

Research Article**Utility of Point of Care Ultrasound in Predicting the Severity for Patients with Dengue Fever – A Prospective Cross-sectional Study.****Dr. Vivek Nayagam¹, Dr. Safdhar Hasmi. R², Dr. E. Lavanya³**

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ABSTRACT

Background: Dengue infection exhibits a wide clinical spectrum, ranging from mild self-limiting illness to severe dengue associated with plasma leakage, shock, and mortality. Early identification of patients at risk for severe disease remains a clinical challenge, particularly in resource-limited and high-burden settings. Point-of-care ultrasound (POCUS) has emerged as a bedside tool capable of detecting early markers of plasma leakage, but its role in dengue severity stratification requires further evaluation.

Methods: This prospective cross-sectional study was conducted at a tertiary care hospital in India and included 79 adult patients with laboratory-confirmed dengue infection. Clinical features, laboratory parameters, and standardized POCUS findings were recorded at presentation. Dengue severity was classified according to

World Health Organization guidelines and dichotomized into mild and moderate–severe dengue for analysis. Associations between POCUS findings, laboratory markers, disease severity, and clinical outcomes were assessed using appropriate statistical tests.

Results: The study population had a mean age of 42.7 ± 11.7 years, with a slight male predominance (54.4%). Moderate–severe dengue was observed in 62.0% of patients, while mortality occurred in 12.7%. Ultrasound evidence of plasma leakage was present in 67.1% of patients, with gallbladder wall thickening (67.1%), ascites (57.0%), and pericholecystic edema (59.5%) being the most frequent findings. All major POCUS markers showed a strong association with moderate–severe dengue ($p < 0.001$). Laboratory parameters, including moderate to severe thrombocytopenia and severe hemoconcentration, were also significantly

associated with disease severity. Moderate–severe dengue was linked to increased transfusion requirements, prolonged hospital stay, and all recorded deaths.

Conclusions: POCUS-detected plasma leakage markers are strongly associated with dengue severity and adverse clinical outcomes. Integrating bedside ultrasound with clinical and laboratory assessment may improve early risk stratification and guide timely management in dengue patients.

Keywords: Dengue fever, Point-of-care ultrasound, Plasma leakage, Disease severity, Emergency medicine

INTRODUCTION

Dengue fever is among the most significant viral diseases associated with mosquitoes globally, and a significant health issue to a large population of people in the tropics and subtropics, such as India.¹ The disease scales between an autolimiting febrile condition and severe dengue manifesting through plasma leakage, bleeding, organ and shock. Early detection of patients who may develop into severe dengue is one of the key issues in the healthcare practice, especially in outbreaks when the work of health institutions is overloaded.^{2–5}

Increased permeability of capillary resulting in plasma leakage is the pathophysiological hallmark of severe dengue. It frequently leads to obvious clinical worsening and it may not be accurately identified by normal clinical inspection or lab values like platelet count and hematocrit during the initial stages.⁶ Though warning signs as given in the World Health Organization (WHO) classification give warning signs that can be used in triage and management, they can come out late and be inconsistent with regard to sensitivity,

particularly in young adults and children. As a result, there is an urgent desire to develop simple, quick, bedside instruments that can detect the presence of early plasma leakage and be useful in predicting the severity of the disease.^{7,8}

Ultrasonography is now considered to be a useful addition to the dengue fever assessment tool and has made it possible to observe the signs of plasma leakage without invasion like thickening of the gallbladder wall, ascites, pleural effusion, and pericardial effusion.^{9,10} Of these, the thickening of the gallbladder wall can be regarded as one of the first and most sensitive predictors of capillary leakage. Traditional ultrasound, however, is frequently constrained by accessibility, affordability, and reliance on radiology services, potentially slowing the decision process in acute care organizations.

In this regard, point-of-care ultrasound (POCUS) has a number of benefits. It is also portable, repeatable, radiation free, and could be done at the bedside by the treating clinician, so that the real time assessment and serial monitoring could be done.^{4,5,11–14} Recent studies have indicated that POCUS is potentially able to identify subclinical plasma leakage sooner than clinical or laboratory observations and may enhance risk stratification, triage, and early referral to a higher level of care. Increasingly popular, the use of POCUS in dengue severity prediction has not been consistently introduced into the mainstream management procedures and especially in the resource-restricted environments.^{15,16}

Since the burden of dengue fever is high, the disease dynamics is dynamic, and the prognosing of its severity is to be conducted early, the assessment of the usefulness of

point-of-care ultrasound as a prognostic device may be of great clinical value. The research question of the study is how useful POCUS is in terms of predicting the severity of dengue fever by comparing some of the ultrasound findings with clinical severity and prognosis, and in this regard the research paper seeks to establish whether POCUS is a useful and accessible tool in the management of dengue.

