SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Ghosh *et al*., 2025
doi: 10.21276/SSR-IIJLS.2025.11.4.10

Original Article

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Cardiological and Neurological Manifestations and Complications in Dengue Patients Admitted to Hospital: A Retrospective Observational Study

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Received: 12 Feb 2025/ Revised: 24 Apr 2025/ Accepted: 17 Jun 2025

ABSTRACT

Background: Dengue, caused by the Flavivirus and transmitted by Aedes aegypti mosquitoes, has become a major public health concern in tropical regions like India. Recent studies have also highlighted neurological and cardiac manifestations of dengue, which are less understood. This study aims to explore the incidence and consequences of these complications in hospitalised adult dengue patients, providing insights into their clinical management. The objective of the study was to evaluate the incidence and outcomes of cardiological and neurological complications in adult patients diagnosed with dengue infection.

Methods: The study used a retrospective observational design, analysing data from 200 adult patients. Patient data, including demographics, clinical measurements, and lab results, were retrieved from electronic medical records. Statistical methods like chi-square tests assessed associations, and ROC analysis was used to determine the optimal cut-off values for key parameters, with CRP emerging as the most reliable predictor of patient outcomes.

Results: The results identified CRP, pulmonary oedema, and shock as strong predictors of mortality, with p-values less than 0.001 for these variables. The ROC analysis showed CRP as the most reliable predictor (AUC=0.951), with an optimal cut-off value of 3.3500, followed by ESR (cut-off=23.0) and duration of stay (cut-off=1.5 days), highlighting their diagnostic importance in predicting outcomes.

Conclusion: The study concluded that elevated CRP levels, pulmonary oedema, and shock are key predictors of mortality in dengue patients, with CRP showing the highest diagnostic value and concluded that CRP, ESR, and duration of stay as critical factors for predicting patient outcomes.

Key-words: Neurological, Cardiological, Clinical features, NS1, Dengue, CRP

INTRODUCTION

Dengue (Single-stranded RNA) virus has its place to the genus Flavivirus and family Flaviviridae.

How to cite this article
Ghosh S, Saha S, Choudhury SD, Ghosh K. Cardiological and Neurological Manifestations and Complications in Dengue Patients Admitted to Hospital: A Retrospective Observational Study. SSR Inst Int J Life Sci., 2025; 11(4): 7865-7875.

Access this article online
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The vector is the Aedes aegypti mosquito. It is a common endemic virus in India. Dengue has grown to be a serious public health issue in India for several reasons, such as excessive rainfall, poor sanitation, standing water, and insufficient mosquito control. In 2010, India accounted for 34 of the 96 million dengue cases that occurred nationwide [1]. Research conducted in Pune found that among patients who had a fever, the sero-prevalence of dengue infection was 21.65% [2]. The most typical early symptoms include fever, body aches, bone pain, muscle

doi: 10.21276/SSR-IIJLS.2025.11.4.10

pain, and general weakness. According to the WHO, there are three types of dengue infections: deadly dengue, dengue with warning signs, and dengue without warning signs. The revised classification now includes severe organ symptoms such as liver failure, heart blockage, or central nervous system dysfunction [3].

Dengue was thought to be a non-neurotropic virus in the 1970s, and neurological symptoms were uncommon. The PCR was then used to detect the dengue virus in CSF, indicating neuro-invasion [4]. The dengue virus has four serotypes: DENVs-1-4. Of these, DENV-2 and 3 have been associated with neurological symptoms [5]. Both the central and peripheral nerve systems have been the subject of numerous studies in India and around the world, with an incidence of neurological symptoms ranging from 2.63 to 40% [6–8].

