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Article

The Relationship Between Toxoplasma Gondii Infection And Immunological, Hormonal And Antioxidant Parameters In Women Who Have Experienced Abortion

Hajir Zaidan Khalaf*[1]

1. Department of Life Sciences, College of Science, University of Tikrit, Iraq
*Correspondance: hajer.alkhalaf@tu.edu.iq

Abstract: Toxoplasma gondii is an intracellular opportunistic protozoan that is among the most common acute or latent abortifacient zoonoses. The study aimed to measured the level of some immunological, hormonal and oxidative stress parameters in women suffered from abortion. Eighty blood samples were collected from women experiencing miscarriages and twenty samples from healthy women. The diagnosis were carried out by toxoplasma rapid test. The measurement of Interleukins, hormones and antioxidants were carried out by ELISA and Cobas device. The results of T. gondii diagnosis in eighty women after abortion showed that 40% of them were positive for IgG while 23.7% were positive for IgM in rapid diagnosis test . The patients group showed significant high mean level of IL-17A, IL-27, Anti-Mullerian hormone and Prostaglandin (299.5± 51.5, 234.0± 25.8, 8844.5± 490, 1450.0± 75.60pg/ml) compared with healthy group (201.8± 65.9, 160.5± 20.1, 300.3± 33.0, 9.6± 1.2 pg/ml) with ($p<0.001$).The patients group showed significant low mean level of Gpxs and GSH (119.9± 10.1, 3.75± 0.11pg/ml) compared with healthy group (300.3± 33.0, 9.6± 1.2pg/ml) with ($p<0.001$). IgG antibodies were more common than IgM antibodies in women with a history of abortion in this investigation. The increase in blood IL-17A and IL-27 levels suggests an altered immune response linked to these women's inflammatory and immunoregulatory processes. The greater levels of anti-Müllerian hormone (AMH) and prostaglandin and the lower levels of glutathione peroxidase (GPx) and glutathione (GSH) reflect hormonal and inflammatory alterations and a compromised antioxidant defence. These findings suggest that women with abortion histories should be tested for immunological, hormonal, and oxidative stress indicators.

Keywords: Toxoplasma gondii, Interleukins, antioxidants, abortion.

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1. Introduction

Toxoplasma gondii is an intracellular opportunistic protozoan that is among the most common acute or latent abortifacient zoonoses[1].The infective stage of the sporulated oocyst in the soil develops only within the gastrointestinal tract of felines, facilitated by contaminated food or water [2]. The acute tachyzoite phase is accountable for the maternal-fetal transfer. The bradyzoite stage remains viable in dormant tissue as a cyst and can reawaken into latent acute tachyzoites due to significant hormonal changes or corticosteroid treatment during pregnancy, leading to transient gestational hyperglycemia[3].

Females terminated the sequence of T. gondii infection during gestation (either recent or primary infection), mostly exhibiting a dominant IgM titer, or via latent opportunistic mechanisms prompting the re-conversion of bradyzoites to tachyzoites, predominantly characterised by a significant IgG titer [4]. Latent toxoplasmosis poses significant risks, with around 30% of cases including foetal transmission, leading to severe consequences such as abortion and foetal demise, particularly influenced by the gestational stage[5].

Pregnant women who are immune-competent typically have asymptomatic acute infections, but 10% may also exhibit various symptoms, such as fever, headache, flu-like lines, lymphadenopathy, chorioretinitis, and myositis [6].

The control of several intracellular pathogens, including the obligatory intracellular parasite T. gondii, depends on the development of an efficient CD8+ T cell response. While acute T.gondii infection induces both CB4+ and CD8+ T cell responses the CD8+ T cell subset is largely responsible for long-term protection against the parasite[7].

The influence of the Toxoplasma infection on sexual hormones differs. Progesterone, for instance, influences toxoplasmosis differently; it could either aggravate the infection or restrict the parasite's proliferation. Progesterone is synthesised in the ovaries, uterus, and brain, playing a crucial role in numerous bodily activities. Progesterone is distinctive in that it interferes with or halts the regulation of reproduction in cells infected by this parasite[8,9].

