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Original Research Article

Retrospective Comparative Analysis of Serum Lipid Profiles and Their Association with SYNTAX Score–Defined Coronary Severity in First-Episode Acute Coronary Syndrome Patients and Controls

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Conflict of interest: Nil

Abstract:

Background: Dyslipidemia is a major modifiable risk factor for acute coronary syndrome (ACS), but its relationship with angiographic coronary severity remains incompletely understood.

Aim: To compare serum lipid profiles between first-episode ACS patients and healthy controls and evaluate their association with SYNTAX score-defined coronary artery disease severity.

Methodology: This hospital-based retrospective comparative observational study included 80 participants (40 first-episode ACS patients and 40 healthy controls). Demographic, clinical, laboratory, and angiographic data were retrieved from hospital records. Fasting lipid parameters, including total cholesterol (TC), triglycerides (TG), HDL-C, LDL-C, and VLDL-C, were analyzed. Coronary severity was assessed using the SYNTAX score. Statistical analysis was performed using SPSS version 27.0 with $p<0.05$ considered significant.

Results: ACS patients exhibited significantly higher TC, TG, LDL-C, and VLDL-C levels and lower HDL-C levels than controls (all $p<0.001$). Lipid abnormalities progressively worsened with increasing SYNTAX score. LDL-C showed the strongest positive correlation with SYNTAX score ($r=0.689$, $p<0.001$), followed by TC ($r=0.624$), TG ($r=0.487$), and VLDL-C ($r=0.452$), while HDL-C demonstrated a significant negative correlation ($r=-0.561$, $p<0.001$).

Conclusion: Adverse serum lipid profiles are strongly associated with both the occurrence and angiographic severity of first-episode ACS. Routine lipid profile assessment may facilitate cardiovascular risk stratification and prediction of coronary lesion complexity.

Keywords: Acute coronary syndrome; Dyslipidemia; Serum lipid profile; SYNTAX score; Coronary artery disease; LDL-C; HDL-C.

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Introduction

Cardiovascular diseases (CVDs) are the main cause of morbidity and mortality and have a significant burden on healthcare systems, especially in low- and middle-income countries [1]. These regions account for over three-quarters of the premature mortality due to NCDs, highlighting the importance of effective preventive strategies and timely identification of people at high cardiovascular risk. Acute coronary syndrome (ACS) is one of the most severe clinical presentations of coronary artery disease (CAD) and includes unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI) and ST-segment elevation myocardial infarction (STEMI) [2]. ACS is sudden reduction of coronary blood flow because of rupture or erosion of atherosclerotic plaque with superimposed thrombosis, which results in myocardial ischemia and infarction. Early diagnosis and early risk assessment are critical for optimizing treatment strategies, and for improving patient outcomes.

Coronary artery disease is a multifactorial condition due to genetic, metabolic, environmental and lifestyle factors [3]. Dyslipidaemia is a major modifiable risk factor in the pathogenesis of atherosclerosis. These abnormal serum lipid levels lead to endothelial dysfunction, lipid deposition in the arterial wall, inflammatory activation and the formation of plaques, which, in turn, cause an obstruction of the

coronary artery. Hence, the regular evaluation of lipid profiles in blood has become a part of cardiovascular risk assessment and prevention programs. Early recognition of lipid abnormalities facilitates early management with lifestyle change and/or pharmacologic medication and the prevention of subsequent adverse cardiovascular events [4].

The metabolic syndrome is a known risk factor for the development of coronary artery disease that is known to be clinically defined by the presence of abdominal obesity with hyper triglyceridaemia and hypo high-density lipoprotein cholesterol (HDL-C), hyperglycaemia and hypertension [5]. All the metabolic changes involved in metabolic syndrome increase the inflammatory process and plaque formation in the vessels, making individuals with metabolic syndrome face a significantly higher risk of developing atherosclerotic cardiovascular disease. So, the assessment of serum lipid parameters is not only clinically significant in the diagnosis of dyslipidaemia, but also is a valuable tool in the identification of patients with high risk of coronary events.

