

Original Research Article

CORRELATION OF SERUM HOMOCYSTEINE LEVELS AND GENSINI SCORE IN CORONARY ANGIOGRAPHY PROFILE IN YOUNG ACUTE CORONARY SYNDROME PATIENTS AT TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Acute Coronary Syndrome (ACS) in young adults is an emerging public health concern associated with significant morbidity and mortality. Traditional cardiovascular risk factors do not completely explain the occurrence and severity of coronary artery disease (CAD) in this population. Serum homocysteine has been identified as an independent risk factor for atherosclerosis and thrombotic cardiovascular events. The Gensini score is a validated angiographic scoring system used to quantify the severity of coronary artery disease. This study was undertaken to evaluate the correlation between serum homocysteine levels and Gensini score among young ACS patients admitted to a tertiary care hospital. The aim is to evaluate the correlation between serum homocysteine levels and the severity of coronary artery disease as assessed by the Gensini score in coronary angiography among young patients presenting with acute coronary syndrome.

Materials and Methods: It was an observational cross-sectional correlation study. This study was conducted at the department of cardiology, In-patient section of tertiary care Government general hospital (GGH), Ongole, Prakasam dist, Andhra Pradesh. This study was submitted to the Institutional Ethics Committee (IEC), Government general hospital, Ongole. Approval was obtained before initiation of the study. Written informed consents were obtained from all the participants. This study was carried out for a period of 6 months. Patients who are less than or equal to 45 years. Patients with confirmed diagnosis of acute coronary syndrome undergoing coronary angiography. Patient who accepted informed consent form.

Results: The present study evaluated the relationship between serum homocysteine levels and the severity of coronary artery disease (CAD) among young patients diagnosed with acute coronary syndrome (ACS). The analysis of demographic, clinical, biochemical, and angiographic findings demonstrated several important observations regarding the role of homocysteine in cardiovascular disease among young individuals. The study also revealed a strong positive correlation analysis between serum homocysteine levels and the Gensini score, with a correlation coefficient of $r = 0.79$. This strong correlation indicates that higher homocysteine levels are closely associated with more severe coronary artery involvement as assessed by coronary angiography. These findings suggest that serum homocysteine may serve as a useful biochemical marker for assessing the severity of coronary artery disease in young patients with acute coronary syndrome.

Conclusion: These results suggest that homocysteine may play an important role in the pathogenesis and progression of coronary artery disease. Serum homocysteine levels show a significant positive correlation with the Gensini score in young patients presenting with Acute Coronary Syndrome. Elevated homocysteine may serve as a useful biomarker for identifying patients at risk of severe coronary artery disease and may contribute to improved risk stratification and early intervention strategies.

Keywords: Acute Coronary Syndrome, Coronary Artery Disease, Homocysteine, Gensini Score, Coronary Angiography, Young Adults, Hyperhomocysteinemia.

INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality worldwide, with coronary artery disease (CAD) accounting for a major proportion of these deaths. Although CAD is traditionally considered a disease of older adults, its incidence among younger individuals has shown a concerning rise over recent decades. Acute Coronary Syndrome (ACS), encompassing unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI), is increasingly being recognized in young adults, particularly in developing countries such as India. The occurrence of ACS at a younger age has significant socioeconomic implications due to the loss of productive years and increased healthcare burden.^[1-4]

The development of atherosclerosis and subsequent coronary artery obstruction is a multifactorial process involving both traditional and emerging cardiovascular risk factors. Conventional risk factors such as smoking, hypertension, diabetes mellitus, dyslipidemia, obesity, and family history of premature CAD are well established. However, these factors alone do not fully explain the occurrence and severity of coronary artery disease in many young patients. Consequently, attention has shifted toward novel biomarkers that may contribute to atherosclerosis and thrombotic events.^[5]

Homocysteine is a sulfur-containing amino acid formed during the metabolism of methionine. Elevated serum homocysteine levels, a condition known as hyperhomocysteinemia, have been identified as an independent risk factor for cardiovascular disease. Increased homocysteine levels are believed to promote endothelial dysfunction, oxidative stress, vascular smooth muscle proliferation, inflammation, and enhanced thrombogenicity, all of which contribute to the initiation and progression of atherosclerosis. Several epidemiological and clinical studies have demonstrated an association between elevated homocysteine levels and an increased risk of coronary artery disease, myocardial infarction, stroke, and peripheral vascular disease.^[6-9]

