death occur (Muhammad *et al.*, 2018).

Chronic form occurs when immunosuppression, tachyzoites was transform to intracellular cysts containing bradyzoites (parasite dormant). (Vyas 2015).

Clinical appearance of cats infective with *T. gondii* comprise, depression, loss of appetite and increase body temperature, follow up by peritoneal effusion, jaundice , dyspnea, diarrhoea, weight loss, muscle hyperaesthesia, , paresis ,inflammation of iris and pancreas (Bethânia *et al.*, 2014).

In cats, toxoplasmosis is intense in transplacentally infected kitten, which repeatedly promote hepatitis or cholangiohepatitis, pneumonia, and encephalitis and display signs of ascites, lethargy, and dyspnea.

The main symptoms of *Toxoplasma gondii* infection is pneumonia and acute respiratory signs Ocular toxoplasmosis occur in kitten and never appeared any clinical manifestation chorioretinitis, Aqueous flare, glaucoma, and retinal separation are mutual observed (Muhannad *et al.*, 2018) (Dubey & Beattie 1988).

Epidemiology

Cats have a critical role in the infection of toxoplasmosis, so expand about *T. gondii*

infection in cats is an importance. It is worth remanding that epidemiological inspection are still the useful method for evaluate the case of *T. gondii* infection (Chaichan, 2018) grazing herbivores would be expected to have a high risk of exposure to *T. gondii* oocysts on pasture, a low risk of transplacental transmission (Parameswaran *et al.*, 2009), no risk of transmission via carnivorism, and a low risk of sexual transmission (depending on the frequency of intercourse.) (Kolören and Dubey, 2020).

There are a correlation between environment and definitive host which include density of definitive host which lead to increase in parasite shedding which contaminate environment. defecation behaviour of definitive host, (Dubey, *et al.*, 2009).like Bury the faeces, may also increase the probability and participate to parasite transmission. The presence of definitive and intermediate hosts together in the same environment, not necessary, for a intermediate host to become infected. Similarly, both hosts have to present at the same environment, that increase the incidence of consumption of bradyzoites by definitive host, lead to increase probability the infection of intermediate host (Huan *et al.*, 2017).

So complete or partial separation in a distance between the two hosts lead to reduce the infection (Mulisa, 2014).

Diagnosis

Many types of direct and indirect methods used to expose *T. gondii* infection or anti-Toxoplasma antibodies. several methods which are usable to investigate parasite (Anthea, 2015). include: histological coincidence, isolation of the organism in tissue culture, and detection of the parasite DNA by the polymerase chain reaction (PCR) or by a collection of these techniques to a quorate diagnosis , whereas the serological test are used to investigate the types of immunoglobulins (Mohammad *et al.*, 2015) .

Isolation of the parasite in laboratory animals

The detection of *T.gondii* was attempt by the administration of suspected specimen which included blood, CS fluid, Lymphatic nodes or other body fluids or organs, in the peritoneal cavity of the immune-suppressed mice or BALB/c mice. in the peritoneal fluid tachyzoites was detected with microscopy within 1 weeks after inoculation. The parasite was detected after fixation the sample with methanol and stain with Wright, Giemsa then observed by a microscope (Janina *et al.*, 2010).

Propagation of parasite in Cellular culture

Cellular culture was used to detection and segregation of parasite, the parasite has been isolated from lower respiratory system and CS fluid or diagnosis of ocular. To approved host-parasite interaction Cellular cultures are also can be used and used in inherent resistance, molecular characterization of Toxoplasma isolates, and for the valuation of vaccine and treatment development, after the inoculation of tissue culture with suspected samples, Cyto Pathic Effect was appear which manifested by demolition of the cellular layers and is concerning with the initial amount of tachyzoites in the specimen(Al-Saidya, 2006).

