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Original Article

Clinical Spectrum of Malaria in Hospitalised Children at a Tertiary care Centre in North India - A Retrospective study

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Abstract

Introduction: Malaria continues to cause high morbidity and mortality in the tropical countries, children being among the vulnerable age group. We conducted a retrospective study at a tertiary care centre in northern India to determine the pattern of the disease among children in our area.

Methods: A descriptive retrospective study was conducted over a period of one year, in children aged 1 month to 18 years of age with malaria. Presenting features, clinical signs, laboratory parameters, treatment and outcome were recorded. Statistical analysis was done.

Results: 57 patients tested positive for malaria. The parasite species found in all positive tests was Plasmodium vivax. 22 (38.5%) patients were classified as severe malaria. M:F ratio of 1.03:1. Fever was the most common presenting complain (100%), followed by pallor (52.6%) and persistent vomiting (35%). Antimalarial given was injection artesunate in 53 (93%) of patients, oral artemether lumefantrine was started as primary treatment in three (5.26%) patients, while chloroquine was given to only one (1.7%) patient. Blood component transfusion was required in 11 patients. 54 (94.7%) patients improved and were discharged, while one (1.7%) patient was referred to higher centre, two (3.5%) patients left against medical advice. Mean duration of hospital stay was 6.2 (± 2.35) days.

Conclusions: Plasmodium vivax was the leading cause of malaria at our institute, causing both severe and uncomplicated malaria. Plasmodium vivax is no longer a benign entity.

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Introduction

Malaria still remains a global health problem. It is one of the most widespread infectious diseases of tropical countries causing around 263 million cases and 5.97 lacs deaths annually.[1] WHO African region carries the heaviest burden of the disease causing around 95% of malaria deaths worldwide. The South East Asian Region (SEAR) shares around 1.5% of global burden with about four million cases annually. Though India exits from the WHO's High Burden to High Impact group in 2024, signifying a turning point in its fight against malaria, still India alone contributes about 50% of malaria burden of SEAR and shares 58% of total mortality due to malaria in this region.[1]

Five species of plasmodium are known to cause malaria in humans (Falciparum, vivax, malariae, ovale, knowlesi). Falciparum and vivax are the predominant contributors with varying proportions across the world. The proportion of P.

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vivax and P. falciparum varies in different parts of India. Mostly indo-gangatic plains, northern hilly states, northwestern India and southern Tamil Nadu state have less than 10% P. falciparum, and the rest are P. vivax infections. In the forested areas inhabited by ethnic tribes, P. falciparum proportion is 30 – 90% whereas in the remaining areas, it is between 10% and 30%.[2]

Young children continue to be among the vulnerable group, pertaining to physiological characteristics, immune and nutritional factors. There are a number of published researches on presentation of severe malaria in children in India but only a few have attempted to classify the whole spectrum of the disease.[3-6] There have been a relatively fewer studies which are from North India.[7,8] Hence we conducted a retrospective descriptive study to find out the epidemiology, clinical profile, presentation and outcome of malaria in children admitted at a tertiary care teaching institute in Lucknow, Uttar Pradesh, India.

Methods

The present research was conducted at the Department of Paediatrics, Integral Institute of Medical Sciences and Research, a tertiary care teaching institute situated at Lucknow, Uttar Pradesh state in Northern India. This is a descriptive retrospective study conducted over a period of 12 months from January 2024 to December 2024. Children aged one month to 18 years of age were enrolled in the study. All children admitted with fever and / or other associated signs and symptoms consistent with malaria and a positive test for malarial parasite {Rapid Malaria Antigen Test (RMAT)} and / or peripheral blood smear (PBS) were included in the study. Children with features suggestive of malaria and treated clinically as malaria with negative tests for malaria were excluded. Children with co-existing infections like dengue, enteric fever, viral hepatitis, and scrub typhus were also excluded. Our main objective was to study the prevalence and pattern of presentation of malaria. On admission, all children with clinical picture suggestive of malaria were sent for routine investigations including, complete blood count (CBC), PBS and RMAT. Advantage MAL Card malaria test kit, manufactured by J. Mitra & Company Private Limited, was used at our institute. It is based on detection of monoclonal anti Pf pLDH antibody and monoclonal anti Pan specific pLDH antibody. Liver function tests (LFT), renal function tests, serum electrolytes, Xray chest, blood gas analysis, blood culture, coagulation profile were also sent if indicated. Typhidot test, dengue serology, viral markers like HAV IgM were also sent if alternative diagnosis was suspected. Children with positive RMAT and / or positive PBS for malaria were included in the study. Relevant information from case files of children with positive test for malaria were documented, including the clinical features and investigations. The study variables are defined as in Table 1. Statistical analysis was done by using freely available software online – graphpad and medcalcs. P value of less than 0.05 was considered significant. The study was commenced after the approval from the ethics committee of the institute (IEC/IIMSR/2025/26).

