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REVIEW ARTICLE

prevalence of toxoplasmosis in sheep and goats in Iraq

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ABSTRACT

Due to their ability to provide food for people, sheep and goats are important to the economies of many nations. Toxoplasma gondii, or T. gondii, is a protozoan parasite that often infects sheep. Stillbirth, early embryonic death and resorption, neonatal mortality, fetal death and mummification, and parasite infection are examples of possible negative effects. The consequences are more severe the earlier in gestation the infection arises. The stage of pregnancy at which the infection occurs in the sheep and goats is connected with the severity of the illness. T. gondii may infect humans and carnivorous animals via the meat of infected sheep and goats. Less than 4% of sheep that are consistently infected with T. gondii carry the parasite vertically to their offspring. The majority of sheep develop the infection after birth. It's possible that T. gondii is more often transmitted in cows than previously believed. However, these results need more evidence acquired using other methods, since they are only reliant on Polymerase Chain Reaction data. Sheep that have been exposed to T. gondii produce robust humoral and cell-mediated immune responses that protect them against infection in subsequent pregnancies. To the best of our knowledge, documentation about the prevalence of toxoplasmosis in sheep and goats in Iraq is deficient. As a result, A comprehensive research was conducted to find out how common toxoplasmosis is in sheep and goats in Iraq and how it relates to various risk factors.

Keywords Toxoplasma, sheep, goats, Iraq, prevalence

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INTRODUCTION

An major zoonosis that results in congenital malformations in children and abortion in humans is toxoplasmosis. Due to abortion, stillbirth, and abnormalities in the reproductive and neurological systems of sensitive animals, it also result in financial losses for animal herds. Around half a billion individuals have antibodies to T. gondii, and toxoplasmosis is present across the world[1] . People, pets, wild animals, and birds may all get the virus on their own. In some areas, a high frequency may even be feasible. [2] , Congenital transmission of the illness to intermediate hosts may occur via the placenta, contact with free tachyzoites, or

consumption of meat contaminated with sporulated oocysts [3] .During the acute stage of the illness, Tachyzoites target the heart, lymph nodes, liver, spleen, and central nervous system. The sporozoites are found in environmentally resistant oocysts generated during the sexual stage of the life cycle, while the bradyzoites are found in tissue cysts during latent infection[4] . Tiny ruminants, like goats and sheep, are especially susceptible to T. gondii, which causes a variety of issues for these animals [5] .

Wang et al. [6] claim that since toxoplasmosis results in newborn fatalities, stillbirths, and abortions, it harms the reproductive system and reduces the health and productivity of goats and sheep .[7]

It was unclear that sheep and goats might get toxoplasmosis until Feldman and Hartley reported the first case [8] . It was discovered that the primary cause of the sickness was the oocysts that cats excrete in their feces, indicating that cats—both domestic andwild—are the pathogen's primary hosts[9]

Humans get toxoplasmosis from eating raw or undercooked meat or food contaminated with excretedcat oocysts[10] . It has been estimatedthat 33% of peopleworldwideareafflicted with toxoplasmosis [11] , and consuming raw or unpasteurized sheep and goat milk has been determined to be the cause of human toxoplasmosis [12 13]. according to[14] , The most severely affected species of food-producing animals are goats and sheep (small ruminants), which may serve as carriers of human disease[15] .

Scientific classification

Kingdom : Chromista

Superphylum : Alveolata

Phylum: Apicomplexa

Class: Conoidasida

Order: Eucoccidiorida

Family: Sarcocystidae

Subfamily: Toxoplasmatinae

Genus: Toxoplasma [16] .