The range of symptoms includes detrimental influenza-like illness and potentially fatal dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). Children under the age of 15 are most seriously impacted, but the illness may harm people of any age [9]. DHF is currently one of the leading causes of death and sickness in many tropical Asian countries. About 95% of DHF/DSS instances occur in children under the age of 15, while 5% or more of incidents occur in infants [10]. The most severely impacted are those who live in areas with weak public health systems and have little knowledge of how to avoid or manage dengue and its seasonal increase in severity. These surroundings typically have higher rates of death and illness than places where dengue has been prevalent for years [11].

The major and commonest reported CNS complications of dengue are encephalopathy and encephalitis, which have an estimated prevalence of 0.5-3% [12]. Even though heart dysfunction is typically mild, it can be serious enough to result in global hypokinesia, sudden dilatation of the heart, and progressive, uncontrollable acute heart failure. The lactic acidosis and calcium abnormalities associated with severe dengue can also cause myocardial damage [13,14].

Around fifteen to fifty per cent of cardiac dysfunction has been reported in multiple investigations, where major involvements range from EEG changes to serious myocardial infarctions leading to heart failure. Although the pathogenesis behind this may not be fully understood, it has been thought that various reasons can be included. There could be entry of viruses in cardiac cells, cytokine storm, immune defence machinery or metabolic instabilities. In prolonged dengue syndrome, many heart dysfunctions, for example, pericarditis, arrhythmias, etc. are the atypical indicators that are mainly seen [15].

Even though atypical dengue symptoms are frequently observed in both adults and children, little is known about their frequency, pathophysiology, and appropriate management. Most Indian research is carried out in dengue-endemic regions, like the southern half of the nation and the vicinity of Delhi, where outbreaks happen every year. Even though Madhya Pradesh, one of the most populous states in the country, experienced a rise in dengue cases in October 2009, there has been little research carried out there [16]. This longitudinal study was designed to investigate the cardiac and neurological symptoms in a group in a hospital setting.

MATERIALS AND METHODS

Research Design- This study was conducted by Medclin Research Pvt. Ltd. at a single-centre site in Kolkata, India, over two years. The target population consisted of adult patients who tested positive for the dengue NS1 antigen or serum IgM antibody. The study aimed to evaluate the incidence and outcomes of cardiological and neurological complications in these patients. This study was intended as a real-world evidence-based retrospective observational study conducted at a single tertiary care hospital. The primary objective was to measure the incidence and consequences of cardiological and neurological manifestations in hospitalised adult patients diagnosed with dengue infection. Patient data were retrieved from the electronic medical records over a two-year study period. This data-driven method enabled a complete evaluation of clinical presentations and problems associated with dengue infection from both cardiac and neurological perspectives. All patient records meeting the study's eligibility criteria were reviewed. Baseline data were defined as the information recorded at the time of diagnosis. Follow-up data spanning two years from the date of diagnosis were collected and analysed to identify cardiac and neurological consequences and their progression or resolution over time. Manifestations such as myocarditis, heart failure, arrhythmias, encephalopathy, seizures, and intracranial haemorrhage were evaluated against patients without any such problems for comparative assessment.

doi: 10.21276/SSR-IIJLS.2025.11.4.10

Inclusion Criteria

- Adult patients aged 18 years and above.
- Patients with a confirmed diagnosis of dengue infection based on:
  - Positive NS1 antigen, or
  - Positive serum IgM antibody as established by the enzyme-linked immunosorbent assay method.

Exclusion Criteria

- Patients with any simultaneous infections alongside dengue.
- Patients with a known history of pre-existing heart disease.
- Patients with a pre-existing neurological condition.

