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Original Research Paper

Pathology

A STUDY OF HEMATOLOGICAL PARAMETERS IN MALARIA IN A WESTERN MAHARASTRA TERTIARY CARE HOSPITAL.

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ABSTRACT

Background: Malaria is a life threatening protozoan disease caused by Plasmodium species, transmitted by the bite of infected female Anopheles mosquito. The hematological changes that have been consistently reported include anemia, thrombocytopenia, atypical lymphocytosis and infrequently disseminated intravascular coagulation. This study aims to determine and correlate various clinico-pathological, hematological and biochemical alterations in patients infected with malaria. **Methods:** This is an observational retrospective and prospective study carried over a period of two years, including 48 cases of malaria, diagnosed on peripheral smear examination (both thick and thin smear) or Malarial antigen testing (Rapid malaria test). **Result:** There was male preponderance (M:F ratio 3:1), commonly affecting the third decade age group (41% of all cases). The commonest complain at presentation was fever with chills [46/48 (95.8%)] cases. Plasmodium vivax was the commonest infecting species [34 cases (70.8%)]. Patients with higherparasitemia had higher incidence of severe thrombocytopenia (42.8%). All patients having altered LFT and RFT had severe malaria. **Conclusion:** Patients with clinical diagnosis of malaria should be monitored with hematological profile to pick up the complicated cases and hence to improve the outcome in cases of malaria.

KEYWORDS : Plasmodium Vivax, Anemia, throbocytopenia.

INTRODUCTION

Malaria is a life threatening protozoan disease caused by Plasmodium species, transmitted by the bite of infected female Anopheles mosquito. As per World malaria report 2022, globally there were an estimated 247 million malaria cases in 2021 in 84 malaria endemic countries (including the territory of French Guiana), with most cases reported from WHO African region (234 million - 95%). The WHO South-East Asian Region accounted for 2% of global malaria cases, with India accounting for 79% of cases in the region. The estimated malaria deaths in 2021 was 619000[1].

Table 1: Reported Malaria Cases By Species, 2010-2021

WHO region country/area		2010	2011	2012	2013	2014	2015
India	Indegenous cases	1599986	1310656	1067824	881730	1102205	1169261
	Total P.falciparum	830779	662748	524370	462079	720795	774627
	Total P.Vivax	765622	645652	534129	417884	379659	390440
	Total Mixed cases	3585	2256	9325	1767	1751	4194
	Total other cases	0	0	0	0	0	0
		2016	2017	2018	2019	2020	2021
	Indegenous cases	1087285	844558	429928	338494	186532	161753
	Total P.falciparum	706257	525637	204733	154645	117567	100442
	Total P.Vivax	375783	315028	222730	181514	67444	60187
	Total Mixed cases	5245	3893	2465	2295	1520	1124
	Total other cases	0	0	0	0	1	0

Two types of parasites: P. vivax and P. falciparum are commonly reported from India. Hematological changes play a fatal role in complications of malaria. The changes that have been consistently reported include anemia, thrombocytopenia, atypical lymphocytosis and infrequently disseminated intravascular coagulation. Leucopenia, leucocytosis, Neutopenia, Neutrophilia, Eosinophilia and monocytosis also have been reported.

Aim and Objectives

The study aims to evaluate the hematological parameters (hemoglobin, total and differential leukocyte count, platelet count, peripheral smear: thick and thin smear) in diagnosed cases of Malaria, and to correlate these findings with biochemical profiles and clinical findings.

MATERIAL AND METHODS

This was a two year observational study, including 48 malaria cases: consisting of one year retrospective and one year prospective study. Hematological investigations performed were, hemoglobin estimation, total and differential leukocyte count, total platelet count (using our semi-automated hematology analyzer), peripheral smear thick and thin smears for malarial parasite and parasite index, ESR and coagulation profile. Minimum of 200 fields (oil immersion) were assessed to label a negative smear. The species, percentage and grading of parasitemia was done after counting schizonts, ring and amoeboid forms in oil immersion on thin smears. Anemia and thrombocytopenia were labeled when hemoglobin (Hb) was < 13.0 g% in males and 12g% in females; and platelet counts were <1.5 lakhs/mm3, respectively. Biochemical parameters (Blood urea, serum creatinine, total bilirubin, direct bilirubin, indirect bilirubin, aspartate aminotransferase, alanine aminotransferase, total protein, serum albumin and serum globulin) were collected from Department of Biochemistry or from the medical records. Data obtained was analyzed to obtain clinico-hematological correlation in malaria patients.

