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Neurological and clinical profiles in dengue patients: A cross-sectional observational study at a tertiary care hospital

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Abstract
Introduction: Dengue fever is a significant public health issue in tropical and subtropical regions, caused by the dengue virus. The disease presents in various clinical forms, ranging from mild to severe, with potential complications affecting multiple organ systems. This study aims to evaluate the clinical, neurological, hematological, radiological, and ECG findings in patients diagnosed with dengue at a tertiary care hospital.
Material and Methods: This cross-sectional observational study was conducted over one year at Department of General Medicine, Saveetha Medical College, Chennai, Tamil Nadu. The study included 150 patients diagnosed with dengue, confirmed through serological tests (NS1 antigen and IgM/IgG antibodies). Data collection involved structured proformas documenting demographic details, clinical examinations, laboratory tests, and radiological and ECG findings. Neurological symptoms were assessed and categorized. Statistical analysis was performed using SPSS software, with chi-square tests to compare findings among different dengue classes.
Results: In this study of 150 dengue patients, 48.7% experienced headaches, 4.0% had neck stiffness, 7.3% showed altered sensorium, 2.0% experienced drowsiness, and 3.3% had meningeal signs. Clinically, 84.0% were febrile, 32.0% had pallor, 21.3% had hypotension, and 20.0% showed splenomegaly. Hematologically, 40.7% had platelet counts below 1 lakh/cc mm, 25.3% had leukopenia, 26.6% had elevated SGOT, and 22.0% had elevated SGPT. Radiological and ECG findings revealed 12.0% with pleural effusion, 14.7% with ascites, and 1.3% with abnormal ECGs. These findings highlight the varied and severe manifestations of dengue.
Conclusions: The study provides a comprehensive overview of the diverse clinical manifestations of dengue, highlighting significant neurological, hematological, and radiological abnormalities. These findings underscore the importance of thorough clinical and laboratory evaluations in dengue patients to ensure accurate diagnosis and effective management.

Keyword: Dengue, Clinical findings, neurological manifestations, hematological abnormalities, radiological findings, ECG, cross-sectional study, tertiary care hospital

Introduction

Dengue fever is a mosquito-borne viral infection that has become a significant public health concern in many tropical and subtropical regions worldwide [1]. The disease is caused by the dengue virus (DENV), which has four distinct serotypes (DENV-1 to DENV-4). It manifests in various clinical forms, ranging from mild dengue fever (DF) to severe manifestations such as dengue hemorrhagic fever (DHF), dengue shock syndrome (DSS), and expanded dengue syndrome (EDS) [2]. The global incidence of dengue has seen a dramatic increase in recent decades, with severe forms contributing to substantial morbidity and mortality.

Despite extensive research, the diverse clinical manifestations of dengue, particularly its neurological, hematological, radiological, and cardiac complications, are not fully understood. Dengue is known to cause a range of neurological complications, including encephalitis, myelitis, and Guillain-Barré syndrome, but the prevalence and characteristics of these complications among different dengue clinical forms remain under-researched [3]. Similarly, the impact of dengue on hematological parameters such as platelet count, leukocyte count, and

coagulation factors, as well as liver and renal functions, needs further elucidation. Radiological findings in dengue, including ultrasound and MRI abnormalities, are also underreported [4].

This study addresses a critical gap in the understanding of the varied presentations of dengue, especially its severe forms. While there are numerous studies on dengue, few have provided a detailed analysis encompassing a broad spectrum of clinical, neurological, hematological, radiological, and ECG findings [5]. This comprehensive approach is essential for developing better diagnostic, management, and treatment strategies for dengue, especially in resource-limited settings where dengue is endemic.

By filling this research gap, the study aims to contribute to the global knowledge base on dengue, providing valuable insights that can enhance clinical management and improve patient outcomes.

The aim of this study is to comprehensively evaluate the clinical, neurological, hematological, radiological, and ECG findings among patients diagnosed with various forms of dengue at a tertiary care hospital, in order to enhance understanding and improve management of the disease.

Materials and Methods

This study was conducted as a cross-sectional observational study to evaluate the clinical, neurological, hematological, radiological, and ECG findings among patients diagnosed with dengue. The present study was carried out in the inpatient Department of General Medicine, Saveetha Medical College, Chennai, Tamil Nadu over a period of one year. The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants or their guardians before inclusion in the study.

A total of 150 patients diagnosed with dengue, including all its clinical forms Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), and Expanded Dengue (ED) were included in the study. The diagnosis of dengue was confirmed using serological tests (NS1 antigen and IgM/IgG antibodies).

Inclusion Criteria

1. Patients of all age groups diagnosed with dengue as per the WHO criteria.
2. Patients who provided informed consent to participate in the study.

Exclusion Criteria

1. Patients with pre-existing neurological disorders.
2. Patients with other known chronic illnesses that could interfere with the study outcomes.
3. Patients who did not consent to participate in the study.