Study Procedure- This study was conducted using a retrospective analysis of patient data obtained from the medical records of individuals diagnosed with dengue. The study aimed to investigate the characteristics and outcomes of patients' post-dengue infection. The data included various demographic details, clinical measurements, and laboratory results such as age, vital signs, platelet count, total leukocyte count (TLC), haemoglobin (Hb), packed cell volume (PCV), and temperature. Information on the history of past infections, including dengue, malaria, and COVID-19, was also collected. The study utilised existing records from 193 patients who were admitted with a confirmed diagnosis of dengue. Descriptive statistical methods were used to summarise the data, with variables such as age, blood pressure, and lab results analysed for their relationship with patient outcomes (survival vs. death). Clinical features such as rash, fever, and weakness were evaluated for their association with the outcome. Logistic regression and ROC analysis were used to identify key predictors of survival, with a focus on CRP, pulmonary oedema, and shock. The retrospective design allowed for the analysis of historical data to identify patterns and correlations between clinical parameters and patient outcomes.

Outcome Analysis- The outcome analysis was based on the relationship between various clinical and demographic parameters and the likelihood of survival or death following dengue infection. Results from Table 2 indicate that there were no significant differences in gender distribution between survivors and non-survivors, as evidenced by the p-value of 0.622. However, the gender distribution showed that 98.4% of male patients and 97.1% of female patients survived, suggesting a slightly higher survival rate among males. Table 3 revealed that patients with a history of dengue or malaria had a 100% survival rate, indicating that prior infection might correlate with better outcomes. In contrast, the presence of previous infections like COVID-19 showed a mixed impact, with 66.7% survival. The chi-square tests for clinical features in Table 4 indicated no statistically significant associations with survival, as most p-values exceeded 0.05. The logistic regression analysis in Table 5 highlighted CRP, pulmonary oedema, and shock as significant predictors of death, with p-values less than 0.001 for these parameters. The ROC analysis reinforced the finding that CRP had the highest diagnostic value, followed by ESR and Duration of stay. This suggests that early detection of elevated CRP levels and signs of pulmonary oedema and shock could significantly inform prognosis and treatment decisions for dengue patients.

Statistical Analysis- The study used SPSS-27 for effective analysis. Descriptive statistics were used to summarise patient demographics and clinical characteristics. Chi-square tests were employed to assess associations between categorical variables, such as gender and clinical features, with patient outcomes. Logistic regression was used to identify significant predictors of survival or death, and receiver operating characteristic (ROC) analysis was conducted to determine the optimal cut-off values for key parameters, including age, CRP, ESR, and duration of stay.

RESULTS

Table 1 provides a summary of various characteristics of patients following dengue infection, including their age, vital signs, and lab results. The mean age of patients is 43.85 years, with a wide range from 10 to 90 years, indicating a relatively broad distribution of ages. The temperature of patients' post-infection ranged from 95.6°F to 105.9°F, with a mean of 98.78°F, suggesting a mild to moderate fever in most cases. Systolic blood pressure ranged from 60 mmHg to 160 mmHg, with a mean of 115.41 mmHg, indicating a typical range for patients in this condition. Diastolic blood pressure varied

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from 30 mmHg to 110 mmHg, with a mean of 72.55 mmHg, which is within the normal range but indicates some variability. The average pulse rate was 91.38 beats per minute, with a range from 30 to 148 bpm, suggesting potential variability in cardiac response. Platelet count, a crucial marker in dengue, ranged from 12,000 to 382,000, with a mean of 138,474, indicating a significant variability in platelet levels, typical in dengue infections. Other lab results, such as TLC (Total Leukocyte Count) and Hb (Haemoglobin), showed wide variation, with means of 5139.36 and 12.49, respectively, while PCV (Packed Cell Volume) had a mean of 37.17%. The data highlights the varied presentation of dengue infection and suggests the need for tailored clinical management based on these parameters.

