

Evaluating TLR2, MYD88, Profilin and hematological parameters in human cutaneous leishmaniasis, a case control study

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ABSTRACT

Background: Cutaneous leishmaniasis (CL) is a parasitic disease that affects both skin and systemic immune responses. Innate immunity, particularly Toll-like receptors (TLRs), plays a key role in host defense. Among these, TLR2 and its adaptor MyD88, along with Profilin protein, are believed to contribute to immune activation. However, the immune and hematological alterations associated with CL remain insufficiently understood in local populations. **Objective:** This study aimed to evaluate some immune markers (TLR2, MYD88, and Profilin) and analyze some blood parameters in patients with cutaneous leishmaniasis compared to healthy individuals. **Methodology:** A case-control study was conducted on 90 participants (60 patients, 30 controls) aged 10 to 60 years. Blood samples were collected and analyzed using ELISA to measure immunological markers, and a complete blood count (CBC) was performed to evaluate hematological changes. **Results:** The results showed the presence of hematological changes in patients with cutaneous leishmaniasis, including a slight decrease in white blood cells (7.5 ± 2.5) without the difference being significant. In contrast, a significant decrease ($p \leq 0.05$) was observed in the average number of red blood cells in patients (4.33 ± 0.42 vs. 4.85 ± 0.48) and significant increases in lymphocytes and monocytes (30.81 ± 6.58) and (3.91 ± 2.1), respectively, and granulocytes (71.08 ± 3.06 vs. 63.05 ± 4.73 , $p \leq 0.05$). The immune levels of TLR2 (5.07 ± 0.92 vs. 1.34 ± 0.56 pg/ml), MyD88 (449.67 ± 212.91 vs. 192.44 ± 37.91 pg/ml), and Profilin (95.43 ± 36.30 vs. 61.58 ± 25.84 pg/ml) were significantly elevated in patients ($p \leq 0.05$). **Conclusion:** These results indicate the presence of an inflammatory immune response associated with cutaneous leishmaniasis infection, reflecting the role of the studied immune markers as potential factors in assessing the disease. The study recommends further research to investigate the relationship between these markers and the severity of infection or the effectiveness of treatments.

Keywords: Cutaneous Leishmaniasis, TLR2, MYD88, Profilin, Hematological Parameters.

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INTRODUCTION

Leishmaniasis is a global health problem, spreading in many countries around the world (1). This disease is classified as a neglected disease resulting from more than twenty species of protozoan parasites belong to the genus *Leishmania*. Which are transmitted by infected female phlebotomine sandflies (2). This disease varies in three main forms: Visceral Leishmaniasis (VL), which is the most severe and sometimes fatal form; mucocutaneous leishmaniasis (MCL), which is characterized by disfiguring facial and nasal symptoms and destruction of mucous membranes; and cutaneous leishmaniasis (CL), which causes ulcerated skin lesions (3). CL "is described as." appearance of skin "ulcers in places." the infected fly bite, which are slow to heal.

Lesions initially appear as small red papules, which later develop into painless nodules and finally into distinct ulcers. The incubation period of the parasite ranges from two weeks to eight weeks, and lesions may progress and sometimes persist for three years (4). Upon infection, flagellate promastigotes penetrate the host's skin and are engulfed by the

resident macrophages. Parasite entry into phagocytic vesicles helps them survive enzymatic digestion, where they transform into amastigotes and multiply within the macrophages (5). The host immune response to *Leishmania* infection involves coordinated contributions from innate and adaptive immune responses.

Chemokines and cytokines play a key role in combating infections early on by attracting specific types of white blood cells. These cells play a crucial role in determining the outcome of infection by regulating and transforming the host's immune response against leishmaniasis (6). Adaptive immune cells play a dual role. When infected with leishmaniasis, as they can enhance the immune system to eliminate the parasite, and form a lasting response against reinfection, or symptoms may progress and the ability to cause disease may increase (7) (8).

