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Original Research Article

Beyond conventional markers: admission serum lactate levels as an early predictor of dengue disease severity: a retrospective cross-sectional study from a tertiary care hospital in Karachi, Pakistan

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ABSTRACT

Background: Dengue is a significant global health concern, with clinical manifestations ranging from mild fever to severe, life-threatening hemorrhagic shock. Despite the use of established warning signs, an effective biomarker for the early identification of severe cases remains elusive. This study aimed to investigate the utility of admission serum lactate levels as an early predictor of dengue disease severity.
Methods: A retrospective cross-sectional study was conducted at a tertiary care hospital in Karachi, Pakistan, reviewing medical records from 2018 to 2022. The study included adult patients aged 18 and above who were admitted with a primary diagnosis of dengue fever and had admission serum lactate levels available. Patients with pre-existing chronic liver or kidney disease were excluded. Data on demographic characteristics, comorbidities, laboratory results (including lactate, hematocrit, and platelet count), and disease outcomes such as ICU admission, intubation, and systemic complications (cardiovascular, ARDS, CNS, acute liver failure, AKI, and mortality) were collected. Data analysis was performed using IBM SPSS Statistics, with a p value of <0.05 considered statistically significant.
Results: A total of 203 eligible patients were included in the final analysis. The study found a statistically significant association between higher median serum lactate levels and various indicators of disease severity. Higher lactate levels were significantly associated intubation, and mortality (p value <0.05). A weak negative correlation was also observed between admission lactate levels and platelet counts. No significant correlation was found between lactate and hematocrit levels.
Conclusions: Admission serum lactate levels can serve as a valuable and early predictor of overall dengue disease severity. Higher lactate levels upon hospital admission are significantly associated with a range of severe outcomes, including cardiovascular complications, ARDS, acute liver failure, AKI, intubation, and mortality.

Keywords: Dengue, Lactate, Pakistan, Severity

INTRODUCTION

Dengue is a vector borne viral disease, transmitted by female Aedes mosquito. There are 4 serotypes of this virus. Every year millions of people suffer from this illness. However, the severity of illness varies from mild symptoms like fever and body aches to severe dengue hemorrhagic shock syndrome.[1] Transmission of this viral illness is greatly influenced by temperature, rainfall and urbanization. The primary pathophysiology of the disease is capillary leakage and hemoconcentration. This viral illness is known for causing multiorgan damage such as encephalopathy, respiratory distress syndrome, acute liver injury, renal failure, coagulopathy and much more. Previously thought to be a pediatric disease has now shown a trend towards young adult population.[2] Early identification of the disease is important. In countries like Pakistan which are endemic for dengue and other illness which have similar clinical spectrum such as malaria or acute viral hepatitis, early recognition and treatment may sometimes be delayed. There are three stages

of dengue infection that is dengue fever, dengue hemorrhagic fever and dengue shock syndrome. It is not necessary that all three stages may always occur in all dengue patients; similarly, the stages may overlap as well. Warning signs used for identification severe cases of dengue fever have not yet been proven to be sensitive enough. No chemical biomarker has yet been approved for early identification of severe cases of dengue fever.[3,4] Various studies have been conducted to identify severity and mortality predictors among dengue patients. Lactate is a well identified mortality predictor among critically ill patients. Studies have been carried out to use lactate as a predictor of disease severity among patients with dengue fever. Study but Gupta et al emphasized the use of lactate as prognosis marker in severe dengue cases.[5] One study in India included lactate among the list of various other biomarkers for assessment of severity of dengue in addition to capillary refill time.[6]

Based on the evidence we planned to conduct a study to see the significance of lactate level at admission in indicating the severity of dengue fever. For the sake of this study disease severity was described in terms of requiring ICU admission, intubation, cardiovascular system (CVS) complications, acute respiratory distress syndrome (ARDS), central nervous system complications (CNS), acute liver failure, acute kidney injury (AKI) and mortality. The study also determined the correlation between lactate levels at the time of hospital admission and hematocrit levels at that time as well as with platelet count on admission, 12, 24 and 48 hours of admission.