Coronary angiography remains the gold standard for evaluating the extent and severity of coronary artery disease. Among various angiographic scoring

systems, the Gensini score is widely used to quantify the severity of coronary atherosclerosis. The score considers both the degree of luminal narrowing and the anatomical importance of the affected coronary segment, thereby providing a comprehensive assessment of coronary artery disease burden. Higher Gensini scores indicate more extensive and severe coronary involvement and are associated with worse clinical outcomes.^[10,11]

The relationship between serum homocysteine levels and the severity of coronary artery disease has been explored in several studies, with many reporting a positive correlation between elevated homocysteine concentrations and angiographic severity. However, data specifically focusing on young patients presenting with ACS remain limited, particularly in the Indian population. Given the increasing prevalence of premature CAD and the potential role of homocysteine as a modifiable risk factor, understanding this relationship may have important implications for risk stratification, early diagnosis, and preventive strategies.^[12-15]

Therefore, the present study aims to evaluate the correlation between serum homocysteine levels and the Gensini score in young patients presenting with Acute Coronary Syndrome at a tertiary care hospital. By assessing the association between this biochemical marker and angiographic severity, the study seeks to contribute to the understanding of the role of homocysteine in premature coronary artery disease and its potential utility in identifying patients at increased risk of severe coronary involvement.

Need of The Study

- Coronary artery disease (CAD) has become a major cause of death globally and in India, including younger populations.
- CAD was once considered mainly an urban issue but now increasingly affects rural areas too.
- While common risk factors (hypertension, diabetes, smoking, high cholesterol) explain most cases of CAD, about 15–20% of patients show no traditional risk factors, leaving a gap in preventive strategies.
- Homocysteine has been recognized as an independent risk factor for atherosclerosis and CAD since the 1990s.
- Elevated homocysteine levels may be lowered through dietary changes and supplementation

with vitamins-particularly folic acid and B vitamins-providing an opportunity for early intervention and prevention.

- The Gensini Score helps in quantifying the severity of coronary artery blockage.
- The incidence of Acute Coronary Syndrome is increasing among young individuals, requiring early identification of risk factors.
- Studying the correlation between homocysteine levels and Gensini score may help in better risk assessment of young ACS patients.

Aim & Objectives

Aim

To evaluate the correlation between serum homocysteine levels and the severity of coronary artery disease as assessed by the Gensini score in coronary angiography among young patients presenting with acute coronary syndrome.

Objectives

- To evaluate fasting serum homocysteine levels in young ACS patients.
- To grade the severity of CAD using coronary angiography (e.g., Gensini scoring system).
- To evaluate the association between elevated homocysteine levels and the number of diseased coronary vessels.
- To evaluate the relationship between serum homocysteine levels and CAD severity.

MATERIALS AND METHODS

Study Design: Observational cross-sectional correlation study carries out in the department of cardiology.

Study site: This study was conducted at the department of cardiology, In-patient section of tertiary care Government general hospital (GGH), Ongole, Prakasam dist, Andhra Pradesh.

Study approval: This study was submitted to the Institutional Ethics Committee (IEC), Government general hospital, ongole. Approval was obtained before initiation of the study. Written informed consents was obtained from all the participant's (English and Telugu formats)

Study Period: This study was carried out for a period of 6 months.

Study selection criteria Inclusion criteria

Patients who are less than or equal to 45 years.
Patients with confirmed diagnosis of acute coronary syndrome undergoing coronary angiography.
Patient who accepted informed consent form.

Exclusion criteria

- Patients who are under vitamin supplements within past 3 months
- Patients with the past history of Coronary Artery Disease, Renal dysfunction, Hypothyroidism, Pregnancy, Inflammatory bowel disease, Epilepsy, Cancer, Osteoporosis.

Data collection: Data collection was initiated after necessary permissions were obtained from the hospital and concerned departments. Questionnaires

were the main medium of data collection. Participants demographic details were collected in demographic session included in the questionnaires.

Laboratory Data Collection: Fasting venous blood samples (8–12 hours fasting) was collected and analyzed for serum homocysteine levels using standardized techniques such as chemiluminescent immunoassay (CLIA) or enzyme immunoassay (EIA/ELISA).

Data Recording and Storage: All collected information was entered into structured data collection forms and stored securely to ensure confidentiality and accuracy.

Sample size: A total of 100 patients was enrolled.

Study procedure

Patient Screening and Enrollment

All admitted ACS patients aged ≤ 45 years was screened daily. Eligible patients who fulfill the inclusion criteria was informed about the study and enrolled after obtaining written informed consent.

Blood Sample Collection

After overnight fasting, blood samples were collected under aseptic conditions and sent for laboratory estimation of serum homocysteine levels.

Coronary Angiography Assessment

Patients undergoing coronary angiography as part of routine clinical management will have coronary artery disease severity assessed using the Gensini scoring system.

