

Hematological and Biochemical Abnormalities in Severe Imported Malaria: A Retrospective Study at the Mohammed V Military Training Hospital

Labrouzi Ismail^{1,2*}, Elbnaissi Yassine^{1,2}, Siyar Hamza^{1,2}, Jnah Mohamed^{1,2}, Iken Maryem^{1,2}, Lmimouni Badre eddine^{1,2}, Naoui Hafida^{1,2}

¹Department of Parasitology and Mycology at the Mohamed V Military Training Hospital

²Faculty of Medicine and Pharmacy, Rabat; Mohammed V University, Rabat

DOI: <https://doi.org/10.36347/sjams.2026.v14i10.001>

| Received: 08.08.2026 | Accepted: 25.09.2026 | Published: 01.10.2026

*Corresponding author: Labrouzi Ismail

Department of Parasitology and Mycology at the Mohamed V Military Training Hospital

Abstract

Original Research Article

Malaria remains a major global health problem, particularly among travelers returning from endemic regions. Most severe or fatal cases occur due to delays in treatment. The aim of our study is to describe the epidemiological, clinical, and biological profile of the severe malaria cases we collected and to analyze the criteria for severity and the reasons for patients' admission to the intensive care unit. This is a descriptive retrospective study of 23 cases of severe malaria diagnosed in the Parasitology and Mycology Department between January 1, 2017, and December 31, 2023. Data were collected from the records and medical files of patients hospitalized for severe malaria. A statistical analysis was conducted to identify risk factors for severe malaria. The mean age of our patients was 35 ± 2 years; 22 were men (96%). Univariate analysis showed that parasitemia $\geq 4\%$ ($p < 0.01$), a shorter length of stay ($p = 0.006$), thrombocytopenia ($p = 0.024$), and elevated total bilirubin levels ($p < 0.01$) were associated with severe disease. Multivariate analysis showed that a parasitemia of $\geq 4\%$ (odds ratio [OR] = 50.3; confidence interval [CI] = 6.31–400; $p < 0.01$) and total bilirubin $> 50 \mu\text{mol/l}$ (OR = 33; CI = 5.17–211; $p < 0.01$) were independently associated with severe disease. Severe malaria remains a public health problem in both endemic and non-endemic countries due to the high mortality rates it causes; in this study, no deaths were reported, which is attributed to prompt diagnosis and treatment.

Keywords: Malaria, severe cases, returning travelers, thrombocytopenia, high parasitemia.

Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

Imported malaria is a major clinical and epidemiological problem in many countries. Although this disease is preventable and curable, it remains a significant public health issue due to its prevalence and high case-fatality rate. It is the deadliest parasitic disease affecting humans. According to the WHO, nearly 600,000 malaria-related deaths were recorded in 2023, primarily among children under 5 years of age in sub-Saharan Africa [1]. Five different species of *Plasmodium* can infect humans; *Plasmodium falciparum* is the most pathogenic species and is responsible for the majority of severe and fatal cases of malaria, primarily due to endothelial cytoadhesion, which causes the sequestration of infected red blood cells at a mature stage in vital organs.

Severe malaria is characterized by the presence of asexual forms of *Plasmodium falciparum* (or, more rarely, one of the four other *Plasmodium* species) in the

blood and the presence of one or more of the 2014 WHO criteria [2].

Most severe or fatal cases occur due to delays in treatment, negligence on the part of patients or their caregivers, and/or diagnostic confusion. Early diagnosis allows for prompt initiation of treatment and consequently reduces mortality rates and the incidence of severe cases. The aim of our study is to describe the epidemiological, clinical, and biological profile of the severe malaria cases collected and to analyze the criteria for severity and the reasons for patients' admission to the intensive care unit.

MATERIALS AND METHODS

Type, Location, and Duration of the Study

This is a descriptive retrospective study of 23 cases of severe malaria diagnosed in the Department of Parasitology and Mycology and treated in the Department of Virology and Infectious and Tropical

Citation: Labrouzi, I., Elbnaissi, Y., Siyar, H., Jnah, M., Iken, M., Lmimouni, B. E., & Naoui, H., (2026). Hematological and Biochemical Abnormalities in Severe Imported Malaria: A Retrospective Study at the Mohammed V Military Training Hospital. Sch J App Med Sci, 14(10), 1182-1186. <https://doi.org/10.36347/sjams.2026.v14i10.001>

Diseases at the Mohammed V Military Training Hospital in Rabat during the period from January 1, 2017, to December 31, 2023.