Data Collection

Data were collected using a structured proforma, which included:

1. **Demographic Details:** Age, gender, and medical history.
2. **Clinical Examination:** Vital signs, neurological symptoms, and other clinical signs were recorded.
3. **Laboratory Tests:** Hematological tests (Total Platelet Count, Hematocrit, Total Leukocyte Count, Hemoglobin Percentage, RBC Count), liver and renal function tests (Total Bilirubin, SGOT, SGPT, ALP, Serum Creatinine, Serum Urea), and clotting factors (Prothrombin Time, PT-INR, aPTT, Serum Fibrinogen Level) were performed.
4. **Radiological and ECG Findings:** Chest X-ray, Ultrasound (USG) of the abdomen, MRI brain, ECG, and 2D echocardiography were conducted as per the clinical indications.

Neurological Assessment

Neurological symptoms were assessed and categorized as headache, neck stiffness, altered sensorium, drowsiness, and meningeal signs. The frequency and percentage of patients exhibiting each symptom were recorded.

Statistical Analysis

Data were analyzed using SPSS software. Descriptive statistics were used to summarize the clinical and laboratory findings. Chi-square tests were performed to compare the prevalence of various symptoms and laboratory abnormalities among the different dengue classes. A p-value of <0.05 was considered statistically significant.

Results

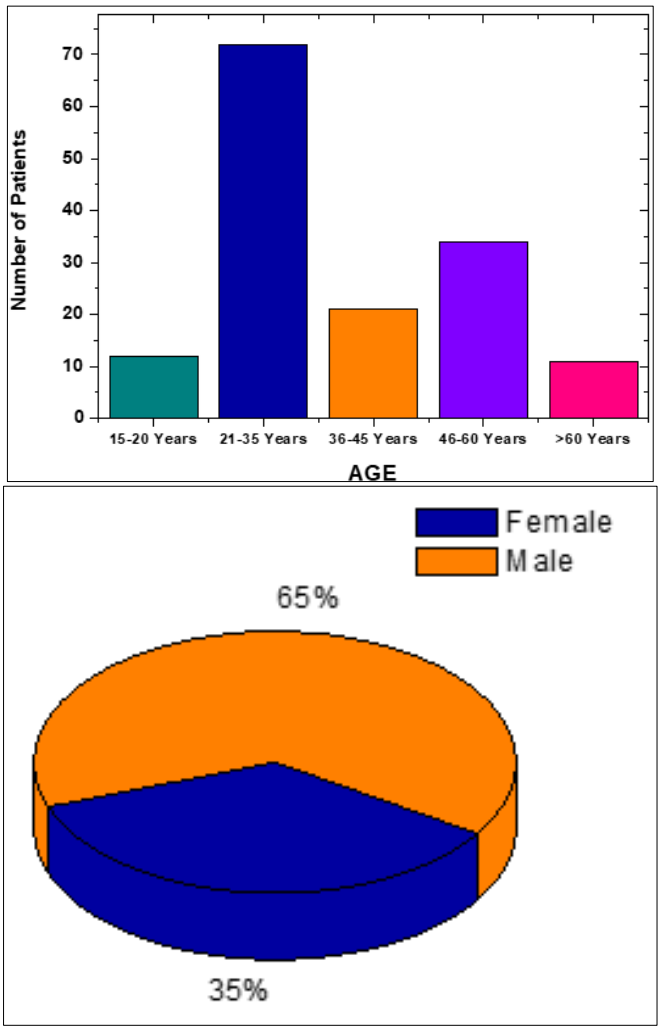

Fig 1: Age and Sex Distribution of Study Participants

Figure 1 shows, the study included 150 participants diagnosed with dengue, with the majority being male (64.7%) compared to female (35.3%). The age distribution shows that the largest group of participants were between 21-35 years old (48.0%), followed by those aged 46-60 years (22.7%). Participants

aged 36-45 years comprised 14.0% of the study population, those aged 15-20 years made up 8.0%, and those over 60 years old accounted for 7.3%. This distribution indicates a higher prevalence of dengue among young to middle-aged adults.

Table 1: Neurological Manifestations in Dengue Patients

Neurological Manifestations	Count (n)	Percentage (%)
Headache	73	48.7%
Neck Stiffness	6	4.0%
Altered Sensorium	11	7.3%
Drowsiness	3	2.0%
Meningeal Sign	5	3.3%

This table 1 presents a summary of neurological symptoms observed in patients diagnosed with dengue. The data is categorized into different types of neurological manifestations, with the respective counts and percentages of patients exhibiting each symptom. Headache is the most common symptom, affecting 48.7% of the patients, represented by 73 individuals. Neck stiffness and altered sensorium are also notable symptoms, occurring in 4.0% and 7.3% of patients respectively. Drowsiness and meningeal signs, although less common, are present in 2.0% and 3.3% of the patients respectively. This table helps in understanding the prevalence of various neurological symptoms among dengue patients.

