Original Research Article

Association of clinical features, comorbidities and laboratory profile with outcomes among dengue patients admitted in a tertiary care hospital, Delhi NCR

Mohit Tiwari¹, Abhishek Tibrewal²*, Varun S. Pichika³, Narinder P. Singh¹, Pankaj N. Choudhry¹, Rajat K. Agarwal³

¹Department of Medicine, ²Max Super Speciality Hospital, Ghaziabad, Uttar Pradesh, India
³Department of Statistics, Institute of Epidemiology and Biostatistics, New Delhi, India

Received: 21 April 2021
Revised: 11 June 2021
Accepted: 14 June 2021

*Correspondence:
Dr. Abhishek Tibrewal,
E-mail: dr.abhishek08@hotmail.com

ABSTRACT

Background: Dengue fever is an endemic disease across multiple countries. Dengue infection results in a wide spectrum of non-specific clinical manifestations with unpredictable clinical course and outcome. Objective of the study was to understand the association of different clinical features, comorbidities and laboratory profile with outcomes (ICU use, ventilation use and blood transfusion) among dengue patients admitted in a tertiary care hospital in Delhi, National Capital Region.

Methods: This cross-sectional study included 75 dengue patients with fever <1 week confirmed based on NS-1 antigen and/or IgM antibody positivity. Descriptive analysis was used.

Results: Gender was not significantly associated with the outcomes. The duration of fever was significantly higher among those with ICU use (median: 6 versus 4 days; p=0.005), ventilator use (median: 5.5 versus 4.0 days; p=0.049) and blood transfusion (median: 6 versus 4 days; p=0.013). Dengue patients with co-morbidities (diabetes, hypertension, or chronic obstructive pulmonary disease) or co-infection had a significantly higher odds of the outcomes. The platelet level was significantly lower while liver enzymes were significantly higher among those with the outcomes.

Conclusions: The clinical features, comorbidities and laboratory profile can help in identifying critical patients for ICU admission and timely intervention to improve outcome.

Keywords: Dengue, Clinical features, Laboratory, Outcomes, Delhi

INTRODUCTION

Dengue caused by a dengue virus (DENV) is regarded as one of the most rapidly spreading vector-borne disease.¹ It has been considered as a major global health problem by the World Health Organization (WHO), due to its impact on the healthcare system worldwide.² It is endemic across multiple countries around the globe including India.³ Dengue infection results in a wide spectrum of non-specific clinical manifestations with unpredictable clinical course and outcome. In majority of patients, dengue is manifested as a mild self-limiting disease, however, some of the patients may also require critical clinical management in intensive care unit (ICU) and the progression to severe clinical manifestations is usually unpredictable.⁴ Approximately 0.3-14.9% develop severe manifestations that result in ICU admission, and 1-5% die without early recognition and proper treatment.⁴-⁸ Timely access to proper treatment for dengue patients by primary healthcare professionals not only reduces the number of unnecessary hospital admissions but also lowers fatality rates below 1%.⁵

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20212509
The group progressing from non-severe to severe disease is difficult to define, but this is an important concern since appropriate treatment may prevent these patients from developing more severe clinical conditions. Healthcare resources such as ICU beds and close monitoring may be limited during a large epidemic, making effective triage of patients who may require ICU requirement more crucial. A very limited data is available in the literature about the association of demographic profile, clinical features and comorbidities with the prognosis/complications of dengue. The association will help in identifying the high risk dengue patients. Also, since the available resources are usually limited, there is a need to identify critical patients who require clinical attention on priority and possibly ICU stay. Moreover, for overall dengue patients, the mortality is usually very low but in case of secondary dengue and dengue with co-morbidities, the mortality is reported to be higher, so there is a need to identify critical patients by identifying trigger signs for ICU admission and timely intervention to improve outcome.