RESULTS

A total of 48 cases of malaria were studied over a period of 2 years in a tertiary care centre based cross sectional study.

Table 2: Month And Year Wise Distribution Of Malaria Cases

Month	2013-14	2014-15	Total
January	02	00	02

February	01	00	01
March	00	02	02
April	00	01	01
May	00	02	02
June	02	06	08
July	02	03	05
August	04	02	06
September	05	05	10
October	02	02	04
November	04	02	06
December	00	01	01
Total	22	26	48

A rise in incidence was recorded during the period of June to September coinciding with rainy season

Male : Female ratio was found to be 3:1 (M=36, F=12). Maximum number of cases was reported in the third decade (n=20, %). Maximum number of cases was found to be positive for Plasmodium vivax (n=34/48,70.8%) followed by equal number of P. falciparum (n=7/48, 14.58%) and mixed infection (n=7/48, 14.58%).

Almost all patients (n=46/48, 100%) presented with fever with chills, followed by splenomegaly (n=12/48, 25%). Other clinical presentation noted were, generalised weakness (n=11/48, 22.91%), pain in abdomen (n=1/48, 2.08%), burning micturation (n=1/48, 2.08%) and respiratory symptoms (n=2/48, 4.16%). 3 out of 48 (6.25%) patients were also positive for Dengu NS1 antigen. Out of 48, 15 (31.25%) cases had a parasitic index of more than >2%.

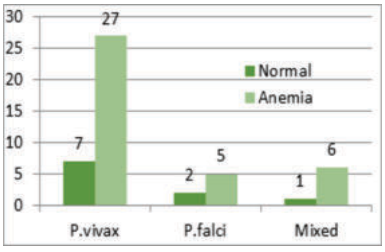

Figure 1: Hemoblobin Estmation In Cases Of Malaria

Out of 48 cases, 38 cases i.e. 79% cases had anemia. 85.7% of patients having mixed infection were anemic.

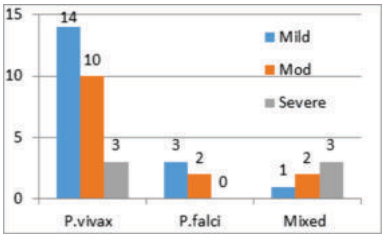

Figure 2: Distribution Of Malaria Cases According To Severity Of Anemia

Majority of the patients had mild anemia. Distribution of cases according to the species of the parasite was almost similar among various categories of anemia.

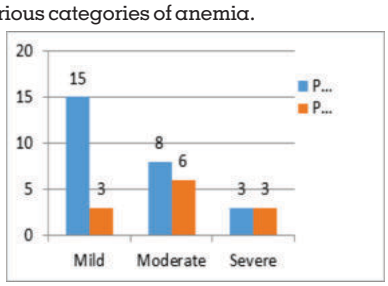

Figure 3: Severity Of Anemia And Parasite Index

A higher number of cases with mild anemia had a P.I <2%. Incidence of P.I >2% was found to increase with severity of anemia.

Majority of the patients had normal leukocyte count (36/48). No significant association noted between leukocyte count and type of malaria.

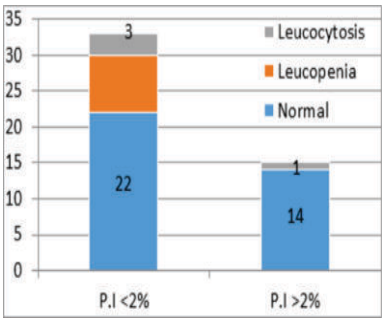

Figure 4: Correlation Of Leukocyte Count With Parasite Index

Majority of the patients with P.I >2% had a normal leukocyte count.