Innate immunity is the first line of defense against leishmaniasis, followed by the activation of cell-mediated immunity, where innate cells actively contribute to combating infection (9). Macrophages, keratinocytes, and mast cells act at the site of infection as sentinel cells, expressing pattern recognition receptors such as TLRs. They recognize pathogens, which stimulate phagocytosis and activate the innate and acquired immune response through the production of cytokines and chemokines (10). Innate cell receptors recognize parasite surface molecules, which stimulate the activation of intracellular signaling pathways dependent on the adaptor protein MYD88, which in turn contributes to the activation of inflammatory transcription factors such as NF- κ B, thus stimulating the production of inflammatory cytokines and immune-stimulating molecules (11) (12). Reactive oxygen species (ROS) and nitric oxide (NO) are two effective mechanisms in controlling *Leishmania* infection and contribute significantly to shaping the immune response against the parasite (13).

The activation of the host's innate immunity requires precision in the function of MyD88, and any dysregulation or overstimulation can lead to inflammatory syndromes and diseases with serious health implications for the host. Given MyD88's significant role in controlling signaling pathways, it can be considered a target for therapeutic intervention, as its recruitment is a prerequisite for inflammatory signals and pro-inflammatory cytokines (14). Profilin is one of the parasitic proteins that stimulate the immune response by binding to innate immune receptors. It is believed to significantly contribute to the activation process of antigen-presenting cells and contributes to mitotic spindle orientation and cell cycle progression in *Leishmania* parasites (15). Profilin not only functions as a structural protein but also plays a role in controlling vesicle movement within the infected cell, helping the parasite survive and multiply during active infection (16).

In addition to immune markers, parasitic infections have been found to induce significant changes in hematological parameters, particularly those associated with the inflammatory response, such as white blood cells (WBCs), neutrophils, lymphocytes, and monocytes. Evaluating these parameters in conjunction with immune markers may provide a more comprehensive view of the progression and severity of the infection (17).

This study aimed to evaluate some immunological markers (TLR2, MYD88, Profilin) and analyze some hematological parameters in patients with cutaneous leishmaniasis compared to healthy individuals.

METHADODOLOGY

This study was conducted as a case-control study to evaluate some immune factors and hematological parameters in individuals suffering from the disease. cutaneous leishmaniasis Compared to the healthy control group. The study included 90 participants, comprising 60 patients with clinical and laboratory diagnoses of cutaneous leishmaniasis using the direct smear test and 30 healthy controls. The sample size was determined based on the number of eligible participants available during the study period who met the predefined inclusion and exclusion criteria. A formal statistical power analysis was not performed prior to data collection. Participants' ages ranged from 10 to 60 years. Samples were collected from the Dermatology Center in Anbar Governorate, Iraq, between October 2024 and February 2025. Participants were selected based on inclusion criteria that included confirmed cutaneous leishmaniasis and the absence of chronic or immune-mediated diseases. Exclusion criteria included patients who had received anti-leishmanial treatment within the past three months, those receiving immunotherapy or antibiotics, patients with other dermatological conditions, pregnant or lactating women, and individuals with known chronic systemic illnesses (e.g., liver, kidney, or hematological disorders).

Blood Sample Collection

Five ml of peripheral venous blood was collected from each participant. The sample was then divided into two parts: 1 ml was placed in a tube containing EDTA for the complete blood count (CBC), while the remaining 4 ml was placed in a gel tube. The serum was separated from the blood cells using a centrifuge at 3,000 rpm, for 10 minutes. The serum was then carefully, transferred to sterile white tubes and stored at -20°C until immunological analysis.

Complete Blood Count (CBC)

A complete blood count (CBC) test was performed using a Sysmex XP-300 automated blood analyzer (Sysmex, Japan), according to standard procedures for measuring white blood cell counts, the amount of red blood cell counts, and lymphocytes. counts, monocyte counts, and granulocyte counts.

Serum levels of some immune markers were assessed

Serum levels of immune markers (TLR2, MyD88, and Profilin) were analyzed using enzyme-linked immunosorbent assay (ELISA) according to the manufacturer's instructions. Ready-made TLR2 and MyD88 assay kit were purchased from Sunlong, China (Cat. No. EL0065Hu and Cat. No. SL3143Hu, respectively), while a Profilin assay kit was purchased from Elabscience, China (Cat. No. E-EL-H2302).

