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The role of high-sensitivity C-reactive protein in patients presenting with acute coronary syndrome at Erbil cardiac center

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Abstract

Background and objective: Acute coronary syndrome (ACS) is the predominant cardiovascular disease cause of death. One of the newer criteria for assessing acute coronary syndromes (ACS) is serum high-sensitive C-reactive protein (hs-CRP), which has demonstrated predictive value for coronary artery conditions independently of conventional cardiovascular risk factors. This study aimed to evaluate and assess the correlation between highly sensitive C-reactive protein (hs-CRP) and the severity of acute coronary syndrome subtypes.

Methods: This cross-sectional study was performed on 180 patients diagnosed with ACS at the Surgical Specialty Hospital-Cardiac Center in Erbil, Iraq. Subjects were classified into three groups according to the types of ACS: Group I (STEMI patients-83 individuals), Group II (NSTEMI patients-74 individuals), and Group III (UA patients-23 individuals). Parameters of high-sensitivity C-reactive protein (hs-CRP), cardiac biomarkers, and lipid profile were evaluated for all patients.

Results: The study population consisted of 74.4% males and 25.6% females, aged 30 to 90 years, with a mean age of 58.66±12.03 years. Among all patients, 66.1% had hyperlipidemia, 58.3% had hypertension, 40% had diabetes, and 67.2% were smokers. Patients with myocardial infarction (STEMI and NSTEMI) had significantly higher levels of hs CRP (P = 0.026), troponin T hs (P <0.001), and CK-MB (P = 0.044) compared to UA patients. There was also found a positive significant correlation between serum hs-CRP with total cholesterol, LDL-C, and troponin T hs among ACS patients with statistically significant (r=0.171, P = 0.022), (r=0.202, P = 0.007), and (r=0.229, P = 0.002), respectively.

Conclusions: The current study shows that serum hs-CRP could serve as a useful biomarker for assessing disease severity in ACS patients.

Keywords: Acute coronary syndrome; Atherothrombosis; High-sensitivity C-reactive protein.

Introduction

Acute Coronary Syndrome (ACS) continues to be a predominant cause of morbidity and mortality globally.[1] Atherosclerosis causes intravascular plaque rupture, vasospasm, and subsequent platelet adhesion, aggregation, and secondary thrombosis, which in turn causes acute coronary syndrome (ACS).[2,3] Acute coronary syndrome (ACS) includes myocardial infarction without ST-segment elevation (NSTEMI), myocardial infarction with ST-segment elevation (STEMI), which usually indicates a total blockage of the coronary arteries, and unstable angina (UA) with or without myocardial damage.[2,4] Vascular inflammation has a significant role in the development of atherosclerosis.[5,6] The development of atherosclerotic plaque

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begins with endothelial dysfunction and continues through all stages, from the production of lipid streaks to the rupture and instability of the plaque to the detrimental clinical cardiomyocyte dysfunction and necrosis in ACS.[7]

Numerous biomarkers have been investigated to identify and evaluate an individual's risk of acute coronary syndrome (ACS).[8] The most notable of them for the inflammatory process of atherosclerosis is (Hs-CRP).[9]

C-reactive protein (CRP) belongs to the pentraxin protein family and is an acute phase reactant. Hepatocytes produce this acute phase protein in response to interleukin (IL)-6, which is further enhanced by tumor necrosis factor-α and IL-1.[8,10] It is frequently employed as a general inflammatory marker through a variety of mechanisms, including increased complement system activation, platelet and cell adhesion molecule expression, suppression of fibrinolysis, promotion of smooth muscle cell proliferation, downregulation of endothelial nitric oxide, altered macrophage uptake of LDL, and fatty streak formation. Hs-CRP also plays a crucial role in thrombogenicity and vascular vulnerability.[9]

Higher levels of hs-CRP were linked to poorer outcomes in the initial observational studies of both general and acute coronary syndrome (ACS) populations. This finding may have resulted from an inflammatory mechanism linked to atherosclerosis that has not yet been recognized.[11]

Due to a lack of data on the relationship between hs-CRP and ACS in our region, we sought to evaluate the association between serum hs-CRP and various factors in different types of ACS patients, as well as to explore the potential of this parameter as a biomarker for assessing severity among the subtypes.

Methods

Study design:

The cross-sectional study was designed to investigate high-sensitivity C-reactive protein (hs-CRP) and additional biochemical marker, such as cardiac biomarkers and lipid profiles in ACS patients.

Study population:

A study was conducted at the Surgical Specialty Hospital-Cardiac Center in Erbil, Iraq, from 25th of October 2024 to the 11th of December 2025. A total of 180 adult patients (aged 30–90 years, both genders) with confirmed ACS were enrolled. Three groups of patients with a verified diagnosis of ACS were established based on serum troponin levels, electrocardiogram (ECG) abnormalities, and clinical symptoms:

ST-elevation ACS (STE-ACS)(Group I): Patients exhibiting sustained ST-segment elevation or newly manifested left bundle branch block on an ECG, accompanied by characteristic severe chest pain persisting for over 20 minutes with elevated troponin level.

Non-ST elevation ACS (NSTE-ACS) (Group II): Patients with chest discomfort without sustained ST segment elevation or left bundle branch block on the ECG. Depending on further troponin readings (whether increased or normal), NSTE-ACS are further classified as either non-ST elevation myocardial infarction (NSTEMI) or unstable angina (UA):

NSTEMI: Elevated troponin levels with ECG changes such as ST depression or T-wave inversion.

Unstable Angina (UA): Normal troponin levels with or without nonspecific ECG changes.

