Toxoplasmosis : Beware of Cats !!!

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Abstract

Anthropozoonotic parasite *Toxoplasma gondii* causes widespread human and animal diseases, mostly involving central nervous system. Human acquires toxoplasmosis from cats, from consuming raw or undercooked meat and from vertical transmission to the fetus through placenta from mother during pregnancy. Socio-epidemiological as well as unique environmental factors also plays a significant role in transmission of this infection. Preventive measures should be taken into account the importance of culture, tradition, and beliefs of people in various communities more than solving poverty and giving health education. Therefore the focus of this article is to create public awareness regarding sense of responsibility of looking after pets to prevent such an important zoonotic disease.

Keywords: Feline, Zoonosis, Vertical Transmission, Public Health.

Introduction

Toxoplasmosis is an anthropozoonotic widespread disease, caused by an obligate intracellular protozoan parasite Toxoplasma gondii. Nicolle and Manceaux in 1908 first observed this parasite in rodents. Its medical importance remains unknown until 1939, when T. gondii was identified in tissues of a congenitally infected infant and simultaneously veterinary importance became known to world when it was found to cause abortion storm in sheep in 1957. The discovery of a T. gondii Ab test, sabin-Feldman dye test in 1948 led to the recognition that T. gondii is a common parasite of most genera of warm blooded animals, including humans, but the primary host is the felid (cat) family. T. gondii has a world wide distribution in human populations infecting upto one third of global population (approx.500 million) and a wide range of other mammalian & avian species. It is a major health problem, with a high socio-economic impact in terms of human suffering including the cost of caring for sick, mentally retarded and blind children. It is a major cause of abortion and infertility in livestock, especially among ewes, and therefore a significant cause of lost profitability in livestock and agriculture. It is a major cause of morbidity in immunodeficient patients, including AIDS. T. gondii contributes to be an important disease in modern world, especially in pregnant woman. Unique environmental factors in various religions and communities indicate the important role that eating habitat and culture have on the transmission of this infection.

The socioepidemiological aspects of toxoplasmosis are one of the major factors for the spread of this disease. Studies of the unique environmental factors in various communities indicate that eating habitats and culture play an important role in transmission of this infection. So preventive measures should take into account the cultures and beliefs of people in various communities more than solving poverty and giving health education.

Transmission

Human became infected with toxoplasmosis by eating uncooked meat containing tissue cysts or by ingesting water or food contaminated with oocysts from the faeces of infected cats. In France, a high prevalence of toxoplasmosis is due to a preference for eating undercooked or raw meat; where as its prevalence in Central America is due to a large number of stray cats in a climate favourable for survival of oocysts. Ingestion of contaminated cat faeces which can occur through hand-to-mouth contact following gardening, contact with children's sandpits, cleaning cat's litter box or touching anything that has come in contact with cat's faeces. It can also be transmitted through milk and semen. In Mexico and Brazil, access for cats to the outdoor environment and feeding cats with raw viscera and raw meats were the risk factors for human infection. The increased risk of sero-positivity in human males is due to less attention being paid to cleanliness during food preparation and consumption than in females. In Thailand, cats are kept as pets and allowed to roam freely outdoors. Thus, these conditions

make Buddhist temples a place of risk for acquiring this zoonotic infection. Transmission may also occur through organ transplant or blood transfusion. Transplacental infection (Vertical transmission) to the foetus occurs by placental transfer of organisms from the mother usually following acute maternal infection. Wide spread natural infection is possible because a cat may excrete millions of oocysts after ingesting infected tissues. The cyst from the parasite is very hard, capable of surviving exposure to freezing down to -12oC and chemical disinfectants such as bleach and can thrive for over a year in the environment. Oocysts can also be mechanically transmitted by invertebrates such as flies, cockroaches, earthworms, run off rain and melting snow. Animals become infected by ingesting food and water contaminated with sporulated oocysts, or congenitally through placenta. This parasite causes abortion in sheep, goats and pigs and brings a huge economic loss in livestock sector.

