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The Impact of Acute and Chronic Infection with Toxoplasma Gondii on Serum IFN-γ and IL-10 levels among Pregnant Women Attending Al-Rifai Hospital in Rifai City , Dhi Qar

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Abstract

Toxoplasmosis is a zoonotic disease caused by the parasite Toxoplasma gondii. It is widespread worldwide and infects most warm-blooded animals, including humans. The present study included 219 blood samples from pregnant women. ELISA was used to detect toxoplasmosis infections, where IgG and IgM were used to detect chronic and acute infections, respectively. Cytokine levels (IL-10, IFN-γ) were also detected in infected and uninfected pregnant women to determine the extent to which their levels in the blood are affected by acute and chronic infections with the parasite. The results of the study showed that acute toxoplasmosis infection led to a significant increase in the levels of IFN-γ and IL-10 in infected pregnant women compared to uninfected pregnant women. On the other hand, chronic infection with toxoplasmosis led to a significant increase in the level of IL-10 in infected pregnant women compared to uninfected pregnant women, while the increase in the level of IFN-γ was not significant in pregnant women infected with acute toxoplasmosis compared to uninfected pregnant women.

Keywords: Toxoplasmosis, acute infection, chronic infection, IL-10, IFN-γ.

الانترفيرون جاما تأثير الإصابة الحادة والمزمنة بداء المقوسات الغوندية على مستويات والانترلوكين 10 في مصل الدم بين النساء الحوامل المراجعات لمستشفى الرفاعي في مدينة الرفاعي، ذي قار

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الخلاصة

داء المقوسات هو مرض حيواني المنشأ يسببه طفيلي التوكسوبلازما غوندي . و هو منتشر في جميع أنحاء العالم ويصيب معظم الحيوانات ذوات الدم الحار، بما في ذلك البشر. شملت الدراسة الحالية 219 عينة دم من النساء الحوامل. تم استخدام جهاز ELISA للكشف عن الإصابات بداء المقوسات حيث استخدمت كتات IgG و IgM للكشف عن الاصابات المزمنة و الحادة على التوالي كذلك تم الكشف عن مستويات السيتوكينات (IL-10, IFN-γ) عند النساء الحوامل المصابات وغير المصابات لمعرفة مدى تأثر مستوياتها في الدم بالإصابات الحادة والمزمنة بالطفيلي. وقد بينت نتائج الدراسة بان الإصابة بداء المقوسات الحاد ادى إلى ارتفاع معنوي في مستوى IFN-γ و IL-10 في النساء الحوامل المصابات مقارنةً بالنساء الحوامل غير المصابات. من ناحية اخرى ادت الإصابة المزمنة بداء المقوسات إلى ارتفاع معنوي في مستوى IL-10 في النساء الحوامل المصابات مقارنةً بالنساء الحوامل غير المصابات ، بينما لم يكن الارتفاع معنوي في مستوى IFN-γ في النساء الحوامل المصابات بداء المقوسات الحاد مقارنةً بالنساء الحوامل غير المصابات.

الكلمات المفتاحية : داء المقوسات، العدوى الحادة، العدوى المزمنة، انترلوكين 10، انترفيرون غاما.

1. Introduction

During natural infection with the Toxoplasma gondii parasite, after the parasite passes the host's intestinal barrier, dendritic cells are the first cells to confront the parasite [1]. Cytokines are among the essential factors for maintaining innate and adaptive immunity to limit the spread of Toxoplasma gondii infection, as many cytokines are produced when dendritic cells (antigen-presenting cells APCs) as well as B and T cells are activated [2]. Immunity to Toxoplasma gondii begins with multiple types of cellular immune response, such as lymphocytes, monocytes, macrophages, and cytokines [3].Cytokines have an important role in controlling acute and chronic Toxoplasma gondii infection during pregnancy [4].

IL-10 is a major immune cytokine with many uses. It is secreted mainly by macrophages, monocytes, dendritic cells, mast cells, B lymphocytes, helper T cells, as well as CD8T cells. IL-10 is one of the cytokines of the second group, which consists of nine Elements (IL-10, IL-19, IL-20, IL-22, IL-24, IL-26, IL-28, IL-28B, IL-29) based on the location of their coding genes and protein structure [4] [5].It has been found that this cytokine works to prevent the killing of Toxoplasma gondii by human macrophages, and in response to the parasite, it works to suppress cellular immunity and reduce diseases associated with the infection [6].It acts as a primary inhibitor against pro-inflammatory processes, as it is considered an immune-modulating cytokine [7] [8].