Study Patients

Inclusion Criteria

The patients included in our study had been admitted to the intensive care unit with severe malaria as their primary or secondary diagnosis. The diagnosis was confirmed by a positive parasitological examination of a thin blood smear and/or thick blood smear showing the presence of *Plasmodium* species. The severity criteria used for diagnosis are those defined by the WHO in 2014 [2]

Exclusion criteria:

The exclusion criteria were:

- Cases treated with antimalarial drugs without parasitological evidence.
- Absence of any of the 2014 WHO criteria for severe malaria.

Data Collection and Analysis

Epidemiological, biological, and clinical data were collected from registries and medical records of patients hospitalized for severe malaria, including age, sex, nationality, country of stay, duration of stay in an endemic area, type of stay (work, tourism, family visit, etc.), chemoprophylaxis, and the time between return and the onset of symptoms. Parasitological and biological data included blood smears and thick smears (*Plasmodium* species, parasitic stages, parasitemia on admission, and hematological and biochemical profiles).

Statistical analysis was performed using Jamovi 2.4.11. First, the normality of the data distribution was tested using the Shapiro-Wilk test. Continuous variables that did not follow a normal distribution were analyzed using the Mann-Whitney test. Categorical variables were analyzed using the chi-square test. Subsequently, a binomial logistic regression model was used to predict risk factors for severe access, incorporating three independent variables: platelet count (PLT), parasitemia, and total bilirubin level. These markers were selected because of their statistically significant association with severe access.

RESULTS

Descriptive Study

1. The Malaria-Affected Population

During the study period, we collected complete data from 790 patients. The mean age was 33.9 ± 10.6 years. Of these, 5.7% (45) were women with a mean age of 33.1 ± 14.7 years, and 94.3% (745) were men with a mean age of 34.0 ± 10.4 years.

Most of our patients were Moroccan nationals (93%, or 512). The average length of stay in an endemic area was 250 days. As for their location, all of our

patients had been in African countries, primarily the Central African Republic and the Democratic Republic of the Congo.

Among the patients, 39.7% (314) tested positive for malaria, and 60.3% (476) tested negative. Among the positive cases, 37.9% (119) were infected with *Plasmodium falciparum*, 39.8% (125) with *Plasmodium ovale*, and 1.3% (4) with *Plasmodium malariae*. Mixed infections with *Plasmodium falciparum* and *Plasmodium ovale* accounted for 6.7% (21), and mixed infections with *Plasmodium falciparum* and *Plasmodium malariae* accounted for 0.6% (2). In total, 13.7% (43) of patients could not be correctly identified due to too low a parasitemia level.

The mean parasitemia in our series was 0.812 ± 1.24 , ranging from a minimum of 0.001% to 10%. 62% of positive patients (171) had parasitemia below 1%. 36% (98) had parasitemia between 1% and 4%. 2% (6) of the patients had severe parasitemia greater than 4%.

With regard to laboratory data, 81 malaria-positive patients were anemic (26%), and 56 malaria-negative patients were also anemic (12%). Eleven percent (35) of malaria-positive patients had leukopenia, compared with 9.70% (45) of malaria-negative patients who had leukopenia. 66% (202) of malaria-positive patients had lymphopenia, while 24.9% (116) of malaria-negative patients had lymphopenia. 64.47% (167) of malaria-positive patients had thrombocytopenia, while only 18% (75) of malaria-negative patients had thrombocytopenia. CRP was positive in 93% (237) of malaria-positive patients and was also positive in 70% (153) of malaria-negative patients. 25% of both malaria-positive and malaria-negative patients had hepatic cytolysis ($ALT > 40$ IU, $AST > 35$ IU). Hyperbilirubinemia was found in 15.66% (47) of malaria-positive patients, while 5% (23) of malaria-negative patients had hyperbilirubinemia.