According to the 2009 WHO classification system, patients can be clinically classified as ‘probable dengue’, ‘dengue with warning signs’ or ‘severe dengue’. In the literature, few case series have been reported focusing on clinical and laboratory risk factors at first presentation in hospital that are predictive of clinical severity, as defined by the requirement for ICU, instead of the WHO classification criteria. Moreover, with the recommendation of close monitoring of patients with warning signs in hospital, there is a greater need to identify these high risk dengue patients 24 hours prior to ICU requirement during hospitalization, which is currently lacking. The different warning signs can be used for early detection of potentially severe cases for timely treatment, to avoid unnecessary hospitalizations, and to decrease the case-fatality of this disease. However, various clinical and epidemiological aspects have still not been completely elucidated, especially in the Indian population. Henceforth, this study aims to understand the association of different clinical features, comorbidities and laboratory profile with ICU use, ventilation use and blood transfusion among dengue patients.

METHODS

The cross-sectional study was carried out over 15 months (1st August 2017 to 31st October 2018) in Max Super Speciality, a tertiary care hospital in Vaishali, Delhi NCR, India. All the prerequisite approval was obtained from the ethics committee and institutional review board of the hospital. The study population included dengue confirmed patients admitted in the inpatient department of the hospital after obtaining their informed consent. The inclusion criteria were patients aged ≥18 years having fever <1 week duration with proven cases of dengue fever previously diagnosed or diagnosed [with serology non-structural protein 1 (NS1) antigen or Immunoglobulin M (IgM) antibody by enzyme-linked immunosorbent assay (ELISA)] during hospitalisation. The exclusion criteria were patients aged <18 years, those without a recent evidence of dengue infection [immunoglobulin G (IgG) positive but IgM negative] and those not giving the consent.

For each of the included patients, the following information was captured using a predefined study proforma. Age (in years); gender (male/female); clinical features: existing co-morbidities; laboratory tests [complete blood count, liver function test, malaria antigen and peripheral smear for malaria parasite, chikungunya polymerase chain reaction (PCR) and/or serology], radiological procedures [chest x-ray (CXR), ultrasound whole-abdomen]. The outcomes of dengue fever are reported as need of ICU care, ventilator support, blood transfusion [packed red blood cells (PRBC)/single donor platelets (SDP)/random donor platelets (RDP); given in patients with clinical bleeding or platelets count <10,000 per mm^3] and mortality during the hospital stay.

The number of the patients considered in the study depended on the patient flow in the hospital during the study time-period. No formal sample size was calculated. Every alternate dengue patient admitted in the inpatient department was considered.

All the variables were entered into a Microsoft excel and analysed using SPSS version 17.0 software. The variables were tested for normality using a Kolmogorov-Smirnov test. The continuous variables are presented as median (interquartile range) and categorical variables are expressed as frequencies and percentages. The association of categorical variables with the outcomes of interest was assessed using chi-square test or Fischer exact test, while that of continuous variables using Mann-Whitney U test. The correlation between two continuous variables was evaluated using Spearman’s correlation coefficient. A two tailed p value <0.05 was considered as statistically significant.

RESULTS

A total of 75 patients with dengue fever [dengue NS-1 antigen positive: 58 (77.3%) patients, IgM antibody positive: 10 (13.3%) patients, and both positive: 7 (9.3%) patients]. Of these, 51 (68.0%) patients were males and 24 (32.0%) patients were females. A total of 25 (33.3%) patients were in the age group of 21-30 years, followed by 21 (28%) in 31-40 years, 8 (10.7%) in 18-20 years, 8 (10.7%) in >60 years, 7 (9.3%) in 50-60 years and 6 (8%) in 41-50 years. Type-2 diabetes mellitus was the most observed comorbidities among the patients [16 (21.3%)], followed by chronic obstructive pulmonary disease [COPD: 13 (17.3%)], coronary artery disease [CAD: 5 (6.7%)], hypertension [4 (5.3%)], chronic kidney disease [3 (4%)].

Also, a total of 14 (18.7%) patients also had co-infection, with 10 (13.3%) patients having malaria and 4 (5.3%) having chikungunya.
Association of demographic factors with the outcomes

Gender was not significantly associated with intensive care use (ICU; p=0.917), ventilator use (p=0.884) and blood transfusion (p=0.716) (Table 1). However, dengue patients with ICU use (median: 25 versus 35 years; p=0.035), ventilator use (24 versus 34 years; p=0.024) but not blood transfusion (median: 25 versus 34 years; p=0.267) were observed to be younger as compared to those without.