Due to the intracellular life cycle of Toxoplasma gondii, the most important factors that contribute to immune responses are cytotoxic T cells and helper T cells that participate in the immune response and the formation of cytokines, the most important of which is IFN-γ [9].Mucosal and systemic cellular resistance is the basis of acquired immune defense against infection with the parasite Toxoplasma gondii, which leads to the production of INF-γ. Stem cells have an important role in cellular resistance to infection through the production of the main cytokine IL-12, which enhances and develops the production of INF-γ [10] [11]. The INF-γ pathway is the first line of defense against Toxoplasma gondii infection in different hosts [12]. IFN-γ helps reduce the parasitic load in the host during infection, as cytokine signals affect the immune system, which leads to preventing the differentiation of Th2 helper T cells, which leads to the activation of macrophages and cytotoxic T cells to enhance phagocytosis and the production of free nitric oxide. All of these measures work to reduce Parasitic load [13].Interferon-gamma has an important role in switching to bradyzoite production during chronic toxoplasmosis, as well as in activating cytotoxic T cells and other cells, which is important for the survival and continuation of the host [14].

The current study aimed to detect the effect of chronic and acute infection on the level of cytokines IFN-γ and IL-10 in pregnant women attending Al-Rifai General Hospital in Al-Rifai city - Dhi Qar.

2. Materials and methods

The current study included 219 blood samples from pregnant women that were collected from July 2023 to December 2023 at Al-Rifai General Hospital - Dhi Qar. About 3 ml of venous blood was drawn from each woman using disposable medical syringes after sterilization The area from which blood was to be drawn. After that, the blood sample was left at room temperature for 10 minutes and then placed in a centrifuge at a speed of 3000 rpm for 10-20 minutes. After that, the serum was placed inside a plastic test tube (Eppendorf)

and then transferred to a cooling device (refrigerator). Deep freezer and store it at -20°C until the required tests are carried out.

The infection with Toxoplasma gondii was detected by ELISA using IgG and IgM antibodies kit to detect chronic and acute infection, respectively. An ELISA device also was used to analyze the study samples to detect levels cytokines (IL-10, IFN-γ) in the serum.

2.1 Study design

After analyzing, samples were divided into three groups:-

1- Non-infected samples (control group)
2- Chronic infected samples
3- Acute infected samples

IL-10, IFN-γ were analyzed for the three groups to reveal the effect of acute and chronic infection on blood cytokines.

2.2 Data analysis

SPSS for windows operating system was used for statistical analysis. Data were analyzed by using T- test.

3. Results

The current study was conducted on 219 samples from pregnant women at Al-Rifai General Hospital - Dhi Qar Governorate, the results of the current study revealed that infection with acute toxoplasmosis led to a significant increase ($p \leq 0.005$) in the level of IL-10, about (89.57±6.9) pg/ml in infected pregnant women comparing to uninfected women (67.15 ±2.7) pg/ml (Figure 1).

The study also showed that the infection with acute toxoplasmosis led to a significant in the level of IFN-γ about (78.5±8.3)pg/ml in pregnant women with acute toxoplasmosis comparing to uninfected women (57.3±4.2) pg/ml (Figure 2).

Relating to chronic infection with toxoplasmosis the study revealed a significant increase in the level of IL-10 (81.97± 7.1) pg/ml in infected pregnant women comparing to uninfected pregnant women (67.15±2.7) pg/ml (Figure 3)

while The results revealed no significant increase in IFN-γ level of IFN-γ about (66.13 ± 3.3) pg/ml in infected women and about (57.3± 4.2) pg/ml in uninfected pregnant women (Figure 4).