2. Patients with severe malaria

From January 2017 to December 2023, 23 (2.82%) patients with severe malaria were hospitalized at the CVMIT. The average age of our patients was 35 ± 2 years; 22 were men (96%); 20 patients were of Moroccan origin, two were of Chadian origin, and one was from Gabon. The majority of our patients had no reported medical history, except for one case of hyperparathyroidism, one case of delirium, and one case of a cyst in the left eye. The average duration of stay in an endemic area was 145 days. All of our patients contracted the disease on the African continent in the sub-Saharan region. Seven patients had stayed in the Democratic Republic of the Congo (DRC), six in the Central African Republic, three in Gabon, two each in Cameroon and Chad, and one each in Mali, Burkina Faso, and Guinea-Conakry. Chemoprophylaxis was tailored to the recommended protocols for the country visited in 19 patients. It consisted of: mefloquine in 10

cases (43.5%), doxycycline in 5 cases (21.7%), and the chloroquine-proguanil combination in 4 cases (17.4%). This chemoprophylaxis was taken regularly in only 8 cases, while 4 patients did not take any chemoprophylaxis. The time to symptom onset was recorded for 22 patients (96% of cases) and was 16 days $\pm$ 3 days. All of our patients were admitted to the

virology unit via the emergency department. The primary *Plasmodium* species involved was *Plasmodium falciparum*, which was the sole species in 17 cases (73.9%) or was present in combination with *Plasmodium ovale* in five cases (21.7%); one case was caused by *Plasmodium ovale* (4.3%). Parasitemia was high, with a mean of 4.78% $\pm$ 0.82.

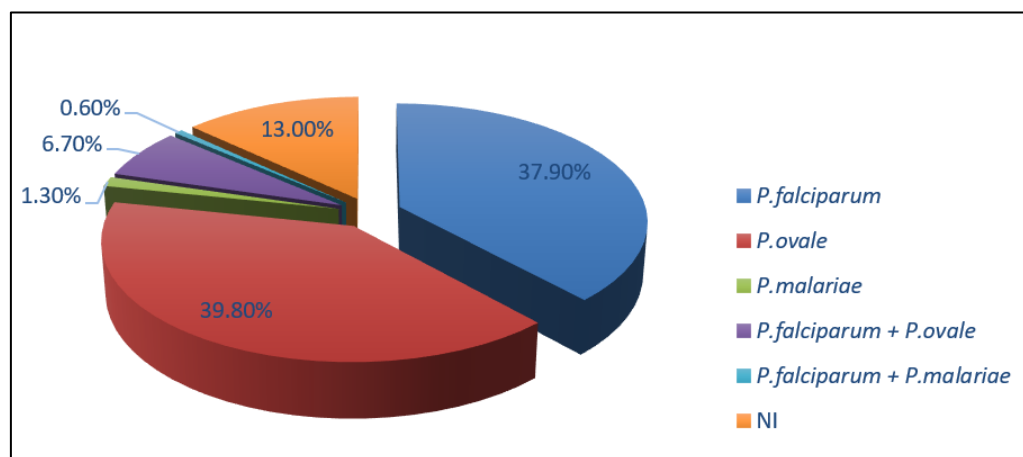


Figure 1: Distribution of Plasmodium species

Analysis of the WHO severity criteria showed that each patient met at least two of the severity criteria established by the WHO. Three patients (13%) developed neurological failure with a deep coma (mean Glasgow Coma Scale score of 5 ± 2) during the course of their illness. Two patients (8%) developed respiratory distress. Acute kidney injury (AKI) was observed in 2 of our patients (8%). In addition, we noted three cases of severe anemia ($Hb < 7$ g/dl) (13%). Hyperparasitemia $\geq 4\%$ was observed in 15 patients (65%). Similarly, 9 of our patients were icteric (39%) (clinical and/or laboratory jaundice with bilirubin levels > 50 μ mol/L).

