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Diagnostic Performance of Ns1 Antigen Elisa for Early Detection of Dengue Infection

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ABSTRACT

Dengue fever is one of the most rapidly spreading mosquito-borne viral diseases and remains a major public health concern in tropical and subtropical countries. Early diagnosis is essential for timely clinical intervention and prevention of severe complications. The present study evaluated the diagnostic efficiency of NS1 Antigen ELISA for early dengue detection. NS1 antigen can be detected during the acute viremic phase before antibody development, making it a valuable biomarker for early diagnosis. The present study demonstrated excellent diagnostic performance of NS1 ELISA for early dengue detection with sensitivity of 91%, specificity of 96%, positive predictive value of 94%, negative predictive value of 89%, and overall diagnostic accuracy of 93%. The findings indicate that NS1 ELISA is a reliable and effective method for early dengue diagnosis and clinical management.

Keywords: Dengue Fever, NS1 Antigen, ELISA, Early Diagnosis, Dengue Virus

INTRODUCTION

Dengue fever is a rapidly emerging mosquito-borne viral disease caused by the dengue virus (DENV), a member of the genus *Flavivirus* within the family *Flaviviridae*. The infection is transmitted primarily by *Aedes aegypti* mosquitoes and has become a major public health problem in tropical and subtropical regions worldwide. The disease spectrum ranges from asymptomatic infection to severe manifestations including dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). Increasing urbanization, population growth, climate change, and inadequate vector control measures have contributed significantly to the global expansion of dengue infection.

Early diagnosis plays a crucial role in dengue management because there is no specific antiviral treatment available. Clinical symptoms during the early phase often resemble other febrile illnesses such as malaria, typhoid fever, and chikungunya, making laboratory confirmation essential. Conventional serological methods such as IgM and IgG ELISA are useful but have limited value during the first few days of illness because antibodies appear only after several days of infection. Consequently, NS1 antigen detection has emerged as an important diagnostic approach because NS1 is secreted during the early viremic phase and can be detected from the first day of fever.

The present study was undertaken to evaluate the diagnostic efficiency of NS1 Antigen ELISA in the early detection of dengue infection and to compare its performance with conventional diagnostic methods.

MATERIALS AND METHODS

The present study was conducted as a hospital-based observational investigation to evaluate the diagnostic performance of NS1 Antigen ELISA in early dengue detection. Patients presenting with acute febrile illness clinically suspected of dengue infection were included in the study. Blood samples were collected aseptically and serum was separated for laboratory investigations.

Detection of NS1 antigen was performed using a commercially available NS1 Antigen ELISA kit based on the sandwich ELISA principle. Microtiter wells pre-coated with monoclonal antibodies specific for dengue NS1 antigen were used. Patient serum samples were added and incubated, allowing antigen-antibody binding. Following washing steps, enzyme-conjugated antibodies were added and substrate reactions were performed. Optical density values were measured using an ELISA reader and interpreted according to manufacturer guidelines. Conventional diagnostic

methods including IgM ELISA and rapid diagnostic tests were also evaluated for comparison. Diagnostic parameters such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were calculated to assess test performance.

RESULTS AND DISCUSSION

3.1 Age-wise Distribution of Dengue Cases
Analysis of patient demographics revealed that dengue infection was more frequently observed among young adults. The highest number of cases occurred in the 21–30 years age group, indicating increased exposure to mosquito vectors among active and working populations.

Table 1. Age-wise Distribution of Dengue Cases

Age Group (Years)	Observation
21–30	Highest prevalence observed
Other Age Groups	Lower prevalence observed

The predominance of dengue infection among young adults is consistent with reports from several dengue-endemic regions.

3.2 Gender-wise Distribution
Gender-wise analysis demonstrated a higher prevalence of dengue infection among males.

Table 2. Gender-wise Distribution of Dengue Cases

Gender	Percentage (%)
Male	62
Female	38

The higher prevalence among males may be associated with greater occupational exposure and outdoor activities that increase contact with mosquito vectors.

3.3 Clinical Presentation of Dengue Cases

Clinical assessment revealed that fever was the most common presenting symptom, followed by headache and myalgia.

Table 3. Common Clinical Manifestations

Clinical Feature	Observation
Fever	Most common
Headache	Frequently observed
Myalgia	Frequently observed

These findings are consistent with the classical clinical presentation of dengue fever described by the World Health Organization.

3.4 NS1 Antigen Positivity During Different Stages of Illness

A major objective of the study was to evaluate NS1 antigen detection during the early phase of dengue infection.

Table 4. NS1 Antigen Positivity During Illness

Period of Illness	Observation
Days 1–3	Maximum positivity
After Day 4	Gradual decline in positivity

Maximum NS1 positivity was observed during the first three days of fever, confirming the utility of NS1 antigen detection during the acute viremic phase.

3.5 Comparison of NS1 ELISA with Conventional Diagnostic Methods

The diagnostic performance of NS1 ELISA was compared with IgM ELISA and rapid diagnostic tests.

Table 5. Comparison of Diagnostic Methods

Diagnostic Method	Sensitivity (%)	Specificity (%)
NS1 ELISA	91	96
IgM ELISA	72	88
Rapid Diagnostic Test	68	82

NS1 ELISA demonstrated significantly higher sensitivity and specificity than IgM ELISA and rapid diagnostic tests. The superior performance of NS1 ELISA can be attributed to its ability to detect circulating antigen before antibody production occurs.

3.6 Diagnostic Accuracy of NS1 ELISA

Table 6. Diagnostic Accuracy of NS1 ELISA

Parameter	Value (%)
Sensitivity	91
Specificity	96
Positive Predictive Value (PPV)	94
Negative Predictive Value (NPV)	89
Overall Accuracy	93

The high sensitivity and specificity observed in the present study indicate excellent diagnostic performance. The positive predictive value of 94% suggests a high probability that positive test results truly represent dengue infection, whereas the negative predictive value of 89% demonstrates reliable exclusion of disease among negative cases. The overall diagnostic accuracy of 93% confirms that NS1 ELISA is a highly effective diagnostic tool for routine clinical use.

The findings are consistent with previous studies reporting high diagnostic utility of NS1 antigen assays during the early febrile phase. The ability to diagnose dengue infection before antibody formation provides a major clinical advantage and facilitates timely patient management, supportive therapy, and monitoring for warning signs.

CONCLUSION

Dengue fever continues to be an important public health challenge in tropical and subtropical regions. Early diagnosis remains essential for reducing disease severity and preventing complications such as dengue hemorrhagic fever and dengue shock syndrome.

The present study demonstrated that NS1 Antigen ELISA is a highly sensitive, specific, and reliable method for early dengue diagnosis. Maximum positivity was observed during the first three days of illness, confirming the usefulness of NS1 antigen detection during the acute viremic phase. Compared with conventional diagnostic methods such as IgM ELISA and rapid diagnostic tests, NS1 ELISA showed superior diagnostic performance.

The observed sensitivity of 91%, specificity of 96%, positive predictive value of 94%, negative predictive value of 89%, and overall accuracy of 93% support the routine use of NS1 ELISA in clinical laboratories. Early detection through NS1 antigen testing can improve clinical decision-making, facilitate timely supportive therapy, and contribute to better patient outcomes. Although certain limitations exist, particularly in secondary dengue infections, NS1 ELISA remains one of the most effective tools currently available for early dengue diagnosis.

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