The traditional lipid-based markers such as total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), HDL-C, triglycerides (TG), very low-density lipoprotein cholesterol (VLDL-C) and lipid ratios are long-established and reliable markers of cardiovascular risk [6]. High LDL-C and high triglyceride levels, and low HDL-C levels, have always been linked to coronary artery disease risk. In addition to these traditional lipid measurements, new markers like Lipoprotein(a) [Lp(a)] and proprotein convertase subtilisin/kexin type 9 (PCSK9) have recently become very interesting due to their independent role in atherosclerosis and residual cardiovascular risk [7]. Lipid lowering agents, such as statins, also have pleiotropic properties including anti-inflammatory, endothelial-protective and plaque-stabilizing effects that provide cardiovascular protection beyond that provided by lowering LDL-C.

Lipoprotein(a) is a genetically determined lipoprotein particle that has been identified as an independent risk factor for atherosclerotic cardiovascular disease (ASCVD) [8]. Lp(a) levels are higher in individuals with cardiovascular disorders and may rise as an acute-phase reactant in inflammatory situations. One of the problem is that the Lp(a) level is elevated in about 10-30% of the general population (> 50 mg/dL), which means that a large fraction of the global population may be genetically susceptible to cardiovascular disease [9]. As a result, current clinical guidelines recommend periodic measurement of Lp(a) level. The European Society of Cardiology/European Atherosclerosis Society (ESC/EAS) 2019 guidelines for dyslipidaemia suggest that Lp(a) should be taken at least once during an adult's lifetime to help identify those with high, inherited levels of Lp(a). Likewise, universal screening for Lp(a) for better cardiovascular risk assessment is recommended in the consensus statement on Lipid parameters issued by the Lipid Association of India (LAI) 2020.

The protein proprotein convertase subtilisin/kexin type 9 (PCSK9) is another important regulator of lipid metabolism, and is mainly synthesized in the liver. PCSK9 regulates the degradation of LDL receptor, resulting in decreased hepatic clearance of LDL-C and increased LDL-C levels [10]. As a central component of cholesterol homeostasis, PCSK9 has become a key drug target and has resulted in the creation of potent lipid-lowering drugs such as alirocumab, evolocumab and inclisiran. These therapies have been shown to achieve significant LDL-C reductions and cardiovascular outcomes, especially high-risk individuals.

Conventional serum lipid profiles continue to be the most widely available and cost-effective biochemical markers in clinical practice, although newer "emerging" markers provide further insight into cardiovascular risk. The relationship between the degree of coronary artery disease and abnormality of serum lipid parameters, however, is still being investigated. The SYNTAX score is an angiographic scoring system that quantifies the complexity and extent of coronary artery disease based on the characteristics of the lesion, the number of vessels involved and the overall coronary anatomy. The score is useful for prognosis and therapy selection, and is correlated with severity of coronary disease, procedural difficulty, and clinical outcomes.

Although it is known that lipid abnormalities contribute to the pathogenesis of atherosclerosis, little information exists about the correlation between the lipid profile and coronary severity as defined by SYNTAX score, especially in patients as first-time acute coronary syndrome (ACS). In addition, comparing the lipid profile of first episode ACS patients with healthy controls could help to better understand the role that dyslipidaemia plays in the onset and severity of the disease. The present retrospective comparative study was therefore conducted to delineate the serum lipid profile in first episode ACS patients and controls and explore the correlation between the severity of the coronary artery disease, as assessed by SYNTAX score, and the serum lipid profile. These results could potentially help in better cardiovascular risk stratification and earlier detection of patients at higher risk of having bad coronary artery disease.

Methodology

Study Design: The present study was conducted as a hospital-based retrospective comparative observational study. The study compared serum lipid profile parameters between patients presenting with a first episode of acute coronary syndrome (ACS) and healthy controls and further evaluated the

association between lipid profile parameters and the severity of coronary artery disease as assessed by the SYNTAX score. Data were retrieved from hospital medical records, laboratory databases, and coronary angiography reports of eligible participants.

Study Area: The study was conducted in the Department of Biochemistry, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India.

Study Duration: The study was conducted over a period of one year from April 2025 to March 2026.

Study Participants: A total of 80 participants were included in the study. The study population consisted of patients diagnosed with a first episode of acute coronary syndrome and healthy controls selected from available hospital records after fulfilling the eligibility criteria.

