المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 – 8441 – ISSN (PRINT): 1858 - 845X

(29)

Assessment of Platelet Clot Retraction Function in Patients with Plasmodium falciparum Malaria

A Cross-Sectional Comparative Study in Gezira State, Sudan

Wala Eldin Osman Elradi
Department of Hematology & Immunohematology,
Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum, Sudan.
Email: mamoma125elradi@gmail.com

Rabeaa El-Jaily Abdalla Mustafa,
Department of Hematology & Immunohematology,
Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum, Sudan

Elharam Ibrahim Abdallah,
Department of Hematology & Immunohematology,
Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum, Sudan

Maye M. Merghani,
Department of Hematology & Immunohematology,
Medical Laboratory Sciences Program, Al-Nahda College, Khartoum, Sudan

Mohamed Mobarak Elbasheir,
Department of Parasitology & Medical Entomology,
Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum, Sudan

Mohamed M. Babeker,
Omdurman Ahlia University, Department of Haematology, Sudan

Ahmed Siddig Akasha Hassan,
Department of Hematology and Blood Bank, Faculty of Medical Laboratory Sciences, Riyadh International College, Khartoum, Sudan

2026

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

Abstract

Malaria is one of the major causes of disease for people living in tropical and subtropical areas, particularly in Sudan. Infection with malaria may result in a wide variety of complications such as hematological abnormalities. Although thrombocytopenia is well established complication of *Plasmodium* infection, data regarding the effect of malaria on qualitative platelet function remain limited. **Aim of the study:** The current study aimed to assess platelet clot retraction function in patients infected with *Plasmodium falciparum* malaria compared to healthy controls. **Materials and Methods:** A cross-sectional comparative study was conducted in Wad Al-Nora, Gezira State between October 2024 and February 2025. Venous blood samples were collected from 50 confirmed *Plasmodium falciparum* malaria-infected patients and 20 apparently healthy, age- and sex-matched controls. Assessment of platelets function was simply done using manual clot retraction test. Data were analyzed with the Chi-square test using SPSS (version 22.0), with statistical significance set at $p<0.05$. **Results:** Among 50 malaria patients, 32 (64%) showed normal clot retraction, 12 (24%) showed poor retraction, and 6 (12%) showed no retraction. All 20 controls (100%) showed normal clot retraction. The difference between the groups was statistically significant ($p = 0.002$). **Conclusion:** Infection with *Plasmodium falciparum* malaria is significantly associated with impaired platelet clot retraction function. These findings suggest that platelet dysfunction, beside reduction (thrombocytopenia), may play a role in the pathogenesis of malaria-related hemostatic complications.

Key words: Malaria, platelets function test, clot retraction, P. falciparum, Sudan

1. Introduction

Malaria continues to be a major parasitic cause of morbidity and mortality globally. An obligate intracellular protozoon of *Plasmodium spp.*, using the mosquito as its vector, spread through the tropical and subtropical world. While four primary species infect humans, *P. falciparum*, *P. vivax*, *P. malariae*, and *P. ovale*, with *P. falciparum* causes the most severe and life-threatening cases [1, 2, 3].

Malaria can lead to illnesses that range from mild to severe, sometimes causing serious damage to vital organs. One of the main symptoms of malaria is a sudden, intense fever that can last up to ten hours. The classic pattern of fever is either quartan, which occurs every 72 hours, or tertian, which happens every 48 hours. This pattern is related to the

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

life cycle of the parasite, specifically when the merozoites, which are the infectious forms of Plasmodium, burst out of red blood cells during the asexual stage of the infection. These episodes of fever often start with a sudden feeling of coldness, known as chills, which usually last for about an hour before transitioning into heavy sweating, high fever, headache, feelings of general discomfort, muscle pain, and then a gradual decrease in body temperature [2, 3].