Table 1: Characteristics of the patient's post-dengue infection

Parameters	Number of patients*	Minimum	Maximum	Mean
Age	193	10	90	43.85±16.92
Temp	192	95.6	105.9	98.78±1.5
Systolic	193	60	160	115.41±17.86
Diastolic	193	30	110	72.55±12.62
Pulse	193	30	148	91.38±15.03
Platelet Count	193	12000	382000	138474.09±70775.54
TLC	188	500	17430	5139.36±2701.51
Hb	191	5.5	17.3	12.49±2.15
PCV	127	18.1	49.5	37.17±6.34

**There are missing cases for each parameter*

Table 2 presents the gender distribution of patients concerning their outcomes (survival or death). The chi-square test result (χ^2=0.33, p=0.62) indicates no significant difference in gender distribution between survivors and non-survivors, as the p-value is well above the 0.05 threshold for statistical significance. Among female patients, 97.1% survived, and 2.9% died, accounting for 36.3% of the total sample. For male patients, 98.4% survived, and 1.6% died, representing 63.7% of the total patient population. Despite the higher number of male patients, the outcome distribution between genders is very similar. The chi-square test confirms that gender does not appear to significantly influence the likelihood of survival or death in this sample. The results suggest that both male and female patients had relatively equal chances of survival, and other factors, such as clinical features or treatment interventions, might play a more significant role in determining the outcome. The p-value (0.62) further supports the lack of a significant relationship between gender and survival in these patients.

Table 2: Gender distribution of the outcome

Gender		Outcome		Total	χ^2	p-value
		Survive	Death			
Female	Count	68	2	70	0.333	0.622
	% within Gender	97.10%	2.90%	100.00%		
	% within Outcome	34.70%	50.00%	35.00%		
	% of Total	34.00%	1.00%	35.00%		
Male	Count	128	2	130		
	% within Gender	98.50%	1.50%	100.00%		
	% within Outcome	65.30%	50.00%	65.00%		
	% of Total	64.00%	1.00%	65.00%		

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Total	Count	196	4	200		
	% within Gender	98.00%	2.00%	100.00%		
	% within Outcome	100.00%	100.00%	100.00%		
	% of Total	98.00%	2.00%	100.00%		

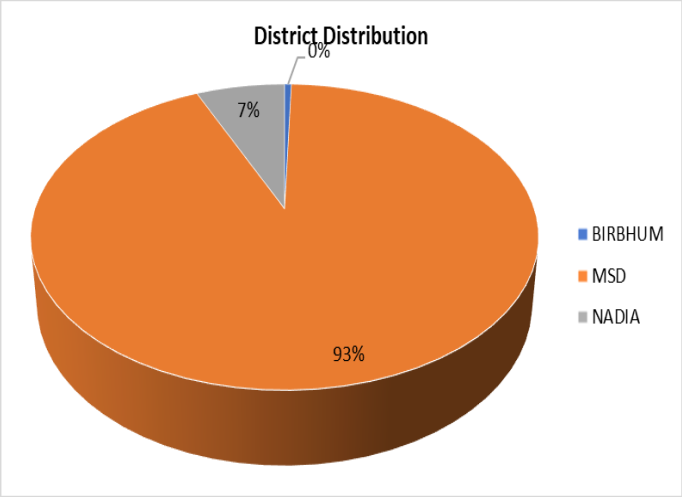

Fig. 1: Distribution of dengue patients based on districts

Table 3 presents the history of past infections of patients, including COVID-19, Dengue, Malaria, NSA1 positivity, and Dengue IgM positivity, about their outcome (survival or death). For patients with a history of COVID-19 infection, 66.7% survived while 33.3% died, but the proportion of deaths was very small (0.5% of the total sample). In contrast, 100% of patients with a history of Dengue and Malaria survived, representing 2.6% and 1% of the total patients, respectively. When considering NSA1 positivity, 98.3% survived, and only 1.7% died, accounting for 91.7% of the total patient population. The Dengue IgM positivity group saw 96.3% survival, with 3.7% deaths, making up 28% of the total sample. The data indicate that the majority of patients with previous infections, particularly Dengue and Malaria, had a favourable outcome. However, the sample size for certain infection histories is small, which limits broader conclusions. The key observation is that the presence of a prior infection like Dengue or Malaria correlates with survival, whereas NSA1 positivity also significantly favours survival.

