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Original Research Article

# A Prospective Observational Study to Determine the Role of GCRBS (Glasgow Coma Score, Creatinine, Respiratory Rate, Bilirubin, Systolic Blood Pressure) Score in Assessing the Severity of Plasmodium Falciparum Malaria

**Sanjay Gulhane[1], Kashyap Bhojak[2], Harshal Joshi[3], Sheela Pandey[4]**

[1]Professor, Dept of General Medicine, HBTMC & Dr R N Cooper Hospital, Juhu, Mumbai
[2]Senior Resident, Dept f General Medicine, HBTMC & Dr R N Cooper Hospital, Juhu, Mumbai
[3]Associate Professor, Dept of General Medicine, HBTMC & Dr R N Cooper Hospital, Juhu, Mumbai
[4]Assistant Professor, Dept of General Medicine, HBTMC & Dr R N Cooper Hospital, Juhu, Mumbai

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**Corresponding author: Dr Sanjay W. Gulhane**
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**Abstract**

The main objective of the research is to determine the role of GCRBS (Glasgow Coma Score, Creatinine, Respiratory Rate, Bilirubin, Systolic Blood Pressure) score in predicting severe plasmodium falciparum malaria infection.

**Material and Methods:** This prospective observational study was conducted over the period of 12 months at the Department of General Medicine in tertiary care public hospital. 100 patients who were diagnosed with falciparum malaria, admitted and willing to participate in the study were included in the study based on the inclusion and exclusion criteria after getting approval from the Ethics committee of the Hospital.

**Results:** In our study, 73% belonged to the age group 21-40 years, while 23% belonged to the 41-60 years age group and there were only 4 patients above 60 years of age. Mean age was 35.2 years. Fever was the chief presenting symptom in 98% patients followed by chills and rigors 90%, vomiting 55%, headache 52%, myalgia 50%, sweating 34% and pain in abdomen 25%. While convulsions were present in only 2% patients. On general examination 17% patients had tachycardia, Hypotension was present in 6 % patients. Pallor was present in 33%, icterus in 14 %. Per abdomen examination revealed 43% patients had splenomegaly, 14 % hepatomegaly, while 18% had hepatosplenomegaly.

**Conclusions:** The GCRBS score seems to be a very good working tool as it is very easy to calculate and helps clinician to predict the severity and mortality in falciparum malaria.

**Keywords:** Plasmodium falciparum, Malaria, Fever.



## Introduction

Malaria is caused by Plasmodium parasites. It is a protozoan disease transmitted by the

bite of infected Anopheles mosquitoes called "malaria vectors". Out of the five parasite species that cause malaria in humans, two of these species – P. falciparum and P. vivax– pose the greatest threat [1,2].

The Indian National Malaria Eradication Programme (INMEP) is reporting 2.5 to 3 million malaria cases and 1,000 deaths annually. Plasmodium vivax is the dominant infection and accounts for 60-65% cases whereas P. falciparum contributes 30-35% cases. In the year 2018 of total 375845 malarial cases in India ,77 deaths were reported. Malaria represents a medical emergency and without prompt and appropriate treatment it may rapidly progress to complications and death [3]. Owing to the high rates of morbidity and mortality, malaria presents a major public health problem in the developing world. About 3.2 billion people are at risk of malaria. According to the latest WHO estimates, released in September 2015, there were 214 million cases of malaria in 2015 and 438,000 deaths. Malaria incidences i.e. rate of new cases fell by 37% globally between 2000 and 2015 and the malaria death rates fell by 60% globally among all age groups, and by 65% among children under five years of age. A high share of the global malaria burden is demonstrated in Sub-Saharan Africa. In 2015, the region was home to 89% of malaria cases and 91% of malaria deaths [1].

Human malaria has a broad clinical spectrum that includes asymptomatic infection, uncomplicated, complicated and lethal malaria cases. The complex interaction between the parasite, human host and environmental factors forms the clinical spectrum of the disease. Residents of all ages have low levels of naturally acquired immunity, in temperate and sub-tropical regions of Asia and Latin America and thus typically present with acute or severe disease to mild and more chronic infections, particularly in adult men [4]. Malaria infections may cause vital organ dysfunction and death. Severe malaria which is caused mostly due to P. falciparum species is defined by clinical or laboratory evidence of vital organ dysfunction. The manifestations of severe malaria include: Unarousable coma/ cerebral malaria, acidosis, severe normochromic normocytic anaemia, renal failure, pulmonary edema/adult respiratory distress syndrome, hypoglycaemia, hypotension/shock, bleeding/disseminated intravascular coagulation and convulsions. Other clinical manifestations include haemoglobinuria, extreme weakness, hyper parasitemia and jaundice [2,5].

There is a changing trend in recent times, regarding not only the clinical manifestations, but also the complications and more patients are presenting with severe systemic complications [6]. Recent updates regarding the changing spectrum of severe malaria is precious for early intervention, because it may become fatal if treatment is delayed. Awareness of prevalence of different complications and neurological ones in particular could greatly facilitate the approach towards early diagnosis and prompt treatment [7].

