International Journal of Advances in Medicine
Khuraiya P et al. Int J Adv Med. 2016 May;3(2):209-217
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20160685

Research Article

The study of clinical, biochemical and hematological profile in malaria patients

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Received: 18 January 2016
Accepted: 22 February 2016

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ABSTRACT

Background: Malaria is a major health problem in India. Malaria is the most important parasitic infection which causes major health challenges. Malaria pathogenesis is based on extensive changes in hematological and biochemical parameters. The objective of this study was to study the clinical features, hematological and biochemical parameters in malaria patients and correlate them.
Methods: The present study was done in the department of medicine, M.G.M.M.C & M.Y.H. Indore (M.P.). In this study various signs and symptoms and frequency of changes in hematological and biochemical parameters caused by Plasmodium species were determined. Mean, standard deviation, minimum, maximum values of laboratory alterations were noted and associations were calculated.
Results: 104 patients who had peripheral smear positive for malaria parasite were included in this study. Out of these 104 patients 53 (50.96%) patients of *P. falciparum*, 48 (46.15%) patients of *P. vivax* and 3 (2.88%) patients of mixed infection. In the present study most common system involved was haematological (69%) followed by hepatic (42.3%), renal (29.04%), neurological (28.84%), cardiovascular (16.34%) and pulmonary (2.88%).
Conclusions: Malaria though potentially treatable, still kills many patients every year in India. The most common presentation of malaria is fever, so in endemic region malaria may be considered as a leading differential diagnosis in all patients presenting as acute febrile illness, especially patients who also have organomegaly, fall in hemoglobin level, thrombocytopenia and altered liver function tests. Therefore, it is vital to know and perform hematological and biochemical investigations to detect early complications and to treat them effectively.

Keywords: Malaria, Clinical features, Hematological parameters, Biochemical parameters, Acute febrile illness

INTRODUCTION

From the time of immortal, malaria has been one of the most prevalent of human disease. Malaria, the disease as old as humanity itself and often called as 'King of disease'. In ancient India, malaria was known as the king of disease because of it formed the vicious cycle of sickness, death and poverty.

Malaria is a protozoan disease transmitted by the bite of infected *Anopheles* mosquitoes. The most important of the parasitic diseases of humans, Malaria is a major cause of morbidity in the tropics, thus disease is of global importance that results in 300-500 million cases and 1.5-2.7 million deaths yearly.[1] Approximately 2.48 million malarial cases are reported annually from south Asia, of which 75% cases are contributed by India alone.[2]

Malaria is a febrile illness characterized by fever and related symptoms; however it is very important to remember that malaria is not a simple disease of fever, chills and rigors.

The number of atypical presentations of malaria has gradually increased during the past few decades.[3] Malaria can present with non-specific symptoms like headache,

fatigue, joint pain, vomiting, abdominal discomfort, myalgia followed by fever to severe complications like jaundice, acute renal failure, anaemia, shock, convulsions and coma. In fact in a malarious region where the endemicity of malaria is high it can presents with such varied and dramatic manifestations that malaria may have to consider as a differential diagnosis for almost in every clinical problems.

A prompt and early diagnosis is important for effective management in malaria. Many acute febrile illnesses like viral fever, arboviral infections, enteric fever and leptospirosis occur in the tropics and it is difficult to distinguish malaria from these illnesses on clinical grounds alone.[4] Hematological and biochemical changes associated with malarial infection are well recognized, but specific changes may vary with the level of malaria endemicity, haematological and nutritional status, demographic factors and malarial immunity.[5]

Malaria can affect single or multiple organs with different levels of severity. This study is an attempt to investigate the effects of severe malaria in infected patients on few hematological and biochemical parameters that could provide a credential clues in understanding malaria pathogenesis, diagnosis and management.

Aims and objective

- To study the incidence of malaria admitted in MY Hospital during the study period.
- To study the various clinical (typical and atypical) manifestation of malaria.
- To study the biochemical and hematological changes in cases of malaria.
- To assess and evaluate the treatment outcomes.

METHODS

"The Study of Clinical, Biochemical & Hematological profile in Malaria patients."