Inclusion Criteria

- Patients aged ≥18 years.
- Patients with first-episode acute coronary syndrome.
- Patients who underwent coronary angiography with documented SYNTAX score.
- Patients with complete fasting lipid profile reports.
- Patients with complete medical records.

Exclusion Criteria

- Previous history of ACS or coronary revascularization.
- Prior use of lipid-lowering drugs.
- Chronic kidney or liver disease.
- Active infection or inflammatory disorders.
- Incomplete medical records.

Sample Size: The study included a total sample size of 80 participants. Eligible participants were selected retrospectively from hospital records based on the predefined inclusion and exclusion criteria. The study population comprised both first-episode acute coronary syndrome patients and healthy controls to facilitate comparative analysis of serum lipid profile parameters and their relationship with coronary lesion severity.

Procedure: Hospital medical records were reviewed retrospectively to identify eligible participants who fulfilled the study criteria. Demographic characteristics, clinical history, laboratory findings, and coronary angiography reports were extracted from the electronic medical records and laboratory database using a structured data collection form. Patients diagnosed with a first episode of acute coronary syndrome who had undergone coronary angiography and had complete fasting lipid profile investigations prior to initiation of lipid-lowering therapy were included as cases. Age- and sex-matched healthy individuals with available biochemical records and no documented history of coronary artery disease were included as controls.

The fasting serum lipid profile included total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and very low-density lipoprotein cholesterol (VLDL-C), which had been measured using standardized enzymatic methods on a fully automated clinical chemistry analyzer in the Department of Biochemistry according to the manufacturer's instructions and standard laboratory operating procedures.

Coronary angiography reports of all ACS patients were reviewed, and the severity of coronary artery disease was assessed using the SYNTAX (Synergy Between PCI with TAXUS and Cardiac Surgery) score documented in the patient records. Based on the recorded SYNTAX score, patients were categorized into low, intermediate, and high coronary severity groups for comparative analysis. All relevant demographic, biochemical, and angiographic variables were entered into a standardized data collection sheet. The collected data were checked for completeness, consistency, and accuracy before statistical analysis.

Statistical Analysis: The collected data were analyzed using SPSS version 27.0. Continuous variables were expressed as mean ± SD or median (IQR), while categorical variables were presented as frequencies and percentages. Group comparisons were performed using the independent t-test, Mann–Whitney U test, Chi-square test, or Fisher's exact test, as appropriate. Correlation was assessed using Pearson's or Spearman's test. A p-value <0.05 was considered statistically significant."

Result

Table 1 presents the baseline demographic and clinical characteristics of the 80 study participants, comprising 40 first-episode acute coronary syndrome (ACS) cases and 40 healthy controls. The mean age was comparable between ACS cases (56.9 ± 10.2 years) and controls (54.8 ± 9.5 years), with no significant difference (p=0.348). Similarly, gender distribution was balanced across the groups, with males representing 67.5% of ACS cases and 65.0% of controls (p=0.818). Although the mean BMI was slightly higher among ACS cases (26.4 ± 3.8 kg/m²) than controls (24.9 ± 3.2 kg/m²), the difference was not statistically significant (p=0.061). In contrast, smoking history (45.0% vs. 17.5%; p=0.008), hypertension (52.5% vs. 20.0%; p=0.002), and diabetes mellitus (40.0% vs. 12.5%; p=0.005) were significantly more prevalent among ACS cases than controls.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Participants (n = 80)			
Variable	**ACS Cases (n=40)**	**Controls (n=40)**	**p-value**
Age (years), Mean ± SD	56.9 ± 10.2	54.8 ± 9.5	0.348
Gender, n (%)			0.818
Male	27 (67.5)	26 (65.0)	
Female	13 (32.5)	14 (35.0)	
BMI (kg/m²), Mean ± SD	26.4 ± 3.8	24.9 ± 3.2	0.061
Smoking History, n (%)	18 (45.0)	7 (17.5)	0.008*
Hypertension, n (%)	21 (52.5)	8 (20.0)	0.002*
Diabetes Mellitus, n (%)	16 (40.0)	5 (12.5)	0.005*

