Acta Scientiarum
http://periodicos.uem.br/ojs/acta
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v47i1.67311

Recommendations for the Diagnosis, Treatment, and Management of Gestational and Congenital Toxoplasmosis in Brazil

Lara Ferreira Cassemiro[1], Igor Rosa Meurer[2], Karolayne Helena Capistrano[1] and Lauren Hubert Jaeger[1*]

[1]Departamento de Ciências Farmacêuticas, Faculdade de Farmácia, Universidade Federal de Juiz de Fora, Rua José Lourenço Kelmer, s/n, 36036-900, Juiz de Fora, Minas Gerais, Brasil. [2]Hospital Universitário, Universidade Federal de Juiz de Fora, Juiz de Fora, Minas Gerais, Brasil.*Author for correspondence. E-mail: laurenhj@gmail.com

ABSTRACT. Toxoplasmosis is a zoonosis caused by the protozoan *Toxoplasma gondii*. It presents severity in patients of certain risk groups, such as pregnant women, fetuses, newborns, and immunocompromised patients. The diagnosis of gestational and congenital toxoplasmosis still poses doubts among healthcare professionals. To perform an analysis of Brazilian official documents with recommendations regarding the diagnosis, treatment, and management of gestational and congenital toxoplasmosis in the country. Official manuals published up to 10 years ago were included in the analysis. Through the analysis of five manuals, it was possible to verify that the diagnosis of gestational toxoplasmosis is primarily performed through immunological tests, with the anti-T*oxoplasma gondii* IgG avidity test being the best choice for confirming acute disease in pregnant women. For the diagnosis of congenital toxoplasmosis, the most indicated diagnostic tools are the detection of anti-*Toxoplasma gondii* IgM and IgG antibodies and computed tomography for newborns, and Polymerase Chain Reaction of amniotic fluid during gestation. There is a consensus regarding the treatment and management of gestational and congenital toxoplasmosis in the studied manuals, with spiramycin and pyrimethamine being the drugs of choice for the treatment of pregnant women and newborns, respectively. It is noteworthy that all recommended drugs are available in the Unified Health System (SUS). However, there is still no drug with suitable pharmaceutical presentation for administration in newborns. In this context, prophylaxis is essential for reducing the occurrence of the disease in pregnant women, through proper hygiene and cooking of raw food.

Keywords: Gestational toxoplasmosis;congenital toxoplasmosis; laboratory diagnosis; pharmacological treatment.

Received on March 21, 2023.
Accepted on February 22, 2024.

Introduction

Toxoplasmosis is a zoonotic disease caused by an intracellular protozoan of the Apicomplexa class, called *Toxoplasma gondii*. Most cases are asymptomatic, especially in immunocompetent individuals, or symptoms may be confused with a range of other diseases, such as cytomegalovirus, dengue, rubella, Hodgkin's disease, among others. However, there are some susceptibility groups where toxoplasmosis presents as a severe and even fatal disease. These groups include pregnant women, fetuses, newborns, and immunocompromised patients (Ministry of Health, 2018; State Department of Health, 2018; Government of Santa Catarina, 2022).

It is estimated that about 30% of the world's population is chronically infected with *T. gondii*. In Brazil, this occurrence can range from 40% to 80% in adults and 50% in children. The seroprevalence of antibodies may vary depending on the region studied, as it will depend on the culture and dietary habits of each population (Dubey et al., 2012; Zeibig, 2014; Walcher et al., 2016; Zhao & Ewlad, 2020). Transmission to humans mainly occurs through the ingestion of water or food, including raw or undercooked meat, contaminated by the protozoan. Vertical transmission (from mother to fetus during pregnancy) is highlighted, as this can lead to serious sequelae in newborns or miscarriages (Nicácio et al., 2015). Thus, gestational and congenital toxoplasmosis are compulsorily notifiable diseases in Brazil since 2016 (Federal Government, 2022; Government of Santa Catarina, 2022).

Considering the importance of toxoplasmosis for the Brazilian population and the severity of congenital toxoplasmosis, this study aims to evaluate the recommended methods for diagnosis, treatment, and management of human infection by the protozoan *T. gondii* as advocated by health authorities in the country.