Sample collection:

A total of 180 blood samples were collected from 83 STEMI patients, 74 NSTEMI patients, and 23 UA patients. For each patient, three milliliters of venous blood were collected into a sterile gel tube. The samples were allowed to clot at room temperature for 15 minutes, then centrifuged at 5000 rpm for 10 minutes. After centrifugation, the separated serum was divided into two Eppendorf tubes to prevent multiple freezing. The serum was stored at -20°C and analyzed within two

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months of collection. It was used for the assessment of biochemical parameters (lipid profile and cardiac biomarkers) and the immunological biomarker (hs-CRP).

Instruments and principles for diagnosis and determining laboratory parameters:

Electrocardiography (ECG) was recorded on the first encounter beside the laboratory assessment. Using the fully automated biochemistry analyzer Cobas c 111 (Roche Diagnostics, Germany) for lipid profile assessments. A colorimetric enzymatic method was employed to assess the lipid profiles of all patients. Using the fully automated biochemistry analyzer Cobas e 411 (Roche Diagnostics, Germany), the electrochemiluminescence binding assay is used to quantify troponin T hs and CK-MB. Hs-CRP levels were measured using SUNLONGBIOTECH ELISA kits (China) following the manufacturer's instructions. All analyses were performed in a controlled laboratory environment according to standard protocols.

Inclusion and exclusion criteria:

Inclusion criteria:

Patients aged 30–90 years of both genders
Clinical and diagnostic confirmation of ACS (STE-ACS, NSTEMI, or UA)

Exclusion criteria:

· Patients with chronic inflammatory or infectious diseases
· Known malignancies
· Severe renal impairment (eGFR <30 mL/min/1.73 m²)

Statistical analysis:

SPSS version 25 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. To determine if a random sample has a normal distribution, the Shapiro-Wilk test was used. The findings were displayed as counts and percentages for categorical data and as the mean± standard error of the mean for continuously normally distributed variables. To identify significant differences across ACS types and risk factors, researchers used the Chi-square test for categorical data and one-way ANOVA for numerical data. Pearson's correlation coefficient was used to evaluate the relationship between hsCRP and other measures based on the normality finding. If a *P*-value was 0.05 or below, it was deemed statistically significant.

Design of the questionnaire form:

A structured, interviewer-administered, in-person questionnaire, which was pretested and revised before the study, was utilized to collect the data. Moreover, possessing access to personally identifiable medical records or other documents containing sensitive personal information that are not readily available to the general public. The questionnaire inquiries about the patient's clinical risk factors, family history, smoking habits, BMI, and demographics, including name, age, gender, home address, time, and date.

8. Considerations for ethics:

The study protocol was approved by the Ethics Committee of Hawler Medical University. Written informed consent was obtained from all participants. Confidentiality of personal and medical data was strictly maintained, and data were used solely for research purposes

Results

A total of 180 individuals were diagnosed with acute coronary syndrome, comprising 46.1% STEMI, 41.1% NSTEMI, and 12.8% UA. As shown in Figure 1.

The mean age was 58.66±12.03, with a range from 30 to 90 years. As is shown in Table 1, most of the patients fell within the middle-age group; 30% were in the 50-59 age group, followed closely by the ≤49 age group (25%), the 60-69 age group (23.3%), and the ≥70 age group (21.7%). The study population comprised 74.4% males and 25.6% females. The majority of the patients were overweight, accounting for 43.9%, followed by obese individuals at 33.3% and normal-weight individuals at 22.8%. Regarding the lifestyles of participants, 60% had inactive lifestyles, while 40% had active lifestyles. Most of the patients identified as Kurds (81.1%), with 18.9% identifying as Arabs.

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Table 1 The baseline characteristics of the studied individuals

Characteristics	STEM (n=83) Frequency (%)	NSTEMI (n=74) Frequency (%)	UA (n=23) Frequency (%)	All subjects (180) Frequency (%)
Age (in years)				
≤49	20 (24.1)	15 (20.3)	10 (43.5)	45 (25)
50-59	31 (37.7)	18 (24.3)	5 (21.7)	54 (30)
60-69	17 (20.5)	20 (27)	5 (21.7)	42 (23.3)
≥70	15 (18.1)	21 (28.4)	3 (13)	39 (21.7)
Gender				
Male	64 (77.1)	54 (73)	16 (69.9)	134 (74.4)
Female	19 (22.9)	20 (27)	7 (30.4)	46 (25.6)
BMI				
Normal weight	25 (30.1)	11 (14.9)	5 (21.7)	41 (22.8)
Overweight	37 (44.6)	27 (36.5)	15 (65.2)	79 (43.9)
Obese	21 (25.3)	36 (48.6)	3 (13)	60 (33.3)
Ethnicity				
Kurd	66 (79.5)	60 (81.1)	20 (87)	146 (81.1)
Arab	17 (20.5)	14 (18.9)	3 (13)	34 (18.9)
Life style				
Active	38 (45.8)	27 (36.5)	7 (30.4)	72 (40)
Inactive	45 (54.2)	47 (63.5)	16 (69.6)	108 (60)