Table 1: Definitions of study variables

Fever	Axillary temperature ≥ 100 F
Persistent vomiting	2 or more episodes in 24 hrs not responding to oral / IV antiemetic
Shock	Evidence of impaired perfusion (cool peripheries, prolonged capillary refill) with / without hypotension
Convulsions	One or more episodes
Abnormal bleeding	Bleeding from nose, gums, venepuncture sites, hematemesis or melena
Hemoglobinuria	Dark red / brown coloured urine with positive microscopic examination
Anemia	Hemoglobin 5 - 10 g / dl (Moderate), < 5 g / dl (Severe)
Thrombocytopenia	Platelet count < 1.5 lacs / μL
Renal impairment	Oliguria (< 1 ml / kg / hr) with rise in both blood urea (> 40 mg / dl) and serum creatinine (> 2 mg / dl)
Liver impairment	Serum bilirubin > 2 mg / dl or fourfold rise in serum transaminases from baseline
Hepatomegaly	Palpable liver which was > 2.5 cms below the costal margin
Splenomegaly	Any degree of palpable spleen below the costal margin
ARDS (Acute respiratory distress syndrome)	Acute onset respiratory failure not fully explained by cardiac failure or fluid overload with bilateral infiltrates on chest x ray
Altered sensorium	Confusion, delirium, stupor or coma
Prostration	Extreme weakness with inability to sit, stand, or walk without assistance
Hypoglycemia	Blood sugar < 40 mg / dl
Severe malaria	Defined as per WHO guidelines

Results

During the study period of one year, 3949 children were admitted at the Paediatrics Department of which 60 (1.5%) were managed as malaria. Three (5%) tested negative for malaria and were excluded from the study. Thus, 57 (95%) patients with positive RMAT and / or PBS were included in the study. All 57 (100%) patients tested positive for P. vivax, there was no case of P. falciparum reported at our centre. There were 22 (38.5%) severe malaria as per WHO guidelines, while 35 (61.4%) had uncomplicated malaria. (Table 2) Age and sex distribution of the study population is depicted in

Table 3. The seasonal trend of malaria is illustrated in Figure 1. The clinical features and the laboratory parameters are demonstrated in Table 4. Table 5 represents the children with anemia and their severity. Similarly, Table 6 shows the severity of thrombocytopenia in the study population.

Table 2: Age distribution of complicated and uncomplicated malaria

	1- 5 yrs (N = 20)	5 - 10 yrs (N = 21)	> 10 yrs (N = 16)	Total (N = 57)
Uncomplicated	15 (75)	13 (61.9)	7 (43.7)	35 (61.4)
Complicated	5 (25)	8 (38.0)	9 (56.2)	22 (38.5)
P value	0.27	0.96	0.20	-

Table 3: Age and sex distribution of total cases (N = 57)

	Age range (Years)				
Sex	< 1	1 - 5	5 - 10	> 10	Total
Male N (%)	0	6 (10.5)	15 (26.3)	8 (14)	29 (50.9)
Female N (%)	0	14 (24.5)	6 (10.5)	8 (14)	28 (49.1)
Total N (%)	0	20 (35.0)	21 (36.8)	16 (28)	57 (100)

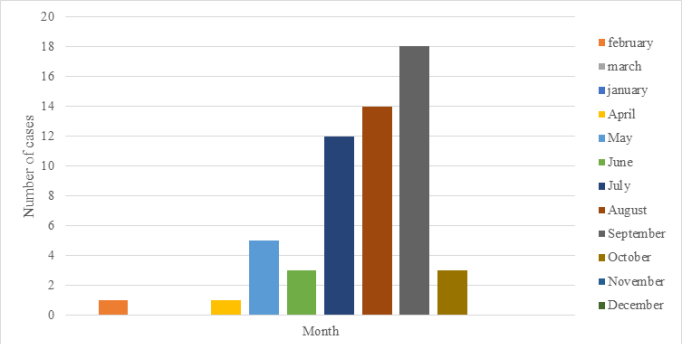

Figure 1: Distribution of malaria cases during the study period

Table 4: Distribution of clinical and lab manifestations in total cases (N = 57)