METHODS

A retrospective cross-sectional study was conducted at Aga Khan University Hospital, Karachi, Pakistan from 2018 to 2022. The study included all the patients of age 18 years or above who had been admitted to AKUH over the last 5 years (i.e. 2018 to 2022) primarily with the diagnosis of dengue fever. Medical records of all such patients were retrieved and reviewed to collect the clinical information including biochemical parameters at the time of admission and clinical course of the disease during hospital admission. However, the study excluded the patients whose lactate level at hospital admission were not available or who were identified to have chronic liver or chronic kidney disease as comorbidity at the time of hospital admission. The data was recorded using pre-designed proforma. Information on baseline characteristics, comorbid and laboratory investigations, such as lactate, hematocrit, and platelet count was recorded. Information was also collected regarding hospital courses, critical care unit stay, intubation, systematic complications and disease outcomes.

Ethical approval for this study was obtained from the ethics review committee, Aga Khan University, Hospital. All steps were taken to ensure anonymity and confidentiality of all the patients included in this study and their respective data was assigned unique three-digit code to maintain the anonymity.

Data was analysed using IBM SPSS Statistics for Windows, version 25. Descriptive statistics were calculated for demographic and disease related characteristics. Frequency and proportions were calculated for categorical variables while median and IQR were calculated for quantitative variables. Mann Whitney U test was applied to compare median lactate values among patients with differences in disease severity described in terms of ICU admission, intubation, and various systematic complications. P value of 0.05 or less was considered statistically significant.

RESULTS

Screening of more than 1600 medical records of adult patients with diagnosis of dengue fever was completed to identify eligible patients. After screening only 203 patients were included in the analysis on the basis of availability of serum lactate levels at the time of hospital admission. 58.6% (n=119) of all the study participants were male and 41.4% (n=84) were females. Majority of the patients had a hospital stay of duration ranging between one to two days. 29.6% (n=60) of all the patients were admitted to special care unit (SCU), 14.8% (n=30) were admitted to intensive care unit (ICU) and 13.8% (n=28) were intubated. Acute kidney injury was the most common systematic complication with a proportion of 32.5% (n=66) followed by CVS complication with a proportion of 23.2 (n=47). 11.3% (n=23) of all patients died during hospital course while 88.7 (n=180) recovered from the disease (Table 1).

The study found statistically significant differences among dengue patients with and without systematic complications with exception of CNS complications. Median serum lactate levels of patients affected with systematic complications were higher as compared to those without complications. Study also found significant higher serum lactate levels among patients who were admitted to ICU and those who were intubated as compared those who were not admitted to ICU and those who didn't required intubation respectively (p value <0.05) (Table 2).

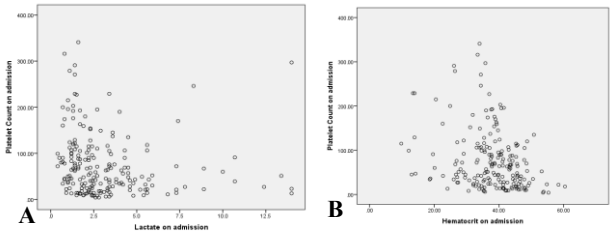

Figure 1: (A) Weak negative correlation between serum LDH levels and platelet count at the time of hospital admission (Spearman correlation coefficient of -0.27); (B) weak positive correlation between serum LDH levels and haematocrit at the time of hospital admission (Spearman correlation coefficient of 0.07).

The study found a weak negative correlation between serum lactate levels at hospital admission and platelet counts at the same time with a correlation coefficient of -0.27 and this finding was statistically significant (p<0.05) (Figure 1A). The study also found very weak positive correlation between serum lactate levels at hospital admission and hematocrit at that time with a correlation coefficient of 0.07 and this finding was statistically non-significant (Figure 1B).

Table 1: Demographic and health related characteristics of patients admitted with dengue fever (n=203).

Variable	Frequency	Percentage
Sex		
Male	119	58.6
Female	84	41.4
Comorbid*		
HTN	45	22.2
DM	44	21.7
COPD	12	5.9
Others	21	10.3
Length of hospital stay		
1-2 days	101	49.8
2-4	50	24.6
5 or more days	52	25.6
Special care unit (SCU) admission		
Yes	60	29.6
No	143	70.4
Intensive care unit (ICU) admission		
Yes	30	14.8
No	173	85.2
Intubation		
Yes	28	13.8
No	175	86.2
Acute respiratory distress syndrome		
Yes	23	11.3
No	180	88.7
Acute liver failure		
Yes	36	17.7
No	167	82.3
CVS complications		
Yes	47	23.2
No	156	76.8
Acute kidney injury		
Yes	66	32.5
No	137	67.5
CNS complications		
Yes	19	9.4
No	184	90.6
Outcome		
Recovered	180	88.7
Mortality	23	11.3

*Multiple responses possible.

