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Original Research Article

Prevalence of transaminitis in pediatric dengue fever and its association with disease severity

Arif M. Khan[1]*, R. Bhanu V. Pillai[1], Arjun C. Meethal[2], Anuradha T. Chathoth[2]

[1]Department of Pediatric Gastroenterology, Amrita Institute of Medical Sciences, Kochi, Kerala, India
[2]Department of Health Service, Government of Kerala, Kozhikode, Kerala, India

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***Correspondence:**
Dr. Arif M. Khan,
E-mail: arifvrg@yahoo.com

ABSTRACT

Background: Hepatic involvement is a common but under-characterized feature of pediatric dengue fever, particularly in India. Transaminitis, defined as elevated serum transaminase levels, is frequently observed in dengue and is included in the 2009 revised World Health Organization (WHO) dengue severity classification, with levels >1000 IU considered a marker of severe dengue. This study aims to determine the prevalence of transaminitis in pediatric dengue fever, to assess the prevalence of markedly elevated transaminase levels in severe dengue, to analyse the association of deranged liver function tests with disease severity, and to evaluate the predictive value of liver function tests in determining dengue disease severity.
Methods: A retrospective cross-sectional study was conducted at a tertiary care centre in Kerala, including 159 children (age <18 years) with serologically confirmed dengue fever from 2009 to 2019. Demographic parameters (age, gender), biochemical tests (SGPT, SGOT, bilirubin, INR, albumin) and serological markers for dengue (NS1, IgM, IgG) were recorded. Transminitis was defined as SGOT or SGPT >50 IU/l. SGPT or SGOT >1000 IU/l was considered as marked elevation. Disease severity was classified as per the WHO criteria. Principal component analysis was used to derive composite liver indices. Ordinal logistic regression analysis assessed the predictors of disease severity.
Results: 159 cases were analysed. 68.6% had dengue without warning signs, 27.0% had warning signs and 4.4% were diagnosed with severe dengue. Elevated SGOT and SGOT were observed in 77.4% and 45.9% respectively, indicating a high prevalence of transaminitis. Both composite liver indices (bilirubin and transaminases) were significantly associated with severe dengue and predicted higher disease severity (p=0.045 and 0.041 respectively). Albumin had a protective effect but it was marginally significant (p=0.057). INR, demographic and serological markers were not significantly associated with severity.
Conclusions: Transminitis is highly prevalent in children with dengue fever and it corelates with the severity of illness. Routine liver enzyme evaluation early in the disease may improve risk assessment. More multicentre prospective studies are required to validate these findings and to investigate dynamic changes in liver function during the disease course.

Keywords: Pediatric dengue, Transaminitis, SGOT, SGPT, Liver function tests

INTRODUCTION

Dengue fever is a mosquito-borne viral illness which has become a significant public health challenge in tropical and sub-tropical countries. Every year we get more than 100-400 million infections especially from these parts of the world.[1] The illness is caused by the dengue virus (DENV) which has four serotypes (DENV-1 to DENV-4). World Health Organization (WHO) classifies dengue fever according to its severity as: dengue without warning signs, dengue with warning signs (abdominal pain, persistent vomiting, mucosal bleed, lethargy, liver enlargement, clinical fluid accumulation, thrombocytopenia with concurrent rise in haematocrit) and severe dengue (dengue with severe plasma leakage, bleeding, SGOT or SGPT>1000 IU; or organ failure).[2] Hepatic involvement is

common in dengue fever and clinically relevant which is due to the direct cytopathic effects of the virus and immune mediated injury. It is seen as hepatomegaly, elevated serum transaminases, hypoalbuminemia and jaundice.[3] Children are especially at risk for severe forms of dengue fever and therefore early identification of markers of clinical severity remains important.[4] Elevated transaminases, especially SGOT, often co relating with disease severity have been quoted by few studies which are mostly from outside the Indian subcontinent.[5] Interpreting these liver enzyme changes in children is tricky due to varying clinical picture, variations in enzyme level according to different age groups and complex nature of hepatic injury.[6] Even though elevated liver enzymes (transaminitis) is common in children with dengue fever, its prevalence and prognostic significance is under characterized. The WHO clinical classification of dengue fever places SGOT or SGPT values >1000 IU as severe dengue but reflects poorly on mild to moderate transaminitis and its prevalence. There is also a paucity of literature from India scrutinizing liver function test abnormalities among childhood dengue fever. This study focuses on this gap and it aims to determine the prevalence of transaminitis in pediatric dengue fever, to assess the prevalence of markedly elevated transaminase levels in severe dengue, to analyse the association of deranged liver function tests with disease severity, and to evaluate the predictive value of liver function tests in determining dengue disease severity.

METHODS

Study design and setting

After getting approval from the Institutional Research Committee, a cross-sectional study was conducted at a tertiary care hospital in Kerala, India, which serves as a referral centre for pediatric infectious diseases. Children admitted between January 2009 to December 2019 were included in the study

Study population

Children below 18 years of age with confirmed diagnosis of dengue infection by positive serological tests (NS1, IgM, or IgG) were included.