Table 3: History of past infection of the patients

Parameters	Outcome		Total
	Survive	Death	
History of COVID-19 infection	2	1	3
% within the History of COVID-19 infection	66.70%	33.30%	100%
% within Outcome	1.10%	25%	1.60%
% of Total	1%	0.50%	1.60%
History of Dengue	5	0	5
% within History of Dengue	100%	0.00%	100%
% within Outcome	2.60%	0.00%	2.60%
% of Total	2.60%	0.00%	2.60%
History of Malaria	2	0	2
% within History of Malaria	100%	0.00%	100%
% within Outcome	1.10%	0.00%	1.00%
% of Total	1.00%	0.00%	1.00%

doi: 10.21276/SSR-IIJLS.2025.11.4.10

NSA1 positive	174	3	177
% within NSA1 positive	98.30%	1.70%	100%
% within Outcome	92.10%	75%	91.70%
% of Total	90.20%	1.60%	91.70%
Dengue IgM Positive	52	2	54
% within Dengue IgM Positive	96.30%	3.70%	100%
% within Outcome	27.50%	50%	28%
% of Total	26.90%	1.00%	28%

Table 4 presents the clinical features of patients and their correlation with outcomes (survival or death), along with chi-square values and p-values. Most features, including loose stool, rash, body ache, cough, fever, and weakness, did not exhibit statistically significant differences between survivors and non-survivors, as indicated by high p-values (e.g., loose stool 0.350, rash 0.695, body ache 0.425). The p-values above 0.05 suggest no significant association between these symptoms and the outcome. However, the presence of rash and fever had extremely high prevalence among survivors, with 96.3% of survivors experiencing a rash and 96.8% experiencing fever. Weakness, present in 38.6% of survivors and 75% of deaths, had a chi-square value of 2.171, and a p-value of 0.141, suggesting a potential but not statistically significant relationship with poor outcomes. Other features like vomiting, nausea, and abdominal pain showed varied distributions between groups but remained statistically significant. Overall, the table shows that while certain clinical features like rash and fever are prevalent in survivors, they are not statistically significant indicators of the outcome based on p-values.

Table 4: Clinical Features of the Patients

Parameter	Outcome		Total	χ2	p-value
	survive	death			
loose stool	34	0	34	.873[a]	0.35
% within Outcome	18.0%	0.0%	17.6%		
Rash	182	4	186	.154[a]	0.69
% within Outcome	96.3%	100.0%	96.4%		
Body ache	26	0	26	.636[a]	0.42
% within Outcome	13.8%	0.0%	13.5%		
Cough	28	1	29	.318[a]	0.57
% within Outcome	14.8%	25.0%	15.0%		
Fever	183	4	187	.131[a]	0.71
% within Outcome	96.8%	100.0%	96.9%		
Retro_orbital_pain	1	0	1	.021[a]	0.88
% within Outcome	0.5%	0.0%	0.5%		
Vomiting	46	2	48	1.380[a]	0.24
% within Outcome	24.3%	50.0%	24.9%		
Nausea	39	0	39	1.034[a]	0.309
% within Outcome	20.6%	0.0%	20.2%		
Abdominal Pain	37	1	38	.073[a]	0.78
% within Outcome	19.6%	25.0%	19.7%		
Itching	5	0	5	.109[a]	0.74
% within Outcome	2.6%	0.0%	2.6%		

doi: 10.21276/SSR-IIJLS.2025.11.4.10

SOB	15	1	16	1.500[a]	0.22
% within Outcome	7.9%	25.0%	8.3%		
Dysuria	16	1	17	1.333[a]	0.24
% within Outcome	8.5%	25.0%	8.8%		
Weakness	73	3	76	2.171[a]	0.14
% within Outcome	38.6%	75.0%	39.4%		