Statistical Analysis

Data were analyzed using SPSS (version 22), with results expressed as mean $\pm$ standard deviation (SD). To determine significant differences between the group of patients with cutaneous leishmaniasis and the healthy control group, independent-samples t-test was used. Differences were considered statistically significant at a probability level of $p \leq 0.05$.

RESULTS

Distribution of hematological parameters between the two study groups

The study results showed a slight decrease, with no significant differences, in the white blood cell count in infected patients (7.5 ± 2.5) compared to healthy controls (8.1 ± 1.6). The study also showed a significant decrease in the mean ($p \leq 0.05$) red blood cell count in infected patients (4.33 ± 0.42) compared to healthy controls (4.85 ± 0.48). There was Increase in the level of lymphocytes, and monocytes in infected” patients (30.81 ± 6.58) and (3.91 ± 2.1), respectively, compared to healthy controls (25.5 ± 2.1) and (0.58 ± 0.19), respectively. The results also showed a significant increase in the percentage. granulocytes in infected patients (71.08 ± 3.06) compared to the control group (63.05 ± 4.73), and the difference was significant at $p \leq 0.05$, as shown in Table 1.

TABLE (1): DISTRIBUTION OF BLOOD VARIABLES BETWEEN INFECTED PATIENTS AND HEALTHY CONTROL

Groups		Mean $\pm$ SD	P-value
WBC $10^3/\mu\text{L}$	Patients	7.5 ± 2.5	$p \geq 0.05$
	Control	8.1 ± 1.6	
RBC $10^6/\mu\text{L}$	Patients	4.33 ± 0.42	$p \leq 0.05$
	Control	4.85 ± 0.48	
Lymphocytes $10^3/\mu\text{L}$	Patients	30.81 ± 6.58	$p \leq 0.05$
	Control	25.5 ± 2.1	
Monocytes $10^3/\mu\text{L}$	Patients	3.91 ± 2.1	$p \leq 0.05$
	Control	0.58 ± 0.19	
Granuloa $10^3/\mu\text{L}$	Patients	71.08 ± 3.06	$p \leq 0.05$
	Control	63.05 ± 4.73	

Note. Differences were considered statistically significant at $p \leq 0.05$.

The results were consistent with the research of (18), as their results showed a decrease in the level of total white blood cells compared to the control group, and there was a significant increase in the average lymphocytes and neutrophils, as well as an increase in monocytes. The results were consistent with (19), as their research results showed a decrease in the number of white blood particles with an increase in lymphocytes, and monocytes in infected individuals. However, our results did not agree with what they recorded regarding a significant increase in red blood cells. The results were also consistent with what was reached by (20), as the data indicated a decrease in the rate of red blood cells with a significant increase in lymphocytes and neutrophils in infected individuals compared to healthy individuals. The reason may be related to the possibility that these cells have a short lifespan, in addition to the fact that red blood cells become more fragile as the infection progresses.

Lymphocytes, particularly CD4⁺ Th1 helper T cells, are essential in activating the cellular immune response against *Leishmania*. These cells secrete cytokines such as IFN- γ and IL-2, which stimulate macrophages to kill intracellular parasites. Studies indicate that patients with cutaneous leishmaniasis exhibit a robust cellular immune response, with increased production of these cytokines, enhancing the ability of macrophages to eliminate the parasite (21).

Neutrophils are among the first innate immune cells to arrive at the site of infection. These cells phagocytosis the parasite and release reactive oxygen species (ROS). Neutrophils also secrete cytokines and chemokines such as CXCL8 and CXCL9, which promote the recruitment of Th1 T cells, enhancing the adaptive immune response. The results of the study (22) also indicated a significant increase in the number of lymphocytes and an increase in granulocytes and monocytes, which helps in the phagocytosis of the parasite" and transform into macrophages or dendritic cells that present antigens to T cells, contributing to the activation of the adaptive immune response and secreting Inflammatory cytokines such as I L-1 β , "which enhance the local immune response (23).