Right now the most effective way to diagnose cerebral malaria is the same as the way to diagnose regular malaria, with a commonly used blood smear by checking for the presence of the parasite and treating with intravenous artemisinin compounds at the earliest [3,8].

WHO enumerates a list of complications for severe falciparum malaria but the importance of each complication has not been assigned [3,4]. For the patients with critical illness various scoring systems have been devised to determine the prognosis Mishra *et al* devised a Malaria Score for Adults (MSA) to prognosticate the outcome in severe falciparum malaria [9]. This score is based on four parameters namely severe anaemia,

acute renal failure, respiratory distress and cerebral malaria. With a cut-off score of 5, the sensitivity and positive predictive value for mortality was 89.9% and 94.1% respectively. Wilairatana *et al* in Bangkok, Thailand applied the APACHE II scoring to stratify the prognosis in patient of cerebral malaria. With the cutoff point at a score of 24, the APACHE II score stratified the patient's mortality outcome with 95.8% accuracy [10]. Since severe falciparum malaria is associated with high mortality, a SCORING system for predicting the outcome will be of great help for the treating clinician in identifying patients needing more intensive medical care and to prognosticate the chances of survival.

Clinical deterioration to severe malaria occurs, it usually develops 3–7 days after fever onset, although there have been rare reports of nonimmune patients dying within 24 hours of developing symptoms. Cerebral malaria is the most common clinical presentation and cause of death in adults with severe malaria. The onset may be dramatic with a generalized convulsion, or gradual with initial drowsiness and confusion, followed by coma lasting from several hours to several days [11]. Pulmonary edema is usually noncardiogenic and may progress to acute respiratory distress syndrome (ARDS) with an increased pulmonary capillary permeability [12]. Acute renal failure is usually oliguric (<400 ml/day) or anuric (<50 ml/day), rarely nonoliguric, and may require temporary dialysis [13]. Hypoglycemia is a common feature in patients with severe malaria. Hypoglycemia may be caused by quinine or quinidine-induced hyperinsulinemia, but it may be found also in patients with normal insulin levels. Most patients with shock exhibit a low peripheral vascular resistance and elevated cardiac output.

In a study by Limaye CS *et al*, 2012 reported the complications of vivax malaria in comparison with falciparum malaria in Mumbai. It was a retrospective observational study done at a tertiary care hospital in Mumbai where all the adult indoor patients positive for malarial infection based on peripheral smear for malarial antigen (LDH) spot test were included in the study [14].

Another study by Abdallah TM *et al* [15], in 2013 reported the clinical manifestations of severe P. falciparum and P. vivax infections. The study demonstrated a total of 139 adult patients (80 males (57.6%) with a mean (SD) age of 37.2 (1.5) years who presented with severe P. falciparum (81.3%) or P. vivax (18.7%) malaria. Manifestations among the 139 patients included hypotension (27.3%), cerebral malaria (16.5%), repeated convulsions (13.0%), hypoglycaemia (10.8%), hyperparasitaemia (10.1%), jaundice (10.1%), severe anaemia (7.2%), bleeding (4.3%), renal impairment (0.7%) and more than one complication (19.4%). The geometric mean of the parasite count was observed to be significantly higher in patients with severe P. vivax than with severe P. falciparum malaria, the different disease manifestations noted were not significantly different between patients with P. falciparum or P. vivax malaria. The study reported three patients (2.2%) who died due to severe P. falciparum malaria. One had cerebral malaria, the second had renal impairment, jaundice and hypoglycaemia, and the third had repeated convulsions and hypotension.

Biranchi Narayan Mohapatra *et al* [16], conducted a study in which 112 cases of severe falciparum malaria diagnosed as per the WHO criteria, were evaluated to determine the parameters which were significantly associated with mortality. The five selected parameters were analyzed using the Odds ratio and a new scoring system named as GCRBS score was designed with a possible score from 0-10. With a cut-off score of 5, the GCRBS score predicted mortality with a sensitivity of 85.3% and a specificity of 95.6%.

## Aims and Objectives

To determine the role of GCRBS score in predicting outcome of severe plasmodium falciparum malaria infection.

## Materials and Method

Study was conducted in Department of General Medicine of a tertiary care public hospital after obtaining Institutional Ethics Committee permission.

## Inclusion Criteria

The study included all those patients who were admitted with age more than 18 years and diagnosed as P falciparum on peripheral smear.

## Exclusion criteria

Those patients with comorbidities, mixed malaria, and concurrent Leptospirosis, Dengue, Enteric fever etc were excluded from the study.

## Sample size

Estimated sample size, n = 87 (95% Binomial Exact Confidence Interval with n = 87). As per Sample size 100 patients were included.

A detailed clinical history included the demographic details, past records, treatment and clinical examination was done in each patient. Routine examination and standard of care was done and documented for each patient. The patients were followed up until their death or discharge from the hospital. All these cases were treated with Artesunate (2.4 mg/ kg stat IV followed by 2.4 mg/kg at 12 and 24 h and then daily followed by a full course of an effective ACT (artemisinin-based combinations therapy) and then Primaquine for radical cure. Supportive therapy was given as per standard recommendations on case to case basis. Blood transfusion (whole blood/ packed cell/ fresh blood) was given in patients with Haematocrit < 20% or with bleeding manifestations/ DIC. Mechanical ventilation was provided to patients with pulmonary oedema/ARDS. Inotropic support (Dopamine/ Nor-adrenaline) was given in patients with shock not improving with IV fluids. Patients with renal failure requiring dialysis were given haemodialysis sessions as per need.