The pathogenesis of *T. gondii* is linked with oxidative stress that causes the high production of free radicals and reduction of endogenous antioxidant capacity. It leads to damage of lipids, proteins, and DNA. Malondialdehyde (MDA) is one of the biomarkers of lipid peroxidation and oxidative stress, and it was increased in samples from patients with chronic toxoplasmosis [10]. The reactive carbonyl species are also related to protein peroxidation associated with a alteration of homeostasis caused by oxidative stress [11].

The enzymatic antioxidant defense is one of the mechanisms that protect the host cells against an excess of free radicals during *T. gondii* infection. A decrease in glutathione (GSH) concentration was observed in patients with toxoplasmosis, which suggests changes in the oxidant–antioxidant balance as a mechanism of tissue damage [12]. The study aimed to measured the level of some immunological, hormonal and oxidative stress parameters in women suffered from abortion.

2. Method

Study design

Eighty samples were collected from women experiencing miscarriages who were admitted to government hospitals and some private medical clinics. The women were aged between 18 and 40 years and the collection period was from to June 2026. Also, 20 control samples (non-infected women) were collected.

Sample Collection and Processing

blood samples were collected from women experiencing miscarriages who were suspected of having parasite infection. Five milliliters of venous blood were drawn using a 5-mL syringe, placed in plastic tubes, and allowed to clot at room temperature. The blood was then centrifuged at 3000 rpm for five minutes to separate the serum. Blood was separated, serum was taken, and a rapid test was performed to detect IgG and IgM. The serums were distributed into 3 Eppendorf tubes of 1.5 ml capacity, one sample for hormones, one for immunological markers and on for oxidative stress markers.. The samples were then kept at -20°C until an ELISA test was performed.

Toxoplasma IgG/IgM Antibody Rapid Test

This test uses a pre-prepared kit to detect the presence of specific antibodies against the parasite. The test operates on the principle of capillary action. Two types of antibodies (Ab) specific to the antigen (Ag) are used. One antibody is attached to the chromatographic paper, while the other is bound to colloidal gold. When the sample is added to the slide well, the antigen in the sample forms an immune complex with the antibody called colloidal gold. The resulting immune complex moves with the sample and binds to the antibody, which is attached to the membrane. The complex then forms with the fixed antibody, resulting in the formation of a red line. A red line appearing at the C mark indicates a negative result. Two lines appearing, one at the C mark and the other at the T mark, indicate a positive result.

Measurements of immunological and oxidative stress markers

Mean level of interluekien-17A,IL-27, glutathione peroxidase and glutathione were measured using ELISA (SUNLONG KIT/CHINA) following the instruction of manufacturer.

Measurements of hormones

Mean level of prostaglandin and AMH were measured by using Cobas E411 ROCHE/ Germany device.

Statistical analysis

The data were statistically analyzed using IBM SPSS Version 22 and the t-test was used. The arithmetic means (mean) and standard error means of the patient and healthy samples were compared at a significance level of less than or equal to p.value ≤ 0.05.

3. Results

Diagnosis of *Toxoplasma gondii* infection using the Toxoplasma IgM/IgG Rapid Test

The results of T. gondii diagnosis in eighty women after abortion showed that 40% of them were positive for IgG while 23.7% were positive for IgM in rapid diagnosis test as shown in table(1).

Table 1: Diagnosis of *Toxoplasma gondii* infection using the Toxoplasma IgM/IgG Rapid Test

Toxoplasma gondii	Positive	Negative	Total
IgG	32(40%)	48(60%)	80(100%)
IgM	19(23.7%)	61(76.3%)	80(100%)

Mean level of IL-17A and IL-27 in patients infected with *T. gondii* and control groups

The results in table (2) showed mean level of serum interleukins in toxoplasma patients and healthy groups. The patients group showed significant high mean level of IL-17A and IL-27 (299.5± 51.5, 234.0± 25.8 pg/ml) compared with healthy group (201.8± 65.9, 160.5± 20.1 pg/ml) with (p<0.001).