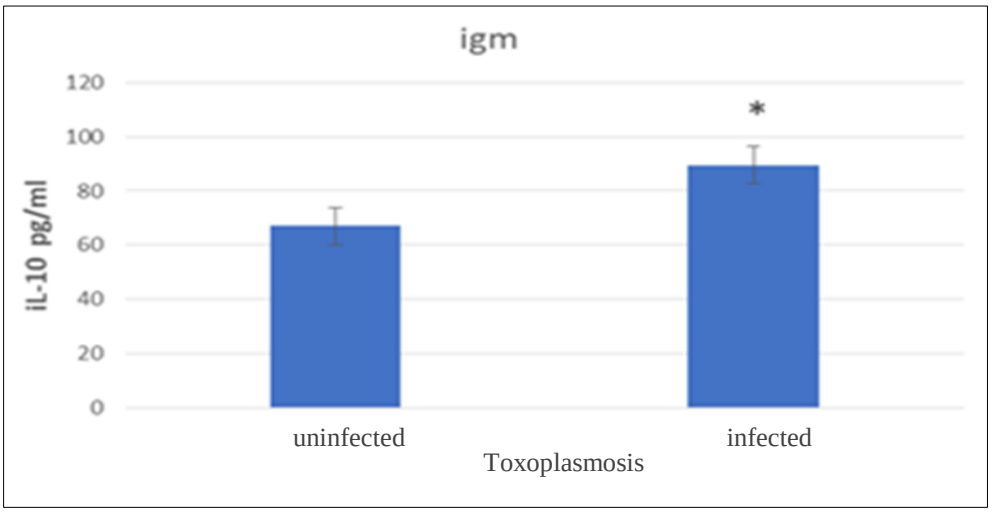

Figure 1- The effect of acute toxoplasmosis on the level of IL-10

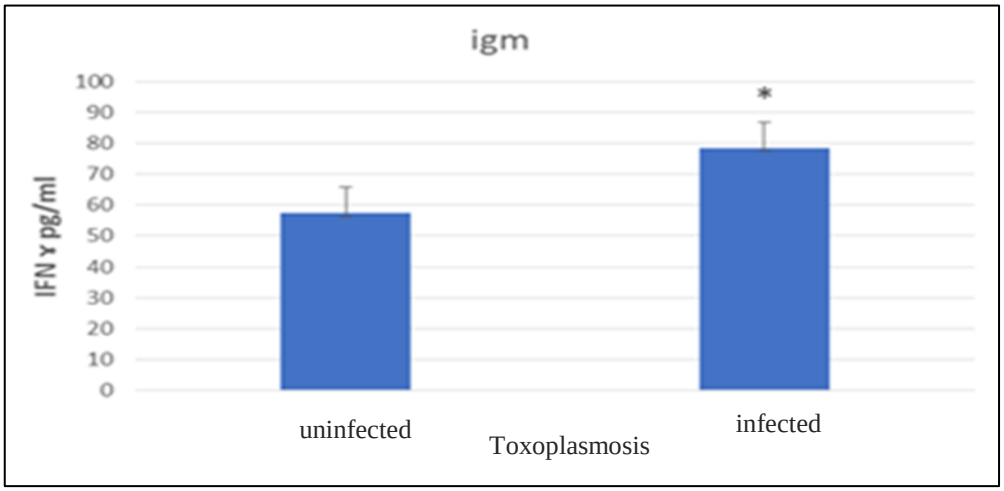

Figure 2- The effect of acute toxoplasmosis on the level of IFN-γ

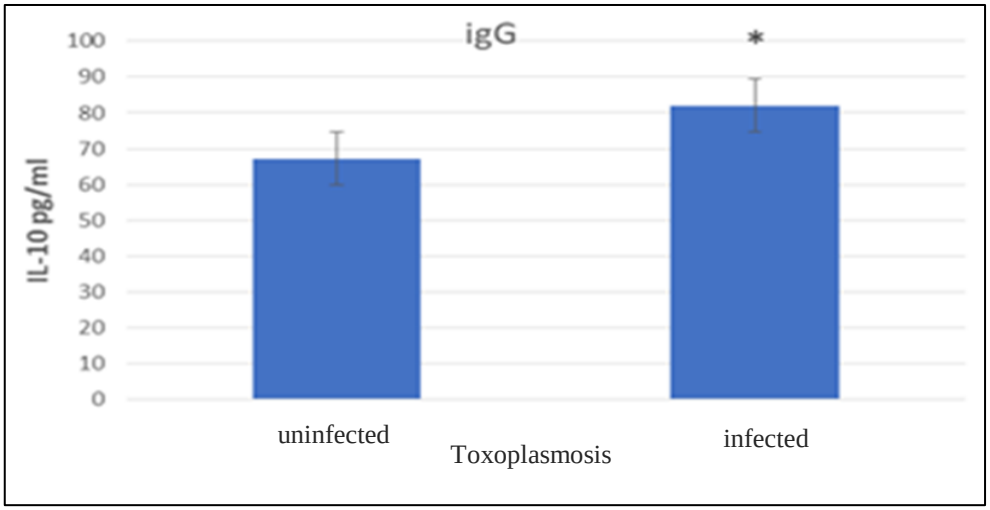

Figure 3- The effect of chronic toxoplasmosis on the level of IL-10

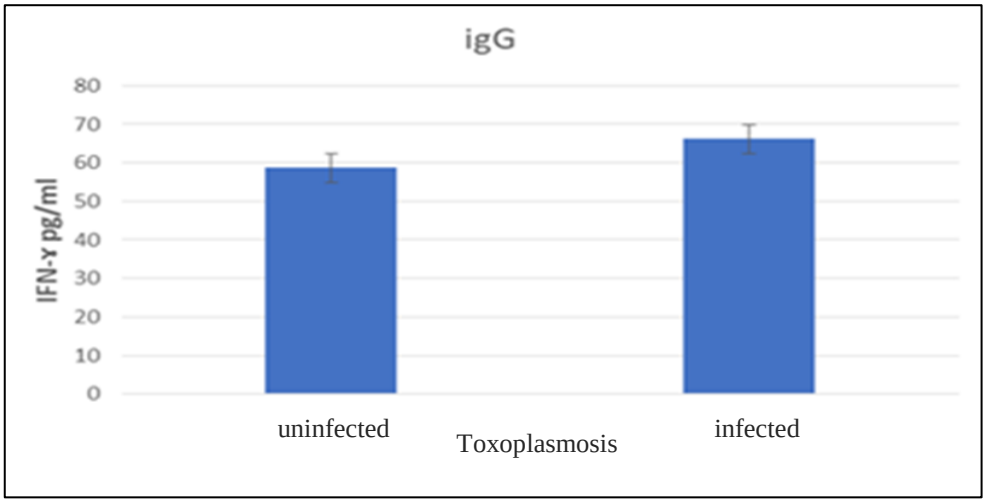

Figure 4- The effect of chronic toxoplasmosis on the level of IFN-γ

4. Discussion

The current study showed that infection with acute and chronic toxoplasmosis led to a significant increase in the level of IL-10. This was evident from the results of the study conducted by the researcher [15] The level of interleukin 10 is 5 times higher in people with acute toxoplasmosis, as it has an important role in the inflammatory response during the acute phase of infection. The results of the current study were different from the results by researcher [16] in Baghdad, which indicated that the level of IL-10 is lower in pregnant women with acute toxoplasmosis compared to uninfected women. Some studies have shown that IL-10 and some other cytokines have an important role in the innate immunity to Toxoplasma gondii and affect the adaptive response, as these cytnokines act as immune modulators during the acute phase of infection [7] [17].

The results of the current study showed that infection with acute toxoplasmosis led to a significant increase in the level of IFNγ. This is similar to what the researcher [18] found in his study that he conducted on pregnant women in Brazil, regarding an increase in the level of IFNγ during the acute phase of the infection, on the one hand, while the results were different from what the researcher found regarding a decrease in the level of IFNγ during the chronic phase of the infection. on the other hand. These results were in agreement with the findings of researcher [19] in Brazil, who indicated in his study that there was a significant increase in IFNγ levels in pregnant women with chronic toxoplasmosis compared to those who were not infected. The reason for this may be due to the important role of interferon-gamma in enhancing the adaptive immune response and controlling parasite replication during chronic infection [20].Interferon-gamma, derived from T cells and natural killer cells, controls the cysts and thus controls chronic Toxoplasma gondii [21]. The results of the current study agreed with the results of the study conducted by [22] in Dhi Qar, which indicated that the level of IFNγ rises during the acute phase of infection, while the current results were different in terms of the level of IFNγ during the chronic phase of infection, as The researcher's study indicated a decrease in the level.