The proposed scoring index GCRBS was tested on the selected 100 patients diagnosed with falciparum malaria. The score for each patient was obtained by adding the specific values designated for the presence of the clinical parameters. Of all the parameters studied, five variables namely Cerebral malaria (GCS < 11), Renal failure (Creatinine > 3 mg/dl), Respiratory distress (Respiratory rate > 24/min), Jaundice (Bilirubin >10 mg/dl) and Shock (Systolic BP < 90 mm of Hg) were all found to be associated with a poor prognosis. Sensitivity and specificity for GCRBS score were computed and the values obtained were plotted on an ROC10 (Receiver Operating Characteristic) curve to determine the best cut-off point. SPSS version 22 was used for analysis of the data.

## Results

Maximum number of patients i.e.73% belonged to the age group 21-40 years, while 23% belonged to the 41-60 years group and there were only 4 patients above 60 years of age. Mean age was 35.2 years (table 1). Male patients were 64% and female 36% (table 2) (graph 1).

Fever was the chief presenting symptom in 98% patients followed by chills/rigors 90%, vomiting 55%, headache 52%, myalgia 50%, sweating 34% and pain in abdomen 25%. While convulsions were present in only 2% patients (table 3) (graph 2).

On general examination 17% patients had tachycardia (pulse >100 beats /min). Hypotension (systolic BP < 80 mmHg) was present in 6% patients. Pallor was present in 33%, icterus in 14% and purpuric rash in only

5% patients (table 4). On per abdomen examination 43% patients had splenomegaly, 14% hepatomegaly, while 18% had hepatosplenomegaly. No organomegaly was seen in 25% patients (table 5). On lab investigations, 69% patients had anaemia (Hb <11 mg/dl), of which only 1 patient had severe anaemia (Hb<5mg/dl). WBC count was normal in 72% patients, 10% had leucopenia (WBC<4000) and 18% had Leucocytosis (WBC>11000). Thrombocytopenia (platelet < 1 lac) was present in 94% patients: mild 27% (50000-1lac), moderate 51% (20000-50000) and severe thrombocytopenia in 16 % (<20000). Parasitic index was ≤ 0.5% in 69 % patients, hyperparasitemia (>5%) was seen in only 1 patient (table 6). Complicated malaria was seen in 28% patients and 72% had uncomplicated malaria (table 7). Among the complications, jaundice was present in 14 (50%), followed by renal failure 9 (32%), Acidosis 8(28%), ARDS 6(21%) patients (table 8) (Graph 3).

Single complication was present in 17 (60.7%) patients, while 11 (39.3%) patients had multiple complications (table 9). Duration of hospital stay was between 4-6 days in most patients (79%). With mean of 5.01 days of hospital stay in all admitted patients (table 10). Most of the admitted patients (97%) were treated with inj Artesunate (as per WHO guidelines). Some patients required intensive therapy, in the form of inotropes (8%), ventilator support (8%), blood transfusion (3%), platelet transfusion (24%), and hemodialysis (1%) (table 11). 6% mortality was observed in patients with mixed malaria infection, while 89% patients recovered and 5% went DAMA (discharge against medical advice) (table 12).

Patients with haemoglobin level of ≥11 gm/dl had significantly lower proportion of complicated malaria (12.9%) while proportion of complicated malaria increased with severity of anaemia. (p value 0.008) (Table 13). Complicated malaria was significantly associated with thrombocytopenia, 81% patients with severe thrombocytopenia (platelet <20000) had complicated malaria. (p value <0.0001). Patients who had serum creatinine level ≤1.2 mg/dl and serum urea level ≤40mg/dl, had significantly lower proportion of complicated malaria, and the proportion of complicated malaria increased significantly with rise in creatinine and urea level (p value <0.0001) (Table 14). Patients with total bilirubin >3mg/dl, SGOT >200U/L and SGPT >200U/L, had significantly higher proportions of complicated malaria (p value <0.0001) (table 15). Most of the study population had Glasgow Coma Score of 7 to 10 (76%) followed by 3 to 6 (16%) and 11 to 15 (8%) (table 16).

All the variables were analysed (viz., Glasgow Coma score (GCS), hypotension, creatinine, bilirubin, respiratory rate). Of these cerebral malaria (GCS < 11), Renal failure (Creatinine > 3 mg /dl), Respiratory distress (Respiratory rate > 24/min), Jaundice (Bilirubin > 10 mg/dl) and Shock (Systolic BP < 90 mm of Hg) were significantly associated with death ($p < 0.05$) (table 17).

The sensitivity and specificity of GCRBS at cut off of 5 was 83.33% and 78.65% respectively for predicting outcome. The positive and negative predictive value was 20.83% and 98.59% respectively (table 18).