Table 5 presents the results of a logistic regression analysis to evaluate the odds of death or survival based on various predictors. The predictors include age, gender, platelet transfusion, CRP, ESR, pulmonary oedema, pleural effusion, peripheral oedema, shock, and duration of stay. Key findings include CRP (C-reactive protein), pulmonary oedema, and shock, all showing strong associations with death, as indicated by their low p-values (<0.001). CRP, with a score of 23.95, strongly predicts the likelihood of death, as does pulmonary oedema and shock, each with a score of 34.49. These factors have the highest odds ratios, indicating they are crucial predictors of poor outcomes. On the other hand, variables like age (p=0.36), gender (p=0.6), platelet transfusion (p=0.42), and pleural effusion (p=0.69) have high p-values, suggesting no significant association with the outcome. The overall model's statistics (78.41) with a p<0.001 indicate that the model is statistically significant, highlighting the importance of CRP, pulmonary oedema, and shock in predicting patient survival. This suggests that interventions targeting these factors could improve patient outcomes.

Table 5: Logistic regression showing the odds of death or survival based on the parameters (predictors) in this study

Variables	Score	P-value
Age	0.83	0.36
Gender	0.18	0.67
Platelet transfused	0.65	0.42
CRP	23.95	<0.001
ESR	1.11	0.29
Pulmonary edema	34.49	<0.001
Pleural effusion	0.151	0.69
Peripheral edema	0.05	0.80
Shock	34.49	<0.001
Duration of stay	0.93	0.33
Overall Statistics	78.41	<0.001

The ROC analysis for the various parameters (Age, CRP, ESR, and Duration of stay) provides findings into their predictive performance for patient outcomes (survival or death). The area under the curve (AUC) values are as follows: Age (0.61), CRP (0.951), ESR (0.66), and Duration of stay (0.65). Among these, CRP exhibits the highest AUC, indicating its excellent ability to discriminate between survival and death, while Age has the lowest AUC, suggesting a weaker predictive ability. For Age, the optimal cut-off value for predicting survival is around 24.5 years**,** as this provides a significant distinction between high sensitivity (1.00) and relatively lower specificity (0.83). For CRP, the best cut-off value lies at 3.35, which provides high sensitivity (1.00) and specificity (0.93), making it the most reliable predictor of outcomes among the variables. For ESR, a cut-off value of 23.0 optimises the balance between sensitivity (1.00) and specificity (0.82), which is substantial, but lower compared to CRP. For Duration of stay, the ideal cut-off appears to be 1.5 days, where sensitivity remains high (0.75), and specificity starts to show a considerable drop, emphasising its role in initial diagnosis. Thus, CRP stands out with the highest diagnostic value, followed by ESR and Duration of stay, while Age appears to be a weaker predictor in this context (Fig 2).