Exclusion criteria

Neonates (age <28 days), children with pre-existing liver disease, co-infections with hepatitis A, malaria or leptospirosis and those with incomplete laboratory data were excluded.

Sample size

Minimum sample size was estimated to be 150 using the formula given.[7]

$$Z = 4pq/d^2$$

Data collection

Data were obtained from the hospital's medical records. The following variables were collected.

Demographics

Demographic characteristics involved age and gender.

Biochemical markers

Serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), total bilirubin (TB), conjugated bilirubin (CB), total protein, serum albumin, alkaline phosphatase (ALP), international normalized ratio (INR).

Serological markers

Serological markers involved NS1 antigen, IgM and IgG dengue.

Severity was scored according to WHO classification: 0-dengue fever without warning signs, 1-dengue with warning signs, and 2-severe dengue fever.

Normal transaminases levels across different pediatric age groups were reviewed.[8] A cut off of >50 IU/l for either SGOT or SGPT was used to define transaminitis in this study. In case of multiple lab results, highest values from the first 96 hours of hospitalization were used for standardization.

Data analysis

Data were entered into Microsoft Excel and analysed using statistical package for the social sciences (SPSS) v18 and Jamovi v2.6. Descriptive statistics were calculated for all variables. Continuous variables were presented as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. After proportional odds and multiple collinearity assumption checks, principal component analysis (PCA) was used to combine co related variables into an index.

Total bilirubin and conjugated bilirubin were combined to form composite liver index 1. SGOT and SGPT were combined to form composite liver index 2. Goodness-of-fit was assessed using Akaike information criterion (AIC) and McFadden's R^2. Ordinal regression test was done to assess the predictors of dengue severity and association of liver function test to disease severity. A $p<0.05$ was considered statistically significant.

RESULTS

A total of 159 cases were included in the study. 109 (68.55%) were having dengue fever without warning signs, 43 (27.04%) had warning signs, 7 (4.40%) had severe dengue. Mean values by severity group for various

demographic and biochemical markers are summarized in Table 1 and it shows a trend of increasing SGOT, SGOT, TB, CB and INR with severity. Albumin level declined with increasing severity.

77.4% of patients showed elevated SGOT and 45.9% had elevated SGPT levels, which is the overall prevalence of transaminitis according to this study (Table 2). The ordinal logistic regression model predicting dengue severity (Table 3) was statistically significant, $\chi^2(9)=34.9$, $p<0.001$, with a McFadden R^2 of 0.146. Both composite liver index 1 and 2 were significant predictors of increasing dengue severity ($p=0.045$ and 0.041). The odds ratio of 1.61 and 1.70 respectively suggest that for every 1-unit increase in score component 1 and 2, the odds of being in a higher severity category increase by ~60.8% and ~69.5% respectively, assuming all other variables remain constant.

Table 1: Clinical and biochemical parameters according to dengue severity grades (Mean ± SD).

Variables	Dengue without warning signs	Dengue with warning signs	Severe dengue
Age (years)	12.0±4.96	12.7±4.50	10.4±6.35
Total bilirubin (mg/dl)	0.472±0.243	0.701±0.774	1.27±1.24
Conjugated bilirubin (mg/dl)	0.113±0.0583	0.192±0.221	0.624±0.943
SGOT (IU/l)	112±113	164±170	792±878
SGPT (IU/l)	62.8±59.8	94.7±101	252±248
Albumin (g/dl)	3.98±0.376	3.89±0.473	2.93±0.862
INR	0.979±0.130	1.02±0.126	1.17±0.559

Table 2: Frequency distribution of liver function abnormalities and serological markers across dengue severity grades.

Variables	Value	Severity 0 (%)	Severity 1 (%)	Severity 2 (%)	Total (N)	Total (%)
SGOT (IU/l)	<50	28 (17.6)	8 (5.0)	0 (0.0)	36	22.6
	51–100	39 (24.5)	15 (9.4)	0 (0.0)	54	33.9
	101–500	41 (25.8)	17 (10.7)	4 (2.5)	62	38.7
	501–1000	1 (0.6)	3 (1.9)	1 (0.6)	5	3.1
	>1000	0 (0.0)	0 (0.0)	2 (1.3)	2	1.3
SGPT (IU/l)	<50	65 (40.9)	21 (13.2)	0 (0.0)	86	54.1
	51–100	26 (16.4)	8 (5.0)	2 (1.3)	36	22.6
	101–500	18 (11.3)	14 (8.8)	3 (1.9)	35	22.0
	501–1000	0 (0.0)	0 (0.0)	2 (1.3)	2	1.3
Total bilirubin (mg/dl)	<2	109 (68.6)	41 (25.8)	6 (3.8)	156	98.1
	>2	0 (0.0)	2 (1.3)	1 (0.6)	3	1.9
Conjugated bilirubin	<20 of TB	108 (67.9)	39 (24.5)	4 (2.5)	151	95.0
	>20 of TB	1 (0.6)	4 (2.5)	3 (1.9)	8	5.0
Albumin (mg/dl)	<3.5	9 (5.6)	9 (5.6)	5 (3.1)	23	14.4
	>3.5	100 (62.8)	34 (21.3)	2 (1.2)	136	85.5
INR	<1.2	106 (66.7)	38 (23.9)	5 (3.1)	149	93.7
	>1.2	3 (1.9)	5 (3.1)	2 (1.3)	10	6.3
NS1	Negative	67 (42.1)	18 (11.3)	6 (3.8)	91	57.2
	Positive	42 (26.4)	25 (15.7)	1 (0.6)	68	42.8
IgM	Negative	17 (10.7)	12 (7.5)	0 (0.0)	29	18.2
	Positive	92 (57.9)	31 (19.5)	7 (4.4)	130	81.8
IgG	Negative	96 (60.4)	36 (22.6)	5 (3.1)	137	86.2
	Positive	13 (8.2)	7 (4.4)	2 (1.3)	22	13.8