*Results are presented by frequency (percentage). BMI-body mass index

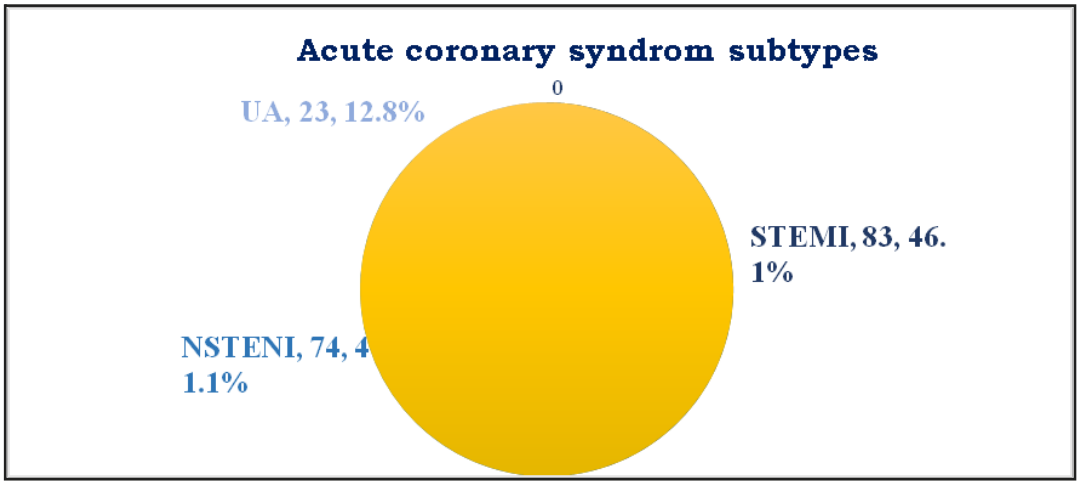

Figure 1 Distribution of subgroups of acute coronary syndromes among study population

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As is shown in Table 2, upon analyzing the risk factor relationship within the groups of patient individuals, the chi-square test analysis revealed a statistically significant difference among the three patient groups concerning various risk factors, including hyperlipidemia, hypertension, smoking, physical inactivity, and overweight, with *P*-values of 0.019, 0.011, 0.032, 0.044, and 0.002, respectively.

Moreover, upon examining the disparities in risk factors across STEMI, NSTEMI, and UA individuals, the STEMI patient group tends to have the most smokers (77.1%) compared to the NSTEMI group (59.5%) and UA patient group (56.5%). The incidence of hypertension among the NSTEMI group was 68.9%, while the STEMI and UA groups were 55.4% and 34.8%. Hyperlipidemia constituted a substantial risk factor for acute coronary syndrome across all patients, the STEMI group 75.9% higher than the NSTEMI group 60.8% and the UA group 47.8%. The prevalence of physical inactivity was markedly elevated across ACS-defined patient groups, specifically STEMI 66.3%, NSTEMI 43.4%, and UA 82.6%. The incidence of overweight among the UA group was 65.2%, while the STEMI and NSTEMI groups were 44.6% and 36.5%. The incidence of ACS was greater in male patients compared to females; however, the difference was not statistically significant across the groups. The prevalence of diabetes was highest among the UA group, while lower in STEMI and lowest in NSTEMI; however, this difference wasn't statistically significant.

Table 2 Comparing the risk factors of the study groups based on the presence of ACS

Risk factors	STEMI N (%)	NSTEMI N (%)	UA N (%)	*P*-value*
Hyperlipidemia	63 (75.9)	45 (60.8)	11 (47.8)	0.019
Hypertension	46 (55.4)	51 (68.9)	8 (34.8)	0.011
Diabetes mellitus	36 (43.4)	24 (32.4)	12 (52.2)	0.167
Smoking	64 (77.1)	36 (59.5)	13 (56.5)	0.032
Physical inactivity	55 (66.3)	61 (82.4)	19 (82.6)	0.044
BMI (Overweight)	37 (44.6)	27 (36.5)	15 (65.2)	0.002
Gender				
Male	64 (77.1)	54 (73)	16 (69.6)	0.711
Female	19 (22.9)	20 (27)	7 (30.4)	

*Data were analyzed using the Chi-square test, and findings are reported as frequency (%)

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Concerning the lab parameters of participants, there was a highly significant difference between the mean level of total cholesterol among the patient groups; predictably, the STEMI group had the highest cholesterol level (207.5±7.63), followed by the NSTEMI group (183.5±6.78) and the UA group (166.4±12.1), with *P* = 0.008. The UA and NSTEMI had a higher HDL level (38.33±1.46) and (38.45±1.46), respectively compared to the STEMI (37.22±0.98); this was not significant, (*P* = 0.617). The STEMI had the highest mean LDL levels (125.3±5.19), lower in NSTEMI (110.0±4.22) and lowest in UA (101.5±8.07), with a *P*-value of 0.017. The mean triglyceride level was elevated in STEMI (174.9±8.35) compared to NSTEMI (173.7±10.8) and UA (161.9±14.3); this was not significant, *P* = 0.795. The STEMI had the highest mean of VLDL levels (37.20±2.86), lower in the NSTEMI group (34.78±2.16), and lowest in UA (32.60±2.85); this was not significant, *P* = 0.600. The serum hs-CRP levels were found to be highest among the STEMI (4.380±0.17), lower in the NSTEMI group (3.828±0.15) and lowest in the UA group (3.783±0.14), and this possessed a *P*-value of 0.026 and was statistically relevant. Predictably, the mean of troponin T hs levels was found to be very high among the MI groups; the mean of STEMI was (higher 1.459±0.21) compared to (NSTEMI 0.359±0.08), while UA with normal levels (0.009±0.001) was strongly statistically significant (*P* <0.0001). Although the mean of CK-MB levels was found to be high among the patients, STEMI had the highest mean CK-MB levels (36.61±9.44), lower in NSTEMI (21.15±3.40), and lowest in UA (2.262±0.31), and this had a *P*-value of 0.044 and was statistically significant, as shown in Table 3 and Figure 2.