Association of clinical features with the outcomes

The duration of fever was significantly higher among those with ICU use (median: 6 versus 4 days; p=0.005), ventilator use (median: 5.5 versus 4.0 days; p=0.049) and blood transfusion (median: 6 versus 4 days; p=0.013). ICU usage was observed to be significantly higher among those with haematuria (100% versus 16.2%; p=0.028), however, it was significantly lower among those with retro orbital pain/headache (9.6% versus 34.8%; p=0.008) and generalized weakness (10.7% versus 36.8%; p=0.009). The ventilator use was found to be significantly lower among those with retro orbital pain / headache (9.6% versus 21.7%; p=0.004). The blood transfusion was observed to be significantly higher among those with ICU use (median: 63.9 versus 10.7%; p=0.009). SGOT was significantly higher among those with ICU use (median: 180 versus 160 U/l; p=0.03) and blood transfusion (median: 14,500 versus 60,000 per mm; p=0.001). SGOT was significantly higher among those with ICU use (median: 278 versus 79 U/l; p<0.001), ventilator use (median: 320 versus 81 U/l; p=0.001) and blood transfusion (median: 278 versus 81 U/l; p=0.001). SPGT was significantly higher among those with ICU use (median: 180 versus 56 U/l; p<0.01), ventilator use (median: 160 versus 57 U/l; p=0.03) and blood transfusion (median: 180 versus 57 U/l; p=0.04) (Table 4). Also, duration of fever was mild to moderately correlated with SGOT (rho=0.483; p<0.001) and SGPT (rho=0.360; p=0.002) values.

Table 1: Association of gender with outcomes among dengue patients.

| Outcomes          | Male (%) | Female (%) | OR (95% CI)        | P value |
|-------------------|----------|------------|--------------------|---------|
| ICU               |          |            |                    |         |
| Yes               | 9 (69.2) | 4 (30.8)   | 1.071 (0.294-3.902) | 0.917   |
| No                | 42 (67.7)| 20 (32.3)  | Reference          |         |
| Ventilator        |          |            |                    |         |
| Yes               | 7 (70)   | 3 (30)     | 1.114 (0.261-4.743) | 0.884   |
| No                | 44 (67.7)| 21 (32.3)  | Reference          |         |
| Blood transfusion |          |            |                    |         |
| Yes               | 8 (72.7) | 3 (27.3)   | 1.302 (0.313-5.419) | 0.716   |
| No                | 43 (67.2)| 21 (32.8)  | Reference          |         |

Table 2: Association of clinical features with outcomes among dengue patients.

| Clinical features | ICU (%) | Ventilator (%) | Blood transfusion (%) |
|-------------------|---------|----------------|-----------------------|
| Vomiting          |         |                |                       |
| Yes               | 8 (23.5)| 6 (17.6)       | 6 (17.6)              |
| No                | 5 (12.2)| 4 (9.8)        | 5 (12.2)              |
| Pain in abdomen   |         |                |                       |
| Yes               | 3 (25)  | 3 (25)         | 1 (8.3)               |

Continued.
### Table 3: Comparison of different parameters with outcomes among dengue patients.