Material and methods

This study consists of an analysis of recommendations from official documents for the diagnosis, treatment, and management of gestational and congenital toxoplasmosis in Brazil. Brazilian official resolutions and manuals were accessed using the databases: SciELO Brazil (https://www.scielo.br/) and *Ministério da Saúde* (Ministry of Health, https://www.gov.br/saude/pt-br/). The inclusion criterion was to select manuals containing recommendations on the diagnosis and treatment of gestational and congenital toxoplasmosis for two risk groups: I - Pregnant women with suspected or confirmed gestational toxoplasmosis; II - Newborns with suspected or confirmed congenital toxoplasmosis. The exclusion criterion was to exclude manuals with publication dates exceeding 10 years past. Brazilian resolutions were used to construct a database in Microsoft Office Excel 2007 software. The collected data included microscopy, biopsy, cerebrospinal fluid cytology, immunological tests (IgM, IgA, IgG, and IgG avidity), Polymerase Chain Reaction (PCR) in different biological samples (cerebrospinal fluid, blood, amniotic fluid, and urine), computed tomography (CT), obstetric ultrasound (USG), drug used for treatment, choice (recommendation order), and treatment regimen (dose, administration interval, duration).

Results

Based on the bibliography databases searched and the inclusion and exclusion criteria, five manuals were found, and all were included in the analysis of recommended diagnostic tools in the context of toxoplasmosis. (Table 1) presents the recommended laboratory tools for diagnosing *T. gondii* infection in pregnant patients in Brazil. It was observed that immunological tests for the detection of IgM, IgG, and IgG avidity antibodies are recommended by all manuals evaluated for this risk group.

Table 2 presents the recommended laboratory tools for diagnosing *T. gondii* infection in newborns or minors with suspected congenital toxoplasmosis in Brazil. It was noted that a greater number of tests are recommended for confirmation and diagnosis of congenital toxoplasmosis in newborns compared to the pregnant risk group.

Table 1. Laboratory tools recommended for the diagnosis of *Toxoplasma gondii* infection in pregnant patients with suspected gestational toxoplasmosis in Brazil.

Diagnostic tool	Reference				
	(Ministério da Saúde [MS]., 2014)	(Brasil, 2018)	(Ministério da Saúde [MS]., 2020)	(Governo de Estado de Tocantins, 2020)	(Governo de Santa Catarina, 2022)
Microscopy		✓			
Biopsy		✓			
Immunological test IgM	✓	✓	✓	✓	✓
Immunological test IgG	✓	✓	✓	✓	✓
Immunological test IgG avidity	✓	✓	✓	✓	✓
Immunological test IgA		✓			
PCR (CSF)					✓
PCR (LA)	✓	✓			✓
Obstetric ultrasound (USG)	✓	✓		✓	✓

PCR: Polymerase Chain Reaction. USG: Ultrasonography. CSF: Cerebrospinal Fluid. LA: Amniotic Fluid.

Table 2. Recommended laboratory tools for the diagnosis of *Toxoplasma gondii* infection in newborns or minors with suspected congenital toxoplasmosis in Brazil.

Diagnostic tool	Reference				
	(Ministério da Saúde [MS]., 2014)	(Brasil, 2018)	(Ministério da Saúde [MS]., 2020)	(Secretaria da Saúde do Rio Grande do Sul, 2021)	(Governo de Santa Catarina, 2022)
Cytology (CSF)	✓		✓	✓	✓
Immunological test IgM	✓	✓	✓	✓	✓
Immunological test IgG	✓	✓	✓	✓	✓
Immunological test IgA	✓	✓	✓	✓	
PCR (blood)		✓		✓	✓
PCR (CSF)		✓		✓	✓
PCR (LA)	✓	✓	✓	✓	✓
PCR (urine)		✓		✓	✓
CT	✓	✓	✓	✓	✓

PCR: Polymerase Chain Reaction. CSF: Cerebrospinal Fluid. LA: Amniotic Fluid. CT: computed tomography.

Four manuals were selected for the analysis of recommended treatment and management in the context of gestational and congenital toxoplasmosis in Brazil. (Table 3) presents the therapeutic approaches for pharmacological treatment and management recommended for pregnant women with gestational toxoplasmosis in Brazil. Table 4 presents the therapeutic approaches for pharmacological treatment and management recommended for newborns with congenital toxoplasmosis in Brazil.

Table 3. Recommended Treatment and Management for Pregnant Women with Gestational Toxoplasmosis in Brazil.