Table 3 A comparative analysis of the mean values of laboratory parameters among the types of acute coronary syndrome patients

Characteristics	STEM (Mean ± SE)	NSTEMI (Mean ± SE)	UA (Mean ± SE)	*P*-value
Total cholesterol (mg/dl)	207.5±7.63	183.5±6.78	166.4±12.1	0.008
HDL-cholesterol (mg/dl)	37.22±0.98	38.45±0.88	38.33±1.46	0.617
LDL-cholesterol (mg/dl)	125.3±5.19	110.0±4.22	101.5±8.07	0.017
Triglycerides (mg/dl)	174.9±8.35	173.7±10.8	161.9±14.3	0.795
VLDL-cholesterol (mg/dl)	37.20±2.86	34.78±2.16	32.60±2.85	0.600
Hs-CRP(ng/ml)	4.380±0.17	3.828±0.15	3.783±0.14	0.026
Hs-Troponin T (ng/ml)	1.459±0.21	0.359±0.08	0.009±0.001	<0.001
CK-MB (ng/ml)	36.61±9.44	21.15±3.40	2.262±0.31	0.044

*Data were analyzed via one-way ANOVA, and findings are provided as mean±SE.

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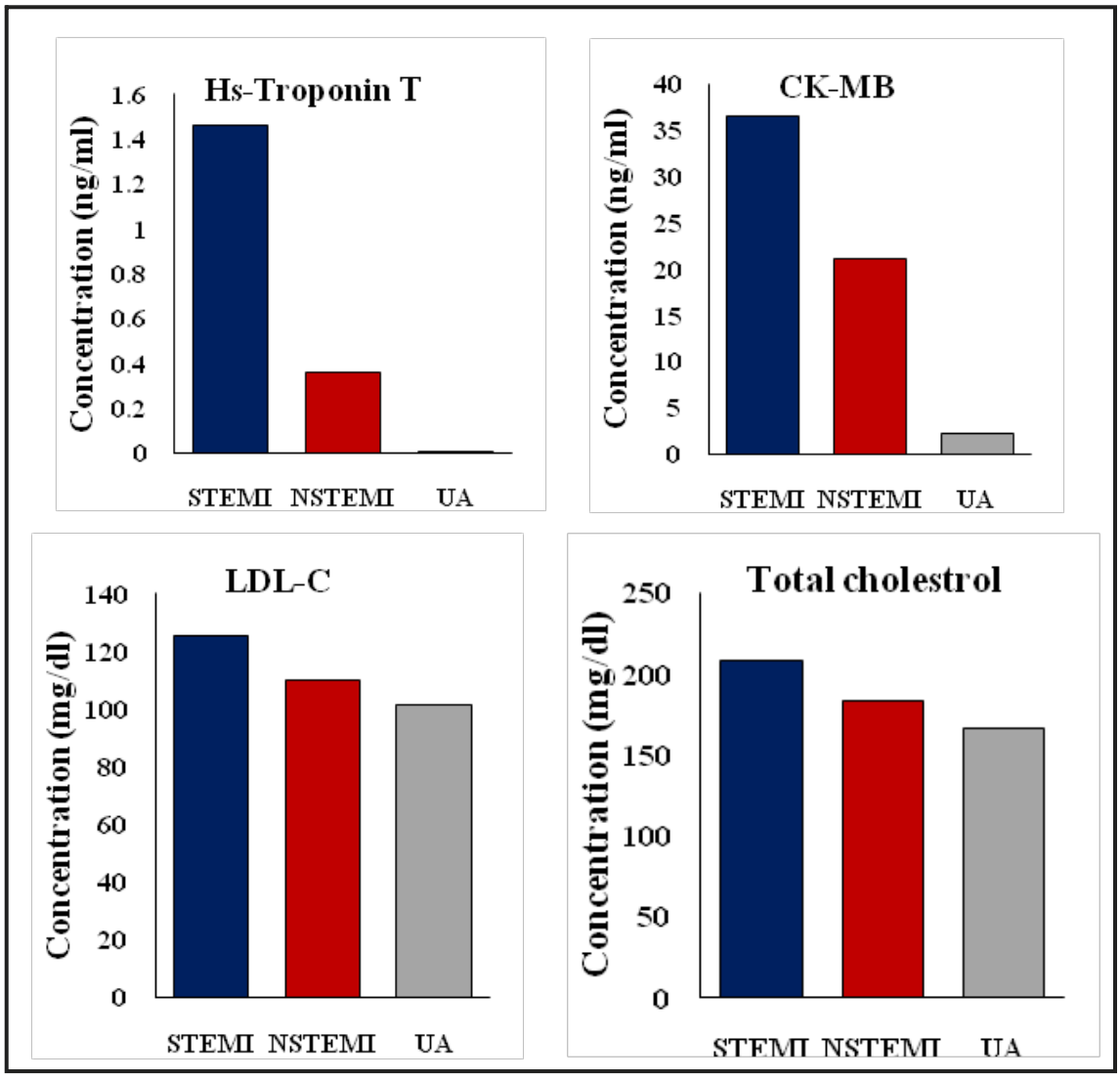

Figure 2 A comparative analysis of laboratory parameters among acute coronary syndrome subtypes

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Regarding the correlation of serum hs-CRP with other variables, a weak positive and statistically significant correlation was found between serum hs-CRP and total cholesterol, LDL-C, and troponin T (r=0.171, *P* = 0.022), (r=0.202, *P* = 0.007), and (r=0.229, *P* = 0.002). As shown in Table 4 and Figure 3.