| Clinical features                  | ICU (%) | Ventilator (%) | Blood transfusion (%) |
|------------------------------------|---------|----------------|-----------------------|
| No                                 | 10 (15.9)| 7 (11.1)      | 10 (15.9)             |
| **Oliguria**                       |         |                |                       |
| Yes                                | 0 (0)   | 0 (0)          | 0 (0)                 |
| No                                 | 13 (18.1)| 10 (13.9)     | 11 (15.3)             |
| **Black stool**                    |         |                |                       |
| Yes                                | 0 (0)   | 0 (0)          | 0 (0)                 |
| No                                 | 13 (17.6)| 10 (13.5)     | 11 (14.9)             |
| **Haematuria**                     |         |                |                       |
| Yes                                | 1 (100)*| 1 (100)        | 1 (100)               |
| No                                 | 12 (16.2)| 9 (12.2)      | 10 (13.5)*            |
| **Joint pain**                     |         |                |                       |
| Yes                                | 2 (14.3)| 2 (14.3)       | 2 (14.3)              |
| No                                 | 11 (18) | 8 (13.1)       | 9 (14.8)              |
| **Retro orbital pain/headache**   |         |                |                       |
| Yes                                | 5 (9.6) | 5 (9.6)        | 4 (7.7)               |
| No                                 | 8 (34.8)*| 5 (21.7)*     | 7 (30.4)*             |
| **Bleeding sites**                 |         |                |                       |
| Yes                                | 4 (33.3)| 4 (33.3)       | 3 (25)                |
| No                                 | 9 (14.3)| 6 (9.5)        | 8 (12.7)              |
| **Rashes**                         |         |                |                       |
| Yes                                | 3 (25)  | 3 (25)         | 2 (16.7)              |
| No                                 | 10 (15.9)| 7 (11.1)     | 9 (14.3)              |
| **Itching**                        |         |                |                       |
| Yes                                | 0 (0)   | 0 (0)          | 0 (0)                 |
| No                                 | 13 (18.6)| 10 (14.3)     | 11 (15.7)             |
| **Generalized weakness**           |         |                |                       |
| Yes                                | 6 (10.7)| 6 (10.7)       | 6 (10.7)              |
| No                                 | 7 (36.8)*| 4 (21.1)      | 5 (26.3)              |
| **Cough**                          |         |                |                       |
| Yes                                | 4 (25)  | 4 (25)         | 2 (12.5)              |
| No                                 | 9 (15.3)| 6 (10.2)       | 9 (15.3)              |
| **Shortness of breath**            |         |                |                       |
| Yes                                | 4 (33.3)| 4 (33.3)       | 2 (16.7)              |
| No                                 | 9 (14.3)| 6 (9.5)        | 9 (14.3)              |

*p<0.05

| Variables                  | Yes Median (IQR) | No Median (IQR) | P value |
|----------------------------|------------------|-----------------|---------|
| **ICU (yes: 13; no: 62)**  |                   |                 |         |
| Age (years)                | 25 (19-35.5)     | 34.5 (27-46)    | 0.035   |
| Duration fever (days)      | 6 (4.5-6)        | 4 (3-5)         | 0.005   |
| Hb (g/dl)                  | 16 (12-16.5)     | 14 (12-16)      | 0.154   |
| Platelet (x10^3/mm³)       | 16 (10-22.5)     | 60 (24.8-90.8)  | <0.001  |
| Leucocyte (x10^3/mm³)      | 4 (3.5-7)        | 3 (3-4.25)      | 0.053   |
| SGOT (U/l)                 | 278 (131.5-5.725.5)| 78.5 (52-141)  | <0.001  |
| SGPT (U/l)                 | 180 (50.5-2.070)| 56 (40-94)     | 0.01    |
| **Ventilator (yes: 10; no: 65)** |             |                 |         |
| Age (years)                | 24 (19.5-33.5)   | 34 (27-47)      | 0.024   |
| Duration fever (days)      | 5.5 (3.8-6)      | 4 (3-5)         | 0.049   |
| Hb (g/dl)                  | 15.5 (11.5-16.5)| 14 (12-16)      | 0.233   |
| Platelet (x10^3/mm³)       | 18 (9-23.8)      | 60 (22-90)      | 0.001   |
| Leucocyte (x10^3/mm³)      | 5 (3.5-6.5)      | 3 (3-4.5)       | 0.087   |
| SGOT (U/l)                 | 319.5 (148.5-6.963)| 81 (53.5-147)  | 0.001   |

Continued.
DISCUSSION

Our study was on dengue, a major health problem in India. There were a higher proportion of males and younger age group patients in our study. With respect to the co-morbidities, type-2 diabetes mellitus (21.3%) and COPD (17.3%) were the most common co-morbidities. Also, approximately 20% of patients had co-infection suggesting that dengue fever can co-exist with other arboviral or vector-borne parasitic disease.

