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ORIGINAL RESEARCH

Comparison of clinico-laboratory profile and severity of malaria in *Plasmodium vivax* and *Plasmodium falciparum* at a tertiary care centre

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Abstract

Introduction: Malaria is a vector-borne disease, a major public health concern. Due to changes in the clinical and epidemiological profile of malaria in our country *P. vivax* known to be benign has been reported to cause severe complications. This study is carried out to analyse the laboratory profile, clinical features and severity of disease in both *P. vivax* and *P. falciparum* infection.

Materials and methods: This was the hospital-based cross-sectional type of prospective study. Blood sample was collected from clinically suspected malaria cases based on certain inclusion and exclusion criteria as per WHO guidelines. For the diagnosis of malaria, a conventional thick and thin peripheral smear and rapid diagnostic test (Advantage MALCARD) was done.

Result: A total number of 60 patients with malaria were included in the study. Out of 60 patients, 34 (56.66%) were males and 26 (43.33%) were females. The highest occurrence of malaria was in the age group 10-40 years. Among 60 patients, 40 (66.66%) were positive for *P. vivax* and 20 (33.33%) for *P. falciparum.* The most common presenting features in the patients were fever 60 (100%) followed by chills /rigor 58 (96.66%), headache 55 (91.66%), vomiting 50 (83.33%), splenomegaly 20 (33.33%). Severe anemia (Hb <5 gm %), leukopenia (TLC <4000 per cmm) was found more in *P. vivax* 25 (62.5%), 15 (37.5%), as compared to *P. falciparum* 8 (40%), 10 (50%), 20 (100%) respectively, while thrombocytopenia (<50,000 per cmm) was observed in 20 (100%) *P. falciparum* as compared to 17 (42.5%) *P. vivax*. Out of 60 malaria patients, 14 (35%) of *P. vivax* and 8 (40%) of *P. falciparum* had severe malaria. Co-morbidities were present in these patients.

Conclusion: *P. vivax* is the major species, accounting for the majority of cases of malaria. *P. vivax* had more complications in our study. Association of co-morbidities in affecting the clinical outcome of malaria should be further explored.

Key words: *P. vivax, P. falciparum*, severe malaria

Introduction

Malaria is a life-threatening infection in humans caused by intracellular protozoa of the genus *Plasmodium* which is transmitted by the bite of infected female Anopheles mosquito called malaria vectors. Malaria is endemic in the tropic and Subtropic with highest prevalence in Africa followed by Southeast Asia. India contributes 80% of Southeast Asia malaria burden [24 million cases Per year].[1] Among the 5 species of *Plasmodium*, *P. falciparum* and *P. vivax* pose the greatest threat.[2] India is co-endemic for both *P. falciparum* and *P. vivax*, contributing to about 2/3rd of Malaria in the Southeast Asia region. Despite recent reductions in the incidence of overall malaria cases, it remains an important cause of morbidity and mortality.[1] However, the proportional distribution varies across India and a wide range of clinical presentations are seen from both predominant species of malaria. The disease caused by *P. vivax* has a benign cause with multiple relapses. In contrast *P. falciparum* causes severe malaria and often produces multi-organ failure unless treated early with multiple drugs. Several cases of *P. vivax* with multi-organ dysfunction syndrome have also been reported. [3] In *P. falciparum* profound thrombocytopenia is a common complication, but recently several reports of *P. vivax* malaria with thrombocytopenia have been reported. [4, 5] Likewise, acute respiratory distress syndrome, hepatic involvement and renal involvement which is more common in *P. falciparum* malaria, have also been reported in *P. vivax* Malaria. [6,7] Hence, morbidity and mortality of *P. vivax* have increased recently due to the serious complications associated with it. Nowadays the classic clinical picture is more of an exception than the rule, particularly with *P. falciparum* infection, which can easily be mistaken for other diseases with catastrophic results, exerts increased premature mortality and morbidity. These results in considerable economic wastage owing to lost manpower and treatment costs, and have a serious impediment to the economic development of countries in which this disease is endemic. Keeping in mind the seriousness, complications of malaria and indistinguishable clinical features, it is necessary to investigate the laboratory parameters associated with acute

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phase of malaria. So, this study is carried out to analyse the laboratory profile, clinical features and severity of disease in both *P. vivax* and *P. falciparum* infection.