Table 4 The correlation analysis of hs-CRP levels with risk factors and laboratory indicators of acute coronary syndrome

Parameters	**High-sensitivity C-reactive protein (hs-CRP)**	
	ACS patients (n=180)	
	R	***P*-value**
Total cholesterol	0.171	0.022
HDL-cholesterol	0.128	0.086
LDL-cholesterol	0.202	0.007
VLDL-cholesterol	0.037	0.622
Triglyceride	0.024	0.753
CK-MB	0.008	0.918
Hs-Troponin T	0.229	0.002
Weight (kg)	-0.090	0.222
Age (years)	0.083	0.294
BMI	-0.131	0.088

*Data are assessed using Pearson's correlation coefficient test.

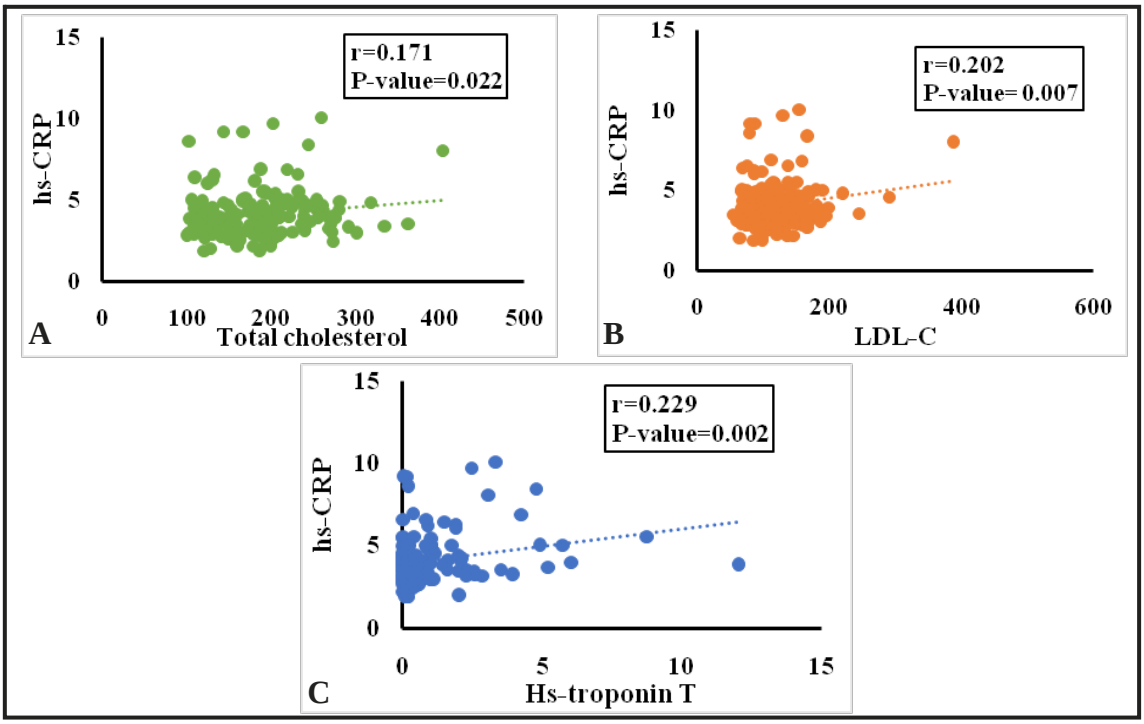

Figure 3 The correlation graphs of ACS patients. (A) The correlation between hs-CRP and total cholesterol, (B) The correlation between hs-CRP and LDL-C. (C) The correlation between hs-CRP and hs-troponin T among ACS patients

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Discussion

Acute coronary syndrome (ACS) remains a primary cause of morbidity and mortality worldwide, despite the implementation of several preventive and therapeutic strategies.[12] Globally, nearly four million individuals are hospitalized annually with ACS including, STEMI,NSTEMI, and UA.[13] Among the overall patient population, STEMI constituted 46.1% as the predominant presentation in ACS patients, followed by NSTEMI at 41.1% and UA at 12.8%. This distribution is consistent with findings from earlier studies, which reported STEMI as the most frequent ACS presentation, followed by NSTEMI and UA.[14-16]

The research found that approximately 74.4% of patients with ACS were male, and the male gender exhibited a significant association with three forms of ACS compared to the female gender. These findings correspond with various research indicating that the incidence of ACS is greater in males than in females.[15,17,18] Although over fifty percent of male patients exhibit STEMI, the same finding was reported by Li et al. and Hao et al.[16,19] In contrast, a higher proportion of female patients were diagnosed with UA, indicating a relatively increased risk for UA among women compared to NSTEMI and STEMI, as evidenced by numerous studies[13,20].

The study showed that most of the patients were aged between 50 and 59 years old, which is comparable to the study carried out by Ibrahim and his colleagues.[21] The biggest proportion of STEMI patients was observed in the 50–59 age group, whereas the greatest percentage of NSTEMI patients was found in the 60–69 age group, the same findings were observed by Ralapanawa and his colleagues.[22]

The study also reaffirmed the significance of conventional cardiovascular risk factors in ACS pathogenesis. We focused on six key risk factors: smoking, hypertension, hyperlipidemia, physical inactivity, diabetes mellitus, and a positive family history of cardiovascular disease.

