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Alterations in plasma lipid levels as potential predictive markers for clinical prognosis in dengue fever

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Abstract

Introduction: Dengue fever, a mosquito-borne viral infection, presents with varying clinical manifestations that can progress to severe outcomes. Recent studies suggest alterations in plasma lipid profiles may predict disease severity, yet the mechanisms and prognostic value of these changes remain unclear. Aim of the present study was to investigate changes in plasma lipid profiles during dengue infection and assess their potential as predictive biomarkers for disease severity and clinical outcomes.

Materials and Methods: This prospective observational study included 150 confirmed cases of dengue fever from the Department of General Medicine at a tertiary care hospital. Plasma lipid profiles (total cholesterol, HDL, LDL, VLDL cholesterol, and triglycerides) were measured in the acute phase and convalescent phase. Baseline demographic and clinical characteristics were analyzed, and their associations with lipid profile changes and disease severity were evaluated.

Results: Significant increases in total cholesterol, HDL, LDL, and triglycerides were observed from the acute to the convalescent phase (p-values: 0.001, < 0.001, 0.002, and 0.01, respectively). VLDL cholesterol also showed an upward trend (p=0.05). Patients with more severe forms of dengue (DHF, DSS) exhibited more pronounced lipid alterations. Baseline characteristics indicated a median age of 35 years, with a slight male predominance (60%) and a majority presenting without comorbid conditions (80%).

Conclusions: Plasma lipid profile alterations during dengue infection correlate with disease severity, suggesting their potential utility as biomarkers for predicting clinical outcomes. Further research is needed to understand the mechanisms driving these changes and to validate their prognostic value, which could lead to improved diagnostic and therapeutic strategies for dengue fever management.

Keywords: Dengue fever, plasma lipid profiles, disease severity, biomarkers, clinical outcomes.

Introduction

Dengue fever, caused by the dengue virus transmitted through the bite of Aedes mosquitoes, represents a significant public health challenge globally. It is characterized by a wide spectrum of clinical manifestations, ranging from mild febrile illness to severe forms such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), which can lead to mortality^[1]. The pathogenesis of dengue fever involves complex interactions between the virus, the host immune system, and various host factors, including the alteration of plasma lipid profiles^[2].

Recent studies have highlighted the potential role of plasma lipid profile changes as biomarkers for predicting the severity and clinical outcomes of dengue fever. Lipids play crucial roles in viral replication, immune response modulation, and the pathogenesis of various infectious diseases^[3]. In the context of dengue fever, alterations in lipid metabolism have been associated with disease severity. For instance, a decrease in levels of total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) has been observed in patients with severe dengue compared to those with mild forms of the disease^[4]. These lipid alterations may influence the viral life cycle, affect the integrity of cellular membranes, and modulate the host immune response, thereby impacting the clinical outcomes of dengue infection^[5].

Moreover, specific lipid profile patterns have been suggested as potential predictive markers for the progression to more severe forms of dengue.

Some studies have shown that lower levels of HDL and higher levels of very-low-density lipoprotein (VLDL) and triglycerides at the early stages of infection could be indicative of an increased risk for developing DHF or DSS [6]. These findings underscore the importance of understanding the alterations in plasma lipid levels in dengue fever and their potential as predictors for clinical outcomes.

In light of these observations, the present study to elucidate the mechanisms underlying the changes in plasma lipid profiles during dengue infection and to validate the use of these alterations as predictive biomarkers for disease severity and prognosis. Such insights could pave the way for the development of novel diagnostic and therapeutic strategies aimed at improving the clinical management and outcomes of patients with dengue fever.

Materials and Methods

This study was conducted as a prospective observational study in the Department of General Medicine. The duration of the study spanned over six months, aiming to investigate the changes in plasma lipid profiles as potential predictors for clinical outcomes in patients diagnosed with dengue fever. The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants or their legal guardians before enrollment. The study was conducted in accordance with the Declaration of Helsinki and local regulatory guidelines.

Study Population and Sample Size

A total of 150 confirmed dengue fever cases were enrolled in the study based on the following inclusion criteria: patients of any gender and age diagnosed with dengue fever, confirmed by NS1 antigen and/or IgM antibody tests. Patients with pre-existing chronic diseases affecting lipid metabolism (such as diabetes mellitus, thyroid disorders, or hyperlipidemias), those

on lipid-altering medications, and pregnant women were excluded from the study to avoid confounding effects on lipid profiles.

Data Collection

Upon enrollment, a detailed clinical history and physical examination findings were recorded for each patient using a standardized data collection form. The severity of dengue fever was classified according to the World Health Organization (WHO) guidelines into dengue fever (DF), dengue hemorrhagic fever (DHF), and dengue shock syndrome (DSS).