Table(2): Mean level of IL-17A and IL-27 in patients infected with *T. gondii* and control groups

Groups	IL-17A	IL-27
Patients	299.5± 51.5	234.0± 25.8
Control	201.8± 65.9	160.5± 20.1
P-value	p<0.001	p<0.001

Mean level of AMH and Prostaglandin in patients infected with *T. gondii* and control groups

The results in table (3) showed mean level of serum Anti-Mullerian hormone and Prostaglandin in toxoplasma patients and healthy groups. The patients group showed significant high mean level of Anti-Mullerian hormone and Prostaglandin (8844.5± 490, 1450.0± 75.60pg/ml) compared with healthy group (7989.3± 499, 230.6± 15.2pg/ml) with (p<0.001).

Table(3): Mean level of AMH and Prostaglandin in patients infected with *T. gondii* and control groups

Groups	AMH	Prostaglandin
Patients	8844.5± 490	1450.0± 75.60
Control	7989.3± 499	230.6± 15.2
P-value	p<0.001	p<0.001

Mean level of antioxidants in patients infected with *T. gondii* and control groups

The results in table (4) showed mean level of serum Glutathione and glutathione peroxidase in toxoplasma patients and healthy groups. The patients group showed significant low mean level of Gpxs and GSH (119.9± 10.1, 3.75± 0.11pg/ml) compared with healthy group (300.3± 33.0, 9.6± 1.2pg/ml) with (p<0.001).

Table(4): Mean level of antioxidants in patients infected with *T. gondii* and control groups

Groups	Gpxs	GSH
Patients	119.9± 10.1	3.75± 0.11

Control	300.3± 33.0	9.6± 1.2
P-value	p<0.001	p<0.001

4. Discussion

In the present study, the serological status of *T. gondii* and the changes in inflammatory cytokines, reproductive parameters and antioxidant parameters were determined among women with a history of abortion. The rapid diagnostic test showed 40% (32 women) were anti-T. gondii IgG positive and 23.7% (19 women) were anti-T. gondii IgM positive. The higher prevalence of IgG positivity could be attributed to the presence of past infections since IgG antibodies tend to stay in the blood for a longer time after infection, while IgM might be present at recent infections, but remain in the blood after the acute phase of infection. The findings are similar to those of Baqer et al.[13], who examined Iraqi women who experienced recurrent abortions and found that serological markers for toxoplasmosis were found and that there were significant differences in immune markers between the patient and control groups. Likewise, Alkardhi et al. [14] in their study on 94 women with abortion history in Al-Diwaniyah, found *T. gondii* in 31.9% of the samples using molecular techniques. Saadi and Ahmed [15] in Akre and Karim et al. [16] in Sulaymaniyah found greater IgG antibody levels than IgM antibodies in toxoplasmosis-infected women. This study contradicts Mohammed's [17]findings in Tarmiyah, north of Baghdad, where pregnant women infected with the parasite had lower IgG antibody levels than IgM antibodies.

In regulating parasite spread, the humoral immune response relies heavily on the IgG antibody. It appears one to two weeks after infection, peaks between six and eight weeks, and then declines over one to two years. Long-term presence in the body helps regulate parasite infection and inhibit its spread [18]. Due to their potential to diminish toxoplasmosis stages, IgG and IgM antibodies defend against slow-reproducing bradyzoite and fast-reproducing tachyzoite antigens [19].

IgM and IgG immunoglobulin present alone or together in acute instances. Kota et al., [20] defines chronic cases as IgG immunoglobulin without IgM. The acute phase is the most clinically and diagnostically significant because infected women have the fast-reproducing tachyzoite parasite in their blood. Since only the fast-reproducing stage can spread from an infected pregnant mother to the foetus via the placenta, infected pregnant women must be treated to eliminate the parasite and prevent transmission. Foetus. The inflammatory cytokine results showed that the levels of IL-17A and IL-27 in patients' serum were significantly higher than those in healthy controls. This increase in IL-17A may be a consequence of activation of inflammatory immune pathways in response to parasitic antigens. IL-17A plays a role in attracting neutrophils and in the organization of inflammatory responses, and it can potentially be beneficial to host defence against infection, but overactive or persistent inflammation may also lead to inflammation of tissues and immune imbalance necessary for the successful pregnancy[21]. The results of this study are consistent with those of Baqer et al., [13] who found that women with recurrent abortion had higher levels of IL-17A than healthy women, even in women with toxoplasmosis. They also discovered that there was a considerable increase in IL-27 in women who had recurrent abortion and toxoplasmosis. Both inflammatory and immunoregulatory mechanisms are clearly engaged in the host response to T. gondii as indicated by the present findings and this Iraqi study.