Analytical Study

The Shapiro-Wilk test revealed an abnormal distribution of our hematological and biochemical parameters. Given this abnormal distribution of the data, we used the nonparametric Mann-Whitney test. Using the Mann-Whitney test, we compared the median values of the hematological and biochemical parameters with the diagnosis of malaria. The median values for white blood cells, lymphocytes, platelets, and hemoglobin in

positive patients were significantly lower than those in negative patients. The median values for monocytes, CRP, alkaline phosphatase, total bilirubin, and urea in the positive group were higher than those in the negative group. No statistically significant differences were observed between the groups regarding neutrophil count, ALT, AST, LDH, and triglycerides.

Risk Factors for Severe Malaria

The mean age, white blood cell count, lymphocyte count, monocyte count, ALAT, ASAT, PAL, LDH, TG, serum creatinine, and urea levels were similar between the group of patients with severe access and the group of patients with simple access; Patients with severe infection had a shorter duration of stay in the endemic area (145 ± 88.9 days vs. 222 ± 200 days, $p = 0.006$), a higher mean parasitemia (4.78 ± 3.95 vs. 0.812 , $p < 0.01$), higher total bilirubin (34.0 vs. 11.0 mg/dL, $p = 0.01$), higher CRP (164 vs. 66.0 mg/L, $p < 0.001$), lower hemoglobin levels (12.3 vs. 14.0 g/dL, $p < 0.005$), and lower platelet counts ($54 \times 10^3/\mu$ L vs. $122 \times 10^3/\mu$ L, $p < 0.001$) (Table 1).

Table 1: Logistic regression model to assess risk factors associated with severe access

Variable	Uncomplicated Malaria	Severe malaria	Odds Ratio [95% CI]	p-value
	n=314	n=23		
Sex				
Man	303(97)	22(96)	0,798[0,09-6,47]	0,833
Length of stay, median days (IQR)	222 $\pm$ 200	145 $\pm$ 88,9	0,99[0,98-0,99]	0,006
Parasitemia ≥ 4 %, n (%)	9(3,27)	15(65,12)	55,41[18,72-164,06]	<0,01
White blood cells $< 4000/\mu$ L, n (%)	35(11,43)	2(18,18)	1,72[0,35-8,28]	0,499
Lymphocytes $< 1500/\mu$ L, n (%)	202(66,01)	7(63,63)	0,90[0,25-3,14]	0,87

Neutrophils (PNN) < 1500 / μ L, n (%)	11(3,59)	1(9,09)	2,68[0,31-22,83]	0,37
Hemoglobin < 7 g/dL or hematocrit < 20%, n (%)	0(0)	4(36,36)		0,99
Platelets < 150 x 10 ³ / μ L, n (%)	167(64,72)	19(95)	10,35[1,36-78,59]	0,024
CRP > 5 mg/L, n (%)	237(93,30)	19(100)		0,99
ALT (ALAT) > 40 IU/L, n (%)	65(25,29)	2(18,18)	0,65[0,13-3,11]	0,59
AST (ASAT) > 35 IU/L, n (%)	70(27,23)	3(27,27)	1,00[0,25-3,88]	0,99
Total bilirubin > 50 μ mol/L, n (%)	12(6,35)	6(50)	14,75[4,12-52,71]	<0,01
Creatinine > 265 μ mol/L, n (%)	3(1,01)	1(9,09)	9,73[0,92-101,98]	0,058

Univariate analysis showed that a parasitemia level $\geq 4\%$ ($p < 0.01$), a shorter length of stay ($p = 0.006$), thrombocytopenia ($p = 0.024$), and elevated total bilirubin levels ($p < 0.01$) were associated with severe disease (Table 1). Multivariate analysis showed that a parasitemia of $\geq 4\%$ (odds ratio [OR] = 50.3; confidence interval [CI] = 6.31–400; $p < 0.01$) and total bilirubin > 50 μ mol/L (OR = 33; CI = 5.17–211; $p < 0.01$) were independently associated with severe disease.

DISCUSSION

Malaria is an acute febrile illness caused by the *Plasmodium* parasite, which is transmitted through the bites of infected female *Anopheles* mosquitoes. Five different species of *Plasmodium* can infect humans; *Plasmodium falciparum* is the most pathogenic species and is responsible for the majority of severe and fatal cases of malaria, primarily due to endothelial cytoadhesion, which causes the sequestration of mature, infected red blood cells in vital organs.

