Background: Severe falciparum malaria with liver function abnormalities is more vulnerable to the development of dreaded complications in Northeastern state of India. Objective: Therefore present study was designed to explore the liver functions variables in severe falciparum malaria in Northeastern region of Rajasthan.

Methods: This observational study was performed at the R N T Medical College Udaipur, India. Total 60 malarial patients who tested positive for plasmodium falciparum were enrolled in present study. Severity of falciparum was diagnosed by clinical and laboratory biomarkers as given by working group of World Health Organization and subsequently all 60 patients were divided into severe malaria (Group-I) which comprised of 20 patients and simple falciparum malaria (Group-II) it include 40 patients. A comprehensive clinical history, socio-demographic information and liver function variables were examined. SPSS-16 software was used for statistical analysis.

Results: Males with falciparum malaria were significantly (p<0.01) higher as compared to females and significantly (p<0.01) higher numbers of patients died in severe malaria as compared to simple falciparum malaria. The liver function variables, Aspartate amino-Transf erase (AST), Alanine amino-Transferase (ALT), serum total bilirubin and blood urea were significantly (p<0.001) higher in patients with severe malaria as compared to simple falciparum malaria while random blood glucose, serum albumin and prothrombin time were significantly (p<0.001) lower in patients with severe malaria.

Conclusion: It concluded that a high incidence of severe P. falciparum malaria was significantly associated with high mortality rate and declined lung functions.

KEYWORDS
Severe Falciparum Malaria, Uncomplicated malaria, Mortality, Liver function, Prothrombin Time.
plain test tubes were analyzed for prothrombin time and biochemical parameters, respectively. After clot formation, all samples were instantly centrifuged (3000 rpm) for 8-10 minute; the sera were separated and kept for analysis. Prothrombin time was measured using commercial available diagnostic kit by tissue thromboplastin method.

Sera were used for measurement of biochemical variable, at room temperature by enzymatic process using marketable offered diagnostic kit on semi-automated biochemical analyzer (Transasia Erba Chem 5 plus). The liver function variables and the respectively methods applied are the followings: aspartate amino-transferase (AST) and alanine amino-transferase (ALT) - Henry method (Modified IFCC); random blood glucose-GOD/POD method; total serum bilirubin-Diao method; serum alkaline phosphates (ALP); beckman unical method, Albumin: Bromocresol Green (BCG) method.

Statistical Analysis
The data were statistically analyzed and baseline characteristics of the malaria patients were expressed in percentages and mean ± SD. Chi-square test was used for the relationship of qualitative data and Independent Student “t” test was used to compare difference liver functions variables between severe and simple falciparum malaria groups. P< 0.05 was considered statistically significant. Statistical analysis was done using SPSS windows version 20.0 software (SPSS Inc., Chicago, Illinois).

Results:
This study was conducted on 60 P. falciparum malaria patients or cases in Department of general Medicine, R T N Medical College associated, Maharauna Bhupal hospital, Udaipur (Maharauna, India) and the following results were drawn from the present study. This study was performed on population over 10 year’s age group. Total 60 blood smear positives patients of falciparum malaria were observed out of these 36 had males (60 %) and 24 (40 %) had females age ranging from 10 to 70 years.

| Table no-1: Incidence of severe and simple falciparum malaria (As per WHO) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Type of Malaria                | Total Cases     | Survived        | Died            |
| Severe (n=20)                  | 11 (55 %)       | 9 (45%)         | 2 (10%)         |
| Simple (n=40)                  | 25 (62.5%)      | 15 (37.5%)      | 10 (25%)        |

\[ \chi^2 \text{(Chi square)} = 5.35. \text{df} = 1, \text{p}<0.001 \text{considered significant. The row and column association is statistically significant. (Severe malaria > Simple malaria} \ P<0.001, \text{In case severe malaria Male> female} \ P<0.05, \text{significant, died malaria cases significantly higher in severe malaria} \ (P<0.05) \text{as compared to simple malaria.} \]

Out of 60 patients, 20 (33.3%) patients were presented as severe malaria as defined by World health organization. Among these 11 (55%) had male and 9 (33.3%) had female. Amongst severe malaria 10 (50%) patients were survived and 10 (50%) were died. Moreover, 40 (66.66%) patients showed as simple falciparum malaria amongst these 25 (62.5%) had male and 15 (37.5%) had female amongst this group all has been survived and no death has been reported. As per chi-square test males with falciparum malaria were significantly (p<0.01) higher as compared to females and significantly (p<0.01) lower in patients with severe malaria.