High levels of IL-27 in the current study are of special significance as the cytokine is known to have a dual immunomodulatory effect. The role of IL-27 in promoting early inflammatory responses is seen under conditions of inflammation, however, IL-27 is also known to have an inhibitory effect on excessive inflammation and it is also involved in the regulation of the activity of other cells of the immune system. Hence, an elevation should be considered only as a marker of a pro-inflammatory activity, and not as such. Instead, it could be a regulatory response to the chronic immune stimulation experienced during toxoplasmosis[22]. The interpretation in this study is in line with the study conducted by Jasi et al. [6] which found that the level of IL-27 was higher in Iraqi women with recurrent abortion and toxoplasmosis than in their respective control groups.

Reproductive biomarker analysis revealed significantly higher AMH in the patient as

compared to the control group. The granulosa cells of the growing ovarian follicles are the main producers of AMH, and it is often used as a marker of ovarian reserve. The difference found in the present study can suggest a difference in ovarian or reproductive function between the two groups, but it cannot prove that the other group is indeed more susceptible to AMH increases or to reproductive dysfunction due to toxoplasmosis. The concentrations of AMH may change in the course of age, ovarian physiology, endocrine disorders and other clinical parameters. Furthermore, ovarian reserve is not equivalent to the quality of ooctes or the chances of maintaining a pregnancy[23].

Patients had significantly higher concentrations of prostaglandins in comparison to controls, the result is agreed with the study of Ajmi et al., [24]. Prostaglandins are lipid mediators that participate in inflammation, vascular function and control, uterine activity, and reproduction. The biological actions are determined by the type of prostaglandin being studied, the tissue being studied, and the physiological circumstances. An increase in the present study could be associated with improved inflammatory or reproductive signals in the patient group[25].

In the antioxidant results, there was a significant decrease in glutathione peroxidase (GPx) and reduced glutathione (GSH) in the patient group. GPx is an antioxidant enzyme that is capable of mitigating the effects of hydrogen peroxide and lipid hydroperoxides, and GSH plays a role in the regulation of cellular redox balance and is a substrate for several antioxidant enzymes. Reduced concentrations or activity of these components have been associated with reduced antioxidant capacity or increased consumption under conditions of oxidative stress. The results are consistent with those of karaman et al. [26] who found a significant decrease in GSH and an increase in malondialdehyde (MDA) and nitric oxide in T. gondii-seropositive patients when compared to controls. They also share similar findings with research of seropositive blood donors, which found that GPx activity was reduced and MDA was increased, thus indicating that antioxidant defences are disrupted during toxoplasmosis[27].

The reduction in GPx and GSH as seen in the current study could be due to increased use of antioxidants in the host as it reacts with the parasite producing ROS. Oxidative stress is a state in which the levels of oxidant species are too high to be counteracted by the antioxidant capacity of the organism. ROS are involved in antimicrobial defence, but their overproduction is able to lead to damage of cellular lipids, proteins, and nucleic acids[28]. The relevance of oxidative imbalance in reproductive health lies in the ability to maintain normal reproductive function; however, in the present study, oxidative damage was not directly determined by measuring markers of oxidative damage, and no causal relationships were established between antioxidant depletion and abortion.

5. Conclusion

The present study revealed a considerable prevalence of *Toxoplasma gondii* IgG and IgM antibodies among women with a history of abortion, with IgG positivity exceeding IgM positivity. The observed increase in serum IL-17A and IL-27 levels suggests an altered immune response that may be associated with the inflammatory and immunoregulatory processes observed in these women. In addition, the higher levels of anti-Müllerian hormone (AMH) and prostaglandin, together with the reduced levels of glutathione peroxidase (GPx) and glutathione (GSH), indicate changes in hormonal and inflammatory markers accompanied by a weakened antioxidant defense. These findings highlight the potential importance of evaluating immune, hormonal, and oxidative stress biomarkers in women with a history of abortion.

