STUDY OF SEVERITY ASSESSMENT AND RISK STRATIFICATION OF FALCIPARUM MALARIA IN TERMS OF HOSPITAL MORTALITY IN ADULTS

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ABSTRACT: INTRODUCTION: Malaria is one of the major public health problems of our country. Around 1.5 million confirmed cases are reported annually by NVBDCP and there are estimated about 20000 deaths annually due to malaria. Severity Assessment and Risk stratification can help reduce this burden of mortality due to malaria. This study was aimed to assess the severity of organ dysfunction in malaria. To estimate the patient risk for mortality and Identification of patients at greater risk of complications. **MATERIALS AND METHODS:** This hospital based observational study was carried out from October 2012 to Sept 2013, 80 consecutive patients of plasmodium falciparum malaria, diagnosed and admitted in the Department of Medicine, Pt. J.N.M Medical college, Raipur, Chhattisgarh were studied and assessed on variables such as age, sex, vital signs, Hemoglobin, Total Count, Platelet Count, blood urea, serum creatinine, urine output, Serum Bilirubin, Serum glucose, MSS And classification for complicated versus uncomplicated as per WHO Criteria. **RESULTS AND CONCLUSIONS:** Most patients (76%) were young adult males and presented with fever (100%) and about 1/3 (27%) of patients presented in altered sensorium, there was correlation ($P>0.05$) between the high malaria severity scores and mortality and also 30% mortality was observed in complicated malaria versus 16% in uncomplicated malaria.

KEYWORDS: Falciparum Malaria, Malaria Severity Score.

INTRODUCTION: Malaria has been known as a killer disease for centuries with Hippocrates already describing fevers, mostly correlating to swamps, hence the name "malaria" meaning "bad air". Malaria is also one of the major public health problems of our country. Around 1.5 million confirmed cases are reported annually by NVBDCP and there are estimated about 20000 deaths annually due to malaria of which 40–50% are due to Plasmodium falciparum.¹ The biggest burden of malaria in India is borne by the most backward, poor and remote parts of the country, with >90-95% cases reported from rural areas and 5-10% from urban areas; however, the low malaria incidence in urban areas may be due to almost non-existing surveillance.

The state of Orissa, with a population of 36.7 million (3.5%), contributes about 25% of the total annual malaria cases, more than 40% of P. falciparum malaria cases and nearly 20–30% of deaths caused by malaria in India, followed by Meghalaya, Mizoram, Maharashtra, Rajasthan, Gujarat, Karnataka, Goa, southern Madhya Pradesh, Chhattisgarh, and Jharkhand that also report significant number of malaria cases and deaths. P. falciparum accounts for 30–90% of the infections in the forested areas inhabited by ethnic tribes and 10% of malaria cases in mostly indogangetic plains and northern hilly states, northwestern India, and southern Tamil Nadu.²

Plasmodium falciparum is associated with both uncomplicated and severe malaria. Pathophysiologic and pathologic features of severe P. falciparum malaria include sequestration, cytoadherence, rosette formation, and reduced red blood cell deformability.

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Plasmodia can be found in the microvasculature of any organ of the host, which reflects the systemic nature of *P. falciparum* malaria.³

The World Health Organization (WHO) criteria for severe malaria have been adapted for tropical regions. However, the qualitative nature (e.g., renal failure, severe anemia, pulmonary edema) may not detect pending organ failure at a subclinical level before the onset of deterioration. Furthermore, patients with single organ failure are weighed on equal terms as those patients presenting with multi-organ failure. Complicated and severe are the two terms frequently used in relation to *falciparum* malaria to describe the increasing severity of the disease. Even if the diagnostic features of severe malaria have been set out by WHO, there is no objective criteria to quantify the severity of each complication.⁴

Mohapatra M K et al in 2012 came with Malaria Severity Score (MSS), it is a physiological scoring system that has been developed to assess the disease severity and to estimate the probability of mortality risk among patients with severe *falciparum* malaria.⁵