Life cycle

The life cycle of *T. gondii* has sexual and asexual components. Asexual phase occurs in the intermediate host, i.e. in warm blooded animals. The sexual phase occurs in enteroepithelial cells of the feline definitive host and results in production of oocysts. Oocysts are shed in the faeces for several days following a primary infection. Sporulation of oocysts occurs in the environment over the next 1-5 days depending on aeration and temperature, at which time, it becomes infective. When a susceptible animal ingests sporulated oocysts, the sporozoites penetrate the intestinal lining, become tachyzoites and establish an infection.

There are 2 developmental stages in the asexual cycle, the slowly multiplying bradyzoite and the rapidly multiplying tachyzoite. Tachyzoites actively penetrate host cells, multiply and finally release into blood stream after rupturing the cell. The Parasite transforms into bradyzoite stage and multiplies slowly within tissue cysts to establish a persistent infection when host develops immunity. These tissue cysts are mostly present in brain and skeletal muscle, placenta and represent the quiescent stage of the parasite within the host. In goats, sheep, horses, pigs, human, cysts may remain for rest of the life of the individual. Toxoplasma does not usually cause clinical illness in cattle, camelids or deer, but can cause fatal disease in Australian marsupials, New world monkeys, hares and some birds. One interesting feature is that cat can act both as a definitive host as well as an intermediate host i.e both sexual and asexual stages of the parasite can develop in cat. So keeping in mind the above facts the importance of cat in the life cycle of this parasite is well speculated.

Human Health Risks

T. gondii readily infects human beings and infection is relatively common while clinical illness is relatively uncommon. Pregnant women are usually at risk of developing clinical illness as the parasite can pose a serious threat to unborn child, if the mother becomes infected for the first time while pregnant. Congenital toxoplasmosis is a special form in which an unborn child is infected via placenta. Individuals who are immunosuppressed such as tissue transplant patients, AIDS patients, and those undergoing cancer therapies are at risk of developing acute lethal infection if left untreated. The very young and very old may also be more susceptible. Severely infected infants may have the full tetrad signs like retino-choroiditis, intracerebral necrosis followed by cerebral calcification, convulsion, and hydrocephalus. The most common sequel of congenital toxoplasmosis is ocular disease mostly confined to the posterior chamber. Postnatally acquired infection may be localized or generalized. Lymphadenitis is the most frequently observed clinical form of human toxoplasmosis in which the deep cervical node is mostly involved. Though the condition may be benign, its diagnosis is important in pregnant women because of the risk to the foetus.

Animal health risk

T.gondii can cause severe disease in sheep, goats, dogs, cats and various other animals causing abortion which is the most important clinical manifestation. It can cause foetal death, resumption or retention of placenta, still birth, abortion and birth of weak, emaciated young in sheep, goats and pigs.

Prevalence of Toxoplasmosis in India

Prevalence of Toxoplasmosis in India is usually determined by seroepidemiological studies. Such studies are carried out by indirect haemagglutination, complement fixation, enzyme linked immunosorbent assay (ELISA) and dye test has shown significant level of toxoplasma antibody in normal population as well as in high number of suspected toxoplasma infected population living in Delhi, Chandigarh, Mumbai and Various parts of India. The sero positive cases have been reported both in non-vegeratarian and vegetarian population.

Toxoplasma gondii antibodies have been demonstrated in cattle, buffaloes, camels, cats, dogs and other animals. The first report of T. gondii infection in animals was reported in rabbits by Krishnan and Lal in 1993, followed by reports of a dog suffering from toxoplasmosis by Ray and Raghavchari. Since then a wide number of cases on seroprevalence of toxoplasmosis in animals are currently available from different parts of India.