Table 2: Comparison of Neurological Manifestations in Various Dengue Classes

Neurological Manifestations	DF (n=81)	DHF (n=19)	DSS (n=5)	ED (n=45)	Total (N=150)	p-value
Headache						0.141
No	37 (45.7%)	11 (57.9%)	1 (20.0%)	28 (62.2%)	77 (51.3%)	
Yes	44 (54.3%)	8 (42.1%)	4 (80.0%)	17 (37.8%)	73 (48.7%)	
Neck Stiffness						0.954
No	78 (96.3%)	18 (94.7%)	5 (100.0%)	43 (95.6%)	144 (96.0%)	
Yes	3 (3.7%)	1 (5.3%)	0 (0.0%)	2 (4.4%)	6 (4.0%)	
Altered Sensorium						<0.001
No	81 (100.0%)	17 (89.5%)	5 (100.0%)	36 (80.0%)	139 (92.7%)	
Yes	0 (0.0%)	2 (10.5%)	0 (0.0%)	9 (20.0%)	11 (7.3%)	
Drowsiness						0.898
No	79 (97.5%)	19 (100.0%)	5 (100.0%)	44 (97.8%)	147 (98.0%)	
Yes	2 (2.5%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	3 (2.0%)	
Meningeal Signs						0.048
Present	0 (0.0%)	1 (5.3%)	0 (0.0%)	4 (8.9%)	5 (3.3%)	
Absent	81 (100.0%)	18 (94.7%)	5 (100.0%)	41 (91.1%)	145 (96.7%)	

This table 2 provides a detailed comparison of neurological manifestations across different classes of dengue infection, including Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), and Expanded Dengue (ED). The data is presented for a total of 150 patients and includes the count and percentage of patients exhibiting specific neurological symptoms for each class. The results are categorized by the presence or absence of symptoms like headache, neck stiffness, altered sensorium, drowsiness, and meningeal signs. The table also includes p-values from a chi-square test, indicating the statistical significance of the differences observed among the various dengue classes.

The table 3 summarizes the prevalence of various clinical symptoms observed among 150 patients diagnosed with dengue. The most common symptom was febrile illness, affecting 84.0% of the patients. Pallor was also notable, occurring in 32.0% of the cases. Hypotension was present in 21.3% of patients, indicating significant cardiovascular involvement. Splenomegaly and ascites were observed in 20.0% and 14.7% of patients, respectively, suggesting abdominal complications. Pleural effusion and hepatomegaly were each present in 12.0% of the patients. Less frequent symptoms included tachypnoea (7.3%), tachycardia (8.0%), and abnormal pulse pressure (2.0%). Bradycardia, icterus, and oedema were each noted in 1.3% of the patients. These findings highlight the diverse clinical manifestations of dengue, ranging from common febrile symptoms to significant cardiovascular and abdominal abnormalities.

The table 4 presents the distribution of various signs (Pulse Rate, Blood Pressure, Pulse Pressure, and Temperature) across different patient groups: Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Emergency Department (ED), and the Total population. For Pulse Rate, the majority of patients across all groups had a normal pulse rate (90.7%), with bradycardia observed in 2 patients with DF and tachycardia more prevalent in the ED group. The p-value of 0.548 indicates no significant difference in pulse rate distribution among the groups.

Blood Pressure data shows a significant variation (p-value < 0.001), with hypotension being most prevalent in DSS (100%) and ED (31.1%) patients, while the majority in other groups had normal blood pressure. Pulse Pressure was normal in almost all cases, except for 3 patients in the ED group who had abnormal readings, but this was not statistically significant (p-value 0.067).

Table 3: Clinical Signs Among Study Participants

Symptoms	Count (n)	Percentage (%)
Bradycardia	2	1.3%
Tachycardia	12	8.0%
Hypotension	32	21.3%
Abnormal Pulse Pressure	3	2.0%
Febrile	126	84.0%
Tachypnoea	11	7.3%
Pallor	48	32.0%
Icterus	2	1.3%
Oedema	2	1.3%
Ascites	22	14.7%
Hepatomegaly	18	12.0%
Splenomegaly	30	20.0%
Pleural Effusion	18	12.0%

Table 4: Vital Signs Among Dengue Classes

Signs	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
Pulse Rate						0.548
Bradycardia	2 (2.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)	
Normal	75 (92.6%)	17 (89.5%)	5 (100%)	39 (86.7%)	136 (90.7%)	
Tachycardia	4 (4.9%)	2 (10.5%)	0 (0.0%)	6 (13.3%)	12 (8.0%)	
Blood Pressure						<0.001
Hypotension	11 (13.6%)	2 (10.5%)	5 (100%)	14 (31.1%)	32 (21.3%)	
Normal	70 (86.4%)	17 (89.5%)	0 (0.0%)	31 (68.9%)	118 (78.7%)	
Pulse Pressure						0.067
Abnormal	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (6.7%)	3 (2.0%)	
Normal	81 (100%)	19 (100%)	5 (100%)	42 (93.3%)	147 (98.0%)	
Temperature						0.591
Afebrile	13 (16.0%)	2 (10.5%)	0 (0.0%)	9 (20.0%)	24 (16.0%)	
Febrile	68 (84.0%)	17 (89.5%)	5 (100%)	36 (80.0%)	126 (84.0%)	

Regarding Temperature, most patients were febrile (84.0%) across all groups, with afebrile cases distributed among the groups without significant variation (p-value 0.591). Overall, significant differences were observed mainly in Blood Pressure readings among the patient groups.