This study was conducted at M.G.M. Medical College & M.Y. Hospital, Indore (M.P.) from Feb-15 to Oct-15. During this study period 104 patients had Malaria parasite positive in peripheral smear; these patients were included in the study.

Method of collection of data

Patient's informed consent was taken.

A detailed history, clinical examination and laboratory investigations including peripheral smear examination for malaria parasite, Malaria card test, hemoglobin, total wbc count, differential WBC count, platelet count, blood sugar, blood urea, serum creatinine, serum electrolyte, serum bilirubin direct, indirect and total, SGOT and SGPT, urine for routine microscopy, USG abdomen was done.

Patients with suspected co-infections like enteric fever, dengue fever, sepsis, UTI, meningitis, encephalitis etc. were investigated and those who were found to have a specific cause were excluded from study.

Inclusion criteria

- All patients above 12 years of age.
- Patient positive for malaria parasite by peripheral smear.

Exclusion criteria

- Patients less than 12 years of age.
- Patient negative for malaria parasite by peripheral smear.
- Patients having other co-infections like enteric fever, dengue fever, sepsis, UTI, meningitis, encephalitis etc.

Patients diagnosed as malaria were registered and monitoring was done during the admission period.

Various parameters (biochemical/hematological) changes were noted, various complications developed were noted.

Associations were calculated.

RESULTS

The present study was carried out in the Department of Medicine, M.G.M. Medical College & M.Y. Hospital, Indore (M.P.) from Feb-15 to Oct-15 and the following observations were drawn from the study.

Table 1: Incidence of malaria.

S. No.		Cases	%
1	Total admission (Feb 2015 - Oct 2015)	9785	
2	Total pyrexia cases	1057	
3	Clinically malaria fever	409	38.69
4	Malaria parasite found in peripheral smear	104	9.83
	P. falciparum infection	53	50.96
	P. vivax infection	48	46.15
	Mixed infection	3	2.88

The study was carried on population above 12 year age group only. The above table shows highest incidence was in the age group of 21-30 years. In a total of 104 patients there were 58 male patients and 46 female patients. The mean age for male was 33.60±15.68 years and for female it was 32.74±17.83 years and overall mean age±SD is 33.22±16.59 years.

Table 2: Age and sex distribution of malaria.

Age in years	Male			Female			Total		
	P. falciparum	*P. vivax*	Mixed	*P. falciparum*	*P. vivax*	Mixed	Male	Female	Malaria case
12 to 20	4	9	0	6	6	0	13	12	25
21 to 30	15	4	0	8	8	1	19	17	36
31 to 40	6	4	0	2	3	1	10	6	16
41 to 50	3	5	0	1	1	0	8	2	10
51 to 60	2	3	0	3	3	0	5	6	11
>60	2	0	1	1	2	0	3	3	6

Table 3: Monthly incidence of malaria (seasonal variation).

Month	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Feb-15	1	3	0	4	1.88	6.25	0	3.84
Mar-15	5	2	0	7	9.43	4.16	0	6.73
Apr-15	3	3	0	6	5.66	6.25	0	11.32
May-15	2	3	0	5	3.77	6.25	0	4.8
Jun-15	7	6	0	13	13.2	12.5	0	24.52
Jul-15	9	8	1	17	16.98	16.66	33.3	32.07
Aug-15	11	9	1	20	20.75	18.75	33.3	37.73
Sep-15	8	8	0	16	15.09	16.66	0	30.18
Oct-15	7	6	1	13	13.2	12.5	33.3	24.52

Table 4: Various clinical symptoms of malaria and their incidence.

Symptoms	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Fever	53	48	3	104	100	100	100	100
Chills & rigor	47	44	3	94	88.67	91.66	100	90.38
Headache	17	14	2	33	32.07	29.16	66.6	31.73
Altered sensorium	10	4	0	14	18.86	8.33	0	13.46
Seizures	6	1	1	8	11.32	2.08	33.3	7.69
Decreased urine output	7	4	2	13	13.2	8.33	66.6	12.5
Dark urine	7	3	1	11	13.2	6.25	33.3	10.57
Nausea/vomiting	27	26	2	55	50.94	54.16	66.7	52.88
Diarrhoea	4	1	0	5	7.54	2.08	0	4.8
Jaundice	15	6	3	24	28.3	12.5	100	23.07
Difficulty in breathing	5	3	1	9	9.43	6.25	33.3	8.65
Bleeding manifestations	2	0	1	3	3.77	0	33.3	2.88

In our study, the maximum number of cases (approx 50.96%) occurred during the months from Jul-15 to Sept-15, concurring with the rainy season and mosquito breeding.