METHODOLOGY

This study will be conducted as a prospective cross-sectional observational study to assess the utility of point-of-care ultrasound (POCUS) in predicting the severity of dengue fever. The research was carried out during the 18 months long period in the Emergency Medicine Unit, Intensive Care Unit (ICU), and the Department of General Medicine of the study hospital between July 2024 and October 2025. The target population was made up of adult patients aged 18 years and above, who came to the emergency department or were hospitalized with clinically suspected and laboratory-confirmed dengue fever. The case was diagnosed with dengue on the basis of compatible clinical presentation and a positive NS1 antigen and/or the presence of IgM antibody test. The research enrolled 79 patients. An estimation of one proportion was used to determine the sample size, and the estimated proportion assumes that the ultrasound positivity regarding severity prediction is 92 per cent, the absoluteness of the precision is 6 per cent, the 95 confidence interval, and the significance level is 5.

The sample size calculated from study conducted by Nguyen RN (2003) was used to estimate the final sample size 79 patients.¹⁷

The convenience sampling method was used where all eligible patients who attended the study period were recruited until the desired sample size was attained. Inclusion criteria were; patients had an infection of dengue that was confirmed by laboratory and were willing to give an informed written consent. The study excluded pregnant women and children. Other exclusion criteria were patients who had pre-existing conditions related to fluid overload like chronic kidney disease, chronic liver disease, congestive cardiac failure, or tuberculosis, dengue patients having related trauma, and patients referred to other hospitals in the process of follow-up.

Operational definitions of dengue, severe dengue, dengue shock syndrome, pleural effusion, pericardial effusion, ascites, hepatomegaly, splenomegaly and gallbladder wall thickening were used based on predefined criteria as mentioned above and in keeping with the standard WHO definitions. Written informed consent was obtained and the eligible patients were enrolled. A structured data collection proforma was used to enter baseline demographic information such as age and sex and clinical history, the duration of symptoms, referral status, and comorbidities. Critical vital signs and the results of a thorough clinical examination such as the manifestation of bleeding and the signs that were likely to indicate the leakage of the plasma were recorded when the patient was presented to the facility. At presentation thematic laboratory studies such as hemoglobin, hematocrit, and platelet count were noted and then as part of normal clinical management.

Based on the bedside ultrasonography, POCUS examination was conducted by the

treating emergency medicine physician who was trained in the use of bedside ultrasonography at the time of presentation under faculty supervision. The ultrasound protocols used to measure the characteristics of serositis and plasma leakage were standardized. In the ultrasound, the evaluation criteria was based upon assessing the gallbladder wall thickness and pericholecystic edema, the presence and extent of ascites, the right and the left pleural effusion, pericardial effusion, hepatomegaly, and the splenomegaly. The measurements were taken in millimeters as per the laid down ultrasound guidelines. The digital storage and archiving of all ultrasound images were done to view it later.

In order to provide a quality assurance and reduce observer bias, stored ultrasound images were reviewed in blind by an expert sonologist who did not have access to the clinical severity and outcome of the patients. The patients were divided into mild, moderate, and severe dengue cases according to the clinical symptoms, laboratory values, and WHO scales of severity. The measured outcome variables were the need to be

hospitalized or in ICU, hospital stay, platelet/blood transfusion requirement and ultimate outcome (discharged, hospitalized, or expired). All data obtained were put in an

electronic database that had a password, and confidentiality of the patients information was highly upheld during the period of the study. The SPSS was used to perform statistical analysis. The categorical variables were summarized in form of frequency and percentages whereas the continuous variables in form of mean $\pm$ standard deviation or median with interquartile range, depending on the data distribution. The Chi-square test, Student t-test or Mann-Whitney U test was used to analyze the associations between the ultrasound findings and severity of dengue depending on the test by nature. Univariate and multivariate logistic regression analyses were used to determine the independent predictors of severe dengue using ultrasound. On the basis of regression coefficients, a POCUS-based prognostic scoring model was created. The statistical significance was interpreted as $p = < 0.05$. The study was initiated only after obtaining an ethical approval of the study by the Institutional Ethics Committee. Informed consent was signed by all the participants and the study was held in compliance with the principles of the Declaration of Helsinki.

All collected data will be entered into a password-protected electronic database. Confidentiality of patient information will be strictly maintained.