Serological diagnosis

The routine laboratory detection in both humans and animals based on many types of sero-diagnosis of specific immunoglobulins in serum and milk. The increase of the titer of antibodies are related to the immune response next the infection, the limitation the duration of infection by determination the type of immunoglobulin in humoral immune. (Karen *et al.*, 2019).

Several types of serological tests used to measurement various kinds of antibodies, which record rise and decline during or next infection. The detection of the types of immunoglobulin immunoglobulin used in *T. gondii* serodiagnosis, including immunoglobulin's (G,A,M and E), the

elevation of IgM mean the infection is early and relates to the manifestation of intense toxoplasmosis. Mostly immunoglobulin (M) can be expose in serum only 7 days after the infection (Majda, 2017).

IgM antibodies present for even 18 months in the maternal circulation after invasion effect, so the accuracy of this diagnostic process because determining whether an antibody is from active or prior infection is critical during gestation. If an antibody is from a prior infection, no sequel for the embryo normally occur. If the infection occur during pregnancy, the clinician have to decide on administer drugs to treatment to avoid disease complication (Al Hamada *et al.*, 2019)

Detection of IgG antibodies help to diagnosis Immunoglobulin(G) antibodies which showed within 1–2 weeks following infection, and reach high titer within 30–60 days, then decline, but may persist lifelong (Silvia *et al.*, 2005).

Arising the titer of immunoglobulin indicate prior infection., detection of immunoglobulin(G) is used as diagnostic indicator and assist veterinarians to determine chronic infection or not. However, this antibody still has hardness in distinguishing prior infection from a new infection (Eman and Azhar, 2016).

There are several serological methods have been decided for the detection of anti T. gondii immunoglobulin; these include Sabin-Feldman dye test (SFDT), In-direct Fluorescent Assay (IFA), latex agglutination tests, and Enzyme Linked Immuno-sorbent Assays (ELISAs) (Patrick, 2019).

Molecular diagnosis

Polymerase Chain Reaction is mutual Molecular diagnostic method using to detection of T. gondii, it is a simple and sensitive method and suitable to applied in all clinical samples, otherwise PCR can be used for genetic characterization of the parasite (Daland, 2012).

Other best characters of PCR that this molecular method easily differentiates T. gondii from other cyst forming protozoa.

Molecular diagnostics method depend on isolation and detection of specific DNA sequences. (Falah, 2018)

Vaccine

There is one vaccine type “Toxovax” which depend on attenuated of S 48 strain which used to evade vertical transmission in sheep. This vaccine is give limited time of protection, expensive, and give some disadvantage effects, this vaccine not adequate for human use, because may reverse to a virulent isolates (Afsaneh *et al.*, 2019).

Many vaccination trial versus T.gondii have been attempt which applied in animals models, including in-activated and attenuate vaccine, sub-unit vaccine, and DNA vaccines. The results have offer that it may be develop an affective vaccine against T gondii but not approved successfully in field. (Patrick, 2019).

Treatment

There is no confirmed treatment for clinical T gondii infection in cats. Therapy include sulphonamides, pyrimethamine, trimethoprim and clindamycin, spiramycin, either alone or together (Dabritz *et al.*, 2007).

Toxoplasmosis in Iraq

Several studies was conducted T.gondii in Iraq, which include seroprevalance, isolation, and diagnosis in different hosts, So we include some of these studies:

(Aiz, 2016; Kader and Khayat, 2013; Al-Dabagh *et al.*, 2014; Eman and Azhar, 2016; Al Hamada *et al.*, 2019; Nawzat, 2017; Al-Taie and Shadan, 2011; Mikail and Al-Barwary, 2014) These studies looked at the infection of small ruminates with T.gondii, other studies which include the infection in cattle and buffaloes (Sakban and Aiz, 2020; Al-Farwachi *et al.*, 2008; Akber *et al.*, 2004)

other studies include the parasite in camels (Saad *et al.*, 2019; Hanon, 2017) in dogs there are some studies conducted the parasite which include (Abass, 2013) other studies include the diagnosis of parasite in equidae (Alshahery and Mansour, 2012; Asal and Al Zubaidy, 2016).