Clinicians and physicians engaged in treatment and research in malaria can stratify risk to make decisions in treatment to improve quality of patient care and outcome evaluation. Comparison between different groups can be done in a quantitative manner. Secondly, it can be used to predict the outcome easily because for each score there is also a probability of mortality which has already been calculated.⁵

Severe complicated malaria also impairs cardiac functions. Cardiac output was significantly decreased in malaria patients. Elevated cardiac enzymes also suggested cardiac injury in severe cases.⁶

Our study aimed to assess the severity of organ dysfunction in malaria. To estimate the patient risk for mortality and Identification of patients at greater risk of complications emphasizing on cardiovascular complication including myocardial injury and elevation in cardiac enzymes.

AIM OF STUDY:

1. To assess the severity of organ dysfunction in malaria.
2. To estimate patient risk of mortality.
3. Identification of patient at greater risk of complications and who would benefit from intensive monitoring and parental antimalarial treatment.

MATERIALS AND METHODS: The study comprises of 80 consecutive patients of plasmodium *falciparum* malaria, diagnosed and admitted in the Department of Medicine, Pt. J.N.M. Medical College and Dr. B.R.A.M. Hospital, Raipur, Chhattisgarh from October 2012 to Sept 2013. Permission from Ethical committee was taken.

Inclusion Criteria for Study Group:

- A. Age >15 years.
- B. Criteria for diagnosis of *falciparum* malaria was,
 - a) Malaria card test positive for plasmodium *falciparum* or,
 - b) Peripheral smear for Malarial Parasite, positive for plasmodium *falciparum* species.

Exclusion Criteria for Study Group:

1. Age < 15 years.

2. Coexistence of other diseases like:

- Diabetes mellitus.
- Chronic renal failure.
- Chronic liver disease.
- Rheumatic heart disease.
- Coronary artery disease.
- Sick cell disease, and associated infections like pneumonia, urinary tract infection and viral hepatitis and pregnancy were excluded from the study.

INVESTIGATIONS: About 80 patients of falciparum malaria who fulfil inclusion/exclusion criteria were enrolled and studied.

Following Investigations Were Carried Out:

1. Malaria card test and peripheral blood smear examination for malaria parasite.
2. Routine haemogram-Hb, total leukocyte count, platelet count.
3. RFT, Serum electrolyte,
4. LFT,
5. RBS,

6. Urine routine microscopic examination:

- About 80 patients of falciparum malaria who fulfil inclusion/exclusion criteria were selected for study purpose who gave oral consent.
- Patients presenting with short duration of fever with chills and rigor were subjected to malaria card test for detection of pfHRP-2 antigen and giemsa stained peripheral smear for malaria parasite.
- All subjects or relations were asked specific questions according to the proforma about demographical profile and chief complains specially fever, vomiting, jaundice, headache, vomiting, decreased urine output, altered sensorium, abnormal bleeding, convulsions etc.
- All subjects underwent complete physical examination. In routine patients were evaluated for fever, pulse rate, respiratory rate, BP, pallor, icterus, edema, haemoglobinuria, organomegaly, GCS.
- All subjects were underwent laboratory investigations and were divided into uncomplicated and complicated malaria as per following definitions of WHO.
- According to the WHO criteria 2000, the diagnosis of severe malaria was confirmed if the patient possessed one or more of the following complications:
 - a) Cerebral malaria: these are malaria patients who have=unarousable coma. Unarousable coma is defined as a best motor response to noxious stimuli that is non-localising and a best vocal response that is considered incomprehensible. In the modified Glasgow Coma Scale (GCS), it usually corresponds to a score ≤ 9 . If the unconsciousness has developed after a convulsion, it should persist for more than 30 minutes to exclude a postictal state. Other causes of coma, such as meningitis and encephalitis, were excluded;
 - b) Severe anaemia (haematocrit < 15% or haemoglobin < 5 g/dl).

