How to Cite:
Mohanty, P., Behera, L., Bag, L., & Biswas, M. (2022). Study of hepatic involvement in falciparum malaria: A hospital based study in South Odisha. *International Journal of Health Sciences*, *6*(S5), 1923–1934. https://doi.org/10.53730/ijhs.v6nS5.9044

Study of hepatic involvement in falciparum malaria: A hospital based study in South Odisha

Dr Premakanta Mohanty
Assistant Professor, Dept Of Internal Medicine, Fakir Mohan Medical College, Balasore, Odisha
Email: Premkantmohanty@Gmail.Com

Dr Lipika Behera
Assistant Professor, Department Of Biochemistry, MKCG Medical College, Berhampur, Odisha
Email: Drbglipika.Behera@Gmail.Com

Dr. Lachhaman Bag
Assistant Professor General Surgery Dept, PRM Medical College, Baripada, Odisha
Email: lachhamanbag@gmail.com

Dr. Mohua Biswas
Associate Professor Community Medicine Dept, SLN Medical College, Koraput, Odisha
Corresponding author email: Drmohuabiswas123@Gmail.Com

***Abstract*---**Background: Malaria is a major hindrance to economic development. It is caused due to infection with Plasmodium and transmitted to human by bite of female anopheles mosquito. Orissa contributes to about 20% of malaria cases to the national total, out of which 85% are P. falciparum cases. 40% of country's malarial deaths occur in the state. In Odisha out of 39,556 positive case and 9 deaths in year 2019. Material and Methods: This prospective case series study was conducted to understand the clinical profile of 60 complicated malaria cases presenting with jaundice out of 450 hospitalized patients diagnosed with acute severe malaria. All cases were treated with quinine dihydrochloride IV 600 mg 8 hourly for 3-4 days, then given orally for a total of 7 days. Results: In the present study forty five cases were males and 15 were females showing a male female ratio 3:1. Maximum cases around 39 (65%) belong to age group from 15-35 years. Fever was the presenting complaint in all cases in this study. The range of temperature varied between 100-103°F. Added to these the cerebral symptoms present in 24 (40%) cases would reasonably justify a clinical diagnosis of Falciparum infection. 12(20%) cases on the other hand enlargement of liver was detected in

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
Manuscript submitted: 18 Feb 2022, Manuscript revised: 27 April 2022, Accepted for publication: 9 June 2022

39(65%) cases prolonged exposure to malarial infection is required for the spleen. present study 39(65%) cases had raised S.G.O.T while 42(70%) cases had raised S.G.P.T. valves more than 100 U/L Indicating definite hepatocellular damage.(Table -9), 30 (50%) cases had SGOT over 100U/L, Twenty seven(45%) had SGPT valve more than 100U/L. The highest value were 200 for SGPT and 145 u/1 for SGPT. Only 15(25%) had mild elevation ofserum alkaline phosphatase level. The highest recorded value was 79.2 U/L. The histopathology of liver showed evidence of swollen hepatocytes in 100% of cases, malarial pigment deposition 'Hemozoin' in 75% of cases, inflammatory infiltrates in 60% of cases, congestion of hepatocytes in 50% of cases and associated centrizonal necrosis in 25% of cases. Conclusion: Sever Hepatic dysfunction in malaria is commonly associated with concomitant viral hepatitis or underlying chronic liver disease. Similarly, patients with malarial Hepatopathy are at higher risk for complication. Since patients with malarial Hepatopathy may have a better outcome than those with other causes of hepatic disease, it should be diagnosed at an early stage and aggressively treated.

***Keywords*---**Malaria Hepatopathy, Malaria, malaria hepatitis, Malarial Jaundice.

Introduction

Malaria is a major public health problem in developing countries and among significant cause of disease burden in terms of morbidity and mortality. [3-5] As per World Malaria Report 2018, India reported about 9.5 million malaria cases in 2017 with a reduction of about 3 million cases since 2016. India is no longer among the top three countries with the highest malaria burden and only India has managed to significantly reduce its disease burden, registering a 24% decrease between 2016 and 2017.[8].