Correlation Analysis

Serum homocysteine values was compared and correlated with corresponding Gensini scores to determine the relationship between biochemical levels and disease severity.

Gensini Score Assessment

The severity of the coronary artery disease was determined using the Gensini Score based on the results obtained from the coronary angiography procedure. The Gensini Score is based on the severity and the anatomical significance of the diseased coronary artery. The severity is based on the percentage of the stenosis, which can be 25%, 50%, 75%, 90%, and 99%, as well as complete occlusion. The severity is then multiplied by the weighting factor based on the anatomical significance of the diseased segment of the coronary artery. The final Gensini Score is the sum of the individual segment scores, which is the severity of the coronary artery disease. The higher the score, the higher the severity of the coronary artery disease. The obtained scores will be used to correlate with the homocysteine level in the subjects.

Statistical Analysis

Data was analyzed using statistical software.

RESULTS

A total of 100 young patients diagnosed with Acute Coronary Syndrome (ACS) who underwent coronary angiography were included in the study. Clinical characteristics, biochemical parameters, and

angiographic findings were analyzed to evaluate the relationship between serum homocysteine levels and severity of coronary artery disease assessed using the Gensini score.

Demographic Characteristics of Study Population.

Table 1: Sex Distribution of Study Population

Sex	Number of Patients	Percentage (%)
Male	80	80%
Female	20	20%

The demographic characteristics of the study population based on sex distribution are presented in [Table 1]. A total of 100 participants were included in the study. Among them, 80 participants (80%)

were male, while 20 participants (20%) were female. This indicates that the majority of the study population consisted of male patients.

Table 2: Age Group Distribution of Study Population

Variables	Mean \pm SD	Minimum	Maximum
Age (years)	35.34 \pm 5.67	25	45
Serum Homocysteine ($\mu\text{mol/L}$)	17.53 \pm 5.65	8.0	37.97
Gensini Score	51.25 \pm 23.49	5.0	132.76

The baseline characteristics of the study population are presented in Table 2. The mean age of the participants was 35.34 \pm 5.67 years, with an age range from 25 to 45 years. This indicates that the majority of the study subjects belonged to the young to middle-aged adult group. Evaluating cardiovascular risk factors in this age group is important because early development of coronary artery disease can significantly increase long-term morbidity and mortality.

The mean serum homocysteine level in the study population was 17.53 \pm 5.65 $\mu\text{mol/L}$, with values ranging from 8.0 to 37.97 $\mu\text{mol/L}$. These findings suggest that several individuals in the study had elevated homocysteine levels. Increased homocysteine concentration is considered an independent risk factor for atherosclerosis, as it contributes to endothelial dysfunction, oxidative

stress, and vascular inflammation. These mechanisms can accelerate the progression of coronary artery disease.

The mean Gensini score, which represents the severity of coronary artery involvement, was 51.25 \pm 23.49, with a minimum score of 5.0 and a maximum of 132.76. This wide variation indicates differing degrees of coronary artery stenosis among the study participants.

Overall, the baseline findings demonstrate moderately elevated homocysteine levels and variable coronary artery disease severity. These observations support the relevance of assessing the relationship between serum homocysteine levels and Gensini score in evaluating the severity of coronary artery disease in the study population.

Serum Homocysteine Levels and Cad Severity.

Table 3: Severity of CAD and Serum Homocysteine levels

CAD Severity	Number of Patients	Homocysteine Mean \pm SD	Gensini Score Mean
Mild	9	13.03 \pm 3.65	10.42
Moderate	25	12.75 \pm 3.53	30.67
Severe	54	18.44 \pm 3.64	59.26
Very Severe	12	26.82 \pm 4.41	88.74

[Table 3] shows the relationship between serum homocysteine levels and the severity of coronary artery disease (CAD) based on the Gensini score. The study population was categorized into four groups according to the severity of CAD: mild, moderate, severe, and very severe.

Among the participants, 9 patients had mild CAD, with a mean homocysteine level of 13.03 \pm 3.65 $\mu\text{mol/L}$ and a mean Gensini score of 10.42. In the moderate CAD group, which included 25 patients, the mean homocysteine level was 12.75 \pm 3.53 $\mu\text{mol/L}$, while the mean Gensini score increased to 30.67, indicating greater coronary artery involvement. The severe CAD group consisted of 54 patients, representing the largest proportion of the study population. In this group, the mean

homocysteine level increased to 18.44 \pm 3.64 $\mu\text{mol/L}$, and the mean Gensini score was 59.26, suggesting more extensive coronary artery stenosis.