Results

Table 1. Demographic and Baseline Characteristics of Study Participants (n = 79)

Variable	Category / Statistic	n (%) / Mean $\pm$ SD
Age (years)	< 30	12 (15.2)
	30–59	62 (78.5)
	≥ 60	5 (6.3)
Gender	Male	43 (54.4)
	Female	36 (45.6)
Residence	Urban	53 (67.1)
	Rural	26 (32.9)

Table 2. Clinical Features and Vital Parameters at Presentation (n = 79)

Clinical Feature	Present n (%)
Abdominal pain	53 (67.1)
Bleeding manifestations	30 (38.0)
Petechiae	25 (31.6)
Hepatomegaly (clinical)	31 (39.2)
Splenomegaly (clinical)	14 (17.7)
Vital Parameter	Mean $\pm$ SD
Duration of fever (days)	4.43 $\pm$ 1.20
Systolic BP (mmHg)	114.6 $\pm$ 14.8
Diastolic BP (mmHg)	73.5 $\pm$ 8.8
Pulse rate (beats/min)	99.5 $\pm$ 12.2
Respiratory rate (breaths/min)	23.1 $\pm$ 2.6
Oxygen saturation (%)	94.4 $\pm$ 2.4

Table 3. Laboratory and Serological Profile of Dengue Patients (n = 79)

Parameter	Category	n (%)
Platelet count	Mild thrombocytopenia	32 (40.5)
	Moderate thrombocytopenia	20 (25.3)
	Severe thrombocytopenia	27 (34.2)
Hematocrit status	Early plasma leakage	8 (10.1)
	Dengue with warning signs	24 (30.4)
	High risk of shock	47 (59.5)
Serology	NS1 antigen positive	79 (100.0)
	IgM antibody positive	23 (29.1)

Table 4. Point-of-Care Ultrasound (POCUS) Findings in Dengue Patients (n = 79)

Ultrasound Finding	Present n (%)
Gall bladder wall thickening	53 (67.1)
Pericholecystic edema	47 (59.5)
Ascites	45 (57.0)
Pleural effusion	23 (29.1)
Pericardial effusion	35 (44.3)
Hepatomegaly (USG)	49 (62.0)
Splenomegaly (USG)	19 (24.1)
Any plasma leakage on POCUS	53 (67.1)
≥ 2 ultrasound markers	41 (51.9)

Table 5. Association of Dengue Severity with Ultrasound, Laboratory Parameters, and Outcomes (n = 79)

Variable	Mild Dengue n (%)	Moderate–Severe Dengue n (%)	p-value
Gall bladder wall thickening	4 (7.5)	49 (92.5)	<0.001
Ascites	0 (0.0)	45 (100.0)	<0.001
Pleural effusion	0 (0.0)	23 (100.0)	<0.001
Severe thrombocytopenia	0 (0.0)	27 (100.0)	<0.001
High-risk hematocrit	2 (4.3)	45 (95.7)	<0.001
Platelet transfusion required	0 (0.0)	27 (100.0)	<0.001
Mortality	0 (0.0)	10 (100.0)	0.008
Hospital stay (days)	3.30 $\pm$ 1.02	5.96 $\pm$ 1.49	<0.001

Discussion:

This cross-sectional study examines the study of 79 dengue patients with laboratory confirmed cases in a hospital based environment and we show that there is a robust and consistent relationship between point-of-care ultrasound (POCUS)-monitoring of plasma leakage markers, traditional laboratory parameters and the severity of dengue disease. The results show that ultrasound characteristics especially the thickening of the gallbladder wall, pericholecystic edema, ascites, pleural and pericardial effusion are much more prevalent in patients with moderate-severe dengue and are closely associated with unfavorable clinical outcomes such as a requirement of transfusion, an extended hospitalization, and mortality. These findings build on the emerging literature regarding how bedside ultrasonography could be used as an effective supplement to clinical and laboratory evaluation to early identify the risk in dengue.

The demographic picture that we have observed in the current study with middle-aged adults and a small preponderance of males is consistent with the national surveillance data as well as with the data of other dengue-infested regions (Khamnuan et al., 2025; Jain et al., 2024).^{18,19} Urban prevalence in our sample matches the national surveillance data and other reports in the dengue-infested areas indicate the known association between dengue transmission and urbanisation, population density, and ecology of vectors (WHO, 2022). The account of similar age and residence trends among Indian and southeast Asian hospital-based cohorts has been reported, which highlights the representativeness of our population.