Accumulated evidence suggests that the role of platelets in malaria is complex, and in particular, that platelets can impact malaria pathogenesis through a number of different mechanisms. Previous postmortem studies on children with cerebral malaria have demonstrated significant platelet accumulation in the cerebral microvasculature [4]. This finding is consistent with other data demonstrating that platelets play a critical role in enabling cytoadhesion of malaria-infected erythrocytes to endothelial cells. Interestingly, recent studies have defined a role for ultra-large von Willebrand factor (VWF) multimers in promoting this platelet-mediated infected erythrocytes (IE) cytoadhesion and proposed that this mechanism may be particularly important during the early stages of malaria infection.[5] Platelets have also been reported to be important in enhancing IE clumping, which further contributes to microvasculature occlusion in malaria.[6] In addition to these effects in promoting vasculature occlusion, platelets also play an important role in driving development of inflammation and endothelial cells activation, both of which are critical in malaria pathogenesis.[7] Malaria is typically diagnosed by the microscopic examination of thin and thick blood smears, or with antigen-based rapid diagnostic tests [8]. Methods that use the polymerase chain reaction to detect the parasite›s DNA was developed, but unfortunately, they are not widely used in each areas where malaria is common, and that relate to their cost and complexity [9]. According to global estimates, hundreds of millions of cases and over half a million deaths occur annually, with sub-Saharan Africa bearing the highest burden [11, 12, 13]

Cumulatively, these data, therefore suggest that the role of platelets in malaria pathogenesis is predominantly deleterious in nature, and that platelets promote malaria progression through a number of different routes. So the current study was done to assess platelets function among patients with *P. falciparum* malaria.

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

2. Materials and Methods

2.1 Study design and Setting

This comparative cross-sectional study was conducted in Wad Al-Nora city, Gezira State, during the period from October 2024 to February 2025.

2.2 Study Population and Selection Criteria

A Total of 70 participants were enrolled in the study using a non-probability convenience sampling, comprising 50 confirmed cases of acute *Plasmodium falciparum* malaria and 20 age and sex matched apparently healthy controls.

2.2.1 Inclusion Criteria:

Male and female patients presenting with clinical symptoms of acute malaria, confirmed positive for *Plasmodium falciparum* mono infection using peripheral thick and thin blood film microscopy.

2.2.2 Exclusion criteria

Plasmodium falciparum malaria patients who receiving Aspirin or any drug that affects platelet›s function like; Nonsteroidal anti-inflammatory (NSAIDs), antiplatelet drugs, anticoagulants medication use within two weeks prior to sample collection. Patients diagnosed with chronic liver disease, renal failure, or other acute systemic infections were excluded.

2.3 Clot Retraction Test Procedures

Venous blood (2 mL) was drawn under aseptic conditions into clean, dry glass test tubes without anticoagulants. Tubes were immediately placed in a water bath maintained at 37◦C to permit physiological coagulation. Clot formation and subsequent retraction were visually assessed at 2 and 4 hours. The parameters were categorized as follows: Normal retraction, formation of a firm, shrunken clot completely separated from the glass tube wall, accompanied by clear, straw-colored serum extrusion accounting for approximately 40%–60% of total blood volume. Poor retraction, formation of a soft, unshrinkable clot adhering to the inner walls of the tube, with minimal serum extrusion. Absent Retraction, a loose, non-contracted clot occupying nearly the total original blood volume with no observable serum extrusion.

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

2.4 Ethical Consideration:

Ethical approval was formally granted by the Health Research Ethics Committee of the Faculty of Medical Laboratory Sciences at Alzaiem Alazhari University. Administrative authorization and operational clearance were obtained from the administration of Wad Al-Nora Clinic prior to data and sample collection.

2.5 Statistical Analysis

Data were analyzed by using Statistical Package for Social Sciences (versions 22). Differences in qualitative clot retraction between malaria cases and healthy controls were assessed using the Pearson Chi-square (χ^2) test. A p value was set at less than 0.05 to be statistically significant.

3. Results

Results of the platelet retraction test revealed that; Among the 50 malaria patients assessed, normal clot retraction was observed in 32 cases (64%), while abnormal clot retraction were showed in 36% (18 cases), Figure (1).