Table 5: Respiratory and Visible Signs Among Dengue Classes

Signs	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
Respiratory Rate						0.879
Normal	75 (92.6%)	18 (94.7%)	5 (100%)	41 (91.1%)	139 (92.7%)	
Tachypnoea	6 (7.4%)	1 (5.3%)	0 (0.0%)	4 (8.9%)	11 (7.3%)	
Pallor						0.019
Absent	64 (79.0%)	10 (52.6%)	3 (60.0%)	25 (55.6%)	102 (68.0%)	
Present	17 (21.0%)	9 (47.4%)	2 (40.0%)	20 (44.4%)	48 (32.0%)	
Icterus						0.193
Absent	81 (100%)	19 (100%)	5 (100%)	43 (95.6%)	148 (98.7%)	
Present	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.4%)	2 (1.3%)	
Oedema						0.631
Absent	79 (97.5%)	19 (100%)	5 (100%)	45 (100%)	148 (98.7%)	
Present	2 (2.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)	

The table 5 displays the distribution of signs (Respiratory Rate, Pallor, Icterus, and Oedema) among different patient groups: Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Emergency Department (ED), and the total population. For Respiratory Rate, the majority of patients across all groups had a normal respiratory rate (92.7%), with tachypnoea observed in 11 patients (7.3%). The p-value of 0.879 suggests no significant difference in respiratory rate among the groups. Pallor shows a significant difference (p-value 0.019), with pallor absent in 68.0% of the total population but more prevalent in DHF (47.4%) and ED (44.4%) groups compared to DF (21.0%). For Icterus, almost all patients were absent of this sign (98.7%), with only 2 cases present in the ED group. The p-value of 0.193 indicates no significant variation among the groups. Oedema was generally absent in most patients (98.7%), with only 2 cases present in the DF group. The p-value of 0.631 shows no significant difference in the presence of oedema among the groups. In summary, significant differences were observed primarily in the presence of pallor among the patient groups, while other signs did not show statistically significant variations.

Table 6: Physiological Changes and Tourniquet Test Among Dengue Classes

Signs	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
Jugular Venous Pressure						<0.001
Absent	81 (100%)	19 (100%)	5 (100%)	45 (100%)	150 (100%)	
Tourniquet Test						<0.001
Negative	81 (100%)	17 (89.5%)	2 (40.0%)	42 (93.3%)	142 (94.7%)	
Positive	0 (0.0%)	2 (10.5%)	3 (60.0%)	3 (6.7%)	8 (5.3%)	
Ascites						<0.001
No	81 (100%)	8 (42.1%)	4 (80.0%)	35 (77.8%)	128 (85.3%)	
Yes	0 (0.0%)	11 (57.9%)	1 (20.0%)	10 (22.2%)	22 (14.7%)	
Hepatomegaly						0.009
No	76 (93.8%)	18 (94.7%)	3 (60.0%)	35 (77.8%)	132 (88.0%)	
Yes	5 (6.2%)	1 (5.3%)	2 (40.0%)	10 (22.2%)	18 (12.0%)	
Splenomegaly						<0.001
No	72 (88.9%)	13 (68.4%)	1 (20.0%)	34 (75.6%)	120 (80.0%)	
Yes	9 (11.1%)	6 (31.6%)	4 (80.0%)	11 (24.4%)	30 (20.0%)	
Pleural Effusion						<0.001

No	77 (95.1%)	11 (57.9%)	4 (80.0%)	40 (88.9%)	132 (88.0%)	
Yes	4 (4.9%)	8 (42.1%)	1 (20.0%)	5 (11.1%)	18 (12.0%)	

The table 6 displays the distribution of clinical signs among different patient groups (DF, DHF, DSS, ED, and Total). Jugular Venous Pressure was normal in all patients. The Tourniquet Test, Ascites, Hepatomegaly, Splenomegaly, and Pleural Effusion showed significant differences among the groups (all p-values < 0.01), with positive results and abnormalities more prevalent in DHF and DSS patients compared to DF and ED groups. This indicates varying clinical presentations and severities of illness across the different patient groups.