In our study, dengue patients with ICU use and ventilator use were observed to be younger as compared to those without. This finding might be due to relatively higher proportion of younger patients (almost 70% aged <40 years) in our study. Dengue patients aged >55 years had 5 times higher risk of death in a multiple logistic regression model and those aged ≥60 years had 3 times higher risk of severe organ involvement than age group between 12–29 years of age.13,14

As expected, dengue patients having any pre-existing co-morbidity had a significantly higher odds of ICU use, ventilator use and blood transfusion. Similarly, it was observed that those with diabetes, hypertension, coronary arterial disease (CAD), COPD, or co-infection had a significantly higher odds of one or more outcomes (ICU use, ventilator use and blood transfusion). In consistent with our findings, dengue patients who presented with (versus without) any pre-existing co-morbidity [adjusted odds ratio (AOR): 1.6; 95% CI: 1.1–2.5] and ≥2 existing co-morbidities (2.9; 95% CI: 1.7–5.1) had a significantly higher risk of severe organ involvement. Also, those with (versus without) pre-existing diabetes (AOR: 2.2; 95% CI: 1.1–5.0); with (versus without) pre-existing cardiac disorder (AOR: 4.3; 95% CI: 1.5–12.8); with pre-existing asthma (AOR: 2.1; 95% CI: 1.0–4.4) had a significantly

| Variables | Yes | No | P value |
|-----------|-----|----|---------|
| **SGPT (U/l)** | Median (IQR) | Median (IQR) | |
| Blood transfusion (yes: 11; no: 64) | | | |
| Age (years) | 25 (20-55) | 34 (27-43) | 0.267 |
| Duration fever (days) | 6 (5-6) | 4 (3-5) | 0.013 |
| Hb (g/dl) | 16 (11.9-16.6) | 14 (12-16) | 0.213 |
| Platelet (x10^3/mm^3) | 14.5 (10-25) | 60 (21-90) | <0.001 |
| Leucocyte (x10^3/mm^3) | 4 (3-6) | 4 (3-5) | 0.567 |
| SGOT (U/l) | 278 (97-2.098) | 80.5 (53.3-147) | 0.001 |
| SGPT (U/l) | 180 (44-1.823) | 57 (40-95) | 0.04 |

Table 4: Association of comorbidities with outcomes among dengue patients.

| Outcome comorbidity | Yes (%) | No (%) | P value | OR (95% CI) |
|---------------------|---------|--------|---------|-------------|
| **ICU (n=13)** | | | | |
| Diabetes | 12 (75) | 1 (1.7) | <0.001 | 174 (17.8-1697.3) |
| Hypertension | 3 (75) | 10 (14.1) | 0.002 | 18.3 (1.7-193.8) |
| CAD | 3 (60) | 10 (14.3) | 0.009 | 9 (1.3-60.8) |
| CKD | 1 (33.3) | 12 (16.7) | 0.455 | 2.5 (0.2-29.8) |
| COPD | 7 (53.8) | 6 (9.7) | <0.001 | 10.9 (2.7-43.2) |
| Co-infection | 10 (71.4) | 3 (4.9) | <0.001 | 48.3 (9.4-249.3) |
| **Ventilator (n=10)** | | | | |
| Diabetes | 9 (56.3) | 1 (1.7) | <0.001 | 74.6 (8.2-679.6) |
| Hypertension | 2 (50) | 8 (11.3) | 0.027 | 7.9 (1.0-63.9) |
| CAD | 1 (20) | 9 (12.9) | 0.65 | 1.694 (0.2-16.9) |
| CKD | 0 (0) | 10 (13.9) | 0.488 | NA |
| COPD | 6 (46.2) | 4 (6.5) | <0.001 | 12.4 (2.8-55.1) |
| Co-infection | 8 (57.1) | 2 (3.3) | <0.001 | 39.3 (6.8-229.2) |
| **Blood transfusion (n=11)** | | | | |
| Diabetes | 10 (62.5) | 1 (1.7) | <0.001 | 96.7 (10.5-890.8) |
| Hypertension | 3 (75) | 8 (11.3) | <0.001 | 23.6 (2.2-255.2) |
| CAD | 4 (80) | 7 (10) | <0.001 | 36 (3.5-368.6) |
| CKD | 2 (66.7) | 9 (12.5) | 0.009 | 14 (1.1-170.6) |
| COPD | 5 (38.5) | 6 (9.7) | 0.008 | 5.8 (1.4-23.6) |
| Co-infection | 9 (64.3) | 2 (3.3) | <0.001 | 53.1 (8.9-316.0) |