REFERENCES

[1] M. Farhab, M. W. Aziz, A. Shaukat, M. X. Cao, Z. Hou, S. Y. Huang, L. Li, and Y. G. Yuan, “Review of toxoplasmosis: What we still need to do,” Veterinary Sciences, vol. 12, no. 8, p. 772, Aug. 2025.

[2] E. S. Al-Malki, “Toxoplasmosis: Stages of the protozoan life cycle and risk assessment in humans and animals for an enhanced awareness and an improved socio-economic status,” Saudi Journal of Biological Sciences, vol. 28, no. 1, pp. 962–969, Jan. 2021.

[3] D. Adem and M. Ame, “Toxoplasmosis and its significance in public health: A review,” Journal of Biomedical and

Biological Sciences, vol. 2, no. 1, pp. 1–20, 2023.

[4] M. Deganich, C. Boudreaux, and I. Benmerzouga, "Toxoplasmosis infection during pregnancy," Tropical Medicine and Infectious Disease, vol. 8, no. 1, p. 3, 2023, doi: 10.3390/tropicalmed8010003.

[5] L. Bollani, C. Auriti, C. Achille, F. Garofoli, D. U. De Rose, V. Meroni, G. Salvatori, and C. Tzialla, "Congenital toxoplasmosis: The state of the art," Frontiers in Pediatrics, vol. 10, Art. no. 894573, Jul. 2022.

[6] A. S. Jasim, "The association of interleukin levels with toxoplasmosis in recurrent abortion among Iraqi women," South Asian Research Journal of Biology and Applied Biosciences, vol. 8, no. 3, pp. 338–343, 2026.

[7] M. Sasai and M. Yamamoto, "Innate, adaptive, and cell-autonomous immunity against Toxoplasma gondii infection," Experimental and Molecular Medicine, vol. 51, no. 12, pp. 1–10, Dec. 2019.

[8] J. Ereño-Orbea, T. Sicard, H. Cui, M. T. Mazhab-Jafari, S. Benlekbir, A. Guarné, J. L. Rubinstein, and J. P. Julien, "Molecular basis of human CD22 function and therapeutic targeting," Nature Communications, vol. 8, no. 1, Art. no. 764, 2017.

[9] M. Farhab, T. Sohail, M. Al-Rasheed, Z. Saeed, and A. Shaukat, "Toxoplasma gondii as a direct cause of reproductive dysfunction: Dual threats to male and female fertility," Veterinary Sciences, vol. 13, no. 5, p. 430, Apr. 2026.

[10] K. Szewczyk-Golec, M. Pawłowska, R. Wesołowski, M. Wróblewski, and C. Mila-Kierzenkowska, "Oxidative stress as a possible target in the treatment of toxoplasmosis: Perspectives and ambiguities," International Journal of Molecular Sciences, vol. 22, no. 11, p. 5705, May 2021.

[11] G. C. Dincel and H. T. Atmaca, "Role of oxidative stress in the pathophysiology of Toxoplasma gondii infection," International Journal of Immunopathology and Pharmacology, vol. 29, no. 2, pp. 226–240, Jun. 2016.

[12] M. L. Paraboni, V. Manfredini, G. E. Schreiner, I. L. Gonçalves, C. Silveira, A. G. Commodaro, and R. Belfort Jr., "Comparative study of oxidative stress and antioxidative markers in patients infected with Toxoplasma gondii," Parasitology International, vol. 91, Art. no. 102645, Dec. 2022.

[13] N. N. Baqer, E. J. Saheb, N. S. Ahmed, and N. A. Alhadad, "The association of IL-3, IL-17A, and IL-27 serum levels with susceptibility to toxoplasmosis in recurrent abortion of Iraqi women," Experimental Parasitology, vol. 234, Art. no. 108217, Mar. 2022.

[14] I. K. Alkardhi, H. Masmoudi, H. A. Muhammedand, and H. Sellami, "Epidemiological study with evaluation of molecular and immunological assay for detection of Toxoplasma gondii in aborted women," Cellular and Molecular Biology, vol. 68, no. 4, pp. 122–128, Apr. 2022.