**Table 1: Age distribution of Patients**

| Age (years) | Frequency | Percentage |
|---|---|---|
| 21-40 | 73 | 73.0 |
| 41-60 | 23 | 23.0 |
| >60 | 4 | 4.0 |

| | | |
|---|---|---|
| Total | 100 | 100.0 |
| Mean= 35.27 years (SD= ±13.77 years) | | |

**Table 2: Gender distribution of Patients**

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 64 | 64.0 |
| Female | 36 | 36.0 |
| Total | 100 | 100.0 |

**Table 3: Symptoms at the time of admission**

| Symptoms | Frequency | Percentage |
|---|---|---|
| **Fever** | 98 | 98.0 |
| **Chills/Rigors** | 90 | 90.0 |
| **Vomiting** | 55 | 55.0 |
| **Headache** | 52 | 52.0 |
| **Myalgia** | 50 | 50.0 |
| **Sweating** | 34 | 34.0 |
| **Pain in abdomen** | 25 | 25.0 |
| **Cough** | 16 | 16.0 |
| **Decreased urine output** | 16 | 16.0 |
| **Jaundice** | 12 | 12.0 |
| **Breathlessness** | 12 | 12.0 |
| **Burning micturition** | 8 | 8.0 |
| **Bleeding** | 6 | 6.0 |
| **Rash** | 4 | 4.0 |
| **Altered sensorium** | 3 | 3.0 |
| **Convulsion** | 2 | 2.0 |

**Table 4: Findings on General Examination at the time of admission**

| Variable | | Frequency | Percentage |
|---|---|---|---|
| **Pulse** | <100 | 83 | 83.0 |
| | >100 | 17 | 17.0 |
| **Blood Pressure (Systolic)** | >/= 120 | 23 | 23.0 |
| | 110-119 | 47 | 47.0 |
| | 80-99 | 24 | 24.0 |
| | 60-79 | 4 | 4.0 |
| | <60 | 2 | 2.0 |
| **Pallor** | Present | 33 | 33.0 |
| | Absent | 67 | 67.0 |
| **Icterus** | Present | 14 | 14.0 |
| | Absent | 86 | 86.0 |
| **Rash** | Present | 5 | 5.0 |
| | Absent | 95 | 95.0 |

**Table 5: Per abdomen findings**

| PA findings | Frequency | Percentage |
|---|---|---|

| | | |
|---|---|---|
| **Only Splenomegaly** | 43 | 43.0 |
| **Only Hepatomegaly** | 14 | 14.0 |
| **Hepatosplenomegaly** | 18 | 18.0 |
| **No Organomegaly** | 25 | 25.0 |
| **Total** | 100 | 100 |

**Table 6: Blood Investigation findings**

| **Variable** | | **Frequency** | **Percentage** |
|---|---|---|---|
| **Hemoglobin** | ≥11 | 31 | 31.0 |
| | 8-10.9 | 64 | 64.0 |
| | 5-7.9 | 4 | 4.0 |
| | <5 | 1 | 1.0 |
| **WBC** | <4000 | 10 | 10.0 |
| | 4000-11000 | 72 | 72.0 |
| | >11000 | 18 | 18.0 |
| **Platelets** | >1.5 lac | 2 | 2.0 |
| | 1-1.5 lac | 4 | 4.0 |
| | 50000-1 lac | 27 | 27.0 |
| | 20000-50000 | 51 | 51.0 |
| | <20000 | 16 | 16.0 |
| **Parasitic Index** | ≤0.5 | 69 | 69.0 |
| | 0.6-2.5 | 21 | 21.0 |
| | 2.6-5 | 9 | 9.0 |
| | >5 | 1 | 1.0 |
| **Total** | | 100 | 100.0 |

**Table 7: Complicated and Uncomplicated malaria**

| **Malaria** | **Frequency** | **Percentage** |
|---|---|---|
| **Uncomplicated** | 72 | 72.0 |
| **Complicated** | 28 | 28.0 |
| **Total** | 100 | 100. |

**Table 8: Various complications seen in patients**

| **Complication** | **Frequency** | **Percentage** |
|---|---|---|
| **Jaundice** | 14 | 50.0 |
| **Renal Failure** | 9 | 32.1 |
| **Acidosis** | 8 | 28.6 |
| **ARDS** | 6 | 21.4 |
| **Bleeding** | 6 | 21.4 |
| **Shock** | 6 | 21.4 |

| | | |
|---|---|---|
| **Cerebral Malaria** | 3 | 10.7 |
| **Severe Anemia** | 1 | 3.6 |
| **Hyperparasitemia** | 1 | 3.6 |

**Table 9: Single and Multiple Complications**

| Variables | Frequency | Percentage |
|---|---|---|
| **Single** | 27 | 60.7 |
| **Multiple** | 11 | 39.3 |
| **Total** | 28 | 100.0 |

**Table 10: Duration of Hospital Stay**

| Duration | Frequency | Percentage |
|---|---|---|
| **≤3** | 11 | 11.0 |
| **4-6** | 79 | 79.0 |
| **>6** | 10 | 10.0 |
| **Total** | 100 | 100.0 |
| **Mean= 5.01 Days (SD=±1.36)** | | |