The fact that we observed thickening of gallbladder walls as the most common ultrasound findings (67.1%) is very close to the findings of pediatric and adult studies in various settings. Michels et al. (2013) also found that the presence

of ultrasound-detected gallbladder wall thickening is highly correlated with subsequent overt ascites and pleural effusion and is stronger in patients who progress to develop severe dengue (pooled OR 2.35), which is consistent with other studies as overall valid markers of such thickening.²⁰ More recently, a review and meta-analysis of studies conducted by Davoudi et al. (2025) revealed that the presence of ultrasound-detected thickening of the gall

The occurrence of ascites and serosal effusiveness was also constitutive in our cohort as 73.4 percent of the patients were found to have serosal involvement and was significantly linked to the moderate-severe dengue ($p < 0.001$). These results are consistent with pediatric and adult studies who have shown progressively high rates of ascites and pleural effusion with the severity of dengue, with Bharath Kumar Reddy et al. (2013) and Sharma et al. (2019) reporting pleural effusion in only about a third of dengue patients and only about half of complicated dengue patients respectively, which supports the role of serosal fluid as an objective measure of plasma leakage.^{21,22}

The strong association observed between ultrasound markers and laboratory indicators—particularly thrombocytopenia and hemoconcentration—is consistent with prior literature. In our study, all patients with moderate or severe thrombocytopenia belonged to the moderate-severe dengue group, paralleling findings from Nahar et al. (2022) and Rasool et al. (2022), who demonstrated significantly lower platelet counts in patients with ultrasound evidence of plasma leakage.^{23,24} Similarly, severe hemoconcentration was almost exclusively observed in the moderate-severe dengue group, in line with studies by Michels et al. (2013) and Xin Tian et al. (2020), which showed that ultrasound often detects plasma leakage earlier than changes in hematocrit.^{20,25}

Importantly, our findings also complement emerging evidence on the limitations of relying solely on laboratory parameters. Serial ultrasonography studies have demonstrated minimal agreement between hematocrit changes and early plasma leakage (Xin Tian et al., 2020), suggesting that ultrasound may capture pathophysiological changes before traditional markers become abnormal.²⁵ This may partially explain why ultrasound markers in our cohort showed near-perfect discrimination between mild and moderate–severe dengue, whereas early laboratory abnormalities were more heterogeneous.

While most studies support the prognostic utility of ultrasound, some authors have questioned its role as a screening tool. Parmar et al. (2017) reported moderate sensitivity but high specificity of ultrasound for dengue diagnosis, concluding that negative ultrasound findings cannot exclude dengue.⁹ Our results do not contradict this conclusion; rather, they emphasise that ultrasound should be interpreted as a **severity-assessment and risk-stratification tool**, not as a standalone diagnostic modality. This distinction is consistent with conclusions from systematic reviews by Low et al. (2018) and Khoo and Lee (2024), which advocate ultrasound as an adjunct rather than a replacement for clinical judgment and laboratory testing.^{26,27}

The strong associations observed between POCUS findings, disease severity, transfusion requirement, hospital stay, and mortality underscore the potential role of bedside ultrasound in early triage and resource allocation. In high-burden, resource-constrained settings, integrating POCUS into routine dengue assessment may assist clinicians in identifying patients who require closer monitoring or early escalation of care. However, these implications should be interpreted cautiously, given the observational nature of the study.

Strengths and limitations

Key strengths of this study include the systematic assessment of multiple ultrasound markers, use of standardized WHO severity classification, and comprehensive correlation with laboratory parameters and clinical outcomes. Nonetheless, several limitations merit consideration. The single-centre design and modest sample size may limit generalizability. As a cross-sectional study, causal inferences cannot be made, and residual confounding related to timing of ultrasound, fluid therapy, or operator variability cannot be fully excluded. Additionally, serial ultrasound assessments were not performed, precluding temporal analysis of evolving plasma leakage.

Future Research Directions

Future multicenter prospective studies with serial ultrasound assessments are needed to validate these findings and define optimal timing and thresholds for ultrasound-based risk stratification. Integration of ultrasound parameters into validated clinical prediction models, alongside laboratory and emerging biomarker data, represents an important area for further investigation.

Conclusion

In summary, this study adds to the growing evidence that point-of-care ultrasound markers of plasma leakage are strongly associated with dengue severity and adverse outcomes. When interpreted alongside clinical and laboratory findings, bedside ultrasound may enhance early risk stratification and support more informed clinical decision-making in dengue-endemic settings.

Conflict of interest: Nil

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