CAD: coronary artery disease; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease
higher risk of severe organ involvement.\textsuperscript{13} Likewise, another study reported that patients with diabetes mellitus had a significantly higher risk (11.6; 95% CI: 1.3-1077) of ICU requirement compared with patients with no diabetes by Pang et al. Additionally, patients who died had a significantly higher prevalence of diabetes along with hypertension and other comorbidities as compared to those who survived.\textsuperscript{15}

The duration of fever was significantly higher among those with ICU use, ventilator use and blood transfusion. Only some of the clinical features were significantly associated with the outcomes. For instance, ICU usage and blood transfusion were observed to be significantly higher among those with haematuria. However, ICU usage, ventilator usage and blood transfusion were significantly lower among those with retro orbital pain / headache and ICU usage was lower among those generalized weakness. In similar line, cough, fever, rashes, and headache were observed to be significantly less in fatal patients as compared with survivors.\textsuperscript{15} Likewise, other signs and symptoms such as haemorrhagic manifestation, rash, leucopenia, nausea/vomiting, aching, and pains and tachycardia were not observed to be significantly associated with ICU requirement.\textsuperscript{13} Similarly, in a multiple logistic regression model, hematuria (OR 5.07) was observed to be significantly associated with death (OR 2.55).\textsuperscript{14}

With respect to the laboratory parameters, only platelet level and liver enzymes were significantly associated with the outcomes such that the platelet level was significantly lower while liver enzymes (SGOT and SPGT) were significantly higher among those with the outcomes. ICU mortality was significantly positively associated with lower platelet count in a multiple logistic regression model.\textsuperscript{19} Only thrombocytopenia, hepatic dysfunction in the form of raised bilirubin were associated with significantly higher risk of mortality.\textsuperscript{16} Liver enzymes (alanine and aspartate aminotransferases) were observed to be significantly higher at presentation among dengue patients who progressed with severe organ involvement; elevated hepatic transaminase >500 IU/l was observed to be an independent predictor of mortality in multivariate logistic regression; and the AST and ALT level at first presentation were positively correlated with ICU requirement.\textsuperscript{13,17}

There are some limitations in our study that should be taken into consideration when interpreting the results. First, this is a single centre study with a relatively small number of patients with ICU requirement which might result in low statistical power to detect true association. Second, no dengue serotype data were available for individual study subjects. Also, the clinical manifestations, laboratory tests reported here were that observed at the time of presentation and not during hospitalization. Therefore, our findings may not be generalizable to all populations at risk as well as in different clinical setting and healthcare system.

**CONCLUSION**

In India, dengue is a notifiable disease. Fever is the most common clinical presentation in dengue patients and the duration of fever is observed to be higher among those with the outcomes. Also, patients with co-morbidities (such as diabetes, hypertension, CAD, COPD) and co-infections had a significantly higher risks of the outcomes. Moreover, platelet level was significantly lower while liver enzymes were significantly higher among those with the outcomes. No specific treatment exists for dengue/severe dengue. There is a potential of lowering fatality rates with early detection and access to proper medical care. These clinical features, comorbidities and laboratory profile can help in identifying critical patients for ICU admission and timely intervention to improve outcome.