Reference	Choice	Drug	Treatment regimen		
			Dose	Administration interval	Duration
Secretaria de Vigilância em Saúde, 2020	1°	Spiramycin	500 mg	8/8h	Up to 16 weeks of gestation
	2°	Primethamine + Sulfadiazine + Folinic acid	25 mg 500 mg 15 mg	24h 12/12h 24h	From 16 weeks of gestation
Governo do Estado do Paraná, 2021	1°	Spiramycin	500 mg	8/8h	Up to 16 weeks of gestation and after 34 weeks of gestation
	2°	Sulfadiazine + Pyrimethamine + Folinic acid	500 mg 100 mg 15 mg	6/6h 12/12h, from 3rd day 24h 24h	Between 17 and 33 weeks of gestation
Governo de Santa Catarina, 2022	1°	Spiramycin	500mg	8/8h	Up to 18 weeks of gestation
	2°	Pyrimethamine + Sulfadiazine + Folinic acid	25 mg 500 mg 15 mg	8/8h, from 3rd day 24h 8/8h 24h	Until the end of pregnancy
Ministério da Saúde [MS]., 2020	1°	Weight <60 kg: Sulfadiazine + Pyrimethamine + Folinic acid Weight >60 kg: Sulfadiazine + Pyrimethamine + Folinic acid	 500 mg 25 mg 15 mg 1,000 mg 50 mg 15 mg	 6/6h 24h 24h 6/6h 24h 24h	Until the end of pregnancy
	2°	Clindamycin + Pyrimethamine + Folinic acid	600 mg 25-50 mg 15 mg	8/8h 24h 24h	Until the end of pregnancy
	3°	Sulfamethoxazole + Trimethoprim	800 mg 160 mg	12/12h	Until the end of pregnancy

Table 4. Recommended Treatment and Management for Newborns with Congenital Toxoplasmosis in Brazil.

Reference	Choice	Drug	Treatment regimen		
			Dose	Administration interval	Duration
Secretaria de Vigilância em Saúde, 2020	1°	Pyrimethamine + Sulfadiazine + Folinic acid	1 mgkg^{-1}day^{-1} 100 mg kg^{-1} day^{-1} 10 mg	24h 12/12h ~48h	1 year
Governo do Estado do Paraná, 2021	1°	Sulfadiazine + Pyrimethamine + Folinic acid	100 mg kg^{-1} day^{-1} 2 mg kg^{-1} day^{-1} 10 mg	12/12h 12/12h, from 3rd day 24h or ~48h ~48h	1 year
Secretaria da Saúde do Rio Grande do Sul, 2021	1°	Pyrimethamine + Sulfadiazine + Folinic acid	1 mg kg^{-1} day^{-1} 100 mg kg^{-1} day^{-1} 15 mg	24h, after 6 months ~48h 12/12h ~48h	1 year
Governo de Santa Catarina, 2022	1°	At up to 6 months of age: Pyrimethamine + Sulfadiazine + Folinic acid After 6 months: Pyrimethamine + Sulfadiazine + Folinic acid	 25 mg kg^{-1} day^{-1} 100 mg kg^{-1} day^{-1} 15 mg 25 mg kg^{-1} day^{-1} 100 mg kg^{-1} day^{-1} 15 mg	 24h 12/12h ~48h ~48h 12/12h ~48h	6 months
	2°	Spiramycin *	100 mg kg^{-1} day^{-1}	12/12h	Until laboratory normalization

*Spiramycin should be used concurrently with the first-line medication, however, it is recommended only for children with severe bone marrow toxicity.

Discussion

Immunological tests for antibody detection have been recommended by all manuals for both gestational toxoplasmosis and congenital toxoplasmosis diagnosis. In gestational toxoplasmosis, it is essential that the anti-*Toxoplasma gondii* IgG avidity test be performed in the first trimester of pregnancy in patients with reactive anti-*Toxoplasma gondii* IgM indexes. The anti-*Toxoplasma gondii* IgG avidity test is widely used to differentiate past (chronic) infection from recently acquired infection (acute). It is used as a confirmatory method, not excluding the performance of other diagnostic methods. Furthermore, the anti-*Toxoplasma gondii* IgG avidity test is associated with the date of the examination and the gestational age of the patient, making it possible to determine the best therapeutic strategy to be used and to evaluate the risks of vertical transmission (Pena & Discacciati, 2013). This is because elevated values in the anti-*Toxoplasma gondii* IgG avidity test indicate chronic infection, reducing the risk of vertical transmission and making therapy unnecessary. Conversely, when low values are found in the anti-*Toxoplasma gondii* IgG avidity test combined with elevated anti-*Toxoplasma gondii* IgM antibody values, there is a strong suspicion of gestational toxoplasmosis (Nicácio et al., 2015). However, an exceptional condition may be found when there are elevated levels in the anti-*Toxoplasma gondii* IgG avidity test along with elevated anti-*Toxoplasma gondii* IgM antibody values, characterizing the presence of persistent IgM antibodies (Bertozzi et al., 1999; Vargas-Villavicencio et al, 2022). Persistent IgM antibodies (also called persistence IgM antibodies) can occur for months or even years after primary infection and have clinical significance in pregnancy (Bertozzi et al., 1999).