Distribution of results of TLR2, MyD88 and Profilin parameters between the two study groups

The results of the current study showed statistically significant differences ($p \leq 0.05$) between patients and controls for the immune proteins TLR2, MyD88, and Profilin. The studied proteins recorded higher levels in patients (5.07 ± 0.92), (449.67 ± 212.91), and (95.43 ± 36.30), respectively, compared to healthy controls (1.34 ± 0.56), (192.44 ± 37.91), and (61.58 ± 25.84), respectively, as shown in Table 2.

TABLE (2): CONCENTRATION OF IMMUNE PROTEINS (TLR2, MYD88 AND PROFILIN) IN INFECTED PATIENTS AND HEALTHY CONTROL

Groups		Mean $\pm$ SD	P-value
TLR2 Pg/ml	Patients	5.07 ± 0.92	$p \leq 0.05$
	Control	1.34 ± 0.56	
MyD88 Pg/ml	Patients	449.67 ± 212.91	$p \leq 0.05$
	Control	192.44 ± 37.91	
Profilin Pg/ml	Patients	95.43 ± 36.30	$p \leq 0.05$
	Control	61.58 ± 25.84	

Note. Differences were considered statistically significant at $P \leq 0.05$.

DISCUSSION

The results of this study showed a significant increase in TLR2 levels in the serum of patients with cutaneous leishmaniasis compared to those without. These findings are supported by previous studies, such as (24), which showed elevated TLR2 expression in skin biopsies from patients with American cutaneous leishmaniasis, particularly in macrophages, without a clear correlation between this expression and local cytokine levels. Therefore, the difference between local and systemic expression may be attributed to a discrepancy in the nature of the immune response in the blood compared with that in tissues. The results are consistent with those reported in (25).

An increase in TLR2 expression has been observed in patients with cutaneous leishmaniasis after infection with *L. braziliensis*, which strengthens the potential role of this receptor in activating the innate immune response against the parasite. The results are in agreement with the study (26) that evaluated the gene expression and membrane protein expression of TLR2 in peripheral blood-derived macrophages in patients with *Leishmania major*. It was found that patients with the curable form of the lesion showed higher expression of TLR2 compared to patients with non-curable lesions. They explained that the increased level of TLR2 may be associated with a more effective immune response against the parasite.

However, the results of our study partially differ from the findings of the study (27). Studies using TLR2 antagonists have shown that neutralizing these receptors results in a reduction in the number of parasites and infected cells, as well as a decrease in the levels of some inflammatory cytokines. This reflects the dual role of TLR2: it contributes to immune defense in the early stages of infection, while it may be involved in promoting chronic inflammation in later stages. Accordingly, regulating the TLR2 response, rather than completely inhibiting it, may represent a more effective approach to controlling infection and reducing tissue damage in cutaneous leishmaniasis.

The results of the current study showed a significant increase in MyD88 protein levels in the serum of leishmaniasis patients. These results are consistent with previous research that confirmed the pivotal role of MyD88 in developing an effective Th1 immune response against *Leishmania* parasites. The study (28) showed that the absence of MyD88-dependent signaling pathways led to a shift in the immune response toward the non-protective Th2 type, as levels of IL-4 and IL-13 increased, confirming the direct stimulatory role of MyD88 in the production of IL-12, which is necessary for protective Th1 immunity. The study also demonstrated that genetically modified IL12AB^{-/-} mice, which lack IL-12 production, were more susceptible to leishmaniasis infection, supporting the hypothesis that protection against infection depends on innate immune pathways linked to MyD88. This is consistent with (29).

A study (30) showed that mice lacking the MyD88 protein developed advanced skin lesions that persisted for a long time without improvement, compared to normal mice, which demonstrated the ability to control the infection and gradually recover within a few weeks. A noticeable increase in the number of parasites was also observed, in the lymph nodes of MyD88-deficient mice, reflecting the immune system's weak ability to combat the parasite in the absence of this protein. The study attributed this deficiency to a failure to activate Toll-like pathways, particularly TLR2, due to the ineffective recognition of parasite surface molecules such as LPG. The results also indicated that activation of these pathways requires the presence of MyD88, which in turn contributes to stimulating the production of IL-12, necessary for the Th1 defensive response.