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- c) Acute renal failure (urine output < 400 ml/ 24 hours in adults, failing to improve after rehydration; & serum creatinine >265µmol/l i.e. >3 mg/dl).
- d) Pulmonary oedema or Adult Respiratory Distress Syndrome (ARDS)
- e) Hypoglycaemia (whole blood glucose <2.2mmol i.e., <70mmHg in adults), with cold, clammy extremities.
- f) Spontaneous Bleeding/Disseminated Intravascular Coagulation (DIC). Repeated generalised convulsions (more than two episodes in 24 hours).
- g) Acidaemia (arterial pH < 7.25) or Acidosis (plasma bicarbonate <15 mmol/l).
- h) Macroscopic haemoglobinuria.

Malaria Severity Score (M. K. Mohapatra et al, 2009): It can be used to predict the outcome easily because for each score there is also a probability of mortality which has already been calculated. Following table shows the probability of mortality associated with severity of malaria score.

Level of Severity of Organ Dysfunction were Assessed on the Basis of following Table (MSS- Malaria Severity Score)

Table 1. Malaria Severity Score by Mohapatra et al 20009

	PARAMETERS OF ORGAN DYSFUNCTION	LEVEL-0	LEVEL- I	LEVEL- II	LEVEL-III
1.	NEUROLOGICAL GCS SCORE	14-15 (0)	10-13 (1)	7-9 (3)	0-6 (5)
2.	RENAL	(0)	(1)	(3)	(5)
	B.UREA (mg/dl)	10.0-36.0	37.0-59.0	60.0-119.0	>120.0
	S.CREAT(mg/dl)	0.6-1.2	1.3-1.9	2.0-4.9	>5.0
	U/O (litres/day)	0.75-3.9	0.5-0.75	0.4-0.5	<0.5
3.	.CVS	(0)	(1)	(3)	
	Heart Rate/min	51-119	120-139	>140 or <51	
	SBP (mmHg)	90-160	70-89	41-69	
4.	.RESPIRATORY RR/min	20-30 (0)	31-40 (1)	>41 (3)	
5.	BLOOD Hb(gm/dl) TLC(/cumm) Platelet (/cumm)	(0) 10.0-13.9 4001-16000 80,000-2,50,000	(1) 7.0- 9.9 2001-4000 or 10-20000 <80,000	(3) <7.0 <2000	
6.	HEPATIC S.bilirubin (mg/dl)	(0) <2.0	(1) >2.0M		
7.	Metabolic B.Glucose(mg/dl)	(0) 60-110	(1) <60		

Table 2 showing probability of mortality on the basis of MSS.

Severity of malaria score	Probability of mortality
1	1.2
2	3.1
3	4.8
3	7.5
4	10.5
5	12.0
6	21.1
7	31.1
8	40.1
9	51.8
10	61.7
11	70.8
12	81.8
13	88.8
14	92.0
15	94.6
16	96.1
17	97.2
18	98.5
19	99.2
20	99.5
21	99.7

Each score can be translated into a corresponding range of estimated probability of mortality. The probability of mortality increases steeply after the severity score of 5; for each point of rise in score the mortality increased approximately by 10.0%. After the score of 12, the probability of mortality was more than 80.0%.

OBSERVATION AND RESULTS:

- In our study out of 80 patients, 61 patients (76.25%) were male while 19 patients (24.75%) were female.
- Maximum patients were young adults and were from the age group of 15-30 years. More than 50 years of age had minimum patients. 29 patients (36.25%) were from 20-30 years age group, 17(21.25%) were from 15-20 year age group, 15(18.75%) from 30-40year age group, 7(8.75%) and 2(2.5%) were from 50-60 year and >60 year age group respectively. Percentage distribution was 57, 31, and 11.25% in 15-30, 30-50, and more than 50 years respectively.