doi: 10.21276/SSR-IIJLS.2025.11.4.10

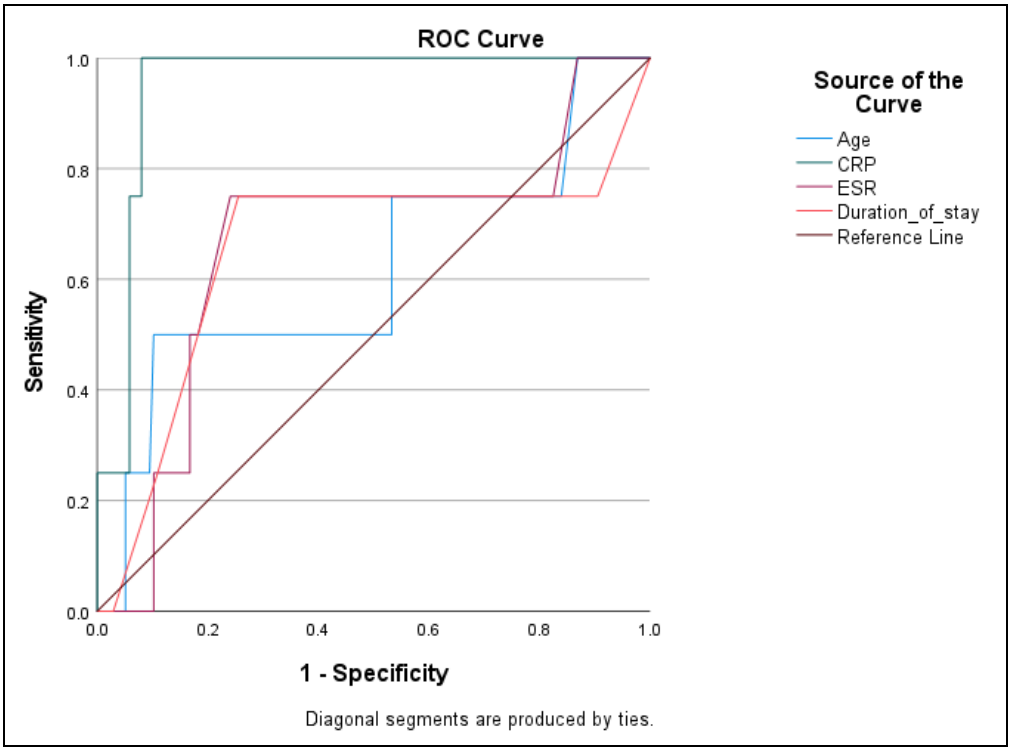

Fig 2: ROC analysis between outcome and various determining parameters

DISCUSSION

Dengue has spread throughout India over the last 20 years, leading to intermittent outbreaks. A survey found that even kids of six to ten (39%) years and 23% of more than 10 years were positive. The analysis found a male preponderance, which is consistent with previous studies [17,18]. While Anders *et al*. [19] discovered a female predominance, Capeding et al. [20] found no gender difference. In a few studies, certain neurological involvement, such as seizures, changed sensory areas are commonest to be found [21,22]. Higher haemoglobin and lower platelet counts are related to dengue [23,24]. In our study, the clinical characteristics of dengue patients, such as age, vital signs, and lab results, revealed significant variability. The mean age of patients was 43.85 years, with a range of 10 to 90 years, which reflects a broad distribution of ages among those affected by dengue. This variability in age is important for understanding the diverse presentation of the disease and suggests that clinical management should be tailored accordingly. The temperature range (95.6°F to 105.9°F) and the mean of 98.78°F indicated mild to moderate fever in most patients, which aligns with the typical fever symptoms observed in dengue infections.

Dengue-linked GBS is an acute neuropathy caused by an antecedent infection from a variety of species. Because it can show oligo-symptoms, screening for it is necessary in endemic areas. GBS can happen with or without infection, and para-infectious neuropathies can show up as severe weakness and a poor response to treatment. Post-infectious neuropathies are typically better and demyelinating. A study of five patients with dengue-associated GBS found that three had axonal neuropathy, two had ophthalmoplegia, two had CSF pleocytosis, and one had bifacial paralysis [25–27]. Our study has found that symptoms like rash and fever were highly prevalent among survivors; the statistical analysis (p=0.69 for rash, p=0.71 for fever) indicated no significant association between these symptoms and patient outcomes. However, weakness was present in 38.6% of survivors and 75% of non-survivors, suggesting a potential relationship with poor outcomes, though it did not reach statistical significance (p=0.14).

Encephalopathy is the most common neurological symptom of dengue, occurring in half of the children with neurological symptoms. The multifactorial pathogenesis includes liver and renal failure, hypoxia, haemorrhage, shock, brain oedema, and hyponatremia. Although the frequency varies depending on the population being studied, encephalopathy is the most common neurological manifestation [28,29]. Dengue encephalitis is linked to a wide range of imaging abnormalities, partly because different definitions of the virus exist. The study found that three patients had

doi: 10.21276/SSR-IIJLS.2025.11.4.10

hyperintense lesions in the splenium of the corpus callosum with diffusion restriction, which has been documented with other diseases like influenza, rotavirus, mumps, legionella, and mycoplasma. Intra-myelin oedema and myelinolysis are the reasons for this lesion, which can be reversed typically [30]. In terms of past infections, Table 3 has shown that patients with a history of COVID-19 had a mixed survival outcome, with 66.7% survival. This finding underscores the complexity of managing dengue in patients with previous infections and suggests that additional factors, such as immunity or co-infections, could influence outcomes.