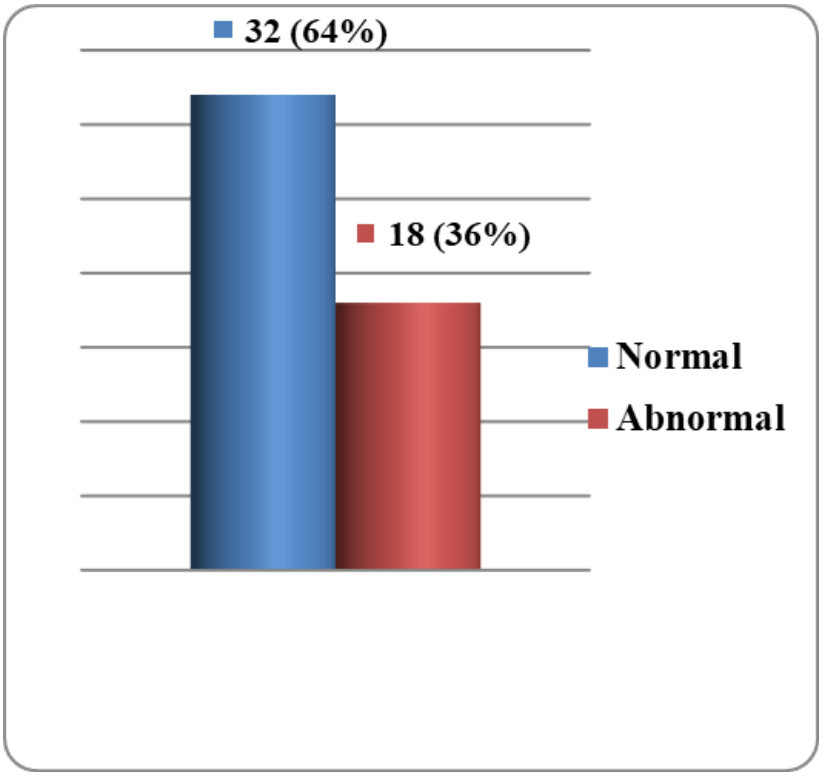


Figure 1: Determination of Platelet function in malaria patients

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

As it shown in table 1, out of the 50 malaria cases assessed, normal clot retraction was observed in 32 cases (64%), poor clot retraction in 12 cases (24%), and absent clot retraction in 6 cases (12%). Totally, 36% (n=18) of the malaria group showed deficient qualitative platelet function. In contrast, all 20 healthy control subjects (100%) demonstrated normal clot retraction. Comparative between the two study groups revealed a statistically significant difference (p. value = 0.002), indicating a marked decline in clot retraction ability among malaria patients.

Table 1: Comparison of clot retraction results between patients with malaria and healthy control

Clot retraction result	Malaria patients n=50	Controls n=20	p. value
Normal	32 (64%)	20 (100%)	0.002
Poor	12 (24%)	00 (0%)	–
No retraction	6 (12%)	00 (0%)	–
Total abnormal	18 (36.0%)	00 (00%)	–

Note: Pearson Chi-square test performed. Significance level set at $p < 0.05$.

4. Discussion & Limitations:

Malaria causes high mortality in tropical and sub-tropical countries. The platelet plays important role in malaria infection, the change and abnormality of platelets are prominent in malaria infection and many complications like intracranial hemorrhage are observed and most of studies relate the bleeding to low platelets count, however, limited data exist regarding some of patients with malaria show disturbance in platelets function. Few or absent studies conducted to detect relation between platelets function and malaria infection.

Result of platelet retraction test of current study revealed that; 36% of patients with malaria had abnormal platelets function, this result was in alignment with study done by Srichaikul et al [14], they studied 48 malarial patients and estimated Platelet function tests (platelet aggregation, PF3, bleeding time and clot retraction); The suppression of platelet aggregation was demonstrated in both *P. vivax* and *P. falciparum* infection. However, this abnormality was more prominent in malarial patients who had systemic complications and bleeding. The

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 – 8441 – ISSN (PRINT): 1858 - 845X

correlation between the suppression of platelet aggregation and thrombocytopenia was observed. Their study concluded that; bleeding in malaria is operated by two mechanisms: thrombocytopenia and severely depressed platelet aggregation.

Similarly, the current study was partially agreed with Asare et al [15], they found that; falciparum malaria has been known to be associated with the various platelet activation markers which possibly contribute to thrombocytopenia. Severe malaria causes a decrease platelet surface membrane glycoprotein due to excessive adhesion of platelets to infected red blood cells.

Critically, however, accumulating evidence suggests that the role of platelets in malaria is complex, and in particular, that platelets can impact upon malaria pathogenesis through a number of different mechanisms.