Statistics:
The levels and comparison of mean of liver function variables between severe and simple falciparum malaria are shown in table-2. The liver function variables Aspartate amino-Transferase (AST), Alanine amino-Transferase (ALT), serum total bilirubin and blood urea were significantly (p<0.001) higher in patients with severe malaria as compared to simple falciparum malaria while random blood glucose, serum albumin and prothrombin time were significantly (p<0.001) lower in patients with severe malaria. Moreover, there were no significantly (p>0.05) difference observed in age and serum alkaline phosphates (ALP) between severe and simple malaria. It implies that severe falciparum malaria significantly associated with decline liver functions.

Discussion:
The incidence of P. falciparum in India is increasing. The entire population of India (99.5 %) is nowadays deemed to be under malaria risk (9). Although in majority of patients, malaria shows as a straightforward fever with punctual recovery, it may exist in severe form with systemic complications mainly renal and hepatic failure, leading to high morbidity and mortality. More recently, Plasmodium falciparum accounts for nearly 50% of reported malaria cases in India\(^{[2,16]}\).

In our study 60 blood smear and rapid diagnostic test positive patients were assessment, among males with falciparum malaria were significantly (p<0.01) higher as compared to females and significantly (p<0.001) higher numbers of patients died in severe malaria as compared to simple falciparum malaria which is agreement with previous report\(^{[15]}\). The most important characteristic of severe malaria is intense parasite sequestration within cerebral blood vessels, cyto-adherence of parasitised red blood cells to endothelial cells\(^{[17–19]}\) to non infected erythrocytes may help to pathogenesis of cerebral malaria by compromising the cerebral circulation\(^{[20]}\).

In present study, liver function variables Aspartate amino-Transferase (AST), Alanine amino-Transferase (ALT), serum total bilirubin and blood urea were significantly (p<0.001) higher in patients with severe malaria as compared to simple falciparum malaria while random blood glucose, serum albumin and prothrombin time were significantly (p<0.001) lower in patients with severe malaria. This findings accordance with several earlier studies\(^{[18,19]}\). A case control study was done by Abro et al,\(^{[20]}\) reported that hepatic dysfunction in P. falciparum malaria ranged from mild elevation of liver enzymes to acute hepatitis (ALT>10 times of normal level). It indicates severe illness with high frequency of complication and mortality rates.

Another study noticed that a significant percentage of patients having falciparum malaria with jaundice fulfill the criteria for malarial hepatic dysfunction. It should be considered in patients presenting with acute febrile illness with jaundice so that specific treatment can be given\(^{[21]}\). In addition, Indian study was performed by Mishra et al,\(^{[22]}\) reported that hepatomegaly and mild elevation of enzymes can be observed in a significant proportion of patients, involvement of liver leading to acute hepatitis or liver cell necrosis is a relatively uncommon complication in P. falciparum malaria. Similarly, el badawil NE et al, suggested that the mean level of most of the biochemical liver function test parameters, were below the normal reference ranges, and a highly significant difference was observed between pregnant women with malaria, and their controls, in the level of AST, ALT, total protein, albumin and globulin, but not in the level of total bilirubin, direct bilirubin and indirect Bilirubin.\(^{[23]}\) Moreover, positive correlation of liver enzymes and bilirubin shows that liver function tests should be
performed along with early diagnosis of \textit{Plasmodium falciparum} infections in order to prevent complications and to reduce mortality\textsuperscript{18}. Results of aforementioned several studies are harmony with present finding.

Limitation of present study is that laboratory indices of poor prognosis and clinical presentation of \textit{falciparum malaria} were not measured in this study therefore further cohort or clinical studies with huge sample and longer duration are required to investigate cause of liver function manifestation in severe malaria and mortality rate.

**Conclusion:**

It concluded that a high incidence of severe malaria and mortality rate in \textit{P. falciparum} and severe malaria had significantly associated with high mortality rate and declined lung functions.

**References:**