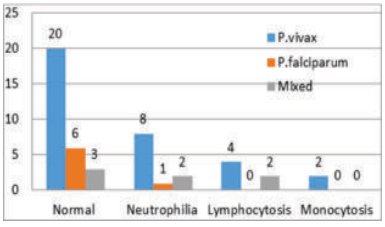

Figure 5: Distribution Of Cases As Per Differential Leukocyte Count

Majority of the cases had normal leukocyte count (29/48). Monocytosis was seen in 2 cases. DLC seems to have no association with type of malarial parasite.

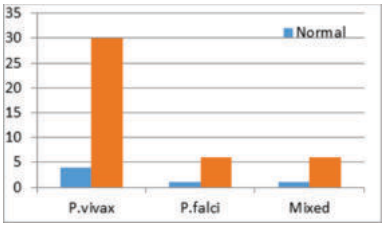

Figure 6: Platelet Count In Cases Of Malaria

Majority patients (with all three types of malaria) had thrombocytopenia i.e. 42/48. No difference was noted in the incidence of thrombocytopenia among different types of infections.

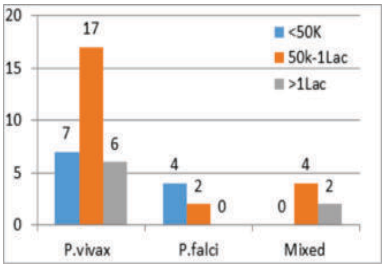

Figure 7: Species Wise Distribution Of Thrombocytopenic Cases

Majority of the patients infected with P.vivax had moderate thrombocytopenia. Whereas majority of the patients infected with P.falciparum showed platelet count of <50,000.

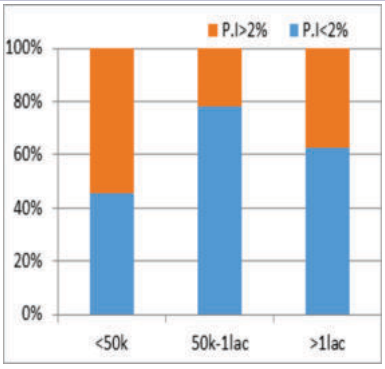

Figure 8: Thrombocytopenia And Parasite Index

Majority of the patients having platelet count <50,000 showed high parasitemia (P.I>2%).

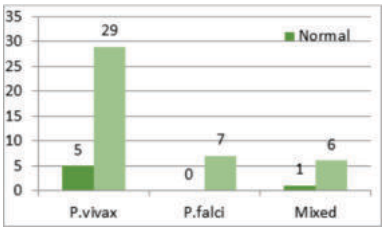

Figure 9: ESR In Cases Of Malaria

The increased ESR was seen in 87.5% of malaria cases. Similar distribution noted among various species of malaria.

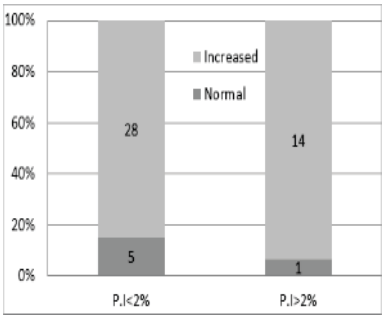

Figure 10: Correlation Of ESR And Parasite Index

Patients having high parasitemia showed higher occurrence of increased ESR i.e. 93.4% as compared to 84.4% in cases with P.I<2%.

Table 3: Correlation Between RMT (Rapid Malaria Test) And Smear Positivity

	Smear positive	Smear negative	Total
RMT positive	41	4	45
RMT negative	1	0	1
Total	42	4	46*

*RMT not performed in 2 cases. (48-2=46)

The RMT was seen negative in one case but smear showed positivity for P. falciparum.

Table 4: Biochemical Investigations In Cases Of Malaria

	P. vivax	P. falciparum	Mixed	Total
Altered LFT	2	1	0	3
Altered RFT	0	1	1	2
Total	2	2	1	5

Out of total 48 cases, only 5 showed altered LFT and RFT. Higher occurrence was noted among P. falciparum cases, however number of cases were very small.

DISCUSSION

This was a two-year cross sectional study, carried out during the period of May 2013 to Apr 2015 in the department of pathology, KIMS Karad. During this period, 48 patients were diagnosed as positive for malarial parasite.