Malaria remains a significant problem in non-endemic countries. In this study, we recorded 23 cases of severe malaria out of a total of 813 malaria cases, with a prevalence of 2.83 percent; this rate is lower than that found in the study by Tao Zhang *et al.*, [3] and that by Aongart [4]. The mean age of our patients (35 ± 2 years) is higher than that reported in the studies by E. El Mezouari *et al.*, [5] and B. Charra *et al.*, [6]. The majority of our patients were young Moroccans, predominantly male, who had contracted the disease on the African continent. The primary *Plasmodium* species involved was *Plasmodium falciparum*, which was the only species implicated in 17 cases (73.9%). The mean parasitemia was $4.78\% \pm 0.82$; this rate is lower than those found in the studies by P. Corne *et al.*, and El Mostafa El Mezouari *et al.*, (15% and 12%, respectively) [7], [5], but remains comparable to that reported in the study by B. Charra *et al.*, (6.85%) [6]. As in most reported studies on imported malaria, the epidemiological factors most frequently associated with the development of severe malaria in cases of imported malaria are the patients' lack of immunity, the absence of or inappropriate chemoprophylaxis, and delayed diagnosis [3], [4], [8].

Severe malaria can rapidly progress to a poor prognosis requiring intensive care, with a case-fatality rate ranging from 5 to 10 percent. In a non-endemic country, any imported case of severe malaria constitutes a medical emergency, often complicated by delayed access to care, diagnosis, and the initiation of specific parenteral treatment. Consequently, identifying patients with severe malaria who are at high risk of death is of paramount importance. However, not all WHO criteria have the same predictive value for the early identification of patients with a poor prognosis. In this study, host biomarkers enabled the early identification of severe imported malaria cases according to WHO criteria, namely: thrombocytopenia, a total bilirubin level of 50 μ mol/L, and high parasitemia (97% specificity with an established sensitivity of 45.5%) when comparing clinically severe cases. Consequently, these biomarkers should be considered useful tools for the initial management of patients with imported malaria. In the prospective, multicenter observational study by F. Bruneel *et al.*, comparing uncomplicated and severe imported *Plasmodium falciparum* malaria in adults, the most useful biomarkers associated with severity were plasma albumin and sTREM-1 [9]. Other studies, such as that by L. Balerdi-Sarasola, have found that the combination of angiopoietin-2 and CRP could serve as a reliable tool for the early detection of severe cases of imported malaria [10]. In the study by Tomás Valença Ferreira *et al.*, patients with severe malaria had significantly higher levels of creatinine ($p = 0.009$) and lactate dehydrogenase [11].

The average length of stay in an endemic area for our patients was 145 days. The average time between returning from the endemic area and the onset of the first symptoms in our study was 16 days ± 3 days. 87% of our patients were of Moroccan origin, with no history of staying in a malaria-endemic area. They are therefore non-immune and at high risk of contracting a severe, potentially fatal form of the disease. This finding supports the theory that even partial immune protection is acquired in individuals who have lived for many years in contact with the parasite without chemoprophylaxis [12]. Regarding the chemoprophylaxis regimen followed in our study, 34% of our patients reported adhering to the correct chemoprophylaxis regimen. The absence of

chemoprophylaxis or inadequate chemoprophylaxis are risk factors for progression to severe malaria [4]. In fact, in our study, 17% of patients had not taken chemoprophylaxis, and 48% had inadequate chemoprophylaxis due to stopping treatment too early and/or taking it irregularly. The laboratory diagnosis of malaria is a medical emergency. 100% of the patients in our study underwent a blood smear and a thick smear. Thick smears and blood smears are used to diagnose malaria as well as to monitor treatment and assess parasitemia [2]. They were performed on days 3, 7, and 28 after the start of treatment to detect the level of parasitemia. A negative result is generally reported after 7 days. No deaths were reported in our study, in contrast to the study by El Mezouari *et al.*, [5]; this is primarily due to early diagnosis and rapid referral of patients to the intensive care unit for severe cases.