**Table 11: Treatment received in the hospital (n=100)**

| Treatment | Frequency (%) |
|---|---|
| **Artesunate** | 97 |
| **Quinine** | 3 |
| **Clindamycin** | 7 |
| **Doxycycline** | 21 |
| **Inotropes** | 8 |
| **Ventilatory Support** | 8 |
| **Blood Transfusion** | 3 |
| **Platelet Transfusion** | 24 |
| **Hemodialysis** | 1 |

**Table 12: Outcome of admitted patients**

| Outcome | Frequency | Percentage |
|---|---|---|
| **Recovered** | 89 | 89.0 |
| **Death** | 6 | 6.0 |
| **DAMA** | 5 | 5.0 |
| **Total** | 100 | 100.0 |

**Table 13: Association of Haemogram and Complications.**

| Variables | | Frequency | Malaria | | p Value |
|---|---|---|---|---|---|
| | | | UCM (%) | CM (%) | |
| **Hemoglobin gm%** | ≥11 | 31 | 27 (87.1) | 4 (12.9) | 0.008 (Highly |
| | 8-10.9 | 64 | 44 (68.8) | 20 (31.2) | |

| | | | | | |
|---|---|---|---|---|---|
| | 5-7.9 | 4 | 1 (25.0) | 3 (75.0) | Significant) |
| | <5 | 1 | 0 (0.0) | 1 (100.0) | |
| **Platelet** | >1.5 lac | 2 | 2 (100.0) | 0 (0.0) | <0.0001 (Very Highly Significant) |
| | 1-1.5 lac | 4 | 4 (100.0) | 0 (0.0) | |
| | 50000- 1 lac | 27 | 27 (100.0) | 0 (0.0) | |
| | 20000-50000 | 51 | 36 (70.6) | 15 (29.4) | |
| | <20000 | 16 | 3 (18.8) | 13 (81.2) | |

**Table 14: Association of Renal function test and Complication**

| **Variables** | | **Frequency** | **Malaria** | | **p Value** |
|---|---|---|---|---|---|
| | | | UCM (%) | CM (%) | |
| **Serum Creatinine mg%** | ≤1.2 | 62 | 54 (87.1) | 8 (12.9) | <0.0001 (Very Highly Significant) |
| | 1.3-3 | 28 | 17 (60.7) | 11 (39.3) | |
| | >3 | 10 | 0 (0.0) | 10 (100.0) | |
| **Serum Urea mg%** | ≤40 | 76 | 66 (86.8) | 10 (13.2) | <0.0001 (Very Highly Significant) |
| | 40-80 | 20 | 6 (30.0) | 14 (70.0) | |
| | >80 | 4 | 0 (0.0) | 4 (100.0) | |

**Table 15: Association of LFT and Complication**

| **Variables** | | **Frequency** | **Malaria** | | **p Value** |
|---|---|---|---|---|---|
| | | | UCM (%) | CM (%) | |
| **Total Bilirubin mg%** | ≤1.1 | 15 | 15 (100.0) | 0 (0.0) | <0.0001 (Very Highly Significant) |
| | 1.2-3 | 70 | 57 (81.4) | 13 (18.6) | |
| | >3 | 15 | 0 (0.0) | 15 (100.0) | |
| **SGOT IU** | ≤40 | 32 | 32 (100.0) | 0 (0.0) | <0.0001 (Very Highly Significant) |
| | 41-100 | 39 | 31 (79.5) | 8 (20.5) | |
| | 101-200 | 19 | 9 (47.4) | 10 (52.6) | |
| | >200 | 10 | 0 (0.0) | 10 (100.0) | |
| **SGPT IU** | ≤40 | 44 | 44 (100.0) | 0 (0.0) | <0.0001 (Very Highly Significant) |
| | 41-100 | 33 | 22 (66.7) | 11 (33.3) | |
| | 101-200 | 15 | 6 (40.0) | 9 (60.0) | |
| | >200 | 8 | 0 (0.0) | 8 (100.0) | |

**Table 16: GLASGOW COMA SCORE**

| **Glasgow Coma Score** | **Frequency** | **Percent** | **Death** |
|---|---|---|---|
| 3 to 6 | 16 | 16 | 5 |
| 7 to 10 | 76 | 76 | 1 |
| 11 to 15 | 8 | 8 | 0 |
| Total | 100 | 100 | 6 |

**Table 17: The GCRBS score**

| **Variables** | | | **Malaria** | | **p value** | **Score** |
|---|---|---|---|---|---|---|

| | value | No. of Patients | Death | Survival (%) | Odds ratio | | |
|---|---|---|---|---|---|---|---|
| **GCS** | ≤7 | 12 | 5 | 7 | 9.81 | <0.0001 | 3 |
| | >7 | 83 | 1 | 82 | | | 1 |
| **Creatinine mg%** | ≤3 | 86 | 1 | 85 | 4.52 | <0.0001 | |
| | >3 | 9 | 5 | 4 | | | 2 |
| **Respiratory rate/min** | ≤24 | 75 | 0 | 75 | 4.13 | <0.0001 | |
| | >24 | 20 | 6 | 14 | | | 1 |
| **Bilirubin mg%** | ≤10 | 81 | 0 | 81 | 5.77 | <0.0001 | |
| | >10 | 14 | 6 | 8 | | | 2 |
| **SBP mmHg** | ≤90 | 15 | 5 | 10 | 6.19 | <0.0001 | 1 |
| | >90 | 70 | 1 | 69 | | | |