A) Incidence of Malaria

Malaria continues to be a great health problem in some of the most populated areas of the world & continues to cause significant morbidity and mortality worldwide. In this study, a total of 48 cases were reported in the duration of two years i.e. 22 in 2013-14 and 26 in 2014-15. The meteorological factors like rainy season affects the survival of Anopheles vectors, hence the rainy season leads to an increase in incidence of malaria cases. In the present study, we recorded maximum number of cases during the period of June to November coinciding with rainy season.

B) Distribution Of Cases According To Sex

In present study, males were seen more affected (36/48 cases i.e. 75%) than females (12/48 cases i.e. 25%). The male to female ratio in our study is 3:1. Male predominance may be correlated to more outdoor activity and hence higher chance of bite by vector mosquito. Similar finding was noted in most of the following studies, which is comparable with our study (tab.5).

Table 5: M:F Ratio Comparison With Other Studies

Authors	Year	M:F ratio
Present study	2015	3:1
Z S Jairajpuri2	2014	2.3:1
Nutan Agarwal3	2015	1.4:1
Syam Sunder4	2013	1.4:1
S Chandra et al5	2013	1.6:1
Subhasish et al6	2015	1.2:1
Manas et al7	2014	1.1:1
Senthikumaar et al8	2013	1:1
Mohan et al9	2014	3.7:1

C) Age Group

In present study, the age group ranged from 14 years old to 80 year old. In present study commonly affected age group was third decade (20/48 cases i.e. 41%) followed by fourth decade (9/48 cases i.e. 18.7%) as compared with other studies. More outdoor activity due to employment can again be attributed to higher incidence of malaria in third decade (tab.6)

Table 6: Table Showing Comparison Og Age Group With Other Studies

Authors	Year	Age Group with Peak incidence
Present study	2015	21-30
Nutan Agarwal3	2015	21-30
Syam Sunder4	2013	31-40
Mohan et al9	2014	21 - 30
S Chandra5	2013	21-30
Manas et al7	2014	31-40

D) Species Wise Distribution

In present study Plasmodium vivax was the commonest species infecting the patients i.e. 34 cases (70.8%), Plasmodium falciparum infection was seen in 7 cases (14.6%) and mixed malarial infection (P.vivax & P.falciparum) was noted in 7 cases (14.6%). Nutan Agarwal et al, Syam Sunder et al and Subhasish et al(2015) also noted P.vivax mala ria as commonest infecting species of malaria, same as present study. Syam Sunder et al (2014) recorded mixed infection in 23%. In this study mixed malarial infection has similar incidence as P.falciparum malaria (tab.7). This difference in incidence of various species may be attributed to various geographical factors and endemicity for P.falciparum infection.

Table 7: Distribution And Comparison As Per Species

AUTHOR	P.VIVAX%	P.FALCI%	MIXED%

Present study(2015)	70.8	14.6	14.6
Syam Sunder(2013)4	46	23	30.9
N Agarwal(2015)3	70	21	9
Subhasish(2015)6	78.12	17.18	4.68
Smita Chandra(2013) 5	69.8	27.5	2.7
Z S Jairajpuri(2014)2	84	4.65	10.46
Patel (2013) 10	41	59	0.9
Manas et al(2014)7	50.1	49.9	-
Senthikumar et al(2013)8	65	30	5

E) Clinical Features

Patients of malarial infection usually present with fever and chills. In tropical countries the patients with fever or splenomegaly should be evaluated for malarial infection. In falciparum malaria other systemic complications take place such as cerebral malaria, algid malaria, acute malarial hepatitis or acute malarial nephropathy. In the present study, almost all patients (46/48 i.e. 95.8%) complained of fever with chills. The other common complaint was generalized weakness (11/48 cases, 22.91%).

Table 8: Comparison Of Clinical Features With Other Studies

Author	Year	Fever with chills (%)	Splenomegaly (%)
Present study	2015	95.8	25
Syam Sunder4	2013	100	62
Mohan et al9	2014	94	53
Z S Jairajpuri2	2014	100	58
Laura et al11	2004	86.8	51

All above studies noted fever with chills as the commonest presentation along with splenomegaly, in the present study fever with chills as presenting complaint was comparable with other studies but splenomegaly was seen in fewer cases (tab.8). Splenomegaly was probably because of engorgement, edema of pulp and later due to lymphoid & reticuloendothelial hyperplasia with increased hemolytic & phagocytic function.