5. Acknowledgment

The authors acknowledge the laboratories and staff of Al-Rifai General Hospital, Dhi Qar, who assisted in obtaining study samples.

6. Competing of interest

There is no competing interest

References

[1] A. F. Poncet, N. Blanchard and S. Marion, "Toxoplasma and dendritic cells: an intimate relationship that deserves further scrutiny," *Trends in parasitology*, vol. 35, no. 11, pp. 870-886, 2019. https://doi.org/10.1016/j.pt.2019.08.001

[2] M. Sana, M. Rashid, I. Rashid, H. Akbar, J. E. Gomez-Marin and I. Dimier-Poisson, "Immune response against toxoplasmosis—some recent updates RH: Toxoplasma gondii immune response," *International journal of immunopathology and pharmacology*, vol. 36, pp. 1-12, 2022. https://doi.org/10.1177/03946320221078436

[3] B. L. Brown, A. N. Berrett, S. D. Gale, L. D. Erickson, E. L. Thacker and D. W. Hedges, "Toxoplasma gondii seropositivity and substance use in US adults," *Folia Parasitologica*, vol. 65, pp. 1-11, 2018. https://scholarsarchive.byu.edu/facpub/5995

[4] M. A. Aldabagh, S. K. Hachim, K. W. Qassim, Q. S. Al-Mayah, J. S. Hassan and D. F. Salloom, "Immune profile in aborted Iraqi women with toxoplasmosis," *Medical Journal of Babylon*, vol. 15, no. 1, pp. 48-52, 2018. https://doi.org/10.4103/MJBL.MJBL_13_18

[5] F. Kheirandish, B. Ezatpour, S. Fallahi, M. J. Tarahi, P. Hosseini, A. K. Rouzbahani and S. Akbari, "Toxoplasma serology status and risk of miscarriage, a case-control study among women with a history of spontaneous abortion," *nternational Journal of Fertility & Sterility*, vol. 13, no. 3, p. 184, 2019. https://doi.org/10.22074%2Fijfs.2019.5740

[6] D. Mukhopadhyay, D. Arranz-Solis and J. P. Saeij, "Influence of the host and parasite strain on the immune response during Toxoplasma infection," *Frontiers in Cellular and Infection Microbiology*, vol. 10, pp. 1-14, 2020. https://doi.org/10.3389/fcimb.2020.580425

[7] K. I. Mohamed, M. S. Khadhum, H. Q. Abu-Al-Ess, S. H. Ali, S. A. Al-Fukhar, W. M. Al-Wattar and J. M. Mousa, "he effect of Toxoplasma gondii on interleukin-8, interleukin- 10, leukotriene B4 and calcium levels in aborted women," *Health Sciences*, vol. 6, no. 11, pp. 76-82, 2017. https://arastirmax.com/en/system/files/dergiler/116856/makaleler/6/11/arastirmax-effect-toxoplasma-gondii-interleukin-8-interleukin-10-leukotriene-b4-and-calcium-levels-aborted-women.pdf

[8] F. Minshawi, S. Lanvermann, E. McKenzie, R. Jeffery, K. Couper, S. Papoutsopoulou and W. Muller, "The generation of an engineered interleukin-10 protein with improved stability and

biological function," *Frontiers in immunology,* vol. 11, pp. 1-16, 2020. https://doi.org/10.3389/fimmu.2020.01794

[9] M. Sasai, A. Pradipta and M. Yamamoto, "Host immune responses to Toxoplasma gondii," *International Immunology,* vol. 30, no. 3, pp. 113-119, 2018. https://doi.org/10.1093/intimm/dxy004

[10] T. S. Lima, L. Gov and M. B. Lodoen, "Evasion of human neutrophil-mediated host defense during Toxoplasma gondii infection," *MBio,* vol. 9, no. 1, pp. 1-12, 2018. https://doi.org/10.1128/mbio.02027-17

[11] A. Safronova, A. Araujo, E. T. Camanzo, T. J. Moon, M. R. Elliott, D. P. Beiting and F. Yarovinsky, "Alarmin S100A11 initiates a chemokine response to the human pathogen Toxoplasma gondii," *Nature immunology,* vol. 20, no. 1, pp. 64-72, 2019. https://doi.org/10.1038/s41590-018-0250-8