India has set 2030 as the target year for malaria elimination. it accounts for 4% of worldwide malaria burden. Similarly, Odisha contributed towards 40% of India's overall malaria cases. India launched its five-year "National strategic Plan for Malaria Elimination" in the year 2017. This plan provides a roadmap to end the presence of malaria as a public health problem in 571 of India's 678 districts by the year 2022. Accordingly, India's fight against malaria has shifted its focus from "disease control" to "disease elimination". [1]

Falciparum malaria is the most severe form of the disease-causing major proportion of complicated malaria worldwide. The clinical profile of Falciparum malaria has changed over the years. All major organs may be affected during the course of the disease. Acute renal failure and malarial hepatopathy are more common in older children and adults. Malarial hepatopathy is one of the most common severe manifestations of falciparum malaria. Its incidence varies 10-45% in different reports and is seen more in adults. Manifestation of jaundice in Falciparum malaria indicates a more severe stage of disease with higher

probability of complications. Mortality is also higher in among patients with jaundice (40%) [7]

Adherence of erythrocytes with parasites to the endothelial cells of liver capillaries leads to the blockage of intrahepatic blood vessels, causing change in blood flow pattern and, subsequently, ischemia. As a result, this, complications such as multi-organ failure and hepatic encephalopathy occurs. Histopathological studies have discovered hepatocyte necrosis, cholestasis, granulomatous lesions and malarial nodules in patients with malaria hepatopathy [7]. Jaundice can result from either severe hemolysis due to blood disorders or hepatic involvement associated with various conditions. The rupture of hepatocytes during the primary schizogony may result in cellular damage but this does not always result in significant hepatic dysfunction. [8] In malaria patients with severe disease, the incidence of jaundice has been reported to be 2.58%. [12] Severe infection of the red blood cells by P. falciparum and resultant hemolysis leads to rise in bilirubin level. Some studies had also reported significant correlation between elevated bilirubin levels and malarial hepatopathy.[6] Similarly, sequestration of the parasite-infested red blood cells in the liver capillaries causes clogging of the capillaries followed by hepatic dysfunction.

Majority of the patients with malarial hepatopathy are treated with intravenous artesunate or oral artesunate, based on the severity of the disease. Present evidences suggest that artesunate is superior to intravenous quinine for the treatment of adults with severe malaria. [2] This study among malaria hepatopathy patients was planned with following objectives.

Objectives:

- What is the clinical behavior of patients?
- How it affects the outcome of the disease?
- What is pattern of abnormalities in liver function tests results?
- What is the influence of treatment on jaundice and comparison of response to the treatment?
- Comparison of Outcome between jaundiced and non -jaundiced patients with falciparum malaria

Material and Methodology

This study was performed in MKCG medical college and hospital, Berhampur a malaria endemic eastern costal city in India. The hospital caters to a large population with higher burden of malaria. Patients presenting with fever and who tested positive for malaria in a peripheral smear test were enrolled in the study. The present study was undertaken to determine Hepatic involvement in malaria after excluding other causes of liver disease. The study included patients who got admitted in the department of Internal medicine, M.K.C.G medical college and hospital, Berhampur, Odisha, during October 2006 to October 2008. A convenient sample of 60 patients was taken for the study. A written informed consent was obtained from all the participants before their enrolment in the study. Institutional Ethics Committee approval was obtained from the institute of the first author.Data was collected as per the Performa and were analyzed using

the statistical analysis program, SPSS 22.0. P-values of less than 0.05($p<0.05$) were considered significant.

Inclusive Criteria

- All patients presenting with fever and /or icterus were initially screened for the presence of plasmodium falciparum in their peripheral smear.
- Cases showing positive smear were included in the study

Exclusive Criteria

- Meticulous care was taken to exclude all patients giving history of alcoholism, taking other hepatotoxic drugs and proved cases of infective Hepatitis.
- Children below the age of 15 were excluded from the study.