Morphology and lifecycle of Toxoplasma gondii

The life cycle of T. gondii consists of two distinct stages: asexual and sexual reproduction. (Figure 1). Followinganinfection, therearetypicallythreephases: theambient, slowly dividingsporozoite, theinvasive, quicklydividingtachyzoite, andtheslowlydividingbradyzoite in tissue cysts. One stage of the environment is the sporozoite stage, which is shielded by the oocyst. T. gondii cells have a crescent form, measuring around 2 m in width and 5 m in length, with rounded posterior and sharp apical ends. The cytoskeleton controls both the structural integrity and motility of cells. Among these are the Golgi complex, ribosomes, apicoplast, endoplasmic reticulum, a mitochondrion, and a multimembrane-bound

organelle that resembles a plastid. Numerous algal endosymbionts are also connected to this parasite[17] . Cell invasion is facilitated by the parasite's cytoskeletal structure as well as many secretary organelles, including as rhoptries, dense granules, and micronemes [18 19 20]

A highly aggressiveparasite known as a chyzoite has the ability to invade nearly all types of vertebrate cells. It progresses into the bradyzoite stage, which forms cysts in various tissues after developing from tachyzoites. In brain cells, these cysts are elongated and less spherical in shape. The size of the cysts varies greatly depending on their age. While early-stage cysts have been observed to grow as large as 100 m, most young cysts are smaller than 10 m. The oldest cysts contain thousands of densely packed bradyzoites. The cyst wall exhibits numerous invaginations and granular granules, as noted by Ferguson[21] . Within cells, the cysts can persist due to the favorable lifestyle of bradyzoites, which are resistant to the pepsin enzyme of the host organism. This resistance enables them to survive in the presence of pepsin-HCl for up to two hours. The oocysts, known as sporozoites, have a size range of 12 to 13 m and are protected by a multilayer wall that safeguards against chemical and mechanicalchanges. Theintricate layeredstructure of theparasiteallows for its survival for extended periods, potentially exceeding a year[22] . The dissemination of diseases among tribes varied in different ways. Toxoplasmosis transmission among them involves the sexualcycle, intermediate hosts, andcarnivory. Thesurvival environment may exhibit different disease transmission patterns, asexual and sexual cycles, based on the physical characteristics and structures of both definitive and intermediate host populations [23] . The first documented case of congenital toxoplasmosis in humans was described by Schwartzman *et al.* in[24] , and there has been a recent increase in clinical toxoplasmosis cases. Over the past 20 years, field research and innovative genotyping techniques have provided insights into the evolution of *T.* gondii [25] .

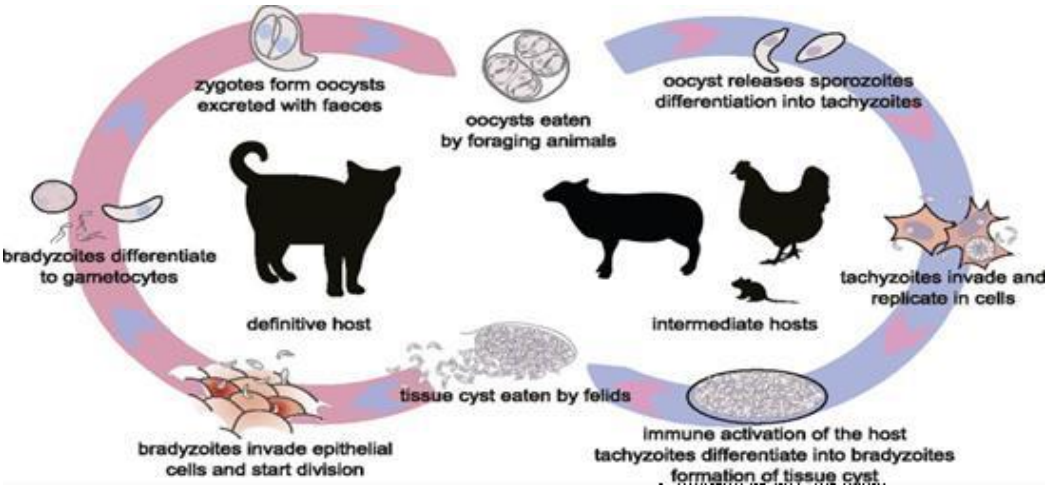

Figure 1 The life cycle of Toxoplasmagondii is depicted on the left, illustrating the sexual stage occurring exclusively within the feline host. On the right, the non-host specific asexual stage is portrayed. This image has been adapted from www.elifesciences.org.

Review of some previous studies Distribution of Toxoplasma gondii in sheep and goat in Iraq .