**Table 18: The GCRBS score vs Final outcome**

| | Score | Total No. | Final outcome | | p value |
|---|---|---|---|---|---|
| | | | Death | Survival (%) | |
| **GCRBS** | ≤5 | 71 | 1 | 70 | <0.0001 |
| | >5 | 24 | 5 | 19 | |
| | Total | 95 | 6 | 89 | |

**Table 19: Age and sex comparison with other studies**

| Table 19 | Present Study | Mohapatra MK *et al* [17] | Joseph V *et al* [18] | Thomas AC *et al* [19] |
|---|---|---|---|---|
| Mean age (years) | 35.2 | 26 | 35 | 44 |
| Males (%) | 64 | 70 | 70 | 84 |
| Females (%) | 36 | 30 | 30 | 16 |

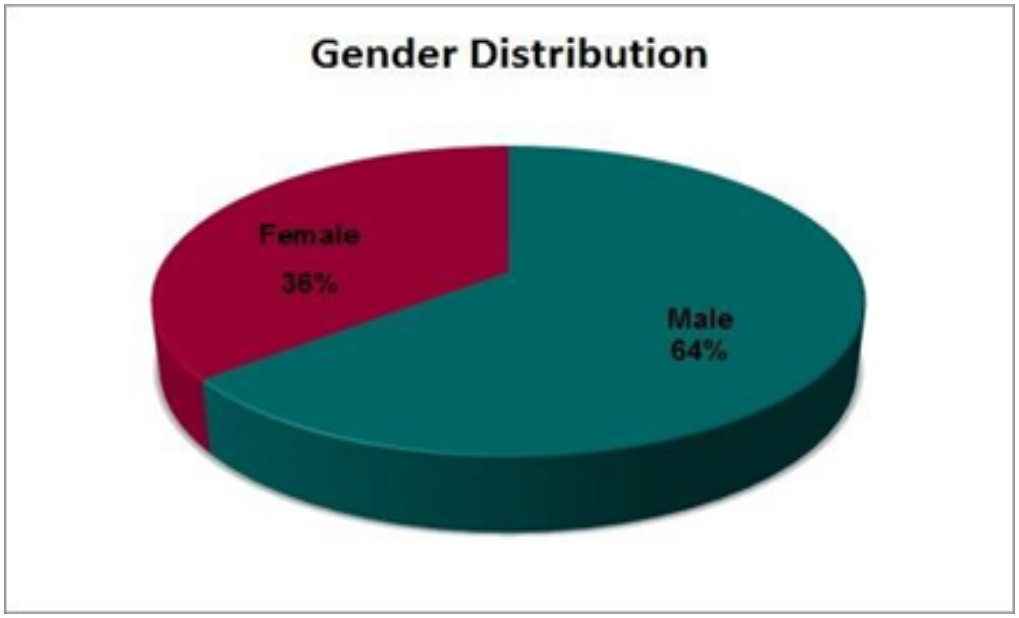
**Table 20: Comparison of symptoms at the time of presentation**

| Symptoms | Present Study (%) | Mohapatra M K *et al* [17] (%) |
|---|---|---|
| Fever | 98 | 93 |
| Vomiting | 55 | 29 |
| Headache | 52 | 38 |
| Myalgia | 50 | 38 |
| Pain in abdomen | 25 | 8.4 |
| Jaundice | 12 | 4.2 |
| Decreased Urine Output | 16 | 1.6 |
| Altered Sensorium | 3 | 1.4 |
| Convulsion | 2 | 0.8 |