Diagnosis

Diagnosis of toxoplasmosis can be aided by serological or histological examination. Clinical signs of the condition can't be dependent on for final diagnosis, as toxoplasmosis clinically mimics various other infectious diseases. Among serological tests, ELISA, Agglutination tests, indirect fluoroscent assay are routinely practiced. But 'sabin-feldman dye test' is most specific for the diagnosis of toxoplasmosis. It is performed to detect specific toxoplasma Ab in the serum and is essentially an in vitro neutralization test. The test is based on the ability of live extra-cellular tachyzoites of toxoplasma to appear thin, colorless and distorted with alkaline methylene blue in presence of antibodies and accessory factors. The parasite dies as a result of antibody mediated complement lysis. But in normal human serum, in absence of toxoplasma Ab, tachyzoites become swollen; stain deep blue with alkaline methylene blue. The tachyzoites of toxoplasma are obtained from peritoneal exudate of mice. According to WHO, as antibody titre of 1:4 or above is diagnostic of toxoplasma infection.

Nucleic acid based recognition methods include polymerase chain reaction (PCR) for detection of DNA from T. gondii. The main target regions are the B1 repetitive sequence, the ribosomal RNA (rRNA) or P3O (SAG1 gene). The B1 and P3O PCR are widely used techniques and good diagnostic aids. Diagnosis can also be made by finding *T. gondii* in the host tissue removed for biopsy or at necropsy. By making impression smears of lesions on glass slides, a rapid diagnosis can be made. The smears are fixed in methyl alcohol and stained in Giemsa after drying. Well preserved toxoplasma is crescent shaped. Occasionally tissue cysts may be found in areas with lesions which are usually spherical, have silver-positive walls and the bradyzoites inside it are strongly PAS positive. Characteristic necrotic lesions in placental cotyledons of sheep and goats are the presumptive diagnosis for *T. gondii.*

Treatment

Sulfonamides and pyrimethamine (Daraprim) are 2 drugs that act synergistically by blocking the metabolic pathway involving p-amino benzoic acid and the folic-falinic acid cycle are widely used for therapy of toxoplasmosis. The adverse effect of drug therapy can be overcome by administering folinic acid and yeast extract. Spiramycin and clindamycin also have anti-toxoplasmic properties.

Prevention

As prevention is better than cure, so following measures should be taken.

Pregnancy precautions: Congenital toxoplasmosis is a special form in which an unborn child is infected through placenta. A positive Ab titer indicates previous exposure and immunity and ensures the unborn baby's safety. If a woman receives her first exposure to toxoplasmosis while pregnant, then the baby is at great risk. A simple blood draw at the first pre-natal doctor visit can determine whether or not the women has had previous exposure and therefore whether or not she is at risk. A woman with no previous exposure should avoid handling raw meat, exposure to cat faeces and gardening (as soil may be contaminated with cat faeces). Treatment is highly recommended for recently infected pregnant women to prevent fetal infection.

Public awareness: One should wash his hands with soap after handling meat and vegetables should be washed properly especially those grown in backyard gardens and drink boiled water. Meat should be cooked thoroughly before consumption. Cat should not be fed uncooked animal tissues, gloves should be worn while gardening and cleaning cat litter trays.

Control

Till date there is no vaccine for human against his parasite. The only available vaccine is a commercially produced live preparation for sheep i.e TOXOVAX which is a tissue culture grown S48 strain of *T. gondii* tachyzoites attenuated by over 8000 passages in mice. But this vaccine has a short shelf-life and is a potential risk to pregnant female and immunocompromised operatives but there are immense rays of hopes of developing a vaccine in near future because man and most animal species acquire good immunity against clinical toxoplasmosis after postnatal infection.

Addressing various problems of disease prevention should, therefore, take into account cultural and ethnic differences. Proper hygienic measures while taking food and keeping pets (like cat) will reduce the chance of transmission of toxoplasma to humans. Apart from that public awareness regarding the disease and the sense of responsibility for looking after pet animals is also important.

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