Two different serological tests were used to determine the T. gondii antibody titer in sheep and goat serum samples in Sulaimania city, Iraq. In sheep, the prevalence rate was 73 (51.7%) and 82 (57%) using the enzyme-linked immunosorbent assay. In goats, the prevalence rate was 21 (54.6%) and 25 (54.35%) using the same assay. [26] conducted this study. In the city of Erbil, [27] employed latex, MAT, and ELISA to test sera from 259 sheep and 88 goats for antibodies to Toxoplasma gondii. They foundthat 25 (28.4%) goats and 75 (25.4%) sheep tested positive for latex. In the Baghdad Governorate, [28] discovered that females had a higher incidence of toxoplasmosis infection compared to males. The infection rate for the ELISA and latex agglutinationtest was 64.10% and 87.32% for females, and 45.45% and 71.42% for males, respectively[29] .

In the Wasit province of Iraq, a genotyping test conducted by[30] revealed that 60% of the type II gene was dominant in sheep. The ELISA and PCR tests showed the highest positive findings insheep, withpercentages of 33.03% and 22.32% respectively. Goat hadthesecond highest positive findings, with percentages of 29.33% for ELISA and 18.66% for PCR.[31] used an indirect enzyme-linked immunosorbent assay (iELISA) and the latex agglutination test (Latex) to find anti-Toxoplasma gondii antibodies in the northern Iraqi province of Dohuk. Concurrent analysis of the test results revealed that 54.5% of the goat sera and 26.2% of the sheep sera examined by CFT in Baghdad[32] were found to have antibodies. In a study conducted by [33] in the Baghdad province, the serological indirect-enzyme-linked immunosorbent test (iELISA) was used to determine the prevalence of toxoplasmosis in blood goats. The positive iELISA findings in sera were recorded at 20.57%.

Prevention and control

The World Health Organization has suggested considering the potential implementation of a preventive program to prevent toxoplasmosis, because by verifying the existence of toxoplasmosis in the herd, it may operate as a control mechanism to lessen the burden of the illness and safeguard the cattle industry's financial sustainability. [34] . Research conducted on pigs in the United States in the early 1990s indicates that cats are less likely to become infected with T. gondii when they are kept away from direct contact with other animals [35] . Toxoplasmosis has traditionally been considered incurable in infected hosts due to the parasite's obligate intracellular nature and rapid encystment, which poses challenges for administering anti-parasitic drugs [36] . For sheep with fewer cysts, there is a live vaccine available that reduces neonatal mortality rates [37 38] . An easy and cost-effective method to reduce the risk of T. gondii transmission appears to be freezing meat in a household freezer for at least one night before consumption by animals and/or humans [33,39] .

Effective collaboration among physicians, veterinarians, and professionals in the health and environmental sectors plays a vital role in developing efficient vaccines, novel treatments, and control strategies for T. gondii infection in humans, cats, and other animals [40] . Additionally, it is imperative to prioritize initiatives focused on public health and education

to effectively prevent illnesses [41] . Controlling toxoplasmosis in both humans and animals is of utmost importance, and prevention measures are essential in order to avoid unnecessary losses and outbreaks resulting from inadequate animal sanitation practices.

CONCLUSION

Despite improvements in our knowledge of toxoplasmosis, additional research is still needed to fully understand a number of aspects of the disease in sheep and goats. Among these is determining0 if breeds of sheep and goats vary from one another in terms of disease susceptibility. Moreover, the potential frequency of flock repeat abortions linked to T. gondii. The review of toxoplasmosis looked at the spread of the illness, its prevalence, and its geographic distribution. Livestock, wild animals that wander free, and birds are the principal vectors for the transmission of toxoplasma infection. T. gondii-contaminated raw or partially cooked meals may spread the illness. One of the deciding elements in illness epidemiology is determined to be the socioeconomic level. Academics, politicians, healthcare workers, and veterinary professionals might all benefit from this review. One of the neglected illnesses that need to be brought to the public's notice is toxoplasmosis. Therefore, increased effort should be made to inform people about toxoplasmosis caused by T. gondii. Iraq has a high infection rate, according to the findings of this systematic review study. More study is required to improve strategies for preventing infection in flocks and consequently in the human population.

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Conflicts of Interest

The author declares no conflict of interest.

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