Unlike the investigation of gestational toxoplasmosis, the IgG avidity test has no clinical significance in congenital toxoplasmosis (Rio Grande do Sul State Health Department, 2021), and the detection of IgA antibodies is recommended by most manuals for newborns. Immunological tests in newborns are widely used due to their high specificity and sensitivity. The measurement of anti-*Toxoplasma gondii* IgM and IgA antibodies confirms the diagnosis of congenital toxoplasmosis shortly after birth, as these markers do not cross the placental barrier (Hironaka & Casanova, 2003). However, it is important that they be performed shortly after birth to exclude false positives, since these antibodies can be acquired through breastfeeding (Passanha et al., 2010; Oliveira et al., 2015). Additionally, negative values of IgM and IgA anti-*Toxoplasma gondii* antibodies do not rule out congenital toxoplasmosis (Ministry of Health, 2014). Detection of anti-*Toxoplasma gondii* IgG antibodies in newborns have no diagnostic value and has to be performed months after birth due to the intrauterine passage of these markers. Since the half-life of IgG antibodies is thirty days, with each month of the newborn's life there will be a decrease in the maternal antibodies acquired in utero and, thus, after twelve months of life, congenital toxoplasmosis can be confirmed by measuring this antibody in the baby's serum (Ministry of Health, 2014; Rio Grande do Sul State Health Department, 2021).

Obstetric ultrasound has been recommended by most manuals to be performed during pregnancy in suspected cases, with only one manual not recommending it. Computed tomography has been recommended for the diagnosis and monitoring of congenital toxoplasmosis in newborns by all manuals analyzed. This method is generally used to research neurological sequelae that can cause brain involvement: cerebral calcifications, ventricular dilation, and hydrocephalus (Santa Catarina State Government, 2022; Rio Grande do Sul State Health Department, 2021).

The main biological material used in tests that detect the parasite's DNA in biological samples is amniotic fluid, although other samples such as blood, urine, and cerebrospinal fluid can also be used in the diagnosis of congenital toxoplasmosis. However, the PCR technique was recommended in only three of the five manuals evaluated. This technique has high sensitivity and specificity in the diagnosis of congenital toxoplasmosis and helps confirm the transmission of the parasite from mother to fetus during pregnancy. Additionally, it is a low-risk test for fetal loss attributed to amniocentesis, which benefits early disease diagnosis and avoids the risks of complications from late therapeutic actions (Azevedo, 2013). PCR in cerebrospinal fluid is only performed in newborns with suspected neurological signs or abnormalities in imaging tests, due to being an invasive collection technique. On the other hand, the search for parasite DNA in urine is a less invasive method, as urine is a very simple and accessible biological material for diagnosis in this risk group (Rio Grande do Sul State Health Department, 2021; Santa Catarina State Government, 2022).

Techniques using visualization of the parasite in biological samples, such as microscopy and biopsy, are not widely recommended. This is because detecting parasitic forms in biological samples is complex. The period of parasitemia (presence of parasites in peripheral blood) is brief and is only observed during the acute phase of the

disease. Additionally, the morphology of *T. gondii* tachyzoites can be confused with other microorganisms, such as fungi (*Histoplasma*, *Cryptococcus*) and other protozoa (*Trypanosoma cruzi* and *Leishmania* spp.) (Rey, 2013).

The existence of nationally comprehensive protocols or guidelines allows for standardized diagnostic approaches for all Brazilian states. However, some states may not have the necessary tools and equipment available, and new recommendations—specific to each state—may be found.