Table 3: Ordinal logistic regression predicting dengue severity and association of biochemical parameters to severe dengue.

Predictor	Estimate	P value	Odds ratio (OR)
Composite liver index 1	0.4750	0.045	1.61
Composite liver index 2	0.5275	0.041	1.70
INR	1.7492	0.269	5.75
Albumin	−0.9092	0.057	0.403
NS1	0.6191	0.135	1.86

Continued.

Predictor	Estimate	P value	Odds ratio (OR)
IgM	−0.1198	0.823	0.89
IgG	0.0249	0.965	1.03
Age	0.0220	0.600	1.02

Out of seven cases of severe dengue, the highest SGPT level noted was 627 IU/l, with two cases showing SGPT values between 500 to 1000 IU/l. The maximum SGOT level was 2124 IU/l, of which two cases showed values greater than 1000 IU/l and one case in 500-1000 IU/l range. Prevalence of severe transaminitis was 28.5% for SGOT. Albumin level showed protective effect although marginally significant (p=0.057). Other variables like INR, NS1 antigen, IgM, IgG, age and gender were not significantly associated with disease severity.

DISCUSSION

Our study highlights a high prevalence of transaminitis in children with dengue fever, confirming that it is a common biochemical abnormality in affected children. Prakash et al and Mohan et al also reported >80% prevalence of transminitis in pediatric dengue fever.[9,10] A clear association between elevated transaminases and increasing clinical severity of dengue fever was demonstrated. Also, composite liver index 2, which included SGOT and SGPT was a significant predictor of severity. SGOT was more frequently elevated than SGPT. Similar trends were also observed in previous studies.[11] Higher SGOT levels may be attributed to its presence in both liver and muscle tissue, which reflects a widespread systemic inflammation happening in dengue fever.[12]

Hyperbilirubinemia was seen only in 1.88% of study population. This percentage was less compared to other studies which have identified hyperbilirubinemia in as much as 7-15%.[11,13] Composite liver index 1, representing total and conjugated bilirubin was significantly associated with severe disease. Jaundice in dengue fever may be due to fulminant hepatitis or obstruction of the biliary canalicular lumen due to ongoing inflammatory process which reduce the luminal diameter.[14,15] Several studies have also described acalculous cholecystitis and intra vascular haemolysis as causes of jaundice in dengue fever.[16]

Albumin had a negative association. Hypoalbuminemia leading to vascular leakage is associated with poor outcome in dengue fever and is also a significant predictor of severe dengue.[5,17] The prevalence of deranged prothrombin time and INR (6.3%) was lower compared to transaminase elevation (77.4%). This is consistent with other studies which finds that coagulopathy is less commonly observed but can still be seen in severe disease.[6] Serological markers (NS1, IgM, IgG) were not found to be significantly associated with severe disease in our cohort. This is in contradiction to some studies which states that IgG positivity and IgG/IgM ratio can demonstrate secondary dengue which maybe a more severe disease.[18] Although not significant mean age was lower in severe dengue compared to other groups, similar to other studies where younger age were predictors of poor outcome in dengue fever.[19,20]

Limitations

Being a retrospective design, data were collected from the existing records which might include missing information or intrinsic discrepancies that the model did not account for. Generalizability of the results may be limited due to the single centre nature, regional focus and data obtained from admitted patients. The number of severe dengue cases were few which would limit how reliable the findings are for that particular sub group. Finally, the lack of serial liver function tests duration the disease course made it difficult to assess the dynamics of liver injury fully.

CONCLUSION

The significance of liver function abnormalities, especially elevated transaminases, as supporting markers in the clinical evaluation of paediatric dengue is highlighted by this study. Although hepatic involvement in dengue is widely recognized, our results support its high frequency and possible function in assessing the severity of the illness. During early phase of the illness, routine liver enzyme monitoring could improve clinical judgement and help anticipate complications. Cases with SGPT levels more than 500IU should be carefully observed for signs of severe dengue. To validate these findings, future studies are needed among diverse cohorts, monitoring serial changes in liver function during disease, and assess their prognostic significance in clinical outcomes and treatment planning.

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