Table 7: Hematological Test Variations in Dengue Classes

Hematological Test	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
Total Platelet Count (TPC)						<0.001
4-1.5 lakh/ccmm	20 (24.7%)	0 (0.0%)	0 (0.0%)	7 (15.6%)	27 (18.0%)	
1.5-1 lakh/ccmm	27 (33.3%)	0 (0.0%)	0 (0.0%)	7 (15.6%)	34 (22.7%)	
1-0.5 lakh/ccmm	24 (29.6%)	12 (63.2%)	3 (60.0%)	22 (48.9%)	61 (40.7%)	
0.5-0.2 lakh/ccmm	6 (7.4%)	3 (15.8%)	2 (40.0%)	7 (15.6%)	18 (12.0%)	
<0.2 lakh/ccmm	4 (4.9%)	4 (21.1%)	0 (0.0%)	2 (4.4%)	10 (6.7%)	
Hematocrit (HCT)						0.122
Normal	57 (70.4%)	15 (78.9%)	4 (80.0%)	24 (53.3%)	100 (66.7%)	
Increased >20%	24 (29.6%)	4 (21.1%)	1 (20.0%)	21 (46.7%)	50 (33.3%)	
Total Leukocyte Count (TLC)						0.031
Normal	53 (65.4%)	15 (78.9%)	3 (60.0%)	31 (68.9%)	102 (68.0%)	
Leukopenia	26 (32.1%)	4 (21.1%)	1 (20.0%)	7 (15.6%)	38 (25.3%)	
Leukocytosis	2 (2.5%)	0 (0.0%)	1 (20.0%)	7 (15.6%)	10 (6.7%)	
Hemoglobin Percentage (HB%)						0.214
>13 gm/dl	42 (51.9%)	13 (68.4%)	3 (60.0%)	20 (44.4%)	78 (52.0%)	
Mild	20 (24.7%)	4 (21.1%)	2 (40.0%)	10 (22.2%)	36 (24.0%)	
Moderate	19 (23.5%)	2 (10.5%)	0 (0.0%)	12 (26.7%)	33 (22.0%)	
Severe	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (6.7%)	3 (2.0%)	
RBC Count						0.522
4.5-5.5 million/dl	61 (75.3%)	16 (84.2%)	5 (100.0%)	34 (75.6%)	116 (77.3%)	
<4.5 million/dl	20 (24.7%)	3 (15.8%)	0 (0.0%)	11 (24.4%)	34 (22.7%)	

*Chi-square test was used and the p-value <0.05 was considered as statistically significant

The table 7 summarizes hematological test results across different patient groups: DF, DHF, DSS, ED, and the Total. Significant differences were observed in Total Platelet Count (TPC), where most DF patients had higher counts, while DHF and DSS patients had notably lower counts ($p < 0.001$). Hematocrit (HCT) levels were generally normal across groups, with no significant difference ($p = 0.122$). Total Leukocyte Count (TLC) showed significant variation ($p = 0.031$), with leukopenia more common in DF and DHF groups. Hemoglobin Percentage (HB%) and RBC Count did not significantly differ among groups ($p = 0.214$ and $p = 0.522$, respectively). These results indicate varying degrees of hematological abnormalities across the different clinical presentations.

Table 8: Clotting Factor Assessment in Study Participants

Clotting Factors	No. of Cases Investigated	Abnormal Value (Deranged)
PT (Prothrombin Time)	7	2
PT-INR (International Normalized Ratio)	10	3
aPTT (Activated Partial Thromboplastin Time)	3	1
Serum Fibrinogen Level	5	1

Table 9: Comparison of Clotting Factors Among Various Dengue Classes

Clotting Factors	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
Prothrombin Time (PT)						0.052
Normal	0 (0.0%)	1 (5.3%)	0 (0.0%)	4 (8.9%)	5 (3.3%)	
Deranged	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.4%)	2 (1.3%)	
PT-INR						0.042
Normal	1 (1.2%)	2 (10.5%)	0 (0.0%)	4 (8.9%)	7 (4.7%)	
Deranged	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (6.7%)	3 (2.0%)	
Activated Partial Thromboplastin Time (aPTT)						0.42
Normal	0 (0.0%)	1 (5.3%)	0 (0.0%)	1 (2.2%)	2 (1.3%)	
Deranged	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	1 (0.7%)	
Serum Fibrinogen Level						<0.001
Normal	2 (2.5%)	0 (0.0%)	2 (40.0%)	0 (0.0%)	4 (2.7%)	
Deranged	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	1 (0.7%)	

*Chi-square test was used and the p-value <0.05 was considered statistically significant.

Table 8 assesses clotting factors in study participants, revealing the number of cases investigated and those with abnormal values. For PT (Prothrombin Time), 7 cases were investigated, with 2 showing abnormal values. PT-INR (International Normalized Ratio) had 10 cases investigated, with 3 showing abnormalities, the highest proportion among the factors. aPTT (Activated Partial Thromboplastin Time) had 1 abnormal result out of 3 cases, while Serum Fibrinogen Level had 1 abnormal result out of 5 cases. This highlights PT-INR as having the most frequent abnormalities among the clotting factors assessed.

The table 9 summarizes clotting factor assessments across patient groups (DF, DHF, DSS, ED, and Total). Prothrombin Time (PT) was mostly normal, with deranged values only in ED patients ($p = 0.052$). PT-INR showed significant differences ($p = 0.042$), with deranged values present in ED patients. Activated Partial Thromboplastin Time (aPTT) had minimal abnormalities ($p = 0.42$). Serum Fibrinogen Levels were significantly different ($p < 0.001$), with deranged values found only in ED patients. Overall, PT-INR and Serum Fibrinogen Level showed the most notable variations among the groups.