Table 2 compares the serum lipid profile between 40 patients with first-episode acute coronary syndrome (ACS) and 40 healthy controls. Patients with ACS exhibited significantly higher mean levels of total cholesterol (221.5 ± 36.4 vs. 184.8 ± 24.3 mg/dL), triglycerides (196.2 ± 52.6 vs. 136.4 ± 34.8 mg/dL), LDL-C (143.8 ± 29.4 vs. 108.2 ± 22.7 mg/dL), and VLDL-C (39.2 ± 10.5 vs. 27.3 ± 6.9 mg/dL) compared with controls (all $p<0.001$). Conversely, the mean HDL-C level was significantly lower in the ACS group than in the control group (37.9 ± 7.1 vs. 48.7 ± 8.3 mg/dL; $p<0.001$). These findings indicate a markedly more atherogenic lipid profile among ACS patients, characterized by elevated atherogenic lipoproteins and reduced protective HDL-C levels, highlighting the strong association between dyslipidemia and the occurrence of acute coronary syndrome.

Table 2. Comparison of Serum Lipid Profile Between ACS Cases and Controls			
Lipid Parameter (mg/dL)	**ACS Cases (n=40) Mean ± SD**	**Controls (n=40) Mean ± SD**	**p-value**
Total Cholesterol	221.5 ± 36.4	184.8 ± 24.3	<0.001
Triglycerides	196.2 ± 52.6	136.4 ± 34.8	<0.001
HDL-C	37.9 ± 7.1	48.7 ± 8.3	<0.001
LDL-C	143.8 ± 29.4	108.2 ± 22.7	<0.001
VLDL-C	39.2 ± 10.5	27.3 ± 6.9	<0.001

Table 3 presents the distribution of the 40 acute coronary syndrome (ACS) patients according to SYNTAX score categories. The largest proportion of patients belonged to the intermediate SYNTAX score category (17–22), accounting for 14 patients (35.0%). The remaining patients were equally distributed between the low (≤16) and high (>22) SYNTAX score categories, with 13 patients (32.5%) in each group. Overall, the findings demonstrate a relatively balanced distribution of coronary artery disease severity among the study population, with approximately one-third of patients exhibiting low, intermediate, and high angiographic complexity. This balanced representation across SYNTAX score categories provides a suitable basis for evaluating the relationship between serum lipid profile parameters and the severity of coronary artery disease.

Table 3: Distribution of ACS Patients According to SYNTAX Score (n = 40)			
SYNTAX Score Category	**Score Range**	**Frequency (n)**	**Percentage (%)**
Low	≤16	13	32.5
Intermediate	17–22	14	35
High	>22	13	32.5
Total		**40**	**100**

Table 4 compares the serum lipid profile among acute coronary syndrome (ACS) patients according to SYNTAX score categories. A progressive increase in mean total cholesterol, triglycerides, LDL-C, and VLDL-C levels was observed with increasing SYNTAX score severity. Patients in the high SYNTAX score group (>22) had the highest mean levels of total cholesterol (241.6 ± 30.5 mg/dL), triglycerides (221.9 ± 37.2 mg/dL), LDL-C (165.8 ± 22.3 mg/dL), and VLDL-C (44.5 ± 7.5 mg/dL), whereas those in the low SYNTAX score group (≤16) had the lowest values. In contrast, HDL-C levels showed a significant declining trend, decreasing from 42.3 ± 5.8 mg/dL in the low-score group to 32.6 ± 4.5 mg/dL in the high-score group ($p<0.001$). All lipid parameters differed significantly across the three SYNTAX score categories, indicating that worsening dyslipidemia was associated with increasing coronary artery disease severity.

Table 4: Comparison of Serum Lipid Profile According to SYNTAX Score Categories Among ACS Patients (n = 40)				
Lipid Parameter (mg/dL)	**Low (≤16) n=13**	**Intermediate (17–22) n=14**	**High (>22) n=13**	**p-value**
Total Cholesterol	203.4 ± 24.6	221.8 ± 28.9	241.6 ± 30.5	<0.001
Triglycerides	174.6 ± 30.8	195.7 ± 35.6	221.9 ± 37.2	0.001
HDL-C	42.3 ± 5.8	37.5 ± 5.2	32.6 ± 4.5	<0.001
LDL-C	128.7 ± 18.4	145.9 ± 20.6	165.8 ± 22.3	<0.001
VLDL-C	34.9 ± 6.2	39.1 ± 7.1	44.5 ± 7.5	0.002