As for the profilin protein, the current study showed a significant increase in its average concentration in the serum of infected people compared to the control group. The results were consistent with what was indicated in the research (31), which explained that the profilin protein plays an important role in stimulating an immune response by activating TLR11 and TLR12 receptors, leading to the secretion of inflammatory cytokines such as IL-12. Another study conducted by (32) showed that the increase in profilin expression contributes to stimulating innate immunity by enhancing the response of dendritic cells, which boosts the immune system's ability to resist intracellular parasites.

Toll-like receptors (TLRs) are among the most important pattern recognition receptors, playing a pivotal role. These receptors are found on the surface or inside some immune cells and are characterized by their ability to recognize pathogens and detect danger signals (33). When these receptors are activated, the signal transducing protein MyD88 is recruited, which transmits the signal inside the cell and leads to the activation of gene expression of inflammatory cytokines to generate a rapid and effective immune response against *Leishmania* parasites (34). On the other hand, Profilin is one of the cytoplasmic proteins associated with the parasite's cytoskeleton.

It has been shown to play a role in stimulating innate immunity through its binding to TLR2 receptors (35). *Leishmania* parasites express a single profilin protein (LdPfn), which plays an important role in regulating intracellular actin dynamics, i.e., cytoskeleton organization. During active infection, the demand for this protein increases within the parasite to enhance its ability to move, replicate, and survive within the host. This increase may result in overexpression or partial secretion of profilin outside the cell, either through active secretion or as a result of lysis of infected cells, leading to its detection in the serum of infected individuals. This highlights the potential for using profilin as a biomarker to reflect the severity of infection and parasite activity in the body (36).

This study has some limitations, including a small sample size, recruitment from a single geographic area, and the case-control design, which does not allow direct causal inference, as well as potential influence from uncontrolled factors such as nutritional status or prior treatments.

An important clinical implication of the present findings is that they may assist clinicians in monitoring and managing patients with cutaneous leishmaniasis. TLR2, MyD88, and Profilin levels could serve as potential biomarkers for disease activity or treatment response, while providing insight into innate immune mechanisms for future therapeutic strategies.

CONCLUSIONS

The results of this study demonstrated that cutaneous leishmaniasis infection significantly affects some hematological and immunological parameters in patients. These findings contribute to enhancing the immunological and physiological understanding of the disease and highlight the role of these markers as potential factors in diagnosing or monitoring the disease. We recommend conducting larger-scale future studies to confirm these findings and examine the relationship between these markers and the severity of infection or patients' responses to treatment.

ETHICAL APPROVAL

The study was approved by the Scientific and Ethical Committee of the College of Medicine, University of Anbar (Approval No. 276, Date: 26/12/2024). Informed consent was obtained from all adult participants and from parents or legal guardians for participants under 18 years of age. Patient confidentiality was maintained, and the study was conducted in accordance with the Declaration of Helsinki.

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REFERENCES

1. Flaih MH. Geographical distribution of cutaneous leishmaniasis and pathogenesis. In: Calderon LdA, editor. *Leishmaniasis: General Aspects of a Stigmatized Disease*. London: IntechOpen; 2022.
2. Cosma C, Maia C, Khan N, Infantino M, Del Riccio M. Leishmaniasis in humans and animals: A one health approach for surveillance, prevention and control in a changing world. *Tropical Medicine and Infectious Disease*. 2024 Nov 1;9(11):258. doi:10.3390/tropicalmed9110258.
3. Rout M, Nisad F, Das JK, Mohapatra SR, Hota A, Sahoo PK. Pathology and emerging treatment of leishmaniasis: The India scenario. *Preprints*. 2025 Mar 11;2025030878. doi:10.20944/preprints202503.0878.v1
4. Sundar S, Singh J, Singh VK, Agrawal N, Kumar R. Current and emerging therapies for the treatment of leishmaniasis. *Expert Opinion on Orphan Drugs*. 2024;12(1):19–32. doi:10.1080/21678707.2024.2335248
5. Valigurová A, Kolářová I. Unrevealing the mystery of latent leishmaniasis: what cells can host *Leishmania*? *Pathogens*. 2023 Feb 3;12(2):246. doi:10.3390/pathogens12020246
6. Dubie T, Mohammed Y. Review on the role of host immune response in protection and immunopathogenesis during cutaneous leishmaniasis infection. *Journal of Immunology Research*. 2020 Jul 17;2020:2496713. doi:10.1155/2020/2496713
7. Bamigbola IE, Ali S. Paradoxical immune response in leishmaniasis: The role of toll-like receptors in disease progression. *Parasite Immunology*. 2022 May; 44(5):e12910. doi:10.1111/pim.12910
8. Jafarzadeh A, Nemati M, Sharifi I, Nair A, Shukla D, Chauhan P, Saha B. *Leishmania* species-dependent functional duality of toll-like receptor 2. *IUBMB Life*. 2019 Nov; 71(11):1685–700. doi:10.1002/iub.2120