Results

Out of 60 cases, 45(75%) were males, while 15(25%) were females. More than half of cases (65%) belonged to younger age group between 15-34 years.

Table. 1.0 Age and Sex wise distribution of study subjects

Age (Years)	Male	Female	Total (%)
15-24	16	4	20(33.33)
25-34	14	5	19(31.66)
35-44	6	6	9(15)
45-54	5	2	7(11.6)
>55	4	1	5(8.3)
Total	45(75%)	15(25%)	60(100)

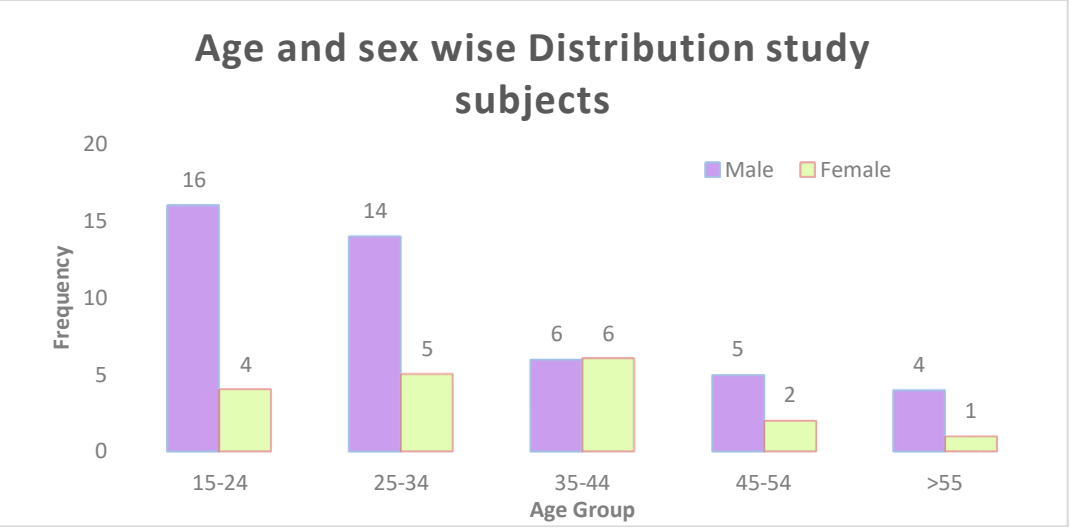

Table 2: Symptoms with which the cases presented

Symptom	No. of Cases	Percentage
Fatigue	26	46.66
Poor appetite	25	41.66
Nausea/vomiting	28	46.66
Upp. abd. discomfort	22	36.66
Headache	52	86.66
Fever	60	100.00
Yellow discoloration of eyes	60	100.00
Dark urine	28	46.60
G1 bleeding	4	6.66
Joint pain	20	30.00
Diarrhoea	10	16.66
Altered sensorium.	24	40.00

Table no. 2 shows that maximum proportion of patients were with fever and yellow discoloration of eyes 60(100%) followed by Headache 52(86.66%) and least number of cases reported G1 bleeding 4(6.66%).

Table. 3: Clinical features of the cases

Sign	No. of cases	Percentage
Pallor	21	35.00
Icterus	60	100.00
Hypotension	9	15.00
Hepatomegaly	39	65.00
Splenomegaly	12	20.00
Altered level of consciousness	24	40.00
Meningeal signs	3	5.00
Respiratory signs	3	5.00
Brisk deep reflex	45	75.00
Extensor plantar	30	50.00

From the above table no.3 it is observed that icterus 60(100%) was present in all the cases studied. Pallor was present in most of the cases of malaria with jaundice. Hypotension even after correction of dehydration was present in 9(15%) cases. Hepatomegaly was present in 39(65%) cases and splenomegaly in 12(20%) cases. Altered level of consciousness at different levels was observed in 24(40%) cases. Meningeal signs and respiratory signs were present in few cases (around 5% cases). Divergent squint of eyes was also seen in some cases. Plantar was Extensor in 30(50%) cases.