Out of the 48 patients 12 patients showed splenomegaly (i.e. 25%) on clinical examination. 7 out of 34 patients with P. Vivax, 3 out of 7 patients with P. Falciparum and 2 out of 7 patients with mixed infection had splenomegaly respectively. Out of 12 patients having splenomegaly, 9 (75%) had mild and 3(25%) had moderate splenomegaly. None of the patient had massive splenomegaly (tab.9).

Table 9: Distribution Of Cases As Per Splenomegaly

Splenomegaly	P. Vivax	P.Falciparum	Mixed	Total
Mild (<4cm)	7	1	1	9
Moderate(4-8cm)	-	2	1	3
Massive (>8cm)	-	-	-	-

F) Malarial Patients With Associated Conditions:

In present study out of 48 patients, 3 patients also had concurrent positivity for dengue NS1 antigen, 1 had typhoid and two had respiratory distress. Two patients were pregnant. Although malaria and dengue are both common infections in tropical countries, concurrent malaria and dengue infection is uncommon. Malaria is a protozoal infection while dengue is a viral infection. Although both present with similar clinical manifestations, dengue and malaria infection is only a co-infection that has no significant alternative effect on each separated infection as seen in study done by Viroj et al[12].

G) Parasitic Index:

Parasitemia is the quantitative content of parasites in the blood and it is used as a measurement of parasite load and indicative of degree of active parasitic infection. The measurement of Parasitemia is important in assessment of disease such as in diagnosis; follow up of therapy, particularly in chronic phase, when cure depends on ascertaining a parasitemia of zero.

Two methods for expressing parasitic index:

1) Parasitic index is expressed as number of parasitized RBCs per 1000 RBCs and
2) The number of parasites/μl of blood is determined by enumerating the number of parasites in relation to the standard number of WBCs/μl.

In this study Parasitic index is expressed as number of parasitized RBCs per 100RBCs (%). Hyperparasitemia is categorized as: Increased mortality at >100,000/μl (2%), High mortality at >500,000/μl (10%) and >20% of parasites identified as pigment containing trophozoites and schizonts.

In present study large majority of the cases had parasitic index < 1lakh/ul of blood(<2%) (43/48), only (5/48) had high parasitic index >5lakh/ul of blood(>2%) . Five of the patients with high parasitic index >2 had deranged organ function tests viz LFT deranged in 3 cases or RFT deranged in 2 cases. However no mortality was encountered in this study. Severe anemia, severe thrombocytopenia and raised ESR were other findings observed in these cases with High parasitemia >2%.

H) Hemoglobin Estimation

Hematological changes are the most common systemic effects which play a significant role in various serious complications. It can affect all the three formed elements of blood and the abnormalities that have been consistently reported include anemia, thrombocytopenia, and lymphocytosis[13,14]. The pathogenesis of anemia in malaria is multifactorial involving mechanical destruction of parasitized red cells, marrow suppression, ineffective erythropoiesis, anemia of chronic disease, nutritional status, demographic factors and malaria immunity.

In this study, Hb level ranged from 5.7gm% to 14.5gm%, and 38 out of 48(79.1%) cases had anemia. Most common anemia noted was normocytic normochromic. Various studies including Nutan Agarwal et al (2015) and Subhasish et al (2015) found higher incidence of anemia in malaria cases which was consistent with the present study (tab.10).

Table 10: Incidence Of Anemia Comparison With Other Studies

Author	Year	Anemia%
N Agarwal et al3	2015	85.5
Mohan et al9	2014	69
Subhasish et al6	2015	86.4
Syam Sunder et al4	2013	60.17
Patel et al10	2013	68
Present study	2015	79

Table 11: Distribution And Comparison According To Severity Of Anemia

Hemoglobin	No. of cases	Percentage
Mild	18	47.5
Moderate	14	36.8
Severe	06	15.7

Out of 38 cases with anemia, mild degree was seen in 18 cases (47.5%). Moderate degree of anemia was seen in 14 cases (36.8%) and severe degree of anemia in 6 cases (15.7%).