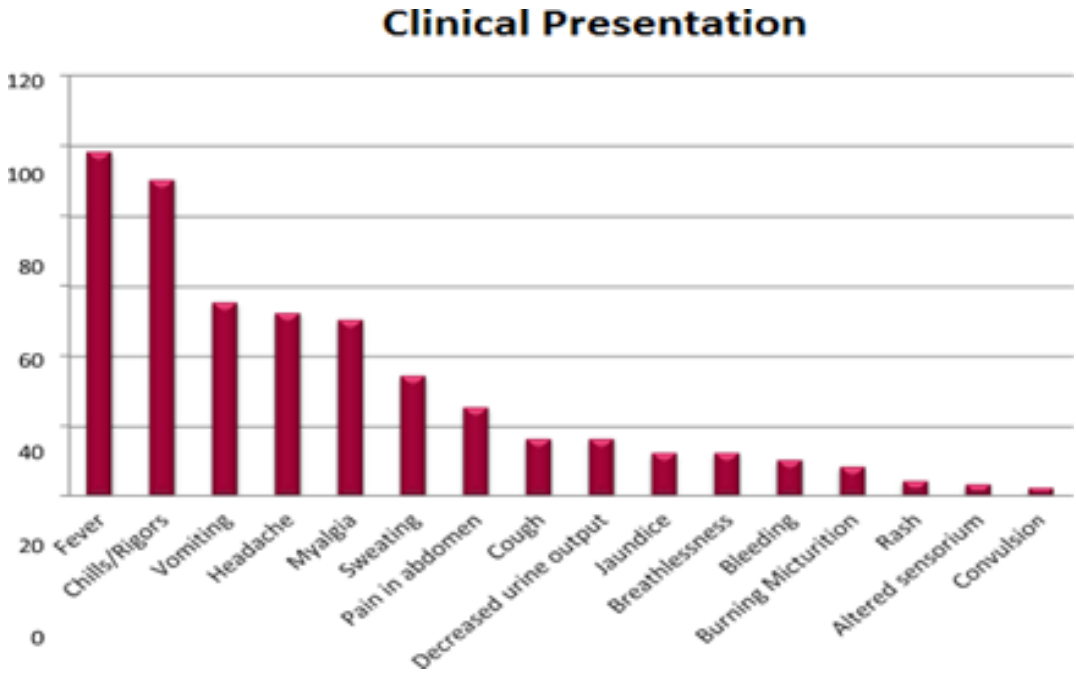
**Table 21: Other lab investigations**

| Lab Investigation | Present Study (%) | Joseph V *et al* [18] (%) |
|---|---|---|
| Bilirubin (>3mg/dl) | 15 | 15 |
| Liver enzyme (>100) | 21 | 36 |

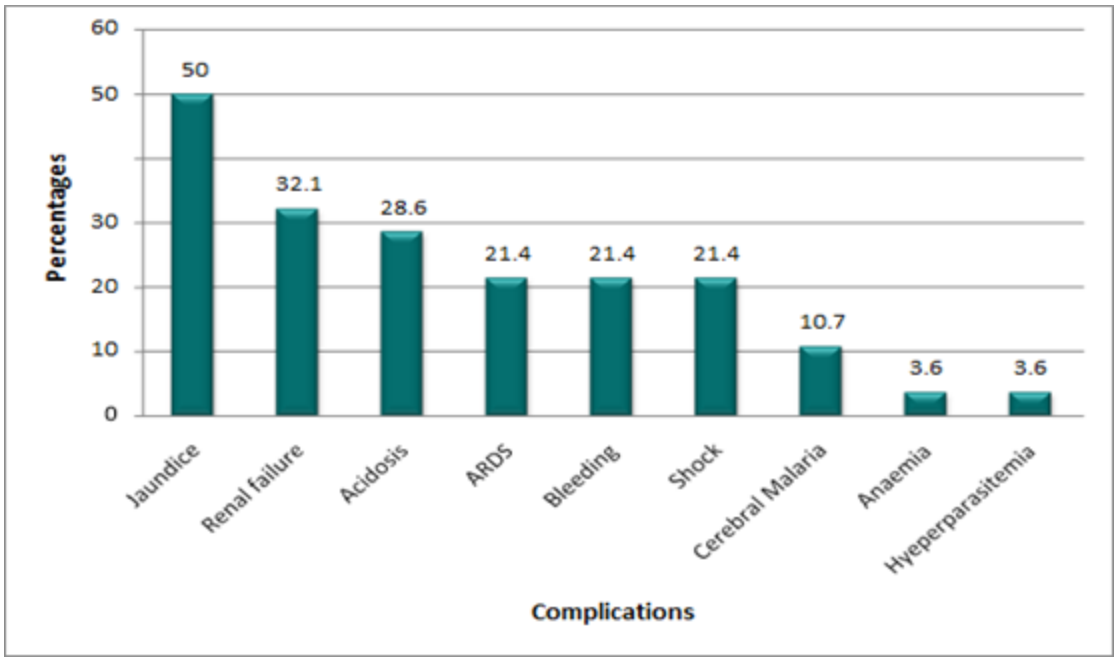
| | | |
|---|---|---|
| Creatinine (>3mg/dl) | 10 | 5 |




**Graph 1: Gender Distribution of Study Participants**




**Graph 2: Symptoms at the time of admission**




**Graph 3: Associated Complications**

## Discussion

Maximum number of patients in present study was young males. 64% patients were male and 36% female. 65% of patients belonged to age group 21-40 years, with mean age of presentation being 35.2 years.

In the study by Mohapatra MK *et al* [17], mean age of presentation was 26 years, percentage of male and female were 70% and 30% respectively. Study by Joseph VC *et al* [18], found the mean age of 35 years and males were 70% while females 30%. In a study by Thomas AC *et al* [19], the mean age was 44 years while male were 84% and females 16%.