The results of the study showed that 67.2% of patients were smokers, almost half of them (52.9%) significantly higher in STEMI than other subtypes, similar to results observed by numerous studies.[16,22,23]

In the current study, 58.3% of patients had hypertension, which was substantially more prevalent among NSTEMI patients compared to those with STEMI and UA. Similarly, Li et al.[16] and Ralapanawa et al.[22] demonstrated a substantial association between hypertension and NSTEMI. By comparing dyslipidemia presence with subtypes of ACS, out of 66.1% of patients with dyslipidemia, it showed significantly half of them in patients with STEMI. This outcome was compatible with earlier studies.[16,24]

The analysis of the patients' BMI data indicated that overweight individuals had a greater risk of ACS compared to obese individuals. Additionally, a local investigation that found being overweight was a risk factor for developing ACS confirmed our assertion.[25] Also similar to results observed by other studies.[21,26] Unexpectedly, normal-weight patients had the highest incidence of STEMI compared to other subtypes, and BMI was significantly different among groups; the same finding was reported by Altaher and his colleagues.[26] Furthermore, our investigation indicated that the STEMI, NSTEMI, and UA groups did not exhibit significant differences concerning diabetes mellitus and familial history of ACS. These findings are comparable to the results reported by numerous studies.[22,26,27]

Our analysis of lipid profiles revealed significantly higher LDL-C and total cholesterol levels in STEMI patients compared to those with NSTEMI, with a further and significant decrease in patients with UA when compared to STEMI and NSTEMI, consistent with the findings of Altaher et al. and Ahmed et al.[26,28] In contrast, HDL-C, triglycerides, and VLDL-C did not differ significantly among ACS subtypes in studies done by Zhan et al.[23]

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and Ahmed et al,[28] and these results align with the outcomes of this investigation.

One of the key contributions of this study is the evaluation of hs-CRP as an inflammatory biomarker in ACS. The study showed the highest mean hs-CRP concentrations were found in STEMI (4.380±0.17), lower levels in NSTEMI (3.828±0.15), and the lowest in UA (3.783±0.14).These results suggested elevated levels of hsCRP were associated with myocardial damage size and major adverse cardiac events, which appear to be raised more during ST-elevation than non-ST-elevation.[29] These findings are supported by Bouzidi et al[29] and Kotain et al,[30] who found that Hs-CRP levels were higher in the STEMI patients than in other subtypes and that they were associated with infarct size and myocardial necrosis.

Among cardiac biomarkers, the mean value of serum troponin T concerning ACS subtypes yielded the following findings. The highest mean troponin T concentrations were found in STEMI, followed by lower levels in NSTEMI and the lowest in UA, consistent with findings from Li et al. and Mihajlović et al.[16,31] The most significant elevation in cardio-specific enzymes occurred in STEMI, attributed to the extensive transmural myocardial damage often associated with this type of ACS, whereas NSTEMI is characterized by lesser subendocardial heart injury, while normal levels of cardiac enzymes in UA indicate non-cardiac damage.[31] CK-MB, as a non-specific biomarker, was also associated with previous enzyme. The greatest mean of CK levels was seen in STEMI, followed by lower levels in NSTEMI and the lowest in UA, which is similar to several other previous studies.[31,32]

The results of the present investigation demonstrate a correlation between serum hs-CRP levels and ACS subtypes. The findings demonstrate a significant positive correlation between hs-CRP and total cholesterol as well as LDL, consistent with the results reported by Rathore and colleagues.[33] Furthermore, the available data has shown a substantial positive correlation between serum hs-CRP and troponin T. It has been suggested that CRP levels before significant increases in cardiac troponin could prepare the body to react to any damaged or necrotic tissue. This result was also in agreement with Aseri and his colleagues, who also indicated that serum hs-CRP is positively correlated to the correlation between serum hs-CRP and troponin.[34]

Clinically, our findings suggest that measuring hs-CRP alongside cardiac enzymes and lipid profiles could enhance diagnostic precision, particularly in early presentations where ECG or troponin changes are equivocal. Furthermore, hs-CRP may serve as a useful biomarker to guide the intensity of anti-inflammatory therapies or statins. This is supported by findings from the CANTOS trial, which demonstrated treatment with canakinumab, with its anti-inflammatory properties, significantly reduced hs-CRP levels without lowering LDL-C and decreased the risk of recurrent cardiovascular events in patients with previous myocardial infarction and elevated hs-CRP.[35]

Conclusion

In conclusion, to our knowledge, the present study is the inaugural investigation assessing serum hs-CRP levels in patients with ACS in this region. This study revealed that hs-CRP is a sensitive inflammatory biomarker for evaluating the severity of ACS subtypes. According to the result of the current investigation, admission hs-CRP levels were significantly elevated across all ACS subtypes, with the highest mean levels observed in STEMI patients (4.380±0.17), followed by NSTEMI (3.828±0.15), and the lowest in UA (3.783±0.14). The serum levels of troponin T hs and CK-MB were significantly higher in STEMI compared to NSTEMI and within normal range in UA. Furthermore, the finding of this investigation demonstrated that the serum level of cholesterol and LDL

was significantly highest in STEMI, lower in NSTEMI, and lowest in patients with UA. Additionally, serum hs-CRP activity has shown a mild to moderate positive correlation with serum troponin T hs (r=0.229), total cholesterol (r=0.171), and LDL-C (r=0.202). Taken together, these changes might further contribute to a higher cardiovascular risk in ACS patients.

These findings underscore the utility of hs-CRP not only in stratifying ACS severity but also as a potential adjunct screening tool in emergency and cardiology settings. We recommend incorporating hs-CRP testing into ACS diagnostic and risk assessment protocols to improve early identification and targeted management of high-risk patients.