CONCLUSION

Severe malaria remains a public health problem in both endemic and non-endemic countries due to the high mortality rates it causes. In this study, no deaths were reported, which is attributed to prompt diagnosis and treatment.

BIBLIOGRAPHY

1. « World malaria report 2024 ». Consulté le: 21 mai 2025. [En ligne]. Disponible sur: <https://www.who.int/fr/teams/global-malaria-programme/reports/world-malaria-report-2024>
2. « La prise en charge du paludisme grave – guide pratique. Troisième édition ». Consulté le: 18 juillet 2024. [En ligne]. Disponible sur: <https://www.who.int/fr/publications/i/item/9789241548526>
3. T. Zhang *et al.*, « Risk factors of severe imported malaria in Anhui province, China », *Acta Trop.*, vol. 197, p. 104934, sept. 2019, doi: 10.1016/j.actatropica.2019.02.020.
4. A. Mahittikorn *et al.*, « Prevalence, anti-malarial chemoprophylaxis and causes of deaths for severe imported malaria: A systematic review and meta-analysis », *Travel Med. Infect. Dis.*, vol. 49, p. 102408, sept. 2022, doi: 10.1016/j.tmaid.2022.102408.
5. E. M. E. Mezouari, A. Belhadj, M. Ziani, M. Boughanem, et R. Moutaj, « Le paludisme grave d'importation chez l'adulte: étude rétrospective de treize cas admis en réanimation à Marrakech », *Pan Afr. Med. J.*, vol. 25, n° 179, Art. n° 179, nov. 2016, doi: 10.11604/pamj.2016.25.179.8558.
6. B. Charra *et al.*, « Paludisme grave d'importation chez l'adulte : étude rétrospective de dix cas admis en réanimation à Casablanca », *Médecine Mal. Infect.*, vol. 37, n° 3, p. 162-165, mars 2007, doi: 10.1016/j.medmal.2006.09.006.
7. P. Corne, K. Klouche, D. Basset, L. Amigues, J.-J. Béraud, et O. Jonquet, « [Severe imported malaria in adults: a retrospective study of 32 cases admitted to intensive care units] », *Pathol. Biol. (Paris)*, vol. 52, n° 10, p. 622-626, déc. 2004, doi: 10.1016/j.patbio.2004.07.017.
8. S. Mathai, E. Bishburg, J. Slim, et S. Nalmas, « Severe malaria in immigrant population: a retrospective review », *J. Immigr. Minor. Health*, vol. 12, n° 6, p. 921-924, déc. 2010, doi: 10.1007/s10903-009-9256-5.
9. F. Bruneel *et al.*, « Imported falciparum malaria in adults: host- and parasite-related factors associated with severity. The French prospective multicenter PALUREA cohort study », *Intensive Care Med.*, vol. 42, n° 10, p. 1588-1596, oct. 2016, doi: 10.1007/s00134-016-4356-x.
10. L. Balerdi-Sarasola *et al.*, « Biomarqueurs de l'hôte pour l'identification précoce du paludisme grave importé à *Plasmodium falciparum* », *Travel Med. Infect. Dis.*, vol. 54, p. 102608, juill. 2023, doi: 10.1016/j.tmaid.2023.102608.
11. T. V. Ferreira, G. A. Silva, et V. Duque, « Imported Malaria in Portugal: A Retrospective Analysis from a Tertiary Public Hospital », *Acta Médica Port.*, vol. 39, n° 3, p. 203-207, 2026, doi: 10.20344/amp.23694.
12. « González: Severe imported malaria in adults: retrospecti... - Google Scholar ». Consulté le: 22 octobre 2024. [En ligne]. Disponible sur: https://scholar.google.com/scholar_lookup?title=Severe%20imported%20malaria%20in%20adults%3A%20retrospective%20study%20of%2020%20cases&publication_year=2009&author=A.%20Gonz%C3%A1lez&author=J.M.%20Nicol%C3%A1s&author=J.%20Mu%C3%B1oz&author=P.%20Castro&author=J.%20Mas&author=M.E.%20Valls