In our study fever was the most common symptom, being present in 100% cases. The fever was associated with chills & rigor in 90.38% cases.

In our study 85.57% patients had Sinus tachycardia in CVS Examination, 63.46% patients had pallor in general examination, 32.69% patients had spleenomegaly in Per-abdomen examination, 19.23% patients had tachypnea in respiratory examination and 12.5% patients had oliguria in renal examination.

In our study 6.73% patients were drowsy and 8.65% were unconscious at the time of presentation. Increased tone was noted in 4.8% patients and decreased tone was noted in 5.76% patients.

In our study the most common system involved was hematological (69%) followed by hepatic (42.3%), renal

(29.04%), neurological (28.84%), cardiovascular (16.34%), and pulmonary (2.88%).

In our study, most common complication observed in malaria patients was hyperpyrexia (61.53%) followed by severe anaemia (34.61%) and most of the patients having hyperpyrexia developed more than 1 complication.

In our study, all the patients that died had multi organ involvement, in which most common systems involved were hematological (100%) and hepatic (100%), followed by Renal (77.7%), neurological (77.7%), shock (66.6%), hypoglycemia (33.3%) and pulmonary involvement (33.3%).

In our study 95 (91.34%) patients got cured and 9 (8.65%) patient died. Most of the patients who died (77.7%) were infected by *P.falciparum*.

Table 5: Clinical signs in studied group (apart from CNS manifestations).

Signs	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
General examination								
Pallor	37	27	2	66	69.81	56.25	66.6	63.46
Icterus	18	8	3	29	33.96	16.66	100	27.88
Hyperpyrexia (>104°F)	39	22	3	64	73.58	45.83	100	61.53
Respiratory examination								
Tachypnea	11	7	2	20	20.75	25	66.6	19.23
Signs of pneumonia	0	0	0	0	0	0	0	0
ARDS like picture	1	1	1	3	1.88	2.08	33.3	2.88
CVS examination								
Shock	7	5	2	14	13.2	10.41	66.6	13.46
Sinus tachycardia	46	40	3	89	86.79	83.3	100	85.57
Haemic murmur	3	1	1	5	5.66	2.08	33.3	4.8
Per-abdomen examination								
Hepatomegaly	15	13	0	28	28.30	27.08	0	26.92
Spleenomegaly	19	15	0	34	35.84	31.25	0	32.69
Hepatospleenomegaly	6	4	2	12	11.32	8.33	66.6	11.53
Renal examination								
Oliguria	7	4	2	13	13.2	8.33	66.6	12.5
Dark urine	7	3	1	11	13.2	6.25	33.3	10.57
Hematological bleeding manifestation	2	0	1	3	3.77	0	33.3	2.88

DISCUSSION

Incidence of malaria

In the present study out of 104 patients there were 53 (50.96%) patients of *P.falciparum*, 48 (46.15%) of *P. vivax* and 3 (2.88%) patients of Mixed infection. Kocher, et al also reported a higher incidence of *P.falciparum* in Bikaner.[6] According to the World Malaria Report 2014, there are more cases of *P.falciparum* than *P. vivax*.[7]

The increase in the proportion of *P.falciparum* infection over *P. vivax* may be because of prevailing chloroquine resistance in *P.falciparum*. Widespread use of chloroquine might have suppressed *P. vivax* more than *P.falciparum*, thus increased incidence. One more cause of less incidence of *P. vivax* malaria could be low reporting to tertiary care centres as *P. vivax* malaria causes relatively mild illness.