Table 4: Level of Hemoglobin in cases of Malarial Hepatitis

Hb (gm%)	Male		Female	
	No of cases	%	No of cases	%
<6	6	15.00	4	20.00

6-8	12	30.00	6	30.00
8-10	16	40.00	7	35.00
>10	6	15.00	3	15.00
Total	40	100.00	20	100.00

Anemia was found to be common in case of malaria with jaundice. As observed out of 60 cases around 10 cases (6 male and 4 female) had hemoglobin below 6 gm % and 18 cases (12 male and 6 female) had Haemoglobin between 6-8 gm%, and 23 cases (16 male and 7 female) had Haemoglobin between 8-10 gm% and only 9 cases (6 male and 3 female) had Haemoglobin above 10 gm %. (Table no.4)

Table 5: Platelet count

Platelet counter cubic mm	**Number of cases**	**Percentage**
<1 lakh	8	13.33
1-1.5 lakh	18	30.00
>1.5 lakh	34	56.66
Total	60	100.00

A tendency for Thrombocytopenia was observed in malarial hepatitis cases as shown in the table -5 around 8 patients (13.33%) had platelet count less than 1 lakh, 18 patients (30%) had platelet count between 1-1.5 lakhs and 34 patients (56.66%) had platelet count more than 1.5 lakh. (Table no.5)

Table 6: Levels of blood urea and serum creatinine

Levels	No of cases	Percentage
Blood urea(mg/dl)		
20-39	14	23.33
40-59	18	30.00
60-79	10	16.66
80-99	10	16.66
>100	8	13.33
Total	60	100.00
Serum creatinine (mg/dl)		
<1.6	30	50.00
1.7-3.0	25	41.66
>3.0	5	8.33
Total	60	100.00

Impaired renal function in the form of elevated blood urea and Sr. creatinine levels were found in around 50% of malaria cases indicating multi organ dysfunction.

Table 7: Type of presentation

Types of presentation	No of cases	Percentage
Fever + altered sensorium+ icterus	24	40.00
Fever + icterus	36	60.00
Fever+ ARF+ icterus	5	8.33

24(40%) cases had fever, lcterus with altered sensorium; where as 36(60%) cases had fever and lcterus. Renal dysfunction was seen in 5(8.33%) cases.

Table 8: Level of serum bilirubin

Sr. Billirubin level (ma/dl)	No of cases	Percentage
<5	36	60.00
5-10	18	30.00
>10	6	10.00
Total	60	100.00
Mean ± SD	3.33±1.32	
Range	0.7 to 11 mg/dl	

From the above Table 8, we found that the maximum cases i.e.36(60%) had Sr. Billirubin below 5mg/dl, 18(30%) cases had Sr. Billirubin between 5-10 mg/di and 6(10%) cases had Billirubin more than 10 mg/dl. The highest value of Sr. Billirubin was 11 mg%. The mean Sr. Billirubin value on admission was found to be 3.33 mg/dL.

Table 9: SGOT level

SGOT(IU/L)	NO. OF CASES	PERCENTAGE
<40	21	35
41-100	9	15
>100	30	50
TOTAL	60	100
MEAN	93.7±59.4	
RANGE	15-200	

Out of all, 21(35%) cases had normal SGOT value (40 IU/L),9(15%) had SGOT value between 41-100 and 30(50%) cases had SGOT level more than 100 U/L. The highest value recorded was 200U/L. The mean value was found to be93.7 ±59.4 IU/L.

Table 10: SGPT level

SGPT(IU/L)	NO. OF CASES	PERCENTAGE
<40	18	30
41-100	15	25
>100	27	45
TOTAL	60	100
MEAN	86.45±48.12	

RANGE	18-145	

Among all study subjects, 18 (30%) cases had normal SGPT values (40U/L), 15(25%) cases had SGPT between 41-100 and 27(45%) cases had SGPT more than 100 U/L. The mean SGPT value was 86.45 ±48.12 IU/L

Table 11: Sr. Alkaline phosphatase level

Sr. Alkaline phosphatase	**No. Of cases**	**Percentage**
<42	45	75
>42	15	25
Total	60	100
MEAN	33.47±19.18	
RANGE	10-79.2	

