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# Study of Haematological Parameters in Seropositive Dengue Fever and Their Significance in the Poor Outcome of the Disease

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## ABSTRACT

**BACKGROUND:** Dengue fever is a mosquito borne illness results morbidity and mortality. Dengue is a major public health problem in India. Dengue infection causes classic dengue fever (DF), dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS). Early detection of these complications helps in the prognosis of the disease.
**OBJECTIVE:** To study the changes in haematological parameters in seropositive dengue infection and to predict their role in the poor outcome of the disease.
**MATERIAL AND METHODS:** Prospective study was conducted at Basaveshwara medical college and hospital, Chitradurga, on 450 suspected cases of dengue fever during the time period November 2017 to June 2019.
**RESULTS:** The present study showed that dengue was common below 20 years and in males. Among 450 study group, 95.8% cases were DF and 4.2% were DHF. NS1 reactivity (73.3%) was common followed by IgM reactivity (28.7%). The most common symptom was fever (100%) followed pain abdomen (28%). Hepatomegaly was seen in 22.9% cases. The common haematological abnormality was thrombocytopenia (53.1%), followed by leukopenia and lymphocytosis (9.8%). Haemoglobin and haematocrit were raised in 8 cases in males and 2cases in females. Platelet Rit was decreased in 72.2% of DF and 100% of DHF. One case of DHF and one case of DSS had four-fold rise in AST and ALT levels. 4 cases of DHF with bleeding manifestation had prolongation of PT and APTT. Hyponatremia was seen in 4 cases of DF and 2 cases of DHF.
**CONCLUSION:** Dengue fever results in fatal complications like DHF and DSS which can be preventable. On careful monitoring of haematological and biochemical parameters provide clue for early diagnosis and prognosis of the disease.

***Keywords****: Dengue fever; dengue haemorrhagic fever; dengue shock syndrome; haematocrit; thrombocytopenia; leukopenia; platelet indices; immature platelet fraction; aspartate and alanine transaminase; coagulation profile.*

## INTRODUCTION

Dengue fever is a major public health problem in tropical and subtropical countries associated with high morbidity and mortality. The WHO estimates the incidence of dengue infection approximately 50-100 million per year and 20,000 people die annually due to dengue disease. WHO identified dengue as one of the 17 neglected tropical diseases in 2010.[1] Dengue fever caused by dengue virus, which is single stranded RNA virus belongs to Flaviviridae family. Dengue virus infects human by the bite of infected female Aedes aegypti mosquito, which is major vector in India.[2] Dengue virus infection results in asymptomatic infection, undifferentiated fever, classic dengue fever (DF) and dengue haemorrhagic fever/ dengue shock syndrome (DHF/DSS). In infants and young children infection leads to development of undifferentiated fever characterized by fever, pharyngitis, rhinitis and cough. Older children and adults usually develop dengue fever characterized by sudden onset of high-grade fever, myalgia, arthralgia, back pain, transient macular rash and generalized lymphadenopathy.[3] DHF associated with bleeding manifestations while DSS associated with severe capillary leakage leads to hypo perfusion and multiple organ damage. Dengue virus has trophism for macrophages and endothelial cells. Dengue virus infects and replicates in the endothelial cells which causes functional derangement of endothelial cells. This results in increased capillary permeability and capillary leakage. When the infection is severe it

causes profound leakage of plasma which leads to hypotension and development of DSS. Dengue infection also infects hepatocytes which lead to the reduced synthesis of coagulation factors. This causes increased bleeding tendencies leads to DHF. DSS and DHF are main complications of dengue which may leads to death. The diagnosis of dengue fever is difficult clinically because many febrile illnesses mimic dengue fever. Thus, the diagnosis of dengue fever is established by detecting NS1 antigen, IgM antibody and IgG antibody against dengue virus. Commonly used diagnostic method in clinical setting is immunochromatographic method. But this method is less specific. Thus, dengue fever diagnosis should be confirmed by ELISA or RT-PCR method. Though these methods are costly and not available in remote places, study of the haematological and biochemical parameters will aid in the diagnosis and treatment.[4] Dengue causes several alterations in haematological parameters, platelet indices, liver function test and coagulation profile. Study of these parameters helps in the early detection of complications like DHF and DSS and management of these complications. Main objective of this study is to evaluate haematological parameters which are essentially predict the onset of the complications and contribute to reduce the adverse outcome of the disease. If these parameters are used timely can help in the better care of the patient and reduces dengue associated morbidity and mortality.