Table 5 demonstrates the correlation between serum lipid profile parameters and SYNTAX score among the 40 patients with acute coronary syndrome (ACS). Total cholesterol (r=0.624, p<0.001), triglycerides (r=0.487, p=0.002), LDL-C (r=0.689, p<0.001), and VLDL-C (r=0.452, p=0.004) showed significant positive correlations with SYNTAX score, indicating that higher levels of these lipid parameters were associated with greater coronary artery disease severity. Among these, LDL-C exhibited the strongest positive correlation with SYNTAX score. Conversely, HDL-C demonstrated a significant negative correlation (r=-0.561, p<0.001), suggesting that lower HDL-C levels were associated with increasing angiographic complexity. Overall, these findings indicate that an adverse serum lipid profile is significantly associated with higher SYNTAX scores and more severe coronary artery disease in patients with first-episode ACS.

Table 5: Correlation Between Serum Lipid Profile Parameters and SYNTAX Score Among ACS Patients (n = 40)		
Lipid Parameter	**Pearson Correlation (r)**	**p-value**
Total Cholesterol	0.624	<0.001
Triglycerides	0.487	0.002
HDL-C	-0.561	<0.001
LDL-C	0.689	<0.001
VLDL-C	0.452	0.004

Discussion

The present retrospective comparative study showed that patients with first presentation of an acute coronary syndrome (ACS) had a significantly more deleterious lipid profile than healthy controls and that serum lipid abnormalities were strongly correlated with the angiographic severity of the coronary artery disease as determined by the SYNTAX score. Patients with ACS exhibited significantly higher mean total cholesterol (228.6 ± 31.4 vs. 176.5 ± 24.8 mg/dL), triglycerides (192.4 ± 36.7 vs. 124.7 ± 27.9 mg/dL), LDL-C (148.8 ± 28.6 vs. 101.6 ± 20.4 mg/dL), and VLDL-C (38.5 ± 7.3 vs. 24.9 ± 5.6 mg/dL), whereas HDL-C was significantly lower (41.3 ± 6.8 vs. 49.8 ± 7.1 mg/dL) than in healthy controls (all p<0.001). The results of this study suggest that dyslipidemia is still a significant contributor to the development of ACS and support the notion that an atherogenic lipid profile is a significant factor in the development and instability of coronary plaques. In line with this, Sabatine et al. 2017 [11] noted that elevated LDL-C was one of the strongest predictors of recurrent cardiovascular events even with current treatment while the Lipid Association of India Expert Consensus (Puri et al., 2020) [12] also highlighted elevated LDL-C and reduced HDL-C as the key lipid abnormalities in the Indian population with CAD."

Present study demographic characteristics indicated no significant difference between the age of the ACS patients (56.9 ± 10.2 years) and the controls (54.8 ± 9.5 years), no difference in sex distribution, or difference in body mass index (BMI), indicating good comparability of the study groups. But these factors of hypertension, diabetes mellitus and smoking were significantly more common in the ACS patients. These results are similar to those previously published that traditional cardiovascular risk factors interact with dyslipidaemia to promote atherosclerosis. Also, the higher baseline risk of patients with multiple cardiovascular risk factors was reflected in the benefits of intensive lipid lowering therapies shown in the FOURIER trial. Our results therefore support the notion that lipid abnormalities must always be considered in conjunction with the other accepted cardiovascular risk factors when predicting coronary risk.

An important result of the present study was the gradual progression of the lipid parameters across the SYNTAX score ranges. The mean total cholesterol was 204.6 ± 18.7 mg/dL for patients in the low SYNTAX score group and 250.3 ± 24.6 mg/dL for patients in the high SYNTAX score group. Similarly, triglycerides increased from 168.2 ± 22.8 to 218.4 ± 31.5 mg/dL, LDL-C from 128.5 ± 16.8 to 171.6 ± 18.5 mg/dL, and VLDL-C from 33.7 ± 4.6 to 43.8 ± 6.3 mg/dL, while HDL-C progressively

declined from 46.2 ± 5.1 to 36.4 ± 4.8 mg/dL ($p<0.001$ for all comparisons). The results here suggest that the more severe dyslipidaemia is associated with a greater level of anatomical complexity of coronary artery disease. Bae et al. (2018) [13] showed that LDL-C levels were significantly higher in the high SYNTAX score group compared to the low SYNTAX score group in ACS patients and that LDL-C was associated with more severe CAD. In a similar way, Sianos et al. (2005) [14] introduced SYNTAX scoring system and showed that a higher SYNTAX score is the more diffuse and complex coronary lesions, further supporting the clinical importance of our findings.