Materials and methods

This hospital-based cross-sectional type of prospective study was conducted for a period of one year from November 2020 to October 2021, after the ethical clearance from the institutional ethical committee. The proposed study had been undertaken in the Department of Microbiology, Rohilkhand Medical College and Hospital, a tertiary care hospital in the Rohilkhand region, Bareilly, Uttar Pradesh.

In this prospective study, blood sample was collected from clinically suspected malaria cases based on certain inclusion and exclusion criteria as per WHO guidelines.

Total 60 cases of malaria were included in this study period.

Inclusion Criteria: The study group includes patients with more than any two symptoms out of the following:

1. Fever and headache.
2. Chills.
3. Pain in the abdomen or muscles.
4. Sweating. [8]

Exclusion Criteria:

1. Patients presenting with fever (malaria smear negative), but treated empirically for malaria.
2. Patients presenting with clinical features mimicking malaria as Leptospirosis, Dengue fever and Sepsis.
3. Cases already on Anti-malarial drugs. [8]

For the diagnosis of malaria, a conventional thick and thin peripheral smear and rapid diagnostic test [Advantage MALCARD] was done. Peripheral blood smear was stained with Leishman stain, and examined under oil immersion. The slide was considered negative when there were no parasites in 100 oil immersion field. Rapid diagnostic test was based on the detection of pan pLDH and pLDH for all species and *P. falciparum* respectively. Demographic details, clinical features, and haematological investigations were recorded.

Severity of malaria was identified by one or more of the following features as per WHO guidelines which includes:

- Impairment of consciousness or unarousable coma: Glasgow coma score
- Prostration, i.e., generalized weakness rendering a patient to be unable to sit, stand or walk without help
- Multiple convulsions; >2 episodes within 24 h.
- Deep breathing and respiratory distress; acidotic breathing.
- Acute pulmonary oedema [radiologically confirmed] or acute respiratory distress syndrome.
- Circulatory collapse or shock; [systolic BP <80 mmHg].
- Renal Impairment [serum creatinine >3 mg/dl]. [9]

Statistical analysis: Descriptive analysis was done and data was processed and arranged into numbers and percentages.

Results

This was a descriptive study and the following observations were made.

A total number of 60 patients of malaria were included in the study. Out of 60 patients, 34 (56.66%) were males and 26 (43.33%) were females. The male-to-female ratio was 1.3:1. The highest occurrence of malaria was in the age group of 10-40 years. [Table. 1] Among 60 patients, 40 (66.66%) were positive for *P. vivax* and 20 (33.33%) for *P. falciparum*, by one of the following tests i.e 35 (87.5%), 12 (60%) by microscopy and 5 (12.5%), 8 (40%) by rapid diagnostic test respectively. [Table 2,3] The most common presenting features in the patients were fever 60 (100%) followed by chills/rigor 58 (96.66%), headache 55 (91.66%), vomiting 50 (83.33%), splenomegaly 20 (33.33%). [Table 4] Table 5 depicts a comparison of different laboratory parameters between *P. vivax* and *P. falciparum*. Anaemia [haemoglobin <5 g%] was present more in *P. vivax* 25 (62.5%) as compared to *P. falciparum* 8 (40%). Likewise, leukopenia (TLC <4000cmm) was also observed in *P. vivax* 15 (37.5%) in contrast to *P. falciparum* 10 (50%). Thrombocytopenia was found in 20 (100%) *P. falciparum* and in 17 (42.5%) *P. vivax* patients. Out of 60 malaria patients, 14 (35%) of *P. vivax* and 8 (40%) of *P. falciparum* had severe malaria. [Table 6]

Table: 1 Age and gender-wise distribution of malaria patients (n= 60)