[12] T. Tomita, R. B. Guevara, L. M. Shah, A. Y. Afrifa and L. M. Weiss, "Secreted effectors modulating immune responses to Toxoplasma gondii," *Life,* vol. 11, no. 9, pp. 1-20, 2021. https://doi.org/10.3390/life11090988

[13] F. Castro, A. P. Cardoso, R. M. Goncalves, R. K. Serre and M. J. Oliveira, "Interferon-gamma at the crossroads of tumor immune surveillance or evasion," *Frontiers in immunology,* vol. 9, pp. 1-10, 2018. https://doi.org/10.3389/fimmu.2018.00847

[14] J. G. Costa, L. V. Pinto, R. C. de Araujo Baraviera, S. M. Geiger, M. S. Araújo, O. A. Martins-Filho and W. A. Vitor, "Toxoplasma gondii: cytokine responses in mice reinfected with atypical strains," *xperimental Parasitology,* vol. 218, p. 107, 2020. https://doi.org/10.1016/j.exppara.2020.108006

[15] J. Babaie, S. Amiri, R. Homayoun, E. Azimi, R. Mohabati, M. Berizi and M. Golkar, "mmunization of C57BL/6 mice with GRA2 combined with MPL conferred partial immune protection against Toxoplasma gondii," *Iranian Biomedical Journal,* vol. 22, no. 1, p. 22, 2018. https://doi.org/10.22034%2Fibj.22.1.22

[16] A. H. Al-Kuraishi, H. I. Khalil, H. H. Hassan and H. M. Al-Kuraishy, "Placental dysfunction and acute toxoplasmosis: The role of melatonin in relation to inflammatory cytokines Interleukin-10 and Interleukin-12," *Journal of Microscopy and Ultrastructure,* vol. 11, no. 2, pp. 87-91, 2023. https://doi.org/10.4103/jmau.jmau_122_20

[17] A. Sher, K. Tosh and D. Jankovic, "Innate recognition of Toxoplasma gondii in humans involves a mechanism distinct from that utilized by rodents," *Cellular & molecular immunology,* vol. 14, no. 1, pp. 36-42, 2017. https://doi.org/10.1038/cmi.2016.12

[18] A. A. Marchioro, C. M. Colli, C. Z. de Souza, S. S. da Silva, B. T. Tiyo, F. F. Evangelista and A. L. Falavigna-Guilherme, "Analysis of cytokines IFN-γ, TNF-α, TGF-β and nitric oxide in amniotic fluid and serum of pregnant women with toxoplasmosis in southern Brazil," *Cytokine,* vol. 106, pp. 35-39,, 2018. https://doi.org/10.1016/j.cyto.2018.02.023

[19] P. V. Santos, D. N. Toledo, D. M. De Souza, T. P. Menezes, L. O. Perucci, Z. M. Silva and A. Talvani, "The imbalance in the relationship between inflammatory and regulatory cytokines during gestational toxoplasmosis can be harmful to fetuses," *Frontiers in Immunology*, vol. 14, pp. 1-8, 2023. https://doi.org/10.3389/fimmu.2023.1074760

[20] Y. Cai and J. Shen, "Modulation of host immune responses to Toxoplasma gondii by micro RNA s," *Parasite Immunology*, vol. 39, no. 2, p. e12417, 2017. https://doi.org/10.1111/pim.12417

[21] N. Blanchard, I. R. Dunay and D. Schluter, "Persistence of Toxoplasma gondii in the central nervous system: a fine-tuned balance between the parasite, the brain and the immune system," *Parasite immunology*, vol. 37, no. 3, pp. 50-158, 2015. https://doi.org/10.1111/pim.12173

[22] I. Al Aboosi, A. Y. AL-Mulla, Q. R. Lahhob, M. I. Kate, M. H. Ali, M. A. Al khegane and A. A. Jasim, "Toxoplasmosis and Relation with Some Immunological Markers for Aborted Women in Dhi-Qar Province," *Journal of Population Therapeutics and Clinical Pharmacology*, vol. 30, no. 2, pp. 309-316, 2023. https://doi.org/10.47750/jptcp.2023.1111