The laboratory parameters assessed in the study participants reveal various abnormalities. Elevated Total Bilirubin levels (>2 mg/dl) were observed in 7.3% of cases, indicating potential liver dysfunction or hemolysis. SGOT and SGPT levels were significantly increased (more than threefold) in 26.6% and 22.0% of participants, respectively, suggesting widespread liver injury or inflammation. Elevated ALP was noted in 18.7% of cases, which can be associated with liver, bone, or bile duct disorders. Serum Creatinine levels were elevated in 3.3% of participants, indicating potential kidney impairment, while increased Serum Urea was found in 12.7% of cases, further pointing to possible renal issues. Overall, these findings highlight notable liver and kidney function abnormalities in the study group.

Table 10: Assessment of Liver and Renal Functions in Study Participants

Parameters	Count (n)	Percentage (%)
Total Bilirubin (>2mg/dl)	11	7.3%
SGOT (>3fold Increased)	40	26.6%
SGPT (>3fold Increased)	33	22.0%
ALP	28	18.7%
Serum Creatinine	5	3.3%
Serum Urea	19	12.7%

Table 11: Comparison of Liver and Renal Function Tests Among Various Dengue Classes

Parameters	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
Total Bilirubin						<0.001
Normal (<2mg/dl)	81 (100.0%)	19 (100.0%)	5 (100.0%)	34 (75.6%)	139 (92.7%)	
Abnormal (>2mg/dl)	0 (0.0%)	0 (0.0%)	0 (0.0%)	11 (24.4%)	11 (7.3%)	
SGOT						<0.001
Normal (5-40mg/dl)	55 (67.9%)	12 (63.2%)	2 (40.0%)	19 (42.2%)	88 (58.7%)	
Mild (2x Increased)	16 (19.8%)	1 (5.3%)	2 (40.0%)	3 (6.7%)	22 (14.7%)	
Moderate (3x Increased)	10 (12.3%)	6 (31.6%)	1 (20.0%)	3 (6.7%)	20 (13.3%)	
Severe (4x Increased)	0 (0.0%)	0 (0.0%)	0 (0.0%)	20 (44.4%)	20 (13.3%)	
SGPT						<0.001
Normal (5-40mg/dl)	67 (82.7%)	12 (63.2%)	4 (80.0%)	24 (53.3%)	107 (71.3%)	
Mild (2x Increased)	5 (6.2%)	3 (15.8%)	0 (0.0%)	2 (4.4%)	10 (6.7%)	
Moderate (3x Increased)	9 (11.1%)	4 (21.1%)	1 (20.0%)	2 (4.4%)	16 (10.7%)	
Severe (4x Increased)	0 (0.0%)	0 (0.0%)	0 (0.0%)	17 (37.8%)	17 (11.3%)	
ALP						<0.001
Normal	75 (92.6%)	15 (78.9%)	5 (100.0%)	27 (60.0%)	122 (81.3%)	
Abnormal	6 (7.4%)	4 (21.1%)	0 (0.0%)	18 (40.0%)	28 (18.7%)	
Serum Creatinine						0.007
Normal	81 (100.0%)	19 (100.0%)	5 (100.0%)	40 (88.9%)	145 (96.7%)	
Increased	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (11.1%)	5 (3.3%)	
Serum Urea						0.209
Normal	69 (85.2%)	15 (78.9%)	4 (80.0%)	43 (95.6%)	131 (87.3%)	
Increased	12 (14.8%)	4 (21.1%)	1 (20.0%)	2 (4.4%)	19 (12.7%)	

*Chi-square test was used, and the p-value <0.05 was considered statistically significant.

The table 11 presents the distribution of various laboratory parameters among patient groups (DF, DHF, DSS, ED, and Total). Total Bilirubin levels were abnormal (>2 mg/dl) in 24.4% of ED patients but normal in all other groups ($p < 0.001$). SGOT levels showed significant variations, with severe increases (>4x) observed in 44.4% of ED patients ($p < 0.001$). SGPT levels were mostly normal but had severe increases in 37.8% of ED patients ($p < 0.001$). Abnormal ALP levels were found in 40% of ED patients and varied significantly across groups ($p < 0.001$). Serum Creatinine levels were increased in 11.1% of ED patients, showing a significant difference ($p = 0.007$). Serum Urea levels did not show a significant difference ($p = 0.209$), though 21.1% of DHF patients had elevated levels. These findings indicate notable liver and kidney function abnormalities, especially in ED patients.

Table 12: Prevalence of Co-infections in Dengue Patients

Other Co-infections	Count (n)	Percentage (%)
Malaria (MP-ICT Positive)	11	7.33%
Salmonella (IgM Positive)	7	4.67%
Chikungunya (IgM Positive)	6	4.00%
Scrub Typhus (IgM Positive)	7	4.67%
Hepatitis B (HbsAg Positive)	1	0.67%
Total	32	21.33%

Table 12 shows the prevalence of co-infections in dengue patients. Malaria, indicated by MP-ICT positivity, was the

most common co-infection, found in 7.33% of cases. Salmonella and Scrub Typhus, both identified by IgM positivity, were present in 4.67% of cases each. Chikungunya, also detected by IgM positivity, was found in 4.00% of patients. Hepatitis B, identified by HbsAg positivity, was the least common, occurring in 0.67% of patients. Overall, 21.33% of dengue patients had at least one co-infection, highlighting the complexity of managing dengue cases with multiple concurrent infections.