**OBJECTIVE**

- To study the changes in hematological parameters in seropositive dengue infection.
- To predict their role in the poor outcome of the disease.

**METHODOLOGY:**

**SOURCE OF DATA:** All the seropositive dengue cases admitted at Basaveshwara medical college and hospital, Chitradurga will be considered.

**METHOD OF COLLECTION OF DATA:**

All seropositive dengue cases, 5ml of venous blood will be drained, 2 ml of blood in EDTA container used for hematological investigations.1ml of plain blood for serological investigations to confirm Dengue. Remaining 2ml plain blood will be used for liver function test, renal function test and electrolytes. Sodium citrate blood sample will be used for measuring PT and APTT. 2ml of plain blood will be used for serological test for Dengue virus by Rapid immunochromatographic card method for the qualitative detection of NS1 antigen and differential detection of IgM and IgG antibodies. The hematological investigations include a complete hemogram for blood counts and peripheral smear. The blood counts were performed on the fully automated hematology analyser Sysmex XP-100 with a three-part differential. The peripheral smears were stained with Leishman stain and studied for differential count, the percentage of normal lymphocytes. Platelet count recorded individually and verified on the slide. The biochemical investigations included liver function test and blood urea and serum creatinine for the renal function. The tests will be performed on automated biochemistry analyser Erba EM 360.The above procedure will be done at the time of admission and repeated as and when required during the stay in the hospital.

The platelet count and IPF were retrieved from hematology analyzer with a six part differential in critical cases to evaluate the bone marrow suppression.

**SAMPLE SIZE:**

**SAMPLE SIZE ESTIMATION** $\mathbf{n= 4pq\div d^2}$

n=Sample size P= Prevalence

The prevalence of dengue is 28.4%

=0.28.74

q=1-P =1-0.284 =0.716

D= Allowable error= 15%. 15% of prevalence= 0.0426

Thus $n=4 \times 0.28X0.716\div (0.046)^2$

$=0.813376 \div 0.00181476$

n=448 The study sample was 448, rounded to 450. **A minimum of 450 cases will be included.**

**PERIOD OF STUDY:** November 2017 to June 2019.

**TYPE OF THE STUDY:** The prospective study.

**INCLUSION CRITERIA:** Serologically confirmed (positive for NS1 or IgM or IgG both) admitted at BMCH, Chitradurga.

- IgG positive with NS1 positive or IgM positive cases for Dengue.
- Both sexes.
- All the age group.

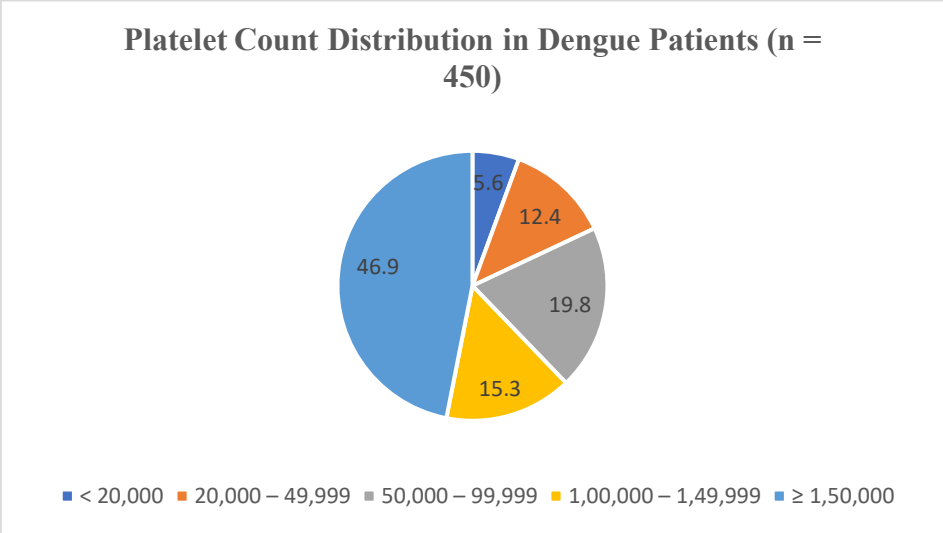
**EXCLUSION CRITERIA:** IgG positive but NS1 or IgM negative cases with features of Dengue. Cases of other viral fever including Chikungunya, enteric fever, malaria, leptospirosis.

## RESULTS

A total of 450 serologically confirmed dengue patients were included in the study. Of these, 431 (95.8%) had Dengue Fever (DF) and 19 (4.2%) had Dengue Haemorrhagic Fever (DHF). The hematological parameters were analysed and compared between DF and DHF groups.