The treatment of gestational toxoplasmosis (pregnant women) is indicated considering gestational age. In the first trimester of pregnancy, drugs with low capacity to cross the placental barrier are chosen and can be maintained until the end of pregnancy, such as spiramycin, which has parasitostatic action (Paraná State Government, 2021). For infection acquired in the third trimester of pregnancy, the recommended treatment is different. The use of combinations with parasiticides, pyrimethamine, and sulfadiazine as a treatment method is because these medications cross the placental barrier when there is confirmation, through diagnosis, that the infection has reached the fetus. The medication clindamycin is used when the pregnant woman presents intolerance or allergy to sulfadiazine (Ministry of Health, 2010; Rey, 2013; Paraná State Government, 2021).

The treatment provided by the Unified Health System (SUS) is through the administration of tablets. Thus, to perform treatment in newborns, it is necessary to manipulate these tablets to turn them into solutions/suspensions to be administered orally and to reach the correct dose considering the child's weight. Since there is no pediatric dosage form in the SUS, administering the drug becomes complex for mothers and contributes to poor treatment adherence, consequently, treatment abandonment may occur (Rio Grande do Sul State Health Department, 2021; Santa Catarina State Government, 2022).

Another important factor to consider in the treatment of congenital toxoplasmosis in newborns is its toxicity. Pyrimethamine causes inhibition of dihydrofolate reductase enzyme activity, a precursor of folic acid, which can cause suppression of hematopoiesis in the child (Rey, 2013). This results in pancytopenia, where all blood cells have a decrease in production and quantity in the bloodstream (neutropenia, anemia, and thrombocytopenia). Other adverse effects that may occur with the use of this drug are epigastric pain, headaches, and, mainly, depression of bone marrow activity. Sulfadiazine's adverse effects are the presence of crystals in the urine, gastric intolerance, and pharmacodermia (skin and body reactions) (Neves, 2016). Thus, folic acid replacement is recommended for these patients when using pyrimethamine, in order to prevent myelotoxicity (Rio Grande do Sul State Health Department, 2021; Santa Catarina State Government, 2022).

The therapy used in the studied risk groups is available in the Ministry of Health's National List of Essential Medicines (*RENAME*), with only pyrimethamine and sulfadiazine being strategic components, the others are considered basic components of pharmaceutical assistance in Brazil. Thus, drugs from the list of basic components are the responsibility of supply by the municipality and drugs from the list of strategic components are the responsibility of supply by the Ministry of Health.

Conclusion

In light of the above, the diagnosis of gestational toxoplasmosis is primarily carried out through immunological tests, with the anti-*Toxoplasma gondii* IgG avidity test being essential for confirming infection in pregnant women. For newborns, immunological tests for detection of anti-*Toxoplasma gondii* IgM and IgG antibodies, PCR of amniotic fluid, and computed tomography are the tests of choice. There is a consensus regarding the treatment and management of gestational and congenital toxoplasmosis in the manuals studied, with spiramycin and pyrimethamine being the drugs of choice for the treatment of pregnant women and newborns, respectively.

References

Azevedo, C. T. O. (2013). *Desempenho da Reação em Cadeia da Polimerase no Líquido Amniótico para Diagnóstico da Toxoplasmose Congênita*. Revisão Sistemática e Metanálise. Fundação Oswaldo Cruz.

Bertozzi, L., Suzuki, L., & Rossi, C. (1999). Serological diagnosis of toxoplasmosis: usefulness of IgA detection and IgG avidity determination in a patient with a persistent IgM antibody response to Toxoplasma gondii. *Revista do Instituto de Medicina Tropical de São Paulo, 41*(3), 175-177. https://doi.org/10.1590/S0036-46651999000300008

Brasil. (2018). *Protocolo de Notificação e Investigação: Toxoplasmose gestacional e congênita*. Ministério da Saúde.

Dubey, J. P., Lago, E.G., Gennari S.M., Su, C., & Jones, J.L. (2012). Toxoplasmose em humanos e animais no Brasil: alta prevalência, alta carga de doença e epidemiologia. *Parasitology, 139*(11), 1375-1424.

Governo de Santa Catarina. (2022). *Manual Técnico de Orientações Sobre Manejo da Toxoplasmose*. https://www.saude.sc.gov.br/index.php/informacoes-gerais-documentos/assistencia-farmaceutica/componente-estrategico/toxoplasmose/20313-manual-técnico-de-orientações-sobre-o-manejo-da-toxoplasmose-agosto-de-2022/file

Governo do Estado do Paraná. (2021). *Caderno de atenção ao pré-natal: toxoplasmose*. https://www.saude.pr.gov.br/sites/default/arquivos_restritos/files/documento/2021-02/Caderno % 20 de % 20Atenção % 20 ao % 20 Pre-Natal % 20-% 20Toxoplasmose-R09-2.pdf.