Results in the present study were consistent with other studies, where mixed malaria was prevalent more among young adults. The number of males outnumbered the females. The reason for this distribution predominantly among males is due to the increased outdoor activities of males and the chances of getting exposure to the risk of malaria is more in males (table 19). The present study is comparable in regards to most of the symptoms with the study done by Mohapatra MK *et al* [17]. Fever was the most common symptom at the time of presentation in present study (98%) and is consistent with the study by Mohapatra MK *et al* (93%) [17]. Vomiting was present in 55% patients of present study and 29% in study by Mohapatra MK *et al* [17]. Headache was present in 52% patients of present study and 38% in study by Mohapatra MK *et al* [17]. Myalgia was presenting symptom in 50% of patients in the current study, while a study by Mohapatra MK *et al* had 38% with myalgia [17]. 25% patients had pain in the abdomen in the present study and 8.4% patients in the study by Mohapatra MK *et al* [17]. Jaundice was present in 12% patients in the current study and only 4.2% patients in study by Mohapatra MK *et al* [17]. Decreased urine output was presenting symptom in 16% patients of the current study while only 1.6% patients in the study of Mohapatra MK *et al* had decreased urine output [17]. Neurological symptoms in the form of altered sensorium and convulsions were present in 5 % patients in the present study while only 2.2 % patients had similar symptoms in study by

Mohapatra MK *et al* [17] (table 20).

Another study Nand *et al*, 2001 reported the presenting clinical features that included fever (100%), body aches (45%), headache (55%), diarrhea (10%), dark urine (10%), altered sensorium (46.6%), oliguria (11.6%), these reports were more or less similar to our study [20].

In a study by Rajkumar A *et al*, 2012 who also studies the clinical outcome of malaria reported the percentage of patients, chills in 43%, vomiting and decreased urine output in 16% patients, while headache, high coloured urine, diarrhea, altered sensorium and stupor/ unconsciousness was reported in 11% each. Even though there was some difference in the clinical features reported, the result of similar clinical features was more or less comparable to our study [21-23].

Splenomegaly was present in 61% patients in present study, while it was 93% in study done by Mohapatra MK *et al* [17], 30% in Joseph V *et al* [18] and 32% in study done by Thomas AC *et al* [19]. 69% patients had anaemia in present study, while it was present in 38% patients in study conducted by Mohapatra MK *et al*, 15% in Joseph V *et al* and 12.8% in study done by Thomas AC *et al* [17-19]. Thrombocytopenia was present in 94 % patients in current study, 35% in Joseph V *et al*, and 50% in study done by Thomas AC *et al* [19]. However only 6% patients had bleeding as complication of mixed malaria, but no patients had bleeding manifestations in study by Mohapatra MK *et al*. [17] Comparison with present above study, recent study suggests no bleeding and complication.

In the present study 15% patients had jaundice (bili >3mg/dl) and in a similar study by Joseph V *et al* [18] 15% patients had jaundice. Liver enzymes were raised in 21% patients in present study and in 36% patients in study by Joseph V *et al* [18]. Renal failure as complication (creatinine >3mg/dl) was seen in 10 % patients in current study and it was 5 % in study by Joseph V *et al* [18] (table 21).

In the present study 28% of patients had complicated malaria. Among the complications, jaundice was most common, present in 14 (50%) patients, followed by renal failure 9 (32%), Acidosis 8(28%), ARDS 6(21%). Out of total complicated malaria patients 60% had single complications and 40% had multiple complications. In the study done by Mohapatra MK *et al* 17.8% patients had complicated mixed malaria of which 66% had single while 34% had multiple complications. Most common complications were cerebral malaria and anaemia. In the present study, mortality was 6% while in the study done by Mohapatra MK *et al* there were no deaths [17].

## GCRBS

Of these cerebral malaria (GCS < 11), Renal failure (Creatinine > 3 mg /dl), Respiratory distress (Respiratory rate > 24/min), Jaundice (Bilirubin > 10 mg/dl) and Shock (Systolic BP <90 mm of Hg) were significantly associated with death ($p < 0.05$). Cerebral malaria was responsible for the maximum number of deaths.

As seen in the previous studies' cerebral malaria and acute renal failure are the major contributors to death. Since the neurological status of a cerebral malaria patient can vary from disoriented to stupor to coma, GCS being an easy to calculate quantitative variable has been used to allot a score for cerebral component. Similarly a respiratory rate of more than 24 has been used to identify patients having pulmonary oedema or ARDS which has a high case fatality rate. But contrary to the previous studies jaundice has been found to be an important predictor of mortality in this study. We observed that with the increase in bilirubin level the death rate also rises, more steeply with bilirubin levels >10 mg/dl. This finding was similar to

Tripathy R *et al* but less than African studies by Mockenhaupt FP *et al* [22,23]. The relationship between higher GCRBS and poorer outcome was similar to Mohapatra BN *et al*. [16]

## Conclusion

The severe cases of falciparum malaria are likely to be only the 'tip of the iceberg'. Many people living far from the health care units may die at some local hospital due to delay in the referrals, hence early diagnosis and classification of severe malaria would allow appropriate management and early referrals. The GCRBS score seems to be a very good working tool as it is very easy to calculate and easy to remember. Like the GCS score system which is popular among doctors, this too will help in predicting outcome of severe malaria in adults and indirectly reducing mortality.

Our study concludes that GCRBS system is sensitive to predict the outcome of the cases of severe malaria. Therefore, a large multi-centric trial would be worthwhile helpful to study the clinical utility of GCRBS Score.

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