Symptoms	N (%)
Fever	57 (100)
Anemia (< 10 g / dl)	44 (77.2)
Pallor	30 (52.6)
Thrombocytopenia (< 1.5 lacs / cumm)	34 (59.6)
Splenomegaly	30 (52)
Hepatomegaly	25 (43.8)
Persistent vomiting	20 (35)
Liver impairment	7 (12.2)
Prostration	4 (7.0)
Shock	3 (5.3)
Convulsions	2 (3.5)
Altered sensorium	2 (3.5)
Bleeding	2 (3.5)
Hypoglycemia	2 (3.5)
Hemoglobinuria	1 (1.7)
ARDS	1 (1.7)
AKI	1 (1.7)

Table 5: Distribution of anemia in different age groups

Anemia Hb (gm / dl)	Age in years		Total (N = 57)	P value
	< 5 years (N =20)	> 5 years (N = 37)		
Moderate (5.1 -10 g / dl)	12 (60%)	23 (62%)	35 (61.4%)	0.28
Severe (< 5 g / dl)	4 (20%)	5 (13.5%)	9 (15.7%)	0.54
Total	16 (80%)	28(75.6 %)	44 (77.1%)	0.10

Table 6: Distribution of severity of thrombocytopenia

Platelets (Lacs / cumm)	N (%)
Less than 0.2	3 (5.2%)
0.2 - 0.5	12 (21.0%)
0.5 - 1.0	13 (22.8%)
1.0 - 1.5	6 (10.5%)
Total	34 (59.6%)

Out of the 57 cases of malaria, treatment was started with inj artesunate in 53 (93%) of patients, who were shifted to oral artemether lumefantrine combination once patient was able to tolerate oral medications. Artemeter lumefantrine was started as primary treatment in three (5.26%) patients,

while chloroquine was given to only one (1.7%) patient. Blood component transfusion was required in 11 (19.2%) patients, of which eight (14%) were transfused PRBC, two (3.5%) were given both platelets and PRBC, while one (1.7%) was transfused only platelet concentrate. None of the patients were deficient in Glucose-6-Phosphate-Dehydrogenase and all patients were given primaquine for 14 days at 0.25 mg / kg / day. 54 (94.7%) patients improved and were discharged, while one (1.7%) had multi organ dysfunction and was referred to higher centre due to limited resources at our institute and two (3.5%) patients left against medical advice. Mean duration of hospital stay was 6.2 (± 2.35) days.

Discussion

Malaria is caused by Plasmodium parasite. The four species of malaria are falciparum, vivax, ovale and malariae. Cases of a fifth species knowlesi have been reported recently from Indonesia as well as Malaysia. Falciparum and vivax are the major contributors in India.

In our study, the most common causative organism of malaria in children was P. vivax in all the cases. P. vivax infection comprised a significant case load of malaria in a study by Badugu et al of 59% in western UP.[7] Bhattacharjee et al reported P vivax as the causative agent for malaria in 168 out of 202 cases (83%) in children in western UP.[8] A few other studies from different parts of India shared similar findings as in our study.[3,4,10] A study by Kocher et al and Verma et al reported P falciparum causing around 60% of cases in other parts of the country.[5,11] P. falciparum continues to be the predominant species of plasmodium causing malaria in WHO African region, which continues to carry the heaviest burden of disease globally.[1] Two studies by Geleleta et al and Chiabi et al have reported P falciparum cases comprising 76% and 100% of case load respectively of the disease in this region.[12,13] Even though P. falciparum is the leading cause of severe malaria in African region, P. vivax has been a growing menace in South East Asian Region in the last decade.[5,14-16] Since there was no case of falciparum infection in our study, no comparison could be drawn between the spectrum of disease caused by these species. In our study we did a comprehensive analysis of epidemiology and clinic-pathologic manifestations of malaria caused by P. vivax. In our knowledge, there haven't been any study on malaria from our city recently, though few have been published from our state.[7,8]

Malaria has a seasonal trend with peaks often occurring after rainy season. In our study we found maximum number of cases from July to September which was also the monsoon period in Uttar Pradesh in 2024.[17]

Male children hospitalised with malaria infection was almost equal to female, M:F ratio being 1.03:1, similar to the results of a study from Uttar Pradesh by Bhattacharjee et al.[8] A few other studies from India reported higher proportion of male children being infected, almost double of the female children.