**Funding:** No funding sources

**Conflict of interest:** None declared

**Ethical approval:** The study was approved by the Institutional Ethics Committee

**REFERENCES**

1. Stanaway JD, Shepard DS, Undurraga EA et al. The global burden of dengue: an analysis from the Global Burden of Disease Study 2013. Lancet Infect Dis. 2016;16:712-23.
2. WHO. Dengue and severe dengue. Available at: https://www.who.int/news-room/facts-sheets/detail/dengue-and-severe-dengue. Accessed on 10 May 2020.
3. Hasan S, Jamdar SF, Alalowi M, Al Ageel Al Beaiji SM. Dengue virus: A global human threat: Review of literature. J Int Soc Prevent Communit Dent 2016;6:1-6.
4. World Health Organization. Geneva, Switzerland. Dengue: guidelines for diagnosis, treatment, prevention and control. 2009. Available at: https://apps.who.int/iris/handle/10665/44188. Accessed on 10 May 2020.
5. Hsieh CC, Cia CT, Lee JC, Sung JM, Lee NY, Chen PL, et al. A cohort study of adult patients with severe dengue in Taiwanese intensive care units: The Elderly and APTT Prolongation Matter for Prognosis. PLoS Negl Trop Dis. 2017;11(1):e0005270.
6. Chen CM, Chan KS, Yu WL, Cheng KC, Chao HC, Yeh CY, et al. The outcomes of patients with severe dengue admitted to intensive care units. Medicine. 2016;95(31):4376.
7. Pang J, Thein TL, Leo YS, Lye DC. Early clinical and laboratory risk factors of intensive care unit requirement during 2004±2008 dengue epidemics in Singapore: a matched case-control study. BMC Infect Dis. 2014;14:649.
8. Bouldouyre MA, Baumann F, Berfioz-Arthaud A, Chungee E, Lacassin F. Factors of severity at admission during an epidemic of dengue 1 in New
Caledonia (South Pacific) in 2003. Scand J Infect Dis. 2006;38(8):675-81.
9. Yeh CY, Chen PL, Chuang KT, Shu YC, Chien YW, Perng GC, Ko WC, Ko NY. Symptoms associated with adverse dengue fever prognoses at the time of reporting in the 2015 dengue outbreak in Taiwan. PLoS Negl Trop Dis. 2017;11(12):e0006091.
10. Juneja D, Nasa P, Singh O, Javeri Y, Uniyal B, Dang R. Clinical profile, intensive care unit course, and outcome of patients admitted in intensive care unit with dengue. J Crit Care. 2011;26(5):449-52.
11. Bouldouyre MA, Baumann F, Berlioz-Arthaud A, Chunge E, Lacassin F. Factors of severity at admission during an epidemic of dengue 1 in New Caledonia (South Pacific) in 2003. Scand J Infect Dis. 2006;38(8):675-81.
12. Chandralekha, Gupta P, Trikha A. The North Indian dengue outbreak 2006: a retrospective analysis of intensive care unit admissions in a tertiary care hospital. Trans R Soc Trop Med Hyg. 2008;102(2):143-7.
13. Pang J, Hsu JP, Yeo TW, Leo TW, Lye DC. Diabetes, cardiac disorders and asthma as risk factors for severe organ involvement among adult dengue patients: A matched case-control study. Sci Rep. 2017;7:39872.
14. Pinto RC, Castro DB, Albuquerque BC, Sampaio Vde S, Passos RA, Costa CF, Sadahiro M, Braga JU. Mortality Predictors in Patients with Severe Dengue in the State of Amazonas, Brazil. PLoS One. 2016;11(8):e0161884.
15. Lee IK, Huang CH, Huang WC, Chen YC, Tsai CY, Chang K, Chen YH. Prognostic Factors in Adult Patients with Dengue: Developing Risk Scoring Models and Emphasizing Factors Associated with Death ≤7 Days after Illness Onset and ≤3 Days after Presentation. J Clin Med. 2018;7(11):396.
16. Shastri PS, Gupta P, Kumar R. A prospective 3-year study of clinical spectrum and outcome of dengue fever in ICU from a tertiary care hospital in North India. Indian J Anaesth. 2020;64:181-6.
17. Medagama A, Dalugama C, Meiyalakan G, Lakmali D. Risk Factors Associated with Fatal Dengue Hemorrhagic Fever in Adults: A Case Control Study. Can J Infect Dis Med Microbiol. 2020;1042976.

Cite this article as: Tiwari M, Tibrewal A, Pichika VS, Singh NP, Choudhry PN, Agarwal RK. Association of clinical features, comorbidities and laboratory profile with outcomes among dengue patients admitted in a tertiary care hospital, Delhi NCR. Int J Res Med Sci 2021;9:1918-24.