Age Group (Years)	Females n=26	Percentage (%)	Males n=34	Percentage %	Total n=60
0-10	04	15.38%	04	11.77%	08
10-20	06	23.1%	10	29.41%	16
20-30	04	15.38%	06	17.64%	10
30-40	07	26.92%	05	14.70%	12

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40-50	04	15.38%	04	11.77%	08
50-60	01	3.84%	04	11.77%	05
60-70	00	00%	01	2.94%	01

Table 2: Distribution of patients as per malaria species [n= 60]

Types of species	No. of cases
Plasmodium vivax	40 [66.67%]
Plasmodium falciparum	20 [33.33%]
Total	60 [100%]

Table 3. Percentage positivity rate of malaria patients by microscopy and rapid diagnostic test [RDT][n= 60]

Plasmodium species	microscopy	RDT	Total
Plasmodium vivax	35[87.5%]	5 [12.5%]	40 [66.60%]
Plasmodium falciparum	12 [60%]	8 [40%]	20 [33.33%]

Table 4: Distribution of malaria patients based on clinical presentation [n=60]

Clinical presentation	No. of cases
Fever	60 [100%]
Vomiting	50 [83.33%]
Chills/rigor	58 [96.66%]
Headache	55 [91.66%]
ARDS	2 [3.33%]
Altered sensorium	1 [1.6%]
Convulsion	3 [5%]
Splenomegaly	20 [33.33%]

Table 5. Comparison of laboratory parameters in *P. vivax* and *P. falciparum* (n=60)

Laboratory parameters	Plasmodium species [%]	
	P. vivax [40 Cases]	*P. falciparum* [20 Cases]
HEMOGLOBIN [g%]		
< 5	25 [62.5%]	8[40%]
5-10	5[12.5%]	5[25%]
>10	10[25%]	7 [35%]
TLC [per cmm]		
< 4,000	15[37.5%]	10[50%]
5-10	5[12.5%]	3[15%]
>10,000	20 [50%]	7 [35%]
Platelets count [Per cmm]		
< 50,0 00 [Severe thrombocytopenia]	17 [42.5%]	20 [100 %
50, 000-100,000 [Thrombocytopenia]	8[20%]	-
150,000-450,000 [Normal]	15[37.5%]	-
SGOT [IU/L]		
<40	20 [50%]	5 [25%]
>40	20 [50%]	15 [75%]
SGPT [IU/L]		
< 56	30 [75%]	11 [55%]
>56	10 [25%]	9 [45%]
SERUM CRETININE [MG/DL]		
NOMAL [0.5-1.5]	22 [55%]	15 [75%]
INCREASED [> 1.5]	18 [45%]	5 [25%]

Table 6: Distribution of malaria patients according to complication [n=60]

Valuables	*Plasmodium vivax*	*Plasmodium falciparum*	total
Severe malaria	14 [35%]	8 [40%]	22 [36.66%]
Non-severe malaria	26 [65%]	12 [60%]	38 [63.33%]