Serum Alkaline phosphatase was raised (>42 u/I) only in 15(25%)cases. But the rise was minimal. The highest value of Alkaline phosphatase was 79.2 U/L. 45(75%) cases had normal Alkaline phosphatase value. The mean value was recorded was 33.47 ±19.18 U/L

Table 12: Descriptive statistics of Parameters

Parameter	**D1(Mean ± SD)**	**D8 (Mean ± SD)**
Sr. Billirbuni (mg%)	3.33±1.42	0.80±0.82
SGOT	93.7±59.4	23.1±5.1
SGPT	86.45±48.12	23.1±5.12
Sr. Alkaline phosphatase	33.47±19.18	28.47±11.67

The mean level of Sr. Billirubin on 1st day in malaria cases was 3.33±3.42 mg% and on day 8 it was 0.8 0±0.82 mg%. In mean regression of Billirubin in malaria with jaundice was 2.53 mg%. The mean value of SGOT / AST was 93.7±59.4 U/L on day 1 and 23.1±5.1 on day 8. The mean regression was 36.3 U/L. The mean level of SGPT/ALT on day 1 was 86.45 and 23.1 U/L on day 8. The mean regression was 63.35 U/L. Value of Alkaline phosphatase also reduced after 8 days of treatment.

Table 13: Different value of parameter studied

Studied	**Value**	**No.**	**%**	**MEAN±SD**	**Range**
Sr. Protein	<5	60	100	6.32±0.35	5.9-7.0
	>5				
Sr. Albumin	3.5-5.5	60	100	3.87±0.27	3.5-4.5
	>5.5				
Sr. Globin	2-3.5	60	100	2.45±0.33	2-3
	>3.5				

Serum protein, serum Albumin and serum Globulin levels in all the cases were within normal limits. The mean value of these parameters was found to be 6.32±0.35 gm/di, 3.87±0.27 gm/di, and 2.45±0.33 gm/di respectively.

Table 14: Distribution of USG Finding:

USG findings		**No. of cases**	**percentage**
	Size enlarged	28	46.66
	Altered Echo pattern	14	23.33
LIVER	Normal architecture	60	100
	Increased wall thickness	14	23.33
	Lumen with sludge	20	33.33
GALL BLADDER	Clear lumen	40	66.66
SPLEEN	Enlargement	24	40

The USG finding in patients of malaria with jaundice showed enlarged liver size in 28 (46.66%) cases, altered Echo pattern in 14 (23.33%) cases. Normal architecture was seen in all the cases. Gall bladder wall was thickened in 14 (23.33%) cases and lumen with sludge was seen in 20 (33.33%) cases and clear lumen in 40 (66.66%) cases. Spleen enlargement was seen in 24 (40%) cases.

Table 15: Survival status of subjects:

Falciparum malaria with malarial hepatitis	**No of cases**	**Percentage**
Expired	8	13.33
Survived	52	86.66
Total	60	100

Out of 60 cases of Falciparum malaria with liver involvement, 8(13.33%) patient expired and 52(86.66%) patients survived and the morality rate was around 13%.

Discussion

The study of Hepatic involvement in malaria was conducted in the department of Medicine, M.KC.G, Medical College and hospital, Berhampur, Orissa from October 2006 to October 2008. Sixty selected case of P. falciparum were observed for the detection and assessment of Hepatic involvement and its response to the antimalarial therapy.

All cases were treated with quinine dihydrochloride IV 600 mg 8 hourly for 3-4 days, then given orally for a total of 7 days. In this study, adults of all age groups were affected by malaria. The most common age group involved was 21—30 years. A similar age incidence was noted. [13] In the present study forty-five cases were males and 15 were females showing a male female ration 3:1 (Table 1). Maximum cases around 65% belong to age group from 15-35 years.