Table 12: Distribution Of Anemia Cases As Per Species And Morphology

	Normocytic Normochromic	Microcytic Hypochromic	Macrocytic	Total
P.Vivax	25	2	-	27
P.Falciparum	4	1	-	05
Mixed	5	1	-	06
Total	34	4	-	38

Out of the 38 cases of anaemia, 34 (89.47%) were normocytic

normochromic type, While 4 (10.52%) were microcytic hypochomic type (tab.12). No case of macrocytic anaemia was seen in our study. The most common type of anaemia observed in our study is Normocytic Normochromic type which is comparable to study done by Nutan agarwal et al, Mohan et. al. and Subhashish et. al.

In P.falciparum malaria, anemia was noted in 5 out of 7 cases i.e. 71.4%. Mixed malarial infection showed anemia in 6/7 cases forming 85.7%. Amongst vivax malaria cases, 27/34 (79.4%) had anemia.

We found a little higher incidence of anemia in vivax malaria as compared to falciparum malaria which may have occurred because of higher number of vivax cases in the study and multifactorial etiology of anemia. We compared haemoglobin estimation in all 48 cases with parasitic index. There was no much difference in incidence of anemia among low Parasite index (78%) as compared to patients having high parasite index (80%).

I) Leukocytic Changes In Malaria:

1. Total leukocyte count: Different studies show varying results regarding WBC counts in cases of malaria. Laura et al[87] showed significantly lower counts of WBCs among infected individuals compared to non-infected cases. However Laura[11] as well as Patel[10], both did not see any variation as per the parasite density. In the present study out of 48 malarial cases, 36 (75%) had normal WBC counts, 8 (16.7%) had leucopenia and 4 (8.3%) showed leucocytosis.

Out of 34 cases of P.vivax , 6 cases (17.6%) had leucopenia and 3 cases (8.8%) had leucocytosis. In falciparum malaria, leucopenia and leucocytosis were seen in 14.2% cases each. In mixed malaria cases majority (6/7) had normal WBCs count.

Table 13: Comparison Of TLC In Malaria Cases With Other Studies

TLC%	Normal	Leucopenia	Leucocytosis
Syamsunder et al4	67.4	25.6	7
N Agarwal et al3	64.5	26.5	9
Subhasish et al6	44	28.37	17.56
Mohan et al9	67	7	11
S Chandra et al5	68	26	6
Present study	75	16.7	8.3

In present study leucopenia was more common (8/48) and leucocytosis was less common (4/48) as compared with above studies (tab.13).

2. Differential Count: In present study out of 48 cases, 29 showed normal DLC followed by neutrophilia (11/48 i.e. 23%). Some authors described striking change in circulating lymphocytes during acute attack of malaria. Changes may be so great in few cases, as to give rise to lymphoid leucocytosis[15]. In present study, only 6/48 cases (12.5%) showed lymphocytosis along with presence of atypical lymphocytes. Most of the authors encountered monocytosis[15,16], which were vacuolated and contained malarial pigment and phagocytosed red blood cells in their cytoplasm. The presence of malarial pigment in the cytoplasm is most useful in diagnosis. In present study, monocytosis was observed in 2/48 cases (4%) and Mohan et al observed monocytosis in 15% cases. No difference was noted among various species of malarial parasites and DLC, which is similar to the studies done previously.

J) Changes In Platelets

The reduction in circulating platelets is consistently reported in the different types of malaria. Possible mechanisms leading to thrombocytopenia include: immune destruction, oxidative stress, alteration in splenic function and a direct interaction between plasmodium and platelets along with DIC[17]. Thrombocytopenic malaria, in contrast to the non-thrombocytopenic variety correlates with higher degree of parasitemia and increased production of cytokines[18]. In the present study, 42/48 patients (87.5%) had thrombocytopenia. Platelet count remained within normal range in 6 cases (12.5%) (tab.14). All types of malarial infections in this study showed almost similar incidence of thrombocytopenia i.e. P.vivax (88.2%), P.falciparum (85.7%) and mixed malarial infection (85.7%).