Age distribution

In this study only Patients aged more than 12 year were included. The maximum numbers of cases were seen in between 12-30 years of age (58.65%). The mean age±SD for male were 33.60±15.68 years and for female 32.74±17.83 years. The mean age±SD of *P. vivax* and *P.falciparum* infected patients were 33.52±16.83 and 32.43±16.12 years respectively. Similar results were found in a study done by Hussain M.M. et al (*P.falciparum* 27.85±4.8 years and *P. vivax* 29.25±3.8 years).[8]

The incidence of malaria is highest in younger physically active age groups in this study. This has been attributed to:

1. State of immunological balance against malaria also known as "premunition" which is achieved late in adulthood.
2. Indian demography suggests that the maximum population right now is of younger adults.
3. Increased chance of contracting the infection due to more outdoor activities in younger age group.

Table 6: Neurological finding in studied group.

Signs	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Higher mental function								
Consciousness	41	45	2	88	77.35	93.75	66.6	84.61
Drowsiness	5	2	0	7	9.43	4.16	0	6.73
Unconscious	7	1	1	9	13.2	2.08	33.3	8.65
Psychiatric manifestation								
Psychosis/altered behaviour	3	1	0	4	5.66	2.08	0	3.84
Motor system examination								
Tone: normal	45	46	2	93	84.9	95.83	66.6	89.42
Decreased	4	1	1	6	7.54	2.08	33.3	5.76
Increased	4	1	0	5	7.54	2.08	0	4.8
Power (motor weakness)								
>4/5	43	45	1	89	81.13	93.75	33.3	85.57
1/5-3/5	6	2	1	9	11.32	4.16	33.3	8.65
<1/5	4	1	1	6	7.54	2.08	33.3	5.76
Abdominal reflexes absent	13	9	1	23	24.52	18.75	33.3	2.11
DTR: normal	45	46	2	93	84.9	95.83	66.6	89.42
Brisk	4	1	0	5	7.54	2.08	0	4.8
Sluggish/absent	4	1	1	6	7.54	2.08	33.3	5.76
Plantar: flexor	41	41	1	83	77.35	85.41	33.3	79.8
Extensor	3	1	0	4	5.66	2.08	0	3.84
Not elicitable	4	2	2	8	7.54	4.16	66.6	7.69
Withdrawal	5	4	0	9	9.43	8.33	0	8.65
Meningeal signs positive	6	1	1	8	11.32	2.08	33.3	7.69
Cerebellar signs positive	0	0	0	0	0	0	0	0
Sensory system examination	0	0	0	0	0	0	0	0
Cranial N. involvement	0	0	0	0	0	0	0	0

Table 7: Frequency of involvement of various systems in malaria.

System involvement	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Hematological system	39	29	3	71	73.58	60.41	100	68.26
Neurological system	22	7	1	30	41.5	14.58	33.3	28.84
Renal system	19	10	2	31	35.84	20.83	66.6	29.04
Hepatic system	26	15	3	44	49.05	31.25	100	42.3
Cardiovascular system	10	5	2	17	18.86	10.41	66.6	16.34
Pulmonary system	1	1	1	3	1.88	2.08	33.3	2.88

Sex distribution

In the present study 56% patients were male and 44% were female. The cause of this relative male preponderance could be due to more outdoor activities in males. Similar observation is seen in the study of Hussain M.M. et al A. K. Saha, et al.[8,9]

Seasonal variation

The maximum number of cases i.e. 51% was observed in the monsoon period i.e. July to September because the conditions were optimum for the development of malaria parasite and also during this period more water accumulation occurs which is suitable for breeding of mosquitoes. This observations corroborates with the findings of Kocher, et al.[6]

Table 8: Relative frequency of severity (as per WHO guideline).

Complications	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Cerebral malaria (coma/impaired cause)	17	5	1	23	32.07	10.41	33.3	22.11
Severe anaemia (Hb <7 gm/dl)	21	13	2	36	39.62	27.08	66.6	34.61
Oliguria or s. creatinine (>3 mg/dl)	13	4	2	19	24.52	8.33	66.6	18.26
ARDS	1	1	1	3	1.88	2.08	33.3	2.88
Hypoglycemia (RBS<40 mg/dl)	4	2	1	7	7.54	4.16	33.3	6.73
Shock (SBP<80 mmHg)	7	5	2	14	13.2	10.41	66.6	13.46
Bleeding manifestation	2	0	1	3	3.77	0	33.3	2.88
GTCS (more than 2)	3	0	0	3	5.6	0	0	2.8
Hyperpyrexia (>104°F)	39	22	3	64	73.58	45.93	100	61.53
Extreme weakness without neurological cause	4	1	1	6	7.54	2.08	33.3	5.76
Jaundice (S. Bilirubin >3 mg/dl)	13	5	3	21	24.53	10.41	100	20.19

Table 9: Complication associated with mortality cases.