Table 2: Comparison of lactate levels at admission among patients with differences in clinical course or specific disease severity outcomes.

Variable	Median (IQR)	P value
ICU admission		
Yes	5.5(6.5)	<0.001
No	2.2(2.0)	
Intubation		
Yes	5.7(6.9)	0.002
No	2.2(2.0)	
ARDS		
Yes	4.3(7.5)	0.013
No	2.2(2.0)	
CVS		
Yes	4.2(5.1)	<0.001
No	2.2(2.0)	
CNS		
Yes	1.8(4.6)	0.101
No	2.3(2.1)	
AKI		
Yes	3.3(4.8)	0.007
No	2.2(1.9)	
Acute liver failure		
Yes	4.3(4.2)	<0.001
No	2.2(2.0)	
Outcome		
Discharged	2.3(2.0)	0.022
Mortality	5.5(8.5)	

P value of 0.05 or less was considered statistically significant.

DISCUSSION

A considerable amount of evidence is available regarding utility of various biomarkers like hematocrit, platelets, and serum ferritin and creatine kinase in predicting severity of disease among the patients diagnosed with dengue fever.[7-10] However, relatively few studies have been reporting the independent role of serum lactate levels in predicting the disease severity among dengue patients in terms of different systematic disease outcomes. In addition, this study has particularly explored the utility of initial lactate levels (at the time of hospital admission) of dengue patients for identifying potential severity of the disease in the local context.

This study found statistically significant association between higher median levels of lactate and disease severity. This finding is apparently comparable to previous studies establishing association between mean lactate levels in earlier phase of disease and severity of disease. A study conducted by Ladani and colleagues have also reported association between dengue severity. The study found significantly higher mean for lactate levels among dengue patients with severe disease as compared to the patient with no disease severity.[11] Another study conducted by Sirikutt and Kalayanaro found significantly higher mean lactate levels on day 0 among dengue patients who developed DHF and DSS as compared to dengue patients with fever only.[12] Similarly, another study conducted by Shahida and colleagues conducted in 2016 at the in-patient department of Benazir Bhutto Hospital (BBH), Rawalpindi, Pakistan found higher mean lactate levels among patients with DSS when compared with dengue fever patients without DSH.[13] However, unlike, previous studies where most have defined the severity in terms of developing dengue hemorrhagic fever or dengue shock syndrome this study has described the disease severity in terms of systematic compilations, ICU admission, intubation and death.

The study reported statistically significant association between lactate and systematic complications related to cardiovascular complication, acute respiratory distress syndrome (ARDS), acute liver failure, acute kidney injury (AKI), intubation and death. The association of early lactate levels or lactate levels at day zero of admission with deranged liver function or acute liver failure and mortality among dengue patients is well supported by previous studies.[14,15] A previous study published in 2021 have supported the association of lactate with mortality and ARDS, but the finding was statistically non-significant.[16] However, we couldn't find any relevant study reporting the severity of disease among dengue patients in terms of cardiovascular complication, intubation and ICU admission. A previous study has linked the serum lactate levels to hospital stay and have developed a prognostic scale to predict the possible length of hospital stay known as lactate in dengue (LID) scale. Such studies indirectly support the disease severity outcomes of our study.[17]

This study also assessed possible correlation between serum lactate levels and hematocrit as well as between serum lactate levels and platelet count at the time of hospital admission. There was a negative but weak correlation

between lactate and platelet count which was not significant and is well supported by the previous studies.[16,18] We couldn't find any study among dengue patients which have studied the correlation between lactate and hematocrit. Nevertheless, a study conducted among patients with immune thrombocytopenia also reported a negative correlation between serum lactate levels and platelets.[19] Hence, the correlation between serum lactate levels and platelets count needs further evaluation.

Our study has few limitations. Small sample size and missing information on various biomarkers have affected the overall scope of this study. Moreover, as this study represents only one private tertiary care hospital in Karachi, Pakistan; hence, generalizability of the study findings remains a major concern. Furthermore, availability of limited evidence regarding correlation of lactate with platelets and hematocrit requires careful interpretation and indicates the need for further research with large scale studies.