Table 14: Comparison Of Changes In Platelet Count With Other Studies

Authors	Platelet count%	
	Normal	Thrombocytopenia
Nutan Agarwal et al (2015) 3	14.5	85.5
Subhasish et al(2015) 6	17.6	82.4
Manas et al7	15.5	84.5
S Chandra et al5	18.5	81.5
Patel et al10	19	81
Syam Sunder et al4	30	70
Present study(2015)	12.5	87.5

We divided thrombocytopenia in mild (1.5lakh to 1lakh/cumm), moderate (1lakh to 50,000/cumm) and severe (<50,000/cumm) grade. Out of 42 cases with thrombocytopenia, 23 cases (54.7%) showed moderate degree of thrombocytopenia forming the largest group. It was followed by severe degree 11 cases (26.2%) and mild grade in 8 (19.1%).

P.falciparum infection was associated commonly with severe thrombocytopenia (66.7%), whereas P.vivax and mixed malarial infection commonly had moderate degree of thrombocytopenia i.e.56.7% and 66.7% respectively.

Out of these 42 cases of thrombocytopenia, 28 cases (66.7%) showed low parasitic index and 14 cases (33.3%) had higher parasitemia. Out of the 14 cases with high parasitic index, 6 cases (42.8%) had severe degree of thrombocytopenia indicating that higher parasitemia affects the thrombotic mechanism commonly.

Thus patients having more parasitic index are at higher risk of disturbances in hemostasis. None of our patients with thrombo-cytopenia had bleeding manifestations, as bleeding episodes are rare in malaria. Edgar et al (2014)[17] found that severe thrombocytopenia was an independent predictor of health. Presence of thrombocytopenia in a patient with acute febrile illness may be used as a tool, in addition to the clinical and microscopical parameters to heighten the suspicion of malaria and prompt initiation of the therapy.

K) Erythrocyte Sedimentation Rate

The rise in plasma immunoglobulins in patients suffering from malaria that neutralizes the natural repulsive negative charges on red blood cells explains why the E.S.R increases in patients infected with malaria[19]. Out of 48 malarial cases in our study, ESR was increased in 42 cases (87.5%). In this study a higher ESR is noted among malarial patients same as compared with below studies (tab.15).

Table 15: Comparison Of ESR With Other Studies

Author	E.S.R(%)	
	Normal	Increased
N Agrawal et al(2010)3	5.2	94.8
Pagaro et al(2013)20	29.30	70.70
Present study (2015)	12.5	87.5

L) Rapid Malaria Antigen Test (RMT):

Examination of blood smears is a Gold Standard method used for diagnosis of malaria, but it requires considerable expertise for its interpretation, particularly at low levels of

parasitemia. Several new methods have been developed to supplement the conventional microscopic method. We used Malascan rapid test for malaria (RMT) which detects the malarial antigen in the blood. The strip has one control band and two bands for malarial infection. One is for Pan, which is positive for any species of malaria, whereas other one is specific for P.falciparum. In our study, RMT was performed in 46 cases. Out of these 46 cases, 45 gave positive RMT whereas one case was negative for RMT and had smear positive for malarial infection, which brought down the sensitivity of RMT to 97.8%. Out of 45 RMT positive cases, 41 had positive smears, however 4 cases did not reveal parasite on microscopic examination of smears, because of low parasitemia or sub-optimal treatment for malaria.

Table 16: Comparison Of Sensitivity And Specificity Of Rmt With Other Studies.

Author	RMT (%)	
	Sensitivity	Specificity
Palmer et al(2003) 21	98	100
Moody et al(2000) 22	96	100
Present study(2015)	97.8	100

The present study showed similar sensitivity and specificity of RMT, to that of studies conducted by Palmer et al (2003) and Moody et al (2000) (tab.16). The RMT positive & blood film negative results may occur because of low parasitemia or sub-optimal treatment for malaria. Our study supports that RMT is complimentary to peripheral blood smear study, but Peripheral smear study will always be Gold standard for the diagnosis of malaria

M) Liver Function Tests

Jaundice seems to be the most frequent among vivax disease considered as 'severe'[23,24]. Since hemolysis is not usually as severe as to cause significant clinical jaundice, most of these patients actually have some hepatocyte necrosis as evidenced by the increase in liver enzymes (AST/ALT) with subsequent cholestasis[25]. Other diseases such as leptospirosis, typhoid fever and viral hepatitis need to be ruled out to attribute the liver damage to malarial parasite. Out of 48 cases of malaria only 3 (6%) cases revealed altered LFT. All these cases had hyperbilirubinemia (direct). Out of these 3 cases, 2 (66.7%) were infected by P.vivax and 1 (33.3%) had P.falciparum infection. All these cases had no evidence of other hepatic diseases, thus indicating malaria associated hepatic dysfunction.