Studies dealing with toxoplasmosis in cats in Iraq are very few, and these studies have receded in several governorates which include the follow:

(Dhamraa *et al.*, 2014) which study the seroprevalence of feline toxoplasmosis in stray cats in Baghdad city, the researchers collect 50 blood samples from cats in different regions, age and genders, the survey was attempt using to investigate of specific toxoplasma IgG using ELISA test, the result showed that the 66% of stray cats was infected with *Toxoplasma gondii*, the female was recorded high prevalence of infection than male and the young kittens (2 months of age) reported high prevalence than adults once, the researchers find the relationships between the infection of cats with *T. gondii* and warm and humid weathers of Iraq, the high seroprevalence of *T. gondii* is due to hunting habit of stray cats that their diet includes rodents, placenta, stillborn foeti and wild birds. other samples in this study which include pieces from internal organs of these cats were taken for histopathological examination, the result of these samples revealed The intestine of animal expressed schizonts in the epithelial cells surrounded by erosion lesion and these cyst also was seen in the LP of the intestine as well as inflammatory cells mainly eosinophils and neutrophils infiltration, while the liver showed large necrotic area with basophilic tachyzoites intracytoplasm of swelling hepatocyte, in addition to granulomatous lesion consisting from aggregation of macrophages and lymphocytes and zoites in sinusoids, It reported severe pathological lesions in the lung, intestine, liver and spleen of cats that expressed high level of OD anti-toxoplasma IgG antibody.

Other researchers Alexandra *et al.* (2013), which study the presence of toxoplasma *gondii* antibodies on sera of 207 stray cats trapped as a result of increase population, stray cats were capture on military bases in Iraq (Baghdad) as department of the USA Army (Zoonotic Disease) Surveillances Program by using Latex Agglutination Test, the results showed that immunoglobulin against *T. gondii* were detect in 30.4% of the cats, the cats from west Iraq had a lower seroprevalence than cats from North of Iraq and cats from Baghdad. (66.6%) percentage of infection in Tom, without significant of variance was detected between sex and *Toxoplasma* positivity. the researchers interpret the increase percentage of infection in stray cats to occasion to victim of *T. gondii* intermediate hosts such as rodent, or become infected through contaminated sand or water.

Other study attempt by Hemdad *et al.* (2019) in north of Iraq in Erbil city -Kurdistan Region, which include Geno-typing of *T. gondii* from stray cats by using RFLP Polymerase Chain Reaction, 100 blood specimen were collect from stray cats to detect the specific antibodies of *T. gondii* using MAT test and 12 samples of heart from seropositive cats to Multi-locus Polymerase Chain Reaction-RFLP genotyping of *T. gondii*, the results of study can be concluded that *T. gondii* isolate from heart tissue of cat by 6 genetic markers (SAG1, GRA6, SAG3, BTUB, c22-8 and c29-2). The type III is also name as ToxoDB genotype #2.

Other study was done by Ziadoon *et al.* (2017), to detection of specific antibodies of *T. gondii* in different hosts (450 women, 124 ewes and 79 does, 20 stray cats, 28 rabbits and 28 birds) in DIYALA PROVINCE by using ELISA and Latex agglutination test, the results showed that 50% of cats was infected with *T. gondii* by using both tests, the researchers Proved this results to habit lives of which rove free and often form groups of animals that freshen

enclose proximately to humans and other hosts .

Afkar and Azhar 2014 investigate the most important protozoa in 80 feces of stray cats in Baghdad using routine fecal examination, the results showed that 3.75% of cats infect with *T. gondii*.

The most important review which attempt by Saleem (2007) which included the most important microorganism which recorded in dogs and cats in Iraq, *T. gondii* recorded in 11 Laboratory confirmation and reference in cats.

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