Complications	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Neurological (Altered sensorium)	6	0	1	7	85.71	0	100	77.7
Renal system (deranged creatinine/urea)	5	1	1	7	71.42	100	100	77.7
Hepatic (deranged bilirubin /enzyme)	7	1	1	9	100	100	100	100
Hematological system (anaemia/ abnormal count/ platelet decreased)	7	1	1	9	100	100	100	100
pulmonary system	1	1	1	3	14.28	100	100	33.3
Hypoglycemia (RBS<40mg/dl)	3	0	0	3	42.85	0	0	33.3
Shock (SBP<80mmHg)	4	1	1	6	57.14	100	100	66.6

Table 10: Outcome of patients.

Outcome	Cases				%			
	P. falciparum	*P. vivax*	Mixed	Total	*P. falciparum*	*P. vivax*	Mixed	Total
Death	7	1	1	9	13.2	2.08	33.3	8.65
Cured	46	47	2	95	86.79	97.91	66.6	91.34

Symptoms

Fever

In our study fever was the most common symptom, being present in 100% cases. The fever was associated with chills & rigor in 90.38% cases.

Mean temperature of patients in the study was 103.39±2.14°F.

Mean temperature of patients suffered from *P. falciparum* malaria was 103.98±1.65°F, and Mean temperature of patients suffered from *P. vivax* malaria was 102.67±2.43°F.

Altered sensorium

In our study, 13.46% patients presented with altered sensorium, which is due to plugging of smaller vessels of brain producing local hypoxia, edema, hyperpyrexia, severe anemia, hepatic dysfunction, acute renal failure and metabolic disturbances etc. all of which contribute to it. Similar results were seen in the study done by Kocher et al, Chetan J. Galande, et al.[6,10]

Convulsions

In our study 8 patients had Convulsions, out of which only 3 patients had severe malaria which is defined as more than 2 Convulsions within 24 hrs as per WHO criteria. Our results corroborates with the results obtained in study conducted by Kocher et al.[6]

Anaemia

In the present study 64.42% patients had anaemia. Severe anaemia i.e. hemoglobin less than 7gm/dl (as per who criteria) was observed in 34.61% of patients. Anemia in Malaria is multi factorial in origin. These factors include hemolysis of parasitized as well as non-parasitized cells, spleenic and reticular hyperactivity, genetic factors and oxidative stress and bone marrow suppression.[11,12]

The nature of hematological abnormalities depends on the time after infection. A recent study has revealed a role of interleukins (IL–4) and interferon's (IFN–gamma) in erythropoietin suppression.[13,14] Inappropriately low reticulocytosis has been observed in malaria patients suggesting that insufficient erythropoiesis is major factor for anaemia.

In our study 57% patients had normocytic normochromic anaemia and 25% of the patients had microcytic hypochromic type of anaemia. In our study Mean Hemoglobin level was 8.16±2.66gm/dl, 9.03±2.86 gm/dl and 6.46±2.97gm/dl in patients was suffered from *P.falciparum, P. vivax* infection and mixed infection.

Similar result was found in study conducted by Hussain M.M et al[8] who found Hemoglobin levels, 9.58±0.2 gm/dl, 10.56±0.3 gm/dl and 9.46±0.7 gm/dl in patients who suffered from *P .falciparum, P. vivax* infection and mixed infection respectively.

Jaundice

In our study Raised serum bilirubin levels were seen in 27.88% cases. Maximum observed value of serum bilirubin was 25.2 mg/dl and mean serum bilirubin level was 2.84±3.88 mg/dl. Serum transaminases, SGOT and SGPT were raised in 31.73% and 33.65% patients respectively. 1269 IU/dl and 1340 IU/dl were the maximum levels of SGOT and SGPT that were seen in the study. The mean±SD level for SGOT was 165.69±328.87 IU/dl and for SGPT was 164.56±310.29 IU/dl. Prothrombin time was increased in 10.57% patients.