N) Renal Function Tests

This complication is suspected in cases of oliguria and confirmed if serum creatinine is higher than 3.0 mg/dl. Bacterial sepsis, dehydration, shock and past history of chronic renal failure should be routinely searched in the differential diagnosis[14]. The pathogenesis of renal failure is unclear but may be related to erythrocyte sequestration interfering with renal microcirculatory flow. Clinically & pathologically, this syndrome manifests as acute tubular necrosis. Out of 48 cases, deranged RFTs were noted in 2 cases (4%). Out of these 2 cases, 1 (50%) had falciparum malaria and other had mixed malarial infection.

These cases with either hepatic or renal dysfunction were seen associated with severe malaria. Present study suggests that any patient presenting with fever and chills, having clinical suspicion of malaria should be monitored with serum bilirubin and blood urea, serum creatinine for adequate management and prevention of severe disease.

CONCLUSION

As observed in the present study, patients with clinical suspicion /diagnosed as malaria should be monitored with hematological profile to pick up complicated cases, and hence improve the outcome. Other illnesses or co-morbities may also adversely affect the hematological parameters and should be ruled out before interpreting the laboratory results.

Limitations Of Present Study: One of the limitation of this study was lower sample size. Similar studies can be performed on a larger population using experimental designs (case-control, etc.) along with standardization of laboratories and adequate training of personnel for evaluation of microscopy slides, to obtain more precise and reproducible data. Preventive measures at the level of community will obviously be of help to minimize the complications.

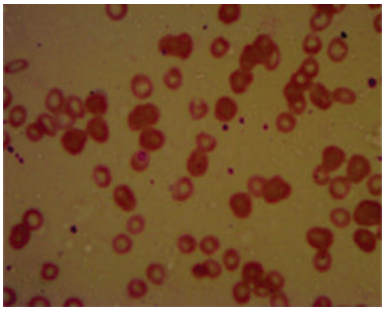

Fig.11: Photomicrograph Showing Rings And Schizonts Of P. vivax (1000x, Leishman)

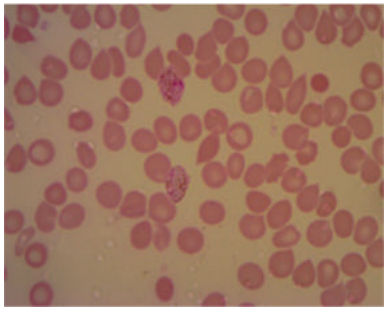

Fig.12: Photomicrograph Showing Rings And Schizonts Of P. vivax (1000x, Leishman)

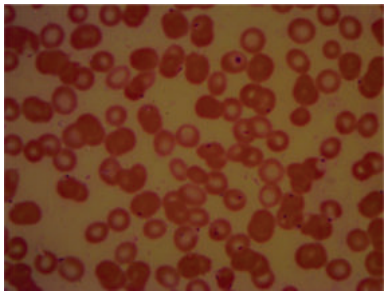

Fig.13: Photomicrograph Showing Merozoites And Rings Of P. falciparum (1000x, Leishman)

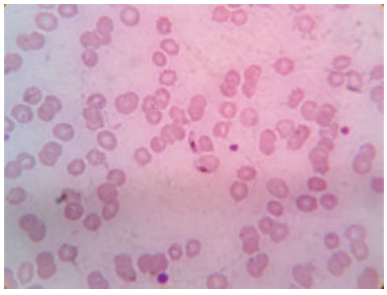

Fig.14: Photomicrograph Showing Gametes Of P. falciparum (1000x, Leishman)

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