Fever was the presenting complaint in all cases in this study. The fever had varying presentation such as intermittent fever, remittent fever or continuous. The duration of fever varied from 1 to 10 days. The range of temperature varied between 100-103°F. Added to these the cerebral symptoms present in 24 (40%) cases would reasonably justify a clinical diagnosis of Falciparum infection. But

the presence of varying degrees of icterus in all cases would mislead the diagnosis as acute fulminant Hepatitis or simple viral Hepatitis, unless a meticulous search for the presence of malaria parasite in peripheral blood is made to clinch the diagnosis.

Nausea, vomiting and right upper quadrant pain, features commonly found in viral Hepatitis was present in small number of cases (20-30%). Extensor plantar response was noted in many cases with disturbed sensorium. Meningeal signs was rarely observed. Although splenomegaly is commonly associated with malarial infection in present study it was present only in 12(20%) cases on the other hand enlargement of liver was detected in 39(65%) cases (Table 3) prolonged exposure to malarial infection is required for the spleen to enlarge since most of the cases in this study the duration of illness was within 2 weeks, splenic enlargement was not detected in most of the cases.

The study conducted by Dakar reported significant correlation between hypoglycemia and malarial hepatopathy ($p < 0.001$). Of all the cases, 38% suffered from hypoglycemia (Fasting blood sugar <70 mg/dl) none of the controls reported hypoglycemia. Hence, patients with malarial hepatopathy, especially with P. falciparum infection, have an increased chance of developing hypoglycemia.[14] In another study, 39(65%) cases had raised S.G.O.T while 42(70%) cases had raised S.G.P.T. valves more than 100 U/L Indicating definite hepatocellular damage. At total of 30 (50%) cases had SGOT over 100U/L, Twenty seven(45%) had SGPT valve more than 100U/L. The highest value were 200 for SGPT and 145 u/1 for SGPT. Only 15(25%) had mild elevation of serum alkaline phosphatase level. The highest recorded value was 79.2 U/L. This is consistent of Hepatocellular damage with the possibility of some intrahepatic obstruction.

In another study among 121 cases of malaria, histopathological examination of the liver showed activation of cells of the mononuclear phagocyte system, kupffer's cells in particular, with the presence of granules of browny-black " malarial pigent and iron deposits. In this study all the patients had normal serum albumin and globulin values. Decrease in serum albumin and increase in serum globulin has been known to occur in hepatic damage associated with malaria. But in present study none had abnormal serum albumin andglobulin values. [15]

They also had Histopathology of liver done which showed evidence of swollen hepatocytes in 100%, malarial pigment deposition 'Hemozoin' in 75%, inflammatory infiltrates in 60%, congestion of hepatocytes in 50% and associated centrizonal necrosis in 25% of cases. On electron microscopy hepatocyte swelling, Kupffer's cell hypemjkjtttdrrtrophy, sinusoidal macrophage hyper trophy along with changes in ER/mitochondria, loss of microvilli and damage to canalicular membranes is seen. Parasites are demonstrated on histology in less than 50% patients. The centrizonal necrosis is seen in some cases may be due to malarial infection or accompanying sepsis/hypotension.

In our study Liver histology could not be done due to unavoidable circumstances. Sr. Billirubin normally starts reducing by 72 hours after beginning treatment; however it may be delayed in patients having coexisting renal compications. A

dramatic improvement in liver function occurred after institution of anti- malarial treatment as evidenced from the sharp fall in serum billirubin and enzyme levels. This suggests complete reversibility of the pathological changes occurring in the liver.

Conclusion

The study was conducted in the Department of medicine, M.K.C.G. Medical College, Berhampur from October 2006 to October 2008. Sixty cases of P. falciparum infection without history of taking alcohol or hepato toxic drugs and HBsAg and HCV negative were investigated in detail for detection of liver damage. They were all given standard anti- malarial regimen. Besides clinical response changes in liver function were assessed.

Twenty-four (40%) cases presented with fever, icterus and altered sensorium. Thirty six (15%) cases had fever and icterus while 5(8.33%) cases presented with fever, icterus and ARF.AII the cases had fever with rigor and chill. Nausea and vomiting was present in 28(46.6%) out of Sixty cases. All cases had icterus, 65% had Hepatomegaly and only 12 cases had splenomegaly.