Competing interests

The authors declare that they have no competing interests.

References

1. Iannuzzo G, Gentile M, Bresciani A, Mallardo V, Di Lorenzo A, Merone P, et al. Inhibitors of protein convertase subtilisin/kexin 9 (PCSK9) and acute coronary syndrome (ACS): the state-of-the-art. J Clin Med. 2021; 10(7):1510. https://doi.org/10.3390/jcm10071510
2. Aslam K, Khan E, Malik Z, Ali A, Fatima F, Khan QH, et al. Frequency Of CRP Levels In Patients Presenting With Acute Coronary Syndrome: CRP Levels in Patients with Acute Coronary Syndrome. PJHS. 2023:78-82. https://doi.org/10.54393/pjhs.v4i03.582
3. Byrne RA, Rossello X, Coughlan J, Barbato E, Berry C, Chieffo A, et al. 2023 ESC guidelines for the management of acute coronary syndromes: developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC). Eur Heart J: Acute Cardiovascular Care. 2024; 13(1):55-161. https://doi.org/10.1093/ehjacc/zuad107
4. Yuan D, Chu J, Qian J, Lin H, Zhu G, Chen F, et al. New concepts on the pathophysiology of acute coronary syndrome. Rev Cardiovasc Med. 2023; 24(4):112. https://doi.org/10.31083/j.rcm2404112
5. Peikert A, Kaier K, Merz J, Manhart L, Schäfer I, Hilgendorf I, et al. Residual inflammatory risk in coronary heart disease: incidence of elevated high-sensitive CRP in a real-world cohort. Clin Res Cardiol. 2020; 109:315-23. https://doi.org/10.1007/s00392-019-01511-0
6. AlTameemi W, Alkhazraji NA. Assessment of C-reactive protein/serum albumin ratio in relation to acute presentation and early outcome of patients with Acute Coronary syndrome. 2022. https://doi.org/10.21203/rs.3.rs-2242908/v1
7. Rezk A, Sarhan M, Elmoghl A. Highly-sensitive C-reactive protein level and its association with intermediate and high syntax score in cases of acute coronary syndrome. EJHM. 2019; 75(1):2064-70. https://dx.doi.org/10.21608/ejhm.2019.29715
8. Mir SR, Lakshmi VB. High-Sensitivity C-Reactive Protein-to-Albumin Ratio in Predicting the Major Adverse Cardiovascular Event in Acute Coronary Syndrome at Presentation. IJCDW. 2022; 7(3):130-6. https://doi.org/10.25259/mm_ijcdw_441
9. Sharma A. Association of Hs-CRP levels in patients with acute coronary syndromes and it's correlation with angiographic severity of coronary artery stenosis. IJCDW. 2023; 8(1):37-42. https://doi.org/10.25259/IJCDW_9_2023
10. Pandey A, Shrivastava AK. High-sensitive C-reactive Protein and Lipid Profile in Early Phase of Acute Coronary Syndrome. IJMB. 2021; 25(3):106. DOI: 10.5005/jp-journals-10054-0192
11. Kaura A, Hartley A, Panoulas V, Glampson B, Shah AS, Davies J, et al. Mortality risk prediction of high-sensitivity C-reactive protein in suspected acute coronary syndrome: A cohort study. PLoS Med. 2022; 19(2):e1003911. https://doi.org/10.1371/journal.pmed.1003911
12. Neemat S, Y. Muhammad Amin K. Evaluation of serum gamma-glutamyl transferase among patients with coronary artery disease in Erbil city. Zanco J Med Sci. 2024; 27(3):244-52. https://doi.org/10.15218/zjms.2023.027
13. MOHAMMED AA. Evaluation of Serum VASPIN and Lipid Profile in Iraqi Patients with Acute Coronary Syndrome. Grn Int J Apl Med Sci. 2024; 2(4):127-33. DOI:10.62046/gijams.2024.v02i04.004
14. Faisal A, Bander A, Ali A, Abadi M, Ahmed A, Alsubaie A. Acute coronary syndrome among young patients in Saudi Arabia (Single center study). J Cardiol Curr Res. 2019; 12:60. https://doi.org/10.15406/jccr.2019.12.00440
15. Kiani SS, Ashraf W, Khan MN, Chaudhry AA, Azad N, Rehman WU, et al. The Role of High-sensitive C-Reactive Protein in predicting Severity of Coronary Artery Disease in Patients with Acute Coronary Syndromes. PHJ. 2023; 56 (1):33-6. https://doi.org/10.47144/phj.v56i1.2468
16. Li SY, Zhou MG, Ye T, Cheng LC, Zhu F, Cui CY, et al. Frequency of ST-segment elevation myocardial infarction, non-ST-segment myocardial infarction, and unstable angina: results from a Southwest Chinese Registry. Rev Cardiovasc Med. 2021; 22(1):239-45. http://doi.org/10.31083/j.rcm.2021.01.103
17. Styczkiewicz K, Styczkiewicz M, Myćka M, Mędrek S, Kondraciuk T, Czerkies-Bieleń A, et al. Clinical presentation and treatment of acute