PRES is shown by elevated blood pressure and bilateral white matter abnormalities, is commonly linked with dengue infections. Vasogenic oedema and a loss of brain auto-regulation are the outcomes of endothelial dysfunction. One study demonstrated that dengue infection was the sole cause of PRES in dengue patients [31]. Syncope, a common symptom of dengue fever that impacts 27.3% of patients, is the first differential diagnosis for seizures. There are various reasons for syncope in dengue, and some patients also experience fever [32].

Early detection of myocardial damage should be the main objective to prevent multiple organ failure and death in patients with severe dengue. The main barrier to achieving this objective is the subtlety of cardiac effects, which can be confused with other illnesses. Unusual indications of dengue-related heart involvement must be recognized by clinicians [33,34]. The low prevalence of heart disease linked to dengue may result in subpar results from the majority of diagnostic tests. Additionally, resources and availability may be limited in countries where dengue is endemic. Imaging should be utilized based on clinical judgment and physical test results. There have recently no image-guided technologies for dengue diagnosis and customized treatment [33,35]. In our current study, the logistic regression analysis in Table 5 highlighted CRP, pulmonary oedema, and shock as significant predictors of death ($p<0.001$). This reinforces the importance of monitoring these factors closely in dengue patients. The ROC analysis further confirmed CRP as the most reliable predictor of outcomes, with an AUC of 0.95, followed by pulmonary oedema and shock. These findings emphasize the need for early detection of elevated CRP levels and the presence of pulmonary complications to guide treatment decisions and improve patient survival.

Similar to other dengue symptoms, myocardial damage is transient and may resolve on its own within the first 2 days of fever onset. However, they can sometimes affect treatment decisions and complicate the clinical course of the illness. When patients do not respond to fluid resuscitation, the main sign of cardiac injury is pump failure. Inotropes may be necessary to treat hypotension [33]. The impact of cardiac rhythm abnormalities on dengue outcomes is unknown. Patients in hospitals should be thoroughly evaluated for conditions like electrolyte imbalance (lower calcium, for instance) that may cause it to manifest or worsen its symptoms. Steer clear of drugs that lengthen the QT interval, for example, amiodarone, chloroquine, and quinolones [36].

CONCLUSIONS

The study conducted a comprehensive retrospective analysis of cardiac and neurological manifestations in adult dengue patients. It concluded that variability in clinical features like age, vitals, and lab findings highlights the importance of early detection of elevated CRP, pulmonary oedema, and shock as mortality predictors. Although rash and fever were common among survivors, they were not significantly associated with outcomes. Interventions focusing on CRP monitoring and pulmonary complications may improve prognosis. Prior dengue or malaria infections were linked to better survival, underlining the role of co-infection history. The study identifies elevated CRP (cut-off: 3.35), ESR (cut-off: 23.0), and hospital stay (1.5 days) as reliable predictors for outcome. CRP showed the highest sensitivity and specificity. These findings support early risk stratification and timely intervention. The study emphasizes targeted monitoring of cardiac and neurological symptoms to guide clinical decisions in severe dengue cases and offers valuable direction for improving treatment strategies.

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Data collection- Sonali Ghosh

doi: 10.21276/SSR-IIJLS.2025.11.4.10

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Critical review- Kaushik Ghosh
Article editing- Sourav Das Choudhury
Final approval- Kaushik Ghosh, Sourav Das Choudhury

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