The table 14 presents radiological and ECG findings among the study participants. Abnormal ECG results were found in 1.3% of cases, with Troponin I positivity and pericarditis each occurring in 0.7% of cases. Ultrasound (USG) of the abdomen revealed various abnormalities: 26.7% had normal findings, 35.6% had splenomegaly, 24.4% had hepatomegaly, 46.7% had ascites, and 11.1% had gallbladder wall thickening. MRI findings included a single case of cerebral hemorrhage (0.7%) and signs of meningitis in 1.3% of cases. Cerebrospinal fluid (CSF) studies showed abnormalities in 4.0% of cases. Additionally, pleural effusion was noted in 12.0% of the patients. These findings highlight the range of radiological and ECG abnormalities that can occur in the study population.

The table 13outlines the prevalence of mixed co-infections in dengue patients. The combination of IgM Scrub Typhus, IgM Chikungunya, and Dengue IgM positivity was found in 2.0% of cases. A combination of IgM Scrub Typhus, Hepatitis B, and Dengue IgM positivity was observed in 0.66% of cases. Another mixed infection involving IgM Scrub Typhus, Malaria, and Dengue IgM positivity occurred in 1.33% of patients. Overall, 4.0% of dengue patients experienced mixed co-infections, underscoring the additional diagnostic and treatment challenges in these cases.

Table 13: Incidence of Mixed Co-Infections in Dengue Patients

Mixed Co-Infections	Count (n)	Percentage (%)
IgM Scrub Typhus + IgM Chikungunya + Dengue IgM Positive	3	2.0%
IgM Scrub Typhus + Hep. B + Dengue IgM Positive	1	0.66%
IgM Scrub Typhus + Malaria + Dengue IgM Positive	2	1.33%
Total	6	4.0%

Table 14: Overview of Radiological and ECG Findings in Study Participants

Radiological and ECG Findings	Count (n)	Percentage (%)
ECG Findings		
Abnormal ECG	2	1.3%
Troponin I (Trop-I) Positive	1	0.7%
Pericarditis	1	0.7%
Ultrasound (USG) Abdomen		
Normal	12	26.7%
Splenomegaly	16	35.6%
Hepatomegaly	11	24.4%
Ascites	21	46.7%
Gallbladder (GB) Wall Thickening	5	11.1%
MRI Findings		
Cerebral Hemorrhage	1	0.7%
Sign of Meningitis	2	1.3%
Cerebrospinal Fluid (CSF) Study		
CSF Study Findings	6	4.0%
Pleural Effusion (Duplicate Entry Corrected)	18	12.0%

Table 15: Comparison of Radiological and ECG Findings Among Various Dengue Groups

Radiological and ECG finding	DF (N=81)	DHF (N=19)	DSS (N=5)	ED (N=45)	Total (N=150)	p-value
ECG						0.193
Abnormal	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.4%)	2 (1.3%)	
Normal	81 (100.0%)	19 (100.0%)	5 (100.0%)	43 (95.6%)	148 (98.7%)	
Troponin I (TROP-I)						0.503
Positive	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	1 (0.7%)	
2D Echocardiography						0.503
Pericarditis	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	1 (0.7%)	
X-ray Chest						<0.001
Normal	81 (100.0%)	13 (68.4%)	3 (60.0%)	41 (91.1%)	138 (92.0%)	
Pleural Effusion	0 (0.0%)	6 (31.6%)	2 (40.0%)	4 (8.9%)	12 (8.0%)	
USG Abdomen						
Normal	65 (80.2%)	0 (0.0%)	0 (0.0%)	12 (26.7%)	77 (51.3%)	
Splenomegaly	9 (11.1%)	8 (42.1%)	4 (80.0%)	16 (35.6%)	37 (24.7%)	
Hepatomegaly	7 (8.6%)	0 (0.0%)	2 (40.0%)	11 (24.4%)	20 (13.3%)	
Ascites	0 (0.0%)	18 (94.7%)	4 (80.0%)	21 (46.7%)	43 (28.7%)	
GB Wall Thickening	2 (2.5%)	2 (10.5%)	1 (20.0%)	5 (11.1%)	10 (6.7%)	
Pleural Effusion	0 (0.0%)	7 (36.8%)	3 (60.0%)	8 (17.8%)	18 (12.0%)	
MRI Brain						0.308
Cerebral Hemorrhage	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	1 (0.7%)	
Normal	81 (100.0%)	19 (100.0%)	5 (100.0%)	42 (93.3%)	147 (98.0%)	
Sign of Meningitis	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.4%)	2 (1.3%)	

*Chi-square test was used, and the p-value <0.05 was considered statistically significant.