9. Kawai T, Akira S. Toll-like receptors and their crosstalk with other innate receptors in infection and immunity. *Immunity*. 2011 May 27;34(5):637–50. doi:10.1016/j.immuni.2011.05.006
10. Pacheco-Fernandez T, Volpedo G, Verma C, Satoskar AR. Understanding the immune responses involved in mediating protection or immunopathology during leishmaniasis. *Biochemical Society Transactions*. 2021 Feb 26;49(1):297–311. doi:10.1042/BST20200827
11. Saini I, Joshi J, Kaur S. Unwelcome prevalence of leishmaniasis with several other infectious diseases. *International Immunopharmacology*. 2022 Sep;110:109059. doi:10.1016/j.intimp.2022.109059
12. Chen L, Zheng L, Chen P, Liang G. Myeloid differentiation primary response protein 88 (MyD88): the central hub of TLR/IL-1R signaling. *Journal of Medicinal Chemistry*. 2020 Dec 10;63(22):13316–29. doi:10.1021/acs.jmedchem.0c00888
13. Matheoud D, Moradin N, Bellemare-Pelletier A, Shio MT, Hong WJ, Olivier M, Descoteaux A. Leishmania evades host immunity by inhibiting antigen cross-presentation through direct cleavage of the SNARE VAMP8. *Cell Host & Microbe*. 2013 Jul 17;14(1):15–25. doi:10.1016/j.chom.2013.06.003
14. Saikh KU. MyD88 and beyond: a perspective on MyD88-targeted therapeutic approach for modulation of host immunity. *Immunologic Research*. 2021 Apr;69(2):117–28. doi:10.1007/s12026-021-09188-0
15. Vizcaíno-Castillo A, Kotila T, Kogan K, Yanase R, Como J, Antenucci L, Lappalainen P. Leishmania profilin interacts with actin through an unusual structural mechanism to control cytoskeletal dynamics in parasites. *Journal of Biological Chemistry*. 2024;300(3):103000. doi:10.1016/j.jbc.2024.103000
16. Ambaru B, Gopalsamy A, Tammana TS, Subramanya HS, Gupta CM. Actin sequestering protein, profilin, regulates intracellular vesicle transport in Leishmania. *Molecular and Biochemical Parasitology*. 2020 Jul;238:111280. doi:10.1016/j.molbiopara.2020.111280
17. Shiferaw E, Murad F, Tigabie M, Abebaw M, Alemu T, Abate S, Tajebe F. Hematological profiles of visceral leishmaniasis patients before and after treatment of anti-leishmanial drugs at University of Gondar Hospital. *BMC Infectious Diseases*. 2021 Dec 6;21(1):1224. doi:10.1186/s12879-021-06927-4
18. Oleiwi AH, Munshad FA, Salman AN. Counting of total and differential white blood cells in cutaneous leishmaniasis patients in Nassiryha City, Thi-Qar Province. *University of Thi-Qar Journal*. 2019;14(4):47–54.
19. Al-Hoot A, Taha SA. Effect of cutaneous leishmaniasis on some haematological and immunological parameters in patients from areas of North Baghdad/Iraq. *Bulletin of Faculty of Science, Zagazig University*. 2017;2017(1):354–66.
20. Al-Abodi HR. Detection of immune response cells, blood indicators, and enzymatic antioxidants in individuals with cutaneous leishmaniasis. *International Journal of Advanced Research*. 2023 Oct;11(10):852–61. doi:10.21474/IJAR01/17748
21. Costa-Madeira JC, Trindade GB, Almeida PHP, Silva JS, Carregaro V. T lymphocyte exhaustion during human and experimental visceral leishmaniasis. *Frontiers in Immunology*. 2022 May 2;13:835711. doi:10.3389/fimmu.2022.835711
22. Ma M, Yahia DA, Ibrahim MH. Evaluation of hematological findings among patients with cutaneous leishmaniasis. *Pakistan Journal of Medical & Health Sciences*. 2020 Jan–Mar;14(1):614–6.
23. Vellozo NS, Rigoni TS, Lopes MF. New therapeutic tools to shape monocyte functional phenotypes in leishmaniasis. *Frontiers in Immunology*. 2021 Jun 25;12:704429. doi:10.3389/fimmu.2021.704429
24. Tuon FF, Fernandes ER, Duarte MI, Amato VS. Expression of TLR2 and TLR4 in lesions of patients with tegumentary American leishmaniasis. *Revista do Instituto de Medicina Tropical de São Paulo*. 2012 May–Jun;54(3):159–63. doi:10.1590/s0036-46652012000300008
25. Carneiro PP, Dórea AS, Oliveira WN, Guimarães LH, Brodskyn C, Carvalho EM, Bacellar O. Blockade of TLR2 and TLR4 attenuates inflammatory response and parasite load in cutaneous leishmaniasis. *Frontiers in Immunology*. 2021 Oct 6;12:706510. doi:10.3389/fimmu.2021.706510
26. Tolouei S, Hejazi SH, Ghaedi K, Khamesipour A, Hasheminia SJ. TLR2 and TLR4 in cutaneous leishmaniasis caused by Leishmania major. *Scandinavian Journal of Immunology*. 2013 Nov;78(5):478–84. doi:10.1111/sji.12106