The elevated SGOT level was observed in 39(65%) cases whereas 42(70%) cases showed raised SGPT values. The serum enzyme level did not exceed more 200 U/L. The serum protein level and albumin, globulin ratio was within normal limits in all the cases studied. The relationship between increased liver enzymes like SGPT value and parasite count was observed.
Most of these show conjugated Hyper Bilirubinemia with raised SGPT and SGOT values indicating Hepatocellular damage.
All the cases responded well to antimalarial treatment clinically and biochemically. By 8th day most of the liver functions returned to normal. In only five cases who had severe jaundice mild icterus persisted for a short period after 8th day.

Presence of raised liver enzymes levels with near normal coagulation parameters in presence of malaria suggests presence of malarial Hepatopathy. Sever Hepatic dysfunction in malaria is usually associated with coexisting viral hepatitis or underlying chronic liver disease. Although, Patients with malarial Hepatopathy are more prone to complication; hence should be promptly diagnosed and managed aggressively as they have better outcome as compared to other causes of hepatic failure.

Authors contribution
Conflicts of interest: No funding sources
Funding: Nil
Ethical Approval: Declared

References

1. https://www.who.int/malaria/publications/world-malaria-report-2018/report/en/.

2. Dondorp A, Nosten F, Stepniewska K, Day N, White N. Arte-sunate versus quinine for treatment of severe falciparummalaria: a randomised trial. Lancet 2005;366:717—25.
3. Menezes RG, Pant S, Kanchan T, Senthilkumaran S,Kharoshah MA, Naik R, et al. Malaria: an infection withglobal impact. In: Peterson AM, Calamandrei GE, editors.Malaria: etiology, pathogenesis, and treatments. New York:Nova Science Publishers; 2011.
4. Menezes RG, Kanchan T, Rai S, Rao PPJ, Naik R, Shetty BSK,et al. An autopsy case of sudden unexplained death causedby malaria. J Forensic Sci 2010;55:835—8.
5. Menezes RG, Pant S, Kharoshah MA, Senthilkumaran S, ArunM, Nagesh KR, et al. Autopsy discoveries of death frommalaria. Leg Med (Tokyo) 2012;14:111—5.
6. Kausar MW, Moeed K, Asif N, Rizwi F, Raza S. Correlationof bilirubin with liver enzymes in patients of falciparummalaria. Intl J Pathol 2010;8:63—7.
7. Baheti R, Laddha P, Gehlot RS. Liver involvement infalciparum malaria——a histo-pathological analysis. JIACM2003;4:34—8.
8. Severe falciparum malaria, World Health Organization,Communicable Diseases Cluster. Trans R Soc Trop Med Hyg2000;94:S1—90.
9. Gupta UC, Kataria ML. Plasmodium falciparum hepatitis during malaria epidemic. J Assoc Physicians India 1993;41:292.
10. Anand AC Puri,P. jaundice in malaria J Gastroenterol Hepatol 2005 ;20:1322-32
11. Anand AC, Ramji C, Narula AS, Singh W. Malarial hepatitis:a heterogeneous syndrome? Natl Med J India 1992;5:59—62.
12. Sabcharoen A, Chongsuphajaisiddhi T, Attanath P. Serum quinine concentrations following the initial dose in children with falciparum malaria. Southeast Asian J Trop Med Public Health 1989;13:556-62.
13. Muddaiah M, Prakash PS. A study of clinical profile ofmalaria in a tertiary referral centre in South Canara. JVector Borne Dis 2006;43:29—33.
14. Camara B, Diagne-Gueye NR, Faye PM, Fall ML, Ndiaye JL,Ba M, et al. Malaria severity criteria and prognostic factors among children in Dakar. Med Mal Infect 2011;41:63-7.
15. Golja J, Nahorski W, Felczak-korzybska I, Myjak P. Liver injury in the course of malaria. Int. Marit Health 2000;51:30-