The table 15 details radiological and ECG findings across different patient groups (DF, DHF, DSS, ED, and Total). Abnormal ECG results were found only in the ED group (4.4%), with a p-value of 0.193, indicating no significant difference. Troponin I was positive in one ED patient (2.2%), and pericarditis was also noted in one ED patient (2.2%), both with a p-value of 0.503, showing no significant differences.

Chest X-rays revealed pleural effusion predominantly in DHF (31.6%) and DSS (40.0%) patients, with a significant p-value < 0.001. USG abdomen findings showed a significant p-value< 0.001, with splenomegaly most common in DSS patients (80.0%) and ascites highly prevalent in DHF (94.7%)

and DSS (80.0%) groups. Hepatomegaly was observed more in DSS (40.0%) and ED (24.4%) patients.

Gallbladder wall thickening and pleural effusion were notably present in DHF and DSS groups, with 36.8% and 60.0% respectively, showing significant variations. MRI brain findings indicated cerebral hemorrhage in one ED patient (2.2%) and signs of meningitis in 4.4% of ED patients, though these findings were not statistically significant (p-value 0.308).

Discussion

This study provides a comprehensive analysis of the clinical, neurological, hematological, radiological, and ECG findings among 150 patients diagnosed with dengue, spanning all its clinical forms. The results offer valuable insights into the diverse manifestations of dengue, highlighting the complexity of the disease and its impact on various body systems.

The neurological symptoms observed in our study, such as headache (48.7%), neck stiffness (4.0%), altered sensorium (7.3%), drowsiness (2.0%), and meningeal signs (3.3%), underscore the neurotropic potential of dengue virus. Similar studies have also reported significant neurological involvement in dengue patients. For instance, Solomon *et al*. (2000) identified headache, altered sensorium, and seizures as common neurological manifestations in dengue patients [6]. The prevalence of altered sensorium was significantly higher in DHF and ED patients, aligning with the findings of Pancharoen and Thisyakorn (2001), who reported severe neurological symptoms in patients with complicated dengue infections [7].

The clinical signs observed, including febrile illness (84.0%), pallor (32.0%), hypotension (21.3%), and splenomegaly (20.0%), indicate the multi-system involvement of dengue. These findings are consistent with those reported by Guzman *et al*. (2010), where fever, pallor, and hypotension were common among dengue patients [8]. The significant differences in blood pressure readings among the different dengue classes, particularly the high prevalence of hypotension in DSS and ED patients, highlight the critical nature of these forms of the disease.

Hematological abnormalities were prominent in our study, with thrombocytopenia being particularly severe in DHF and DSS patients. This aligns with previous studies by Mohan *et al*. (2000) and Sosothiku *et al*. (2015), which reported significant platelet count reductions in severe dengue cases (9, 10). Leukopenia was also noted, with a higher incidence in DHF and DSS patients, consistent with the findings of Malavige *et al*. (2006) [11].

Our study found significant abnormalities in clotting factors, especially in PT-INR and Serum Fibrinogen Levels, particularly in ED patients. These findings are in line with studies by Lee *et al*. (2006) and Wills *et al*. (2002), who reported coagulation abnormalities as markers of severe dengue (12,13).

Liver dysfunction, indicated by elevated SGOT and SGPT levels, was notable in our study, especially in ED patients. This is consistent with the study by Souza *et al*. (2007), which reported significant hepatic involvement in severe dengue cases (14). Renal function abnormalities, though less frequent, were also observed, aligning with studies by Trung *et al*. (2010), which highlighted renal impairment in severe dengue (15). Radiological findings revealed significant abnormalities such as pleural effusion, ascites, splenomegaly, and hepatomegaly, particularly in DHF and DSS patients. These findings correlate with the study by Weerakkody *et al*. (2017), which reported similar radiological abnormalities in severe dengue cases [16]. ECG abnormalities, although less frequent, were also observed, with pericarditis noted in one ED patient. This finding is consistent with the work of Kularatne *et al*. (2007), which documented cardiac involvement in dengue patients [17].

The prevalence of co-infections, including malaria, Salmonella, Chikungunya, and Scrub Typhus, was notable in our study. This highlights the importance of considering co-infections in dengue-endemic areas. Similar findings were reported by Carme *et al*. (2009), who emphasized the need for differential diagnosis in febrile patients in endemic regions [18].

Conclusion

Our study highlights the diverse and multi-system manifestations of dengue, with significant differences observed across the various clinical forms. Neurological, hematological, hepatic, and renal abnormalities were particularly pronounced in severe cases, such as DHF and DSS. These findings underscore the importance of early diagnosis and comprehensive management of dengue patients to prevent severe complications.

Comparative analysis with similar studies reaffirms the multi-faceted nature of dengue and the critical need for vigilant monitoring and treatment. Future research should focus on identifying biomarkers for early detection of severe dengue and developing targeted therapeutic strategies to mitigate the disease's impact on different body systems.

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