27. Gatto M, de Abreu MM, Tasca KI, de Assis Golim M, da Silva LDM, Simão JC, Calvi SA. The involvement of TLR2 and TLR4 in cytokine and nitric oxide production in visceral leishmaniasis patients before and after treatment. *PLoS ONE*. 2015 Feb 13;10(2):e0117977. doi:10.1371/journal.pone.0117977
28. Ives A, Masina S, Castiglioni P, Prével F, Revaz-Breton M, Hartley MA, Launois P, Fasel N, Ronet C. MyD88 and TLR9 dependent immune responses mediate resistance to *Leishmania guyanensis* infections, irrespective of *Leishmania* RNA virus burden. *PLoS ONE*. 2014 May 6;9(5):e96766. doi:10.1371/journal.pone.0096766
29. Muraille E, De Trez C, Brait M, De Baetselier P, Leo O, Carlier Y. Genetically resistant mice lacking MyD88-adaptor protein display a high susceptibility to *Leishmania major* infection. *Journal of Immunology*. 2003 Apr 15;170(8):4237–41. doi:10.4049/jimmunol.170.8.4237.
30. de Veer MJ, Curtis JM, Baldwin TM, DiDonato JA, Sexton A, McConville MJ, Handman E, Schofield L. MyD88 is essential for clearance of *Leishmania major*: possible role for lipophosphoglycan and Toll-like receptor 2 signaling. *European Journal of Immunology*. 2003 Oct;33(10):2822–31. doi:10.1002/eji.200324102
31. Lauw FN, Caffrey DR, Golenbock DT. Of mice and man: TLR11 (finally) finds profilin. *Trends in Immunology*. 2005 Oct;26(10):509–11. doi:10.1016/j.it.2005.08.006
32. Hunter CA, Sher A. Innate immunity to parasitic infections. In: Kaufmann SHE, Rouse BT, Sacks DL, editors. *The Immune Response to Infection*. Washington (DC): ASM Press; 2010. p. 225–36.
33. * Marks KE, Cho K, Stickling C, Reynolds JM. Toll-like receptor 2 in autoimmune inflammation. *Immune Network*. 2021 Jun 25;21(3):e18. doi:10.4110/in.2021.21.e18
34. Satoh T, Akira S. Toll-like receptor signaling and its inducible proteins. *Microbiology Spectrum*. 2016 Dec 9;4(6):10.1128/microbiolspec.mchd-0040-2016. doi:10.1128/microbiolspec.mchd-0040-2016
35. Park MK, Park HK, Yu HS. The recombinant profilin from free-living amoebae induced allergic immune responses via TLR2. *Journal of Inflammation Research*. 2024 May 14;17:2915–25. doi:10.2147/JIR.S459972
36. Ambaru B, Gangadharan GM, Subramanya HS, Gupta CM. Profilin is involved in G1 to S phase progression and mitotic spindle orientation during *Leishmania donovani* cell division cycle. *PLoS ONE*. 2022 Mar 22;17(3):e0265692. doi:10.1371/journal.pone.0265692.