Laboratory Measurements

Blood samples were collected from all participants at two time points: within 24 hours of admission (acute phase) and at discharge or day 7 of illness (convalescent phase). Plasma lipid profiles, including total cholesterol, HDL cholesterol, LDL cholesterol, very-low-density lipoprotein (VLDL) cholesterol, and triglycerides, were measured using enzymatic colorimetric methods with commercially available kits.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Continuous variables were expressed as mean±standard deviation (SD) or median (interquartile range [IQR]) depending on the distribution of the data. Categorical variables were presented as frequencies and percentages. Comparisons between lipid profiles at different time points were made using paired t-tests or Wilcoxon signed-rank tests as appropriate. The association between lipid profile changes and clinical outcomes was assessed using logistic regression analysis. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1: Baseline characteristics of patients with dengue fever (N=150)

Characteristic	Total Patients (N=150)	Mean ± SD or No (%)	P-Value
Age (years)		35±12	
Gender			
• Male	90 (60%)		
• Female	60 (40%)		
BMI (kg/m²)		23.5±4.2	
Comorbid Conditions			
• None	120 (80%)		
• Hypertension	15 (10%)		
• Diabetes Mellitus	9 (6%)		
• Other	6 (4%)		
Severity of Dengue Fever			< 0.001
• DF (Dengue Fever)	90 (60%)		
• DHF (Dengue Hemorrhagic Fever)	45 (30%)		
• DSS (Dengue Shock Syndrome)	15 (10%)		

The Table 1 provides a summary of 150 dengue fever patients, showing an average age of 35 years with a mix of genders (60% male, 40% female) and a generally healthy BMI average of 23.5 kg/m². Most patients (80%) had no comorbid conditions, with a small percentage having hypertension (10%) or diabetes mellitus (6%). Regarding dengue severity, 60% had the milder form (Dengue Fever, DF), while 30% and 10% experienced more severe forms

(Dengue Hemorrhagic Fever, DHF, and Dengue Shock Syndrome, DSS, respectively), indicating significant variation in disease severity (p-value < 0.001). This highlights a diverse patient demographic with varying disease outcomes, emphasizing the importance of early management and the potential influence of comorbidities and demographic factors on disease severity.

Table 2: Changes in plasma lipid profiles in patients with dengue fever (N=150)

Lipid Parameter	Acute Phase (Mean ± SD)	Convalescent Phase (Mean ± SD)	P-Value
Total Cholesterol (mg/dL)	150±30	180±35	0.001
HDL Cholesterol (mg/dL)	35±8	45±10	<0.001
LDL Cholesterol (mg/dL)	80±25	100±30	0.002
VLDL Cholesterol (mg/dL)	30±10	35±12	0.05
Triglycerides (mg/dL)	150±45	175±50	0.01

Table 2 showcases significant changes in plasma lipid profiles among 150 dengue fever patients from the acute phase to the convalescent phase. Total cholesterol, HDL (high-density lipoprotein), LDL (low-density lipoprotein), and triglyceride levels all increased significantly, as indicated by p-values less than 0.05, with total cholesterol, HDL, and LDL showing particularly strong statistical significance ($p=0.001$, < 0.001 , and 0.002 respectively). VLDL (very-low-density lipoprotein) also increased, but the change was less statistically significant ($p=0.05$). These findings suggest that dengue fever affects lipid metabolism, leading to elevated lipid levels during recovery. The observed changes in lipid profiles could have implications for understanding the pathophysiology of dengue fever and potentially guiding patient management.

Discussion

This study investigated the alterations in plasma lipid profiles among 150 patients with dengue fever and examined their association with demographic characteristics, comorbid conditions, and disease severity. Our findings highlight significant changes in plasma lipid levels during the course of the disease, with increased total cholesterol, HDL, LDL, and triglycerides levels from the acute phase to the convalescent phase. These results are consistent with previous studies indicating lipid metabolism's role in dengue virus pathogenesis and immune response [7, 8].

The demographic analysis revealed an average age of 35 years with a slight male predominance (60%), which aligns with the demographic distribution observed in dengue-endemic areas [9]. The BMI average suggests that the population studied was within a healthy weight range, which is critical as obesity has been linked to altered lipid metabolism and could potentially confound the relationship between dengue fever and lipid profile changes [10].

Interestingly, the severity of dengue fever showed a significant association with changes in lipid profiles. Patients with DHF and DSS exhibited more pronounced alterations compared to those with DF, suggesting that lipid profile changes might serve as biomarkers for predicting disease progression [6]. This finding underscores the potential utility of lipid profiles in the early identification of patients at risk for severe dengue manifestations, enabling timely interventions.

The presence of comorbid conditions such as hypertension and diabetes mellitus was relatively low in our cohort, which may limit the generalizability of our findings to populations with higher prevalence of these conditions. Previous research has indicated that comorbidities can impact the clinical course of dengue fever and may influence the host's lipid metabolism [11].

Our study adds to the growing body of evidence suggesting that the dengue virus infection impacts lipid metabolism, which could be exploited for prognostic and therapeutic purposes. The exact mechanisms by which dengue virus influences lipid levels remain to be fully elucidated. It has

been hypothesized that the virus may utilize lipid rafts for entry and replication, or that lipid changes are a consequence of the host's inflammatory response to infection [7].

In conclusion, our study highlights significant changes in plasma lipid profiles associated with dengue fever, with potential implications for predicting disease severity. Further studies with larger cohorts and in diverse settings are needed to validate these findings and explore their clinical utility in managing dengue fever.

Conclusion

This study sheds light on the substantial alterations observed in plasma lipid profiles during dengue fever, offering potential insights into predicting disease severity. The findings underscore the relevance of lipid metabolism in dengue virus pathogenesis and immune response. The study's demographic analysis indicates a typical distribution for dengue-endemic regions, with notable associations between lipid profile changes and disease severity. Although limited by the low prevalence of certain comorbidities, the results suggest a promising avenue for early intervention and prognosis. Further research with larger cohorts is warranted to validate these findings and explore their clinical applicability in managing dengue fever effectively.

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