Per-Abdomen examination

In our study 26.92% patients had hepatomegaly, 32.69% had spleenomegaly and 11.53% had hepato-spleenomegaly.

Renal involvement

In our study 13 patients had oliguria while raised blood urea and S. creatinine was seen in 24.03% and 29.81% patients respectively. The maximum value of blood urea and serum creatinine was 160 mg/dl and 7.8 mg/dl respectively. Similar result was found in study conducted by Chetan J. Galande, et al in which renal involvement was seen in 31% cases.[10] Mean±SD value for blood urea in *P. falciparum* malaria was 43.90±24.66 mg/dl and in *P. vivax* was 38.72±17.92 mg/dl. Mean±SD value for serum creatinine in *P.falciparum* malaria was 1.98±1.37 mg/dl and in *P. vivax* malaria it was 1.43±1.05 mg/dl.

Hematological

In our study 3.84% patients had leukopenia i.e. TLC <4000 while 8.65% patients had leucocytosis i.e. TLC>11000. Similar observation was found in study of Kocher, et al.[6] Thrombocytopenia was observed in 26% of patients (36% among *P. falciparum* infected and 13% among *P. vivax* infected patients) while bleeding manifestation developed only in 2.88% patients. These findings reaffirm the WHO guidelines that platelet transfusion is not indicated in all patients with malaria and thrombocytopenia.

CVS

In our study 86% of patients had sinus tachycardia while 4.8% had haemic murmur. Shock was present in 13.46% of patients. Similar observation was found in the study conducted by Chetan J. Galande, et al (Shock in15%).[10]

Hypoglycemia

In our study Random Blood Sugar less than 40mg% was noted in 6.73% patients which is similar to the study of Chetan J. Galande, et al (3%).[10]

Neurological

In our study 6.73% patients presented with drowsiness, 8.65% patients were unconscious and 13.46% patients were in altered sensorium at the time of presentation. Increased tone was noted in 4.8% patients and decreased tone was noted in 5.76% patients. Deep tendon reflex were found brisk in 4.8% patients and sluggish/absent in 5.76% patients. Plantar were extensor in 3.84% patients, not elicitable in 7.69% patients, withdrawal reflexes were present in 8.65% patients.

Seizure

In our study seizures were found in 7.69% patients, out of which 2.8% patients had more than 2 episodes of seizure within 24 hr (severe malaria as per WHO criteria).

Meningeal sign

Meningeal sign were present in 7.69% patients, all of which had normal CSF pictures. This finding shows that malaria can be a cause of meningeal signs or aseptic meningitis (meningismus).

CSF

CSF was examined in 23 patients, in which proteins were high only in 3 patients while all other have normal range of protein in CSF and glucose was found to be normal in all of the patients and Cells were normal i.e. <5/µl in all of the patients.

CT/MRI brain

Imaging of brain were done in 18 patients, only 1 patient had B/L cerebral edema rest all of the patients had normal imaging of brain.

System involvement

In our study the relative frequencies of involvement of various systems were: hematological involvement in 69% cases, hepatic involvement in 42.3%, renal involvement in 29.03%, neurological involvement in 28.84%, cardiovascular involvement in 16.43% and pulmonary involvement in 2.88% of cases.

Similar result is seen in the study conducted by Y. Khatib, et al haematological system 72.3%, hepatic system 30%, renal system 21%.[15]

Outcomes

In our study out of the 104 patients, 9 (8.65%) patients died during the course of stay and 95 (91.34%) patients were cured. Similar results were seen in the study of Kocher, et al in which 10.93% died and in Chetan J Galande the mortality was 3%.[6,10]

In our study the mortality rate was slightly higher as compare to other study. This might may be explained by the fact that majority of the death were seen in patients presenting late and with systemic involvement.

