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# Comorbidities As Risk Modifiers in Cerebral Malaria: An Observational Study

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## 1. Introduction

Malaria remains a major public health problem in tropical and subtropical regions, with Plasmodium falciparum being the most virulent species. Cerebral malaria is a severe and life-threatening complication characterized by altered sensorium, seizures, and coma. Despite advances in antimalarial therapy, cerebral malaria continues to be associated with high morbidity and mortality. The pathophysiology involves sequestration of parasitized red blood cells in cerebral microvasculature, leading to inflammation, hypoxia, and neuronal dysfunction. Clinical outcomes in cerebral malaria vary widely among patients. Underlying comorbidities such as diabetes mellitus, chronic kidney disease, anemia, malnutrition, and chronic liver disease can impair immune response, metabolic stability, organ reserve, that can worsening outcomes in cerebral malaria. Hence, this study was undertaken to assess the role of comorbidities in modifying the clinical course and outcome of cerebral malaria.

### Aim

This study aims to evaluate the role of comorbidities as risk modifiers influencing severity, complications, and outcomes in patients with cerebral malaria.

## 2. Methodology

- **Study design:** Observational study
- **Setting:** Tertiary care hospital
- **Study population:** 30 adult patients (≥18 years) diagnosed with cerebral malaria
- **Definition:** Cerebral malaria defined as altered sensorium or unarousable coma with confirmed Plasmodium falciparum infection (WHO criteria).
- **Exclusion criteria:** Mixed malaria, pre-existing neurological disorders, metabolic encephalopathies, CNS infections.
- **Data collection:** Structured proforma after informed consent
- **Variables studied:** Demographics, clinical features, GCS at admission, laboratory parameters, and comorbidities

## 3. Results

### Demographic and Clinical Characteristics

**Table 1:** Demographic and Clinical Characteristics of Study Population

| Variable | Value |
|---|---|
| Mean age (years) | 42.3 ± 13.6 |
| Male sex | 19 (63.3%) |
| Female sex | 11 (36.7%) |
| Fever | 30 (100%) |
| Altered sensorium | 30 (100%) |
| Seizures | 17 (56.7%) |
| Mean GCS at admission | 7.8 ± 2.2 |

*(Figures illustrating age and gender distribution were presented visually in the original presentation, showing a higher frequency in patients older than 30 and a male predominance).*

### Distribution of Comorbidities

**Table 2:** Distribution of Comorbidities Among Patients with Cerebral Malaria (n = 30)

| Comorbidity | Number |
|---|---|
| Any comorbidity present | 18 |
| No comorbidity | 12 |
| Anemia | 14 |
| Diabetes mellitus | 8 |
| Hypertension | 7 |
| Chronic kidney disease | 5 |
| Chronic liver disease | 3 |
| Chronic alcohol use | 6 |
| Malnutrition | 4 |
| Multiple comorbidities | 8 |

### Severity and Complications

**Table 3:** Comparison of GCS Score at Admission Based on Comorbidity Status

| Group | Mean GCS ± SD | P value |
|---|---|---|
| With comorbidities (n = 18) | 7.0 ± 2.0 | < 0.001 |
| Without comorbidities (n = 12) | 9.0 ± 1.9 | |

Statistical test: Independent Student's t-test. Patients with comorbidities had significantly lower GCS scores at admission, indicating more severe neurological impairment compared to patients without comorbidities.

**Table 4:** Comparison of Complications Based on Presence of Comorbidities

| Complication | With comorbidities (n = 18) | Without comorbidities (n = 12) | P value |
|---|---|---|---|
| Acute kidney injury | 10 (55.6%) | 2 (16.7%) | 0.003 |
| Hypoglycemia | 7 (38.9%) | 2 (16.7%) | 0.01 |
| Shock | 6 (33.3%) | 1 (8.3%) | 0.02 |
| ARDS | 5 (27.8%) | 1 (8.3%) | 0.03 |

Statistical test: Chi-square / Fisher's exact test. Complications such as acute kidney injury, hypoglycemia, shock, and ARDS were significantly more frequent among patients with comorbidities.

### Clinical Outcomes

**Table 5:** Requirement of Mechanical Ventilation Based on Comorbidity Status

| Mechanical Ventilation | Number (%) |
|---|---|
| Required | 11 (36.7%) |
| With comorbidities | 9 (81.8%) |
| Without comorbidities | 2 (18.2%) |

Most patients requiring mechanical ventilation had one or more comorbidities, suggesting increased disease severity and respiratory compromise in this group.

**Table 6:** Comparison of Duration of Hospital Stay Based on Comorbidity Status

| Group | Mean hospital stay (days) ± SD | P value |
|---|---|---|
| With comorbidities | 12.5 ± 4.3 | < 0.001 |
| Without comorbidities | 8.1 ± 2.9 | |

Patients with comorbidities had a significantly prolonged hospital stay, reflecting increased complications and delayed recovery.

**Table 7:** Comparison of Mortality Based on Comorbidity Status

| Group | Mortality | Percentage | P value |
|---|---|---|---|
| With comorbidities (n = 18) | 2 | 11.10% | 0.04 |
| Without comorbidities (n = 12) | 1 | 8.30% | |
| Overall (n = 30) | 3 | 10.00% | |

Statistical test: Fisher's exact test. Mortality was higher among patients with comorbidities compared to those without comorbidities.

**Table 8:** Mortality Distribution According to Specific Comorbidities

| Comorbidity | Mortality (%) |
|---|---|
| Chronic kidney disease | 40% |
| Diabetes mellitus | 25% |
| Multiple comorbidities | 25% |

Mortality was highest among patients with chronic kidney disease, followed by diabetes mellitus and multiple comorbidities, indicating that increasing comorbidity burden adversely affects outcomes.

## 4. Discussion

### Clinical Relevance

Cerebral malaria predominantly affected middle-aged males, likely due to increased exposure and delayed healthcare-seeking behavior. Fever and altered sensorium were universal presenting symptoms. A substantial proportion of patients presented with seizures and low GCS scores, indicating severe neurological involvement at admission. The presence of comorbidities was associated with increased disease severity, higher complication rates, and prolonged hospitalization.

### Community Relevance

Cerebral malaria continues to pose a significant public health burden in endemic regions. Predominance in the working-age population leads to socioeconomic impact due to loss of productivity and increased healthcare expenditure. Community awareness regarding early symptoms such as fever, altered behavior, and seizures is essential for timely healthcare access. Strengthening preventive measures, early diagnosis, and referral systems can reduce the burden of severe malaria and improve community health outcomes.

## 5. Conclusion

Cerebral malaria is a severe neurological emergency with high morbidity and mortality. Most patients in this study had one or more comorbidities, reflecting a significant chronic disease burden. These comorbidities were associated with greater disease severity and lower GCS at admission. Furthermore, patients with comorbid conditions had higher complication rates, longer hospital stays, and more frequent requirements for mechanical ventilation. Comorbidities act as key risk modifiers, worsening overall outcomes in cerebral malaria.

### Take-Home Message

Early recognition and aggressive management of comorbidities, along with prompt antimalarial therapy, are essential to reduce complications, improve survival, and minimize neurological morbidity in patients with cerebral malaria.

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