Out of 57 cases of P. vivax monoinfection, 22 (38.5%) were classified as severe malaria as per WHO guidelines.[9] In a recent study from our state, the proportion of P. vivax infections causing severe malaria was 74%.7 Proportion of P. vivax infections presenting as severe malaria ranged from 60 - 80% in other studies from India.[3-5]

The age distribution of malaria in our study was 20 (35%) for children less than 5 yrs of age and 37 (65%) for children 5 - 18 yrs of age. The results were similar to other studies from India.[3,5-7] Increasing outdoor play activities and reduced supervision of older children could be a factor for this difference. In contradiction to this finding, African region reported a higher proportion of under five among those hospitalised for malaria. Poor nutritional status and reduced immunity may form an association.[12,13]

Fever was the symptom present in all the children admitted at our institute. Study by Meena et al and Kumari et al also reported fever as the commonest presenting symptom in children affected with malaria.[4,6] Mean duration of symptoms was 8.01 (9) days {Mean (IQR)}.

Anemia was the most common hematological manifestation of malaria in our study. Plasmodium infections are a significant cause of anemia, particularly in tropical region. The common mechanism behind this being hemolysis of infected red blood cells (RBC) and reduced production of RBCs due to ineffective erythropoises. While pallor was present in 50 (87.7%) children, hemoglobin less than 10 g / dl was present in 44 (77.2%) children. Severe anemia with hemoglobin less than 5 g / dl was present in nine (15.7%) cases. Bhattacharjee et al reported a marginally lower incidence of anemia in P. vivax infected children in western Uttar Pradesh[7] while Badugu et al reported 81% prevalence of severe anemia in children in the same region.[8] A few studies from other parts of the country reported a higher incidence of anemia in admitted children.[4-6] Confounding factors in evaluation of this parameter could be prevailing iron deficiency, worm infestation and poor nutritional status.

Thrombocytopenia was also a major manifestation in our study, seen in 34 (59.6%) of patients. Three (5.2%) cases had platelet count less than 20,000 and few with bleeding manifestations were transfused platelets concentrate. Sequestration, immune destruction and oxidative stress could be possible cause of thrombocytopenia in malaria.[18-20]

Malaria infection triggers a strong immune response in human body, leading to enlargement of liver and spleen. Our study reported splenomegaly and hepatomegaly in 30 (52%) and 25 (43.8%) patients respectively. Similar findings have been reported in a few other studies.[4-8] Liver impairment was reported in seven (12.2%) children with serum bilirubin ranging from 2 - 9 mg / dl. None of the cases progressed to

hepatic encephalopathy and the functions normalised during course of hospital stay.

Among the severity parameters, severe anemia was the commonest present in nine (15.7%), followed by prostration in four (7%) and shock in three (5.3%) of cases. There were two (3.5%) cases each of convulsions, altered sensorium, bleeding and hypoglycemia, while ARDS and AKI were present in only one (1.7%) case. These observations indicate that P. vivax infections which were earlier considered benign, can cause all manifestations of severe malaria which were earlier limited to P. falciparum infections. Nonetheless, vivax has been reported as an emerging pathogen causing severe malaria in a few other studies from different geographical regions.[21,22]

Most of the cases were managed with parenteral and subsequently oral artemisinin based combinational therapy. Only one patient was treated with chloroquine. Almost all (94.7%) patients were successfully discharged while two left against medical advice and one with shock with hepatitis and AKI was referred to higher centre with no mortality at our centre.

The present research does not reflect the malaria situation in whole Eastern Uttar Pradesh as it included only admitted children at a single centre. Since the study was conducted for a short period of one year, we could not highlight the changing trends of the disease. Further multicentric prospective studies with a longer study period would strengthen our results and throw light on the changing pattern of disease.

Conclusions

We conclude that P. vivax is the predominant species causing both uncomplicated and severe malaria in children in our region. Since the virulence and burden of P. vivax is increasing, studying the genetic patterns in vivax from different geographical regions may be of help in developing tailored treatment and interventions.

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