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Discussion

Malaria is a major life-threatening public health problem in most of countries and poses a diagnostic challenge to the medical community worldwide. Its occurrence is noted in more than 90 countries, Africa affected the worst (93%) followed by Southeast Asia (3.4%). [10] In our study, 60 cases of malaria were included during the study period. Males (34, 56.67%) were affected more than females (26, 43.33%), which is possibly due to increased outdoor activity and increased exposure to mosquitoes in males as compared to females. In the present study, malaria occurrence was more common in farmers followed by daily labourers, merchants and government workers. It was found more common in rural regions than urban. These findings are comparable with the study by Solmon Sirak et al. [11] In our study the mean age of subjects in both *P. falciparum* and *P. vivax* group was 36.5 ± 7.5 years [range 10-70 years]. The highest occurrence of malaria was in the age group (10-40 years). These observations are similar to other studies. [12,13,14,15] [Table 1] In the present study, out of 60 malaria cases, 32 (53.33%) were diagnosed as malaria on peripheral blood smear and 28 (46.67%), were detected positive by rapid diagnostic test. The major species in our region was *P. vivax* 40 (66.67%) followed by 20 (33.33%) cases of *P. falciparum.* No mixed infection was observed in our study. [Table 2,3] In a similar study carried out by Smita Chandra and Harish Chandra [12] in Uttarakhand, India, 69.8% of cases were positive for *P. vivax* and only 27.5% were positive for *P. falciparum* whereas 2.7%cases were reported to have mixed infection. Another similar study by Rajendra Kumar Verma et. Al. from Kanpur, North India [15] and Gaurav I. Patel et al. [16] from Vadodara Gujarat reported 76.74% cases of *P. vivax*, 13.95% cases of *P. Falciparum* and 9.3% cases of mixed infection and 61% cases of *P. vivax*, 29% of *P. falciparum*, 9.43% of mixed infection respectively. Lauram M. Erhart et. al. from Bangkok, Thailand also reported more percentage of *P. vivax* i.e., 59% and *P. falciparum* of 38% and mixed infection in 2% cases. [17] However, some other studies reported *P. falciparum* as a common infecting species in their regions. [11,14,17] This could be due to heterogeneity and variability in the transmission between and within the states of the country as many ecotypes of Malaria have been recognized.

The commonest clinical manifestations of Malaria in this study were fever 60 (100%), chills/rigour 58 (96.66%), headache 55 (91.66%), vomiting 50 (83.33%) followed by splenomegaly 20 (33.33%) [Table 4]. These findings were similar to the findings of other studies. [18,19] Severe anaemia, leukopenia and thrombocytopenia were the most common complications in our study. [Table 5] Severe anaemia (Hb <5 g%) was observed in *P. vivax* 25 (62.5%) in comparison to *P. falciparum* 8 (40%) which corroborates with the finding of Vijay Baburao Sonawane et. al. [20] Anaemia in malaria was believed to occur due to haemolysis of parasitized and non-parasitized RBCs, peripheral sequestration of RBCs and ineffective erythropoiesis. [21] Leukocytopenia was more common in *P. vivax* 15 (37.5%) patients as compared to *P. falciparum* 10 (50%), which corroborates with the finding of Kocher et al. [22] and Rasini et al. [23] Thrombocytopenia is a well-known complication of *P. falciparum* malaria but is also encountered in *P. vivax* malaria. This may be due to multiple factors which include peripheral destruction, alteration in bone marrow, excessive removal of platelets by splenic pooling and platelet-associated IgG antibody and its consumption. [24,25] In our study thrombocytopenia, (37, 61.66%) was the most common complication which is similar to the finding of Rasheed et. al. [26] Severe thrombocytopenia (Platelet count <50,000/mm^3) was observed more in *P. falciparum* (20, 100%) than *P. vivax* (17, 42.5%). Several other studies also observed similar findings. [11,12,13,14,15,16,17] while some had reported a significantly higher proportion of thrombocytopenia in P. vivax. [27,28] Liver enzymes (30, 75%) and serum creatinine (18, 45%) were comparatively higher in *P. vivax* than in *P. falciparum* in our study which is supported by the studies of J.P. Goval et al [29], Srivastava et. al. [30] and Premaratana R et. al. [31] In our study, we observed that both types of infection were presented with severe and non-severe malaria. Severe malaria patients were (14, 35%) in *P. vivax* and (8, 40%) in *P. falciparum*. Severe malaria patients had comorbidities like diabetes and obesity as compared to those who had uncomplicated malaria, indicating overall host immune status. [32]

Limitations of our study were small sample size and single-centre study. *P. vivax* malaria infection is often underestimated though complications and mortality are almost similar in comparison to *P. falciparum* malaria.

Conclusion

The present study concludes that malaria was predominantly due to *P. vivax* in this region. Severe course and complications may occur in *P. vivax* in contrast to *P. falciparum*. The role of co-morbidities affecting the clinical outcome of malaria should be further explored.

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