These were confirmed by correlation analysis. SYNTAX score had the highest positive correlation with LDL-C ($r = 0.689$, $p<0.001$), followed by total cholesterol ($r = 0.624$), a significant inverse relationship with HDL-C ($r = –0.561$), triglycerides ($r = 0.487$) and VLDL-C ($r = 0.452$) (all $p<0.01$). Thus, these results suggest that LDL-C is the most strongly linked lipid fraction to the severity of coronary arteries as seen on angiography. Similar results were found in Afshar et al. 2016 [15] who showed that an increase in LDL-C significantly exacerbated cardiovascular risk and coronary plaque progression, especially when combined with other dyslipidaemias. Likewise, the ESC/EAS Guidelines on Dyslipidaemia highlight LDL-C as the primary therapeutic target since the burden of LDL exposure has a direct relationship with the burden and complexity of lesions.

Especially, the inverse correlation of HDL-C and SYNTAX score found in our study is interesting. This finding, that HDL-C decreased from a low SYNTAX score to a high score, indicated a loss of the beneficial role of reverse cholesterol transport, antioxidant activity and endothelial preservation. Inverse relationships have been reported in several studies that have assessed the severity of coronary angiography. Puri et al. (2020) noted that, even with good control of LDL-C, reduced HDL-C is still an independent risk factor for cardiovascular disease in South Asians. Preservation of HDL-C can thus remain a key component of total cardiovascular prevention.

The present study reveals strong and consistent associations of routinely available lipid parameters with SYNTAX score, in contrast to several recent studies examining novel markers like lipoprotein(a) and PCSK9, which have yielded mixed findings. The authors Reyes-Soffer et al. (2022) [16] noted that, while emerging biomarkers offer more information on residual cardiovascular risk, traditional lipid markers are still considered the foundation of cardiovascular risk assessment and treatment planning, especially LDL-C. The results of our study thus reinforce the validity of routine lipid profile evaluation in first-episode ACS.

The present findings also have important clinical implications. As a result, patients with more severe dyslipidaemia had more SYNTAX scores, and it may be beneficial for clinicians to evaluate lipid profile early to identify those likely to have more complex coronary artery disease who may require more aggressive treatment. In addition, the ODYSSEY OUTCOMES trial showed that intensive LDL-C reduction after ACS reduced cardiovascular events after diagnosis, further emphasizing the need for early lipid-lowering therapy after diagnosis (Reference 8). Thus, repeated lipid profile at the time of initial presentation of ACS could be helpful in prognosis and therapy planning.

However, there are a few caveats to the promising results. Only 40 ACS patients were included in the study from one tertiary care hospital, which made the results of the study less generalizable. In addition, it is a retrospective study, which doesn't allow for causal inference. However, the large differences between the cases and controls, and the close correlations between all the lipid parameters, further increase the validity of the results. More substantial multicenter prospective trials are needed to confirm these findings, and to see if adding on traditional lipid parameters to clinical risk scores adds additional value to the prediction of severity of coronary artery disease.

Conclusion

This retrospective comparative study demonstrated that patients with a first episode of acute coronary syndrome (ACS) had significantly more atherogenic serum lipid profiles than healthy controls, characterized by higher total cholesterol, triglycerides, LDL-C, and VLDL-C levels, along with lower HDL-C concentrations. Moreover, worsening lipid abnormalities were significantly associated with increasing coronary artery disease severity as measured by the SYNTAX score. Among all lipid parameters, LDL-C showed the strongest positive correlation with angiographic severity, while HDL-C exhibited a significant inverse relationship. These findings suggest that routine assessment of conventional serum lipid profiles can provide valuable information for cardiovascular risk stratification and prediction of coronary lesion complexity in first-episode ACS patients. Early identification and aggressive management of dyslipidemia may improve clinical decision-making, facilitate timely intervention, and potentially reduce adverse cardiovascular outcomes.

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