تقييم TLR2 و MYD88 و Profilin والمعلّمت الدموية في داء الليشمانيات الجلدي البشري،

دراسة حالة وشاهد

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الخلاصة

خلفية عن الموضوع: داء الليشمانيات الجلدي (CL) مرض طفيلي يؤثر على كل من الاستجابات المناعية الجلدية والجهازية. تلعب المناعة الفطرية، وخاصةً مستقبلات الشبيهة بالتول (TLRs)، دورًا رئيسيًا في الدفاع المناعي للجسم وبشكل خاص TLR2 الى جانب محول الإشارة MyD88، وبروتين بروفيلين، اللذان يساهمان في تنشيط المناعة ومع ذلك، لا تزال التغيرات المناعية والدموية المرتبطة بداء الليشمانيات الجلدي غير مفهومة بشكل كافٍ لدى السكان المحليين. **الهدف من الدراسة:** هدفت هذه الدراسة إلى تقييم بعض المؤشرات المناعية (TLR2، MYD88، Profilin) وتحليل بعض معلّمت الدم في مرضى مصابين بداء الليشمانيات الجلدية، مقارنةً بأشخاص أصحاء. **المواد وطرق العمل:** أجريت دراسة حالة-شاهد على 90 مشاركًا (60 مريضًا و30 شخصًا سليمًا) تراوحت أعمارهم بين 10 إلى 60 سنة. تم جمع عينات الدم وتحليلها باستخدام تقنية ELISA لقياس المؤشرات المناعية، بالإضافة إلى إجراء تعداد دم كامل (CBC). **النتائج:** أظهرت النتائج وجود تغيرات دموية لدى مرضى داء الليشمانيات الجلدي، بما في ذلك انخفاض طفيف في خلايا الدم البيضاء (7.5 ± 2.5) مقارنةً بالأصحاء (8.1 ± 1.6) دون أن يكون الفرق ذا دلالة إحصائية. في المقابل، لوحظ انخفاض كبير ($P < 0.05$) في متوسط عدد خلايا الدم الحمراء لدى المرضى (4.33 ± 0.42) مقابل (4.85 ± 0.48) وزيادة كبيرة في الخلايا الليمفاوية والوحيدات (30.81 ± 6.58) و(3.91 ± 2.1) على التوالي، والخلايا المحببة (71.08 ± 3.06) مقابل (63.05 ± 4.73) عند ($P < 0.001$) أما بالنسبة للمستويات المناعية سجل TLR2 (5.07 ± 0.92) مقابل (1.34 ± 0.56) Pg/ml، وسجل MyD88 (449.67 ± 121.91) مقابل (192.44 ± 37.91) Pg/ml، والبروفيلين (95.43 ± 36.30) مقابل (61.58 ± 25.84) Pg/ml في المجموعة الضابطة عند $P < 0.0001$. **الاستنتاجات:** تشير هذه النتائج إلى وجود استجابة مناعية التهابية مصاحبة للإصابة بالليشمانيات الجلدية، مما يعكس دور المؤشرات المناعية المدروسة كعوامل محتملة في تقييم الحالة المرضية. توصي الدراسة بإجراء بحوث إضافية لدراسة العلاقة بين هذه المؤشرات وشدة الإصابة أو فعالية العلاجات.

الكلمات المفتاحية: داء الليشمانيات الجلدي، TLR2، MYD88، بروفيلين، معايير الدم.