coronary syndrome as well as 1-year survival of patients hospitalized due to cancer: A 7-year experience of a nonacademic center. Medicine. 2020; 99(5):e18972. http://dx.doi.org/10.1097/MD.0000000000018972
18. Cheema FM, Cheema HM, Akram Z. Identification of risk factors of acute coronary syndrome in young patients between 18-40 years of age at a teaching hospital. Pak J Med Sci. 2020; 36(4):821. https://doi.org/10.12669/pjms.36.4.2302
19. Hao Y, Liu J, Liu J, Yang N, Smith SC, Jr., Huo Y, et al. Sex Differences in In-Hospital Management and Outcomes of Patients With Acute Coronary Syndrome. Circulation. 2019; 139(15):1776-85. https://doi.org/10.1161/CIRCULATIONAHA.118.037655
20. Ten Haaf ME, Bax M, Ten Berg J, Brouwer J, Van't Hof A, Van der Schaaf R, et al. Sex differences in characteristics and outcome in acute coronary syndrome patients in the Netherlands. Neth Heart J. 2019; 27:263-71. https://doi.org/10.1007/s12471-019-1271-0
21. Ibrahim TH, Almutiri S, Alharbi M, Alotaibi D, Ali M, Hamza W. Relationship between Cardiovascular Risk Factors and Development of Acute Coronary Syndrome. Biomed Pharmacol J. 2023;16(3):1775-83. https://dx.doi.org/10.13005/bpj/2756
22. Ralapanawa U, Kumarasiri PVR, Jayawickreme KP, Kumarihamy P, Wijeratne Y, Ekanayake M, et al. Epidemiology and risk factors of patients with types of acute coronary syndrome presenting to a tertiary care hospital in Sri Lanka. BMC Cardiovasc Disord. 2019; 19:1-9. https://doi.org/10.1186/s12872-019-1217-x
23. Zhan Y, Xu T, Tan X. Two parameters reflect lipid-driven inflammatory state in acute coronary syndrome: atherogenic index of plasma, neutrophil–lymphocyte ratio. BMC Cardiovasc Disord. 2016; 16:1-6. DOI 10.1186/s12872-016-0274-7
24. Dhungana SP, Mahato AK, Ghimire R, Shreewastav RK. Prevalence of dyslipidemia in patients with acute coronary syndrome admitted at tertiary care hospital in Nepal: A descriptive cross-sectional study. JNMA J Nepal Med Assoc. 2020; 58(224):204–8. http://dx.doi.org/10.31729/jnma.4765
25. Amen SO. Role of C-Reactive Protein as an Inflammatory Marker in Patients with Coronary Artery Disease: A Case–Control Study in Erbil-Kurdistan Region of Iraq. Saudi J Med. 2022; 7(3):159-67. DOI: 10.36348/sjm.2022.v07i03.006
26. Altaher A, Mustafa E, Abodahab LH, Mohamed HS. The Pattern of Dyslipidemia among Patients with Acute Coronary Syndrome at Sohag University Hospital. SVU Int J Med Sci. 2022; 5(2):374-84. https://doi.org/10.21608/svuijm.2022.139532.1315
27. Rahman MM, Ahmed FU, Sharmin S, Hyder T, Nehal S. Dyslipidemia and conventional risk factors in patients with acute coronary syndrome admitted in a CCU of a tertiary care hospital of Bangladesh. Cardiovascular Journal. 2021; 14(1):24-9. https://doi.org/10.3329/cardio.v14i1.55370
28. Ahmed¹ FM, Arafa¹ UA, Zaki¹ NA, El-Rashidy MH. Triglycerides/High Density Lipoprotein-Cholesterol Ratio as a Novel Marker of Atherosclerosis in Patients with Acute Coronary Syndrome. NILES JGG. 2024; 7(1). https://dx.doi.org/10.21608/niles.2023.247949.1080
29. Bouzidi N, Messaoud MB, Maatouk F, Gamra H, Ferchichi S. Relationship between high sensitivity C-reactive protein and angiographic severity of coronary artery disease. Journal of geriatric cardiology: J Geriatr Cardiol. 2020; 17(5):256. https://doi.org/10.11909/j.issn.1671-5411.2020.05.003
30. Kotain GB, Shaikh SB, Joy LS, Rao NL, RM P, HM I. High-Sensitivity C-Reactive Protein Correlation with Angiographic Findings in Patients with Acute Coronary Artery Syndrome. SJBR. 2021; 6(4):53-7. DOI: 10.36348/sjbr.2021.v06i04.001
31. Mihajlović D, Maksimović ŽM, Dojčinović B, Banjac N. Acute coronary syndrome (STEMI, NSTEMI and unstable angina pectoris) and risk factors, similarities and differences. Scripta Medica. 2020; 51(4):252-60. DOI: 10.5937/scriptamed51-27722
32. Kurniawan PR, Setiawan AA, Limantoro C, Ariosta A. the Differences in Troponin I and Ck-Mb Values in Acute Myocardial Infarction Patients With St Elevation and Without St Elevation. Diponegoro Medical Journal. 2021; 10(2):138-44. https://doi.org/10.14710/dmj.v10i2.29601
33. Rathore V, Singh N, Rastogi P, Mahat RK, Mishra MK, Shrivastava R. Lipid profile and its correlation with C-reactive protein in patients of acute myocardial infarction. Int J Res Med Sci. 2017; 5(5):2182-6. http://dx.doi.org/10.18203/2320-6012.ijrms20171866
34. Aseri Z, Habib SS, Alhomida AS, Khan HA. Relationship of high sensitivity C-reactive protein with cardiac biomarkers in patients presenting with acute coronary syndrome. J Coll Physicians Surg Pak. 2014; 24(6):387-91. PMID: 24953910
35. Ridker PM, Everett BM, Thuren T, MacFadyen JG, Chang WH, Ballantyne C, et al. Anti-inflammatory therapy with canakinumab for atherosclerotic disease. N Engl J Med. 2017; 377:1119-31. DOI: 10.1056/NEJMoa1707914