[15] H. M. Saadi and A. J. Ahmed, "Sero-epidemiological study of Toxoplasma gondii among pregnant women in Akre City," Kurdistan Journal of Applied Research, pp. 73–80, Dec. 2020.

[16] D. O. Karim, K. H. Azeez, and Y. S. Abdullah, "Seroprevalence of Toxoplasma gondii among ocular infection patient in Shahid Dr. Aso Hospital in Sulaimani City, Iraq," 2022.

[17] A. A. Mohammed, "Frequency of IgM and IgG antibodies against Toxoplasma gondii, Cytomegalovirus and Rubella virus in serum specimens from aborted women in north Baghdad-Al-Tarmiya region," Al-Kufa University Journal for Biology, vol. 8, no. 3, pp. 138–143, 2016.

[18] M. Sana, M. Rashid, I. Rashid, H. Akbar, J. E. Gomez-Marin, and I. Dimier-Poisson, "Immune response against toxoplasmosis—Some recent updates," International Journal of Immunopathology and Pharmacology, vol. 36, Art. no. 3946320221078436, 2022, doi: 10.1177/03946320221078436.

[19] R. Wesołowski, M. Pawłowska, M. Smoguła, and K. Szewczyk-Golec, "Advances and challenges in diagnostics of toxoplasmosis in HIV-infected patients," Pathogens, vol. 12, no. 1, p. 110, Jan. 2023, doi: 10.3390/pathogens12010110.

[20] A. S. Kota and N. Shabbir, "Congenital toxoplasmosis," in StatPearls [Internet]. Treasure Island, FL, USA: StatPearls Publishing, 2023. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK545228/

[21] A. Sauer, A. W. Pfaff, O. Villard, C. Creuzot-Garcher, F. Dalle, C. Chiquet, H. Pelloux, C. Speeg-Schatz, D. Gaucher, G. Prevost, and T. Bourcier, "Interleukin 17A as an effective target for anti-inflammatory and antiparasitic treatment of toxoplasmic uveitis," The Journal of Infectious Diseases, vol. 206, no. 8, pp. 1319–1329, Oct. 2012.

[22] H. Yoshida and M. Yoshiyuki, "Regulation of immune responses by interleukin-27," Immunological Reviews, vol. 226, no. 1, pp. 234–247, Dec. 2008.

[23] S. Kadhim, S. J. Mushattat, and J. A. ALAridi, "Effect of some immunological markers on the level of anti-

Müllerian hormone (AMH) in women infected with Toxoplasma gondii," Wiadomości Lekarskie, vol. 77, no. 10, pp. 2020–2026, Oct. 2024.

[24] M. H. Ajmi, "Immuno-endocrine and inflammatory modifications in human toxoplasmosis: Diagnostic and predictive value of progesterone and prostaglandin," Muthanna Medical Journal, vol. 13, no. 3, pp. 183–193, 2026.

[25] N. A. Ali and S. K. Al-Hadraawy, "Study of gene expression of the ERK1/2 gene and its relationship to PGE2 levels in the serum of patients with Toxoplasma gondii," Infectious, vol. 2, no. 1, pp. 1–5, Nov. 2025.

[26] U. Karaman, T. Celik, T. R. Kiran, C. Colak, and N. U. Daldal, "Malondialdehyde, glutathione, and nitric oxide levels in Toxoplasma gondii seropositive patients," The Korean Journal of Parasitology, vol. 46, no. 4, p. 293, Dec. 2008.

[27] M. Jafari, M. Salehi, S. Shirbazou, L. Abasian, and F. T. Meymand, "Evaluation of gender-related differences in response to oxidative stress in Toxoplasma gondii-positive serum," pp. 64–69, 2014.

[28] Z. H. A. Nazarlu, M. Matini, M. Bahmanzadeh, and F. Foroughi-Parvar, "Toxoplasma gondii: A possible inducer of oxidative stress in reproductive system of male rats," Iranian Journal of Parasitology, vol. 15, no. 4, p. 521, 2020.