**Table 1: Platelet Count Distribution in Dengue Patients (n = 450)**

| Platelet count (cells/cumm) | Number (n) | Percentage (%) |
|---|---|---|
| < 20,000 | 25 | 5.6 |
| 20,000 – 49,999 | 56 | 12.4 |
| 50,000 – 99,999 | 89 | 19.8 |
| 1,00,000 – 1,49,999 | 69 | 15.3 |
| ≥ 1,50,000 | 211 | 46.9 |
| **Total** | **450** | **100** |




**Graph 1: Platelet Count Distribution in Dengue Patients (n = 450)**

### Interpretation

Thrombocytopenia was observed in 53.1% of dengue patients. Most patients had platelet counts between 50,000–99,999/cumm, while 5.6**%** had severe thrombocytopenia (<20,000/cumm), highlighting platelet count as a key marker of disease severity.

**Table 2: Comparison of Platelet Count between DF and DHF**

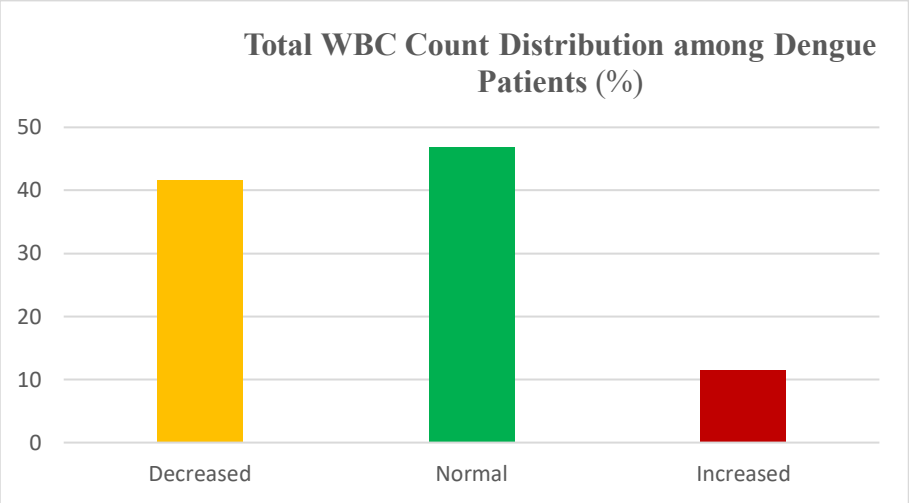
| Platelet count (cells/cumm) | DF (n=431) | DHF (n=19) | *p* value |
|---|---|---|---|
| < 20,000 | 9 (2.1%) | 16 (84.2%) | <0.001* |
| 20,000 – 49,999 | 54 (12.5%) | 2 (10.5%) | |
| 50,000 – 99,999 | 88 (20.4%) | 1 (5.3%) | |
| ≥ 1,00,000 | 280 (65%) | 0 | |

### Interpretation

Severe thrombocytopenia was significantly associated with DHF. A majority (84.2%) of DHF patients had platelet counts <20,000/cumm compared to only **2.1%** of DF patients, demonstrating a strong correlation between low platelet counts and severe dengue ($p < 0.001$).

**Table 3: Total WBC Count Distribution among Dengue Patients**

| WBC count status | Number (n) | Percentage (%) |
|---|---|---|
| Decreased | 187 | 41.6 |
| Normal | 211 | 46.9 |
| Increased | 52 | 11.5 |
| **Total** | **450** | **100** |




**Graph 2: Total WBC Count Distribution among Dengue Patients**

**Interpretation**

Leukopenia was present in 41.6% of patients, making it the second most common hematological abnormality after thrombocytopenia. This finding reflects bone marrow suppression during the acute phase of dengue infection.

**Table 4: Comparison of Haemoglobin and Haematocrit Levels**

| Parameter | Normal n (%) | Increased n (%) |
|---|---|---|
| Hemoglobin | 429 (95.3%) | 10 (2.2%) |
| Hematocrit | 440 (97.8%) | 8 (1.8%) |

**Interpretation**

Only a small proportion of patients showed raised hemoglobin and hematocrit values, indicating hemoconcentration. These changes were predominantly observed in severe dengue cases and are important predictors of plasma leakage and progression to dengue shock syndrome.