Cumulatively, these data suggest that the role of platelets in malaria pathogenesis is predominantly deleterious in nature, and that platelets promote malaria progression through a number of different routes.

Limitation of the study:

The relatively small sample size, particularly the control group, may limit the statistical power and generalizability of the findings. Analysis of demographic factors and *P. falciparum* malaria related factors are not done at this study (eg: age, gender, parasitaemia), in addition to platelet count, which may affect clot retraction time results.

5. Conclusion:

Acute *P. falciparum* infection in Sudanese patients is associated with a statistically significant reduction in platelet clot retraction ability. These findings suggest that alterations in platelet–related clot retraction may occur during malaria infection. Concurrent management of malaria patients, especially assessment of platelets function is recommended to prevent complications. Further research is needed to explain the mechanism of alteration in platelet function and other coagulation profile among patients with *P. falciparum* malaria.

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

References:

1. World Health Organization. World malaria report 2023. Geneva: World Health Organization; 2023 Nov 30. Available from: https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023
2. Centers for Disease Control and Prevention. Clinical guidance: malaria diagnosis & treatment in the U.S. Atlanta: CDC; 2024 Jun 5 [cited 2024 Sep 1]. Available from: https://www.cdc.gov/malaria/hcp/clinical-guidance/index.html
3. World Health Organization. WHO guidelines for malaria. Geneva: World Health Organization; 2024 Oct 16 [cited 2024 Aug 31]. Available from: https://app.magicapp.org/#/guideline/LwRMXj
4. Grau GE, Mackenzie CD, Carr RA, Redard M, Pizza G, Allasia C, et al. Platelet accumulation in brain microvessels in fatal pediatric cerebral malaria. J Infect Dis. 2003 Feb 1;187(3):4616-.
5. O›Sullivan JM, Preston RJ, O›Regan N, O›Donnell JS. Emerging roles for hemostatic dysfunction in malaria pathogenesis. Blood. 2016 May 12;127(19):22818-.
6. Pain A, Ferguson DJ, Kai O, Urban BC, Lowe B, Marsh K, et al. Platelet-mediated clumping of *Plasmodium falciparum*-infected erythrocytes is a common adhesive phenotype and is associated with severe malaria. Proc Natl Acad Sci U S A. 2001 Feb 13;98(4):1805-10.
7. Morrell CN. Understanding platelets in malaria infection. Curr Opin Hematol. 2014 Sep;21(5):4459-.
8. Caraballo H, King K. Emergency department management of mosquito-borne illness: malaria, dengue, and West Nile virus. Emerg Med Pract. 2014 May;16(5):123-.
9. Nadjm B, Behrens RH. Malaria: an update for physicians. Infect Dis Clin North Am. 2012 Jun;26(2):24359-.
10. World Health Organization. Malaria [Fact Sheet N°94]. Geneva: World Health Organization; 2014 Mar [archived 2014 Sep 3; cited 2014 Aug 28]. Available from: https://www.who.int/mediacentre/factsheets/fs094/en/

المجلة العلمية المُحكمة للأكاديمية العربية الدولية
The Scientific Journal of the International Arab Academy
IUU Membership Certificate No.: 1102202600217 - Arab Impact Factor Certificate No.: 287
ISSN (ONLINE): 1858 - 8441 - ISSN (PRINT): 1858 - 845X

11. Daily JP, Parikh S. Malaria. N Engl J Med. 2025 Apr 3;392(13):132033-.

12. UNICEF. Malaria in Africa. New York: UNICEF DATA; [archived 2023 Nov 5; cited 2023 Nov 2]. Available from: https://data.unicef.org/topic/child-health/malaria/

13. Greenwood BM, Bojang K, Whitty CJ, Targett GA. Malaria. Lancet. 2005 Apr 23-98-1487:(9469)365;29.

14. Srichaikul T, Pulket C, Sirisatepisarn T, Prayoonwiwat W. Platelet dysfunction in malaria. Southeast Asian J Trop Med Public Health. 1988 Jun;19(2):22533-.

15. Asare R, Opoku-Okrah C, Danquah KO, Opare-Sem O, Addai-Mensah O, Gyamfi D, et al. Assessment of platelet indices and platelet activation markers in children with *Plasmodium falciparum* malaria. Malar J. 2020 Apr 8;19(1):143.