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- All the 80(100%) had fever at the time of presentation. Sixty-nine (86%) patients had associated chills and rigors. 22 (27%) patients had altered sensorium. 40 (50%) patients complained of headache at the time of presentation. Twenty (25%) patients presented with jaundice. Twelve (15%) complained of decreased urine output. 7(8%) patients had convulsions and complained of breathlessness each. Thirty-two patients (40%) had vomiting and 2(2.5%) patients had haematuria at the time of presentation.
- On physical examination fever was complaint of all the 80(100%) patients while on presentation 45 (56.25%) patients were febrile.
- Sixty-five (81.25%) patients had pallor, in 26 patients (32.5%) icterus was found, edema was present in 9(11.25%) patients, 4(5%) patients had hemoglobinuria.
- Most common cardiovascular finding was tachycardia present in 41(51.25%) patients, there were 10(12.5%) patients whose systolic blood pressure was less than 90 mm Hg.
- Most common respiratory system finding was tachypnoea (>24 breaths/min) present in 31(38.75%) patients, while adventitious sounds were present in 7(8.75%) patients.
- Five (6.25%) patients hepatomegaly, 5(6.25%) patient had splenomegaly while 2(2.5%) patient had hepatosplenomegaly.
- Peripheral blood Smears was positive in only 9 patients (10%) for malarial parasite.
- Total 41(51%) patients had Haemoglobin level between 7.0-9.9gm% and in 15(19%) patients Hb levels of < 7gm% was found.
- Total 38 (48.5%) patients had thrombocytopenia (PLC<85,000/mm³).
- About 28 (40%) patients had raised TLC (>10,000cells/mm³).
- Total 24(30%) of the patients were in Level-0 with blood urea levels of 10-36mg/dl. 13(16.2%) patients were in Level-I with blood urea levels of 37-59 mg/dl. There were 24 patients with level-II severity B. urea 60-119mg/dl. Similarly in Level-III 19 (23.8%) patients were reported with urea levels of ≥ 120mg/dl.
- Level-0 had 36 patients with sr.creatinine in the range of 0.6-1.2mg/dl level-I had 13(16.2%) patients with sr. creatinine in the range of 1.3-1.9mg/dl. There were 21(26.25%) patients in level-II with sr. creatinine 2.0-4.9mg/dl, level-III had 10 patients (12.5%) with creatinine levels of ≥ 5mg/dl.
- There were 12 patients (15%) whose daily urine output was < 500 ml.
- Total 48 patients (60%) patients had hepatic dysfunction with sr. billirubin >2.0 gm/dl.
- Hypoglycemia (RBS <60mg/dl) was found in 5 (6.25%) patients.
- Total 37 patients (46.25%) had uncomplicated malaria and rest 43 patients (53.75%) had complicated malaria.
- Total 42 patients had MSS of 0-5, associated mortality was 4.7%. 14 patients had MSS of 6-10, associated mortality was 21.4%. 12 patients had MSS of 11-15, associated mortality was 41.6%. 12 patients had MSS of 11-15, associated mortality was 41.6%.
- Out of 80 patients studied 61 patients (76%) were discharged and 19 (24%) patients died.

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DISCUSSION: This study shows that falciparum malaria involves Multiorgan system with various levels of severity. Mortality increases with increase in the number of organ system involved⁵. Multiorgan involvement is common in complicated malaria, most common organs involved are CNS, renal and hepatic. Anemia and thrombocytopenia are also common finding but has low risk of mortality. Although high parasitemia is an indicator of mortality but Rapid detection kit detection of HRP-2 antigen are proven to be better than peripheral smear examination. Malaria severity score has great potential to quantify the severity, predict the mortality risk, improved quality of patient care, outcome evaluation and comparison between different groups in quantitative manner of falciparum malaria. It was developed in a similar setting hospital and region where prevalence of malaria is similar, so it can be used in those developing areas where malaria is major mortality factor.^{2,4,6,7}

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