Governo do Estado de Tocantins (2020). *Nota técnica - 4/2020/SES/SVS: Fluxograma estadual para a condução clínica, diagnóstico e tratamento da Toxoplasmose Gestacional*.Governo do Estado de Tocantins.

Hironaka, H.C., & Casanova, L.D. (2003). Concentrações séricas de imunoglobulinas em sangue do funículo umbilical e em sangue materno no momento do parto. *Acta Cirúrgica Brasileira, 18*(2), 159-166. https://doi.org/10.1590/S0102-86502003000200013

Ministério da Saúde [MS]. (2020). *Nota técnica - 14/2020-COSMU/CGCIVI/DAPES/SAPS/MS:fluxograma de diretriz Nacional, para a condução clínica do diagnóstico e tratamento da Toxoplasmose Gestacional e Congênita*.Ministério da Saúde.

Ministério da Saúde [MS]. (2014). *Atenção à saúde do recém-nascido: guia para os profissionais de saúde* (Vol. II).https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/s/saude-da-crianca/publicacoes/atencao-a-saude-do-recem-nascido-guia-para-os-profissionais-de-saude-vol-ii/view

Ministério da Saúde [MS]. (2010). *Doenças infecciosas e parasitárias*. Guia de bolso. Ministério da Saúde.

Neves, D.P. (2016). *Parasitologia Humana*. Atheneu.

Nicácio, D.B., Oliveira, E.Q., Oliveira, L.B., Araújo, V.G.S., & França, A.M.B. (2015). Toxoplasmose, rubéola, citomegalovírus e hepatite: sensibilização na atenção primária durante o pré-natal. *Caderno de Graduação - Ciências Biológicas e da Saúde, 3*(1), 55–68.

Oliveira, L.S., Ferreira, B.C., & Piccinin, A. (2021). Propriedades imunizantes do leite materno e seus benefícios na prevenção de doenças alérgicas. *Revista Multidisciplinar em Saúde, 2*(2), 03. https://doi.org/10.51161/rems/942

Passanha, A., Cervato-Mancuso, A.M., & Silva, M.E.M.P. (2010). Protective elements of breast milk in the prevention of gastrointestinal and respiratory diseases. *Revista Brasileira Crescimento e Desenvolvimento Humano, 20*(2), 351-360.

Pena, L., & Discacciati, M. (2013).Importância do teste de avidez da imunoglobulina G (IgG) anti-Toxoplasma gondii no diagnóstico da toxoplasmose em gestantes. *Revista Instituto Adolfo Lutz, 72*(2), 117-123.

Rey, L. (2013). *Parasitologia: parasitos e doenças parasitárias do homem nos trópicos ocidentais*. Rio de Janeiro, RJ: Guanabara Koogan.

Secretaria da Saúde do Rio Grande do Sul. (2021). *Toxoplasmose congênita: Protocolo elaborado pelo Grupo de Estudos em Toxoplasmose da Secretaria Estadual da Saúde do Rio Grande do Sul – 2021*.https://saude.rs.gov.br/upload/arquivos/202107/06113912-protocolo-toxoplasmose-congenita.pdf

Secretaria de Vigilância em Saúde. (2020) *Protocolo toxoplasmose congênita: diagnóstico e tratamento*. https://saude.rs.gov.br/upload/arquivos/202112/17150850-protocolos-toxo-cong-para-svs-ms-05-02-2020.pdf

Vargas-Villavicencio, J., Cañedo-Solares, I., & Correa, D. (2022). Anti-Toxoplasma gondii IgM Long Persistence: What Are the Underlying Mechanisms? *Microorganisms, 10*(8), 1659. https://doi.org/10.3390/microorganisms10081659

Walcher, D.L., Comparsi, B., & Pedroso, D. (2016). Gestational Toxoplasmosis: a review. *Revista Brasileira de Análises Clínicas, 49*(4), 323-327. https://doi.org/10.21877/2448-3877.201600273

Zeibig, E. (2014). *Parasitologia Clínica: uma abordagem clínico-laboratorial*. Elsevier.

Zhao, X.Y., & Ewald, S. (2020). The molecular biology and immune control of chronic Toxoplasma gondii infection. *Journal of Clinical Investigation, 130*(7), 3370-3380. https://doi.org/10.1172/jci136226