Complication related to mortality with expired case

In our study most of the deaths were due to multisystem involvement. In the patients who died of malaria, combined hematological and hepatic involvement were present in 100% of cases, neurological and renal involvement were seen in 77.7%, respiratory abnormality and hypoglycemia were found in 33.3% and shock was found in 66.6% cases. Similar pattern were observed in Kocher, et al.[6]

CONCLUSION

Malaria though potentially treatable, still kills many patients every year in India. The infection with *P. falciparum* and *P. vivax* causes significant changes in hematological and biochemical parameters in patients. The most common presentation of malaria is fever, so in endemic region malaria may be considered as a leading differential diagnosis in all patients presenting as acute febrile illness, especially patients who also have organomegaly, fall in hemoglobin level, thrombocytopenia and altered liver function tests. Malaria may be associated with life threatening complications such as cerebral malaria, severe anemia, acidosis, respiratory distress and acute renal failure (ARF). So it is vital to know and perform hematological and biochemical investigation to detect early complications and to treat them effectively. Inadvertent use of antimalarial in past has led to increase resistance in plasmodium which is one of the reason for failure of treatment and also of increasing incidence of *P. falciparum*. Due to lack of vaccination, developing resistance to drugs and changing presentation of illness, malaria still remains a major health problem. In order to contain this illness, further ongoing studies are warranted.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Snow RW, Guerra CA, Noor AM, Myint HY, Hay SI. The global distribution of clinical episodes of *Plasmodium falciparum* malaria. Nature. 2005;434:214-7.
2. Yadav D, Chandra J, Dutta AK. Benign tertian malaria: how benign is it today? Indian J Pediatr. 2012;79(4):525-7.
3. Guidelines for diagnosis and treatment of Malaria in India 2009, second edition, 2011.
4. Lathia TB, Joshi R. Can hematological parameters discriminate malaria from non malarious acute febrile illness in the tropics? Indian J. Med. Sci. 2004;58:239-44.
5. Price RN, Simpson JA, Nosten F, Luxemburger C, Hkirjaroen L, Ter Kuile F et al. Factors contributing to anaemia after uncomplicated falciparum malaria. Am. J. Trop. Med. Hyg. 2001;65(5):614-22.
6. Kochar D, Das A, Kochar S, Saxena V, Sirohi P, Garg S. Severe *Plasmodium vivax* malaria: A report on series cases from Bikaner in North western India. Am J Trop Med Hyg. 2009;80(2):194-8.
7. WHO. World Malaria Report 2014. WHO, Geneva. 2014. Available at http://apps.who.int/iris/bitstream/10665/144852/2/9789241564830_eng.pdf. Accessed on 01 January, 2016.

8. Hussian MM, Sohali M, Abhishek K, Raziuddin M. Investigation on *Plasmodium vivax* infection influencing the host factors in tribal dominant and malaria endemic population of Jharkhand. Saudi J Biol Sci. 2013;20(2):195-203.
9. Saha AK, Maitra S, Hazra SC. Comparison of hematological parameters between Plasmodium falciparum, *Plasmodium vivax* and control group. IJMRHS. 2014;3(1):120-7.
10. Galande CJ, Desai RR, Aundhakar SC, Patange AP, Goel UK. Study of clinical profile of malaria in tertiary referral centre in western Maharashtra. ISSN: 2249-9571.
11. Davis TM, Krishna S, Loopreesuwan, Supanaranond W, Pukruttayakamee S, Attatamsooonthorn & white NJ. Erythrocyte sequestration and anaemia in severe falciparum malaria. Analysis of acute changes in venous hematocrit using a simple mathematical model. J Clin Invest. 1990;86(3):793-800.
12. Wickramasinghe SN, Abdulla SH. Blood and bone marrow changes in malaria. Ballieres Best Pract Res Clin Haematol. 2000;13:277-99.
13. Thawani N, Tam M, Stevenson MM, STAT 6 mediated suppression of erythropoiesis in an experimental model of malaria anaemia. Haematologica. 2009;94(2):195-204.
14. Chang KH, Stevenson MM. Malarial anaemia: mechanisms and implications of insufficient erythropoiesis during blood-stage malaria. Int J Parasital. 2004;34:1501-16.
15. Khatib Y, Patel R, Sequeira K, Agrawal G, Chikhale N. Hematological and biochemical alterations in malaria and their correlation with Parasitic Index. IOSR J Pharm. 2015;5(9):53-6.

Cite this article as: Khuraiya P, Sharma SS, Thakur AS, Pandey VP, Verma S. The study of clinical, biochemical and hematological profile in malaria patients. Int J Adv Med 2016;3:209-17.