CONCLUSION

Serum lactate levels measured at the time of hospital admission can serve as a predictor of overall disease severity. Higher levels of serum lactate are associated with cardiovascular complication, ARDS, acute liver failure, intubation and mortality. Serum lactate levels at day 0 were negatively correlated with platelet count among dengue fever patients.

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REFERENCES

1. Guo C, Zhou Z, Wen Z, Liu Y, Zeng C, Xiao D, et al. Global epidemiology of dengue outbreaks in 1990-2015: a systematic review and meta-analysis. Front Cell Infect Microbiol. 2017;7:317.
2. Guha-Sapir D, Schimmer B. Dengue fever: new paradigms for a changing epidemiology. Emerg Themes Epidemiol. 2005;2(1):1.
3. Hadinegoro SR. The revised WHO dengue case classification: does the system need to be modified? Pediatr Int Child Health. 2012;32[1(s1)]:33-8.
4. Thanachartwet V, Wattanathum A, Oer-areemitr N, Jittmittraphap A, Sahassananda D, Monpassorn C, et al. Diagnostic accuracy of peripheral venous lactate and the 2009 WHO warning signs for identifying severe dengue in Thai adults: a prospective observational study. BMC Infect Dis. 2016;16:46.
5. Gupta M, Agrawal N, Sharma SK, Ansari AK, Mahmood T, Singh L. Study of utility of basic arterial blood gas parameters and lactate as prognostic markers in patients with severe dengue. Cureus. 2022;14(5):e24682.
6. Gupta S, Mall P, Alam A. Combined score based on arterial lactate, aspartate transaminase and prolonged capillary refill time is a useful diagnostic criterion for identifying severe dengue. Trans R Soc Trop Med Hyg. 2020;114(11):838-46.
7. Nayak P, Panda M, Jena D, Swain S, Swain SK. Study on the pattern of changes in biochemical and haematological profiles in dengue-positive patients admitted to tertiary health care hospital Puri on the first, third, seventh, and tenth days of their illness. J Cardiovasc Dis Res. 2023;14(12):204-10.
8. Kashif SM, Nawaz Z, Kumar D, Anum G, Qadeer R. Dengue fever and prognostic utility of inflammatory markers. Prof Med J. 2024;31(08):1188-94.
9. Bano N, Tayyab M, Muneer B, Firyal S, Hashmi AS, Wasim M, et al. Clinical, hematological and biochemical manifestations among dengue patients of Lahore region. Pak J Zool. 2022:1-8.
10. Villar-Centeno LA, Díaz-Quijano FA, Martínez-Vega RA. Biochemical alterations as markers of dengue hemorrhagic fever. Am J Trop Med Hyg. 2008;78(3):370-4.
11. Ladani M, Shukla D, Raval R, Goyani T, Vadodaria S. Serum lactate as a predictor of severity in dengue infection. Nat J Med Res. 2023;13(1).
12. Sirikutt P, Kalayanarooj S. Serum lactate and lactate dehydrogenase as parameters for the prediction of dengue severity. J Med Assoc Thai. 2014;97:S220-31.
13. Perveen S, Firdous H, Khalid MA, Ahmed N, Baqai HZ. Relationship between serum lactate dehydrogenase levels and dengue severity. JRMC. 2017;21(1):9-12.
14. Farooq M, Saleem A, Farooq M, Ejaz M. Association of dengue severity with host biomarkers. Pak Armed Forces Med J. 2024;74(4):1046.
15. Raju Naik R, Prabha J, Kumar A. A study on serum lactate dehydrogenase as prognostic indicator in patients with dengue fever. An observational cross-sectional study in North Delhi. Int J Med Pub Health 2025;15(1);875-82.
16. Equebal A, Dhanawade S. Study of serum lactate dehydrogenase levels in critically ill dengue patients admitted in PICU. Pediatr Infect Dis. 2022;3(3):91-4.
17. Kasarabada H, Iyengar SS, Singh D, Kushala P, Joshi SK, Dayanand K. Observational study of using lactate dehydrogenase as prognostic marker in dengue patients. Med J Armed Forces India. 2025;81(3):275-81.
18. Mittal SH, Mittal S, Govil T. Devising a prognostic predictive scale based on lactate dehydrogenase levels in dengue. Astrocyte. 2015;2(2):69-71.
19. Al-Samkari H, Kuter DJ. Lactate dehydrogenase is elevated in immune thrombocytopenia and inversely correlates with platelet count. Br J Hematol. 2019;187(3):61-4.

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