**Table 5: Platelet Indices According to Platelet Count**

| Platelet Index | <20,000 | 20,000–1,00,000 | >1,00,000 | *p* value |
|---|---|---|---|---|
| PDW (%) | 16.4 ± 4.4 | 14.2 ± 3.1 | 13.4 ± 2.2 | <0.05* |
| MPV (fL) | 10.7 ± 4.7 | 10.8 ± 4.9 | 9.9 ± 3.5 | <0.05* |
| P-LCR (%) | 30.6 ± 14.6 | 25.3 ± 14.6 | 19.6 ± 10.6 | <0.001* |
| PCT (%) | 0.03 ± 0.07 | 0.10 ± 0.09 | 0.22 ± 0.12 | <0.001* |

**Interpretation**

Platelet indices showed statistically significant variation with platelet counts. Higher PDW, MPV, and P-LCR with lower plateletcrit were associated with severe thrombocytopenia, suggesting increased peripheral platelet destruction and compensatory marrow response. These indices can serve as early indicators of platelet recovery and disease severity.

## DISCUSSION

Dengue fever is associated with a wide spectrum of hematological abnormalities resulting from bone marrow suppression, immune-mediated destruction, and plasma leakage. In the present study involving 450 seropositive dengue patients, hematological parameters were systematically evaluated to identify markers associated with disease severity and progression.

Thrombocytopenia was the most common hematological abnormality, observed in 53.1% of patients. Similar prevalence rates have been reported by Patel et al. and Yadav et al., who documented thrombocytopenia in 48–65% of dengue cases, emphasizing its diagnostic and prognostic significance (5,6). In our study, severe thrombocytopenia (<20,000/cumm) was present in 5.6% of cases, underscoring the need for close monitoring in such patients. A significant difference in platelet counts was observed between DF and DHF groups. Among DHF patients, 84.2% had platelet counts <20,000/cumm, compared to only 2.1% in DF cases ($p < 0.001$). This strong association between severe thrombocytopenia and DHF aligns with findings by Shekar et al. and Fernando et al., who also demonstrated significantly lower platelet counts in severe dengue cases (7,8). These findings confirm platelet count as a reliable marker of disease severity. Leucopenia was observed in 41.6% of patients in the present study, reflecting transient bone marrow suppression during the viremic phase of dengue infection. Comparable rates of leucopenia have been reported by Rashmi et al. and Tahlan et al., who found reduced WBC counts in 35–50% of dengue cases, particularly during the early phase of illness (9,10). Thus, leucopenia serves as an early hematological clue supporting dengue diagnosis.

Haemoconcentration, reflected by increased hemoglobin and hematocrit values, was observed in a small proportion of patients in the present study (hemoglobin increase in 2.2% and hematocrit increase in 1.8%). These changes were predominantly noted in patients with DHF and DSS. Similar observations were reported by Chavda et al. and Patel et al., who identified raised hematocrit as a marker of plasma leakage and predictor of severe dengue (11,12). Early recognition of hemoconcentration is crucial for timely fluid management and prevention of shock. Platelet indices demonstrated statistically significant variation with platelet counts in the present study. Patients with platelet counts <20,000/cumm showed higher PDW (16.4%), MPV (10.7 fL), and P-LCR (30.6%), along with markedly reduced plateletcrit (0.03%). Similar trends were reported by Katti et al. and Gupta et al., who suggested that increased platelet indices reflect enhanced peripheral destruction and compensatory release of immature platelets from the bone marrow (13,14). These indices may therefore act as early predictors of platelet recovery.

The utility of platelet indices in assessing dengue severity has been increasingly recognized. Studies by Bashir et al. and Dastidar et al. demonstrated that low plateletcrit combined with elevated MPV and PDW correlated strongly with severe thrombocytopenia and bleeding risk, supporting our findings (15,16). Hence, platelet indices serve as valuable adjuncts to routine platelet count in predicting disease progression.

Overall, the hematological abnormalities observed in the present study are consistent with previously published literature. The strong association between thrombocytopenia, altered platelet indices, and disease severity highlights the importance of routine hematological monitoring in dengue patients.

## CONCLUSION

The present study highlights that hematological abnormalities are common in dengue infection and play a crucial role in assessing disease severity. Thrombocytopenia was the most frequent finding, with severe thrombocytopenia being significantly associated with dengue hemorrhagic fever. Leucopenia and hemoconcentration, though less frequent, served as important indicators of bone marrow suppression and plasma leakage, respectively. Alterations in platelet indices, including increased PDW, MPV, and P-LCR with reduced plateletcrit, were strongly correlated with low platelet counts and severe disease. Routine monitoring of platelet count along with platelet indices can aid in early identification of high-risk patients, guide clinical management, and help prevent complications such as dengue hemorrhagic fever and shock syndrome.

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