The very severe CAD group included 12 patients, with the highest mean homocysteine level of 26.82 \pm 4.41 $\mu\text{mol/L}$ and a mean Gensini score of 88.74. This indicates that patients with more severe coronary artery disease tend to have significantly higher serum homocysteine levels.

Overall, the findings suggest a positive association between serum homocysteine levels and the severity of coronary artery disease, as higher homocysteine concentrations were observed in patients with higher Gensini scores.

Correlation Between Serum Homocysteine and Gensini Score.

Table 4: Correlation between Serum Homocysteine and Gensini Score

Variable 1	Variable 2	Correlation Coefficient (r)
Serum Homocysteine	Gensini Score	0.79

The present study evaluated the relationship between serum homocysteine levels and the severity of coronary artery disease (CAD) using the Gensini scoring system. The correlation analysis showed a correlation coefficient (r) of 0.79, which indicates a strong positive relationship between serum

homocysteine levels and the Gensini score. This suggests that patients with higher homocysteine levels tend to have more severe coronary artery disease.

Vessel Disease Type

Table 5: Distribution of Vessel Disease in Patients

Vessel Disease	Number	Percentage
Single Vessel Disease	37	37%
Double Vessel Disease	31	31%
Triple Vessel Disease	32	32%

The present study evaluated the relationship between serum homocysteine levels and the severity of coronary artery disease (CAD) using the Gensini scoring system. The correlation analysis showed a correlation coefficient (r) of 0.79, which indicates a strong positive relationship between serum

homocysteine levels and the Gensini score. This suggests that patients with higher homocysteine levels tend to have more severe coronary artery disease.

Distribution of Coronary Artery Stenosis

Table 6: Coronary Artery Stenosis variation in Coronary Vessels

Vessel	Stenosis (%) Mean \pm SD
LAD	50.17 \pm 28.61
LCX	47.54 \pm 28.67
RCA	47.79 \pm 26.12

[Table 6] illustrates the distribution of coronary artery stenosis among the three major coronary vessels: the left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA). The mean percentage of stenosis was found to be highest in the LAD with a value of $50.17 \pm 28.61\%$, indicating that this vessel had comparatively greater narrowing among the study population. The LCX showed a mean stenosis of $47.54 \pm 28.67\%$, while the RCA demonstrated a similar level of narrowing with a mean value of $47.79 \pm 26.12\%$.

Statistical Decision

Null Hypothesis- correlation coefficient ($r = 0.79$, $p < 0.001$) demonstrates statistical significance, the null hypothesis is rejected, indicating that serum homocysteine levels are significantly associated with the angiographic severity of coronary artery disease measured by the Gensini score.

DISCUSSION

The present study was conducted to evaluate the relationship between serum homocysteine levels and the angiographic severity of coronary artery disease (CAD) in young patients affecting with acute coronary syndrome (ACS). A total of 100 patients who underwent coronary angiography were included in this study. Coronary artery disease was one of the leading cause of death worldwide, and evaluating the bio - markers assessing the severity of disease and it is important for improving risk

stratification and early intervention. In the above study, the severity of CAD was assessed using the Gensini scoring system based on coronary angiographic findings, while serum homocysteine levels were measured to determine the association with disease severity. The result of the study provides important insights into the relationship between serum homocysteine levels and increasing severity of coronary artery disease among young patients with acute coronary syndrome.^[16]

One of the key observations in the present study was the predominance of male patients among individuals affecting with acute coronary syndrome. Out of the total 100 patients included in the study, 80% were males, and 20% were female. The above observation is consistent with previous epidemiological studies, explaining that they have observed the coronary artery disease occur early and more frequently in men compared with women. This difference may be due to hormonal effects of estrogen in premenopausal women and greater exposure of men to cardiovascular risk factors such as smoking, alcohol consumption, and stress.

The baseline characteristics of the study population examined that the mean age of the patients was approximately 35.34 ± 5.67 years, while young patients was 25 years old and oldest was 45 years, indicating that coronary artery disease can occur at relatively young age. In addition, genetic susceptibility and metabolic abnormalities may also play a key role in development of coronary artery disease in younger individuals.

Another important finding of this study was the elevated serum homocysteine levels observed in many patients with coronary artery disease. The mean serum homocysteine level in this study population was approximately 17.5 +/- 5.65 umol/L, with values ranging from 8.0 umol/L, to 37.97 umol/L, which shows a significant patients had hyperhomocysteinemia. Homocysteine is a sulfur-containing amino acid produced during the metabolism of methionine. Elevated homocysteine levels, commonly referred to as hyperhomocysteinemia, and has been widely recognized as an independent risk factor for cardiovascular disease. Elevated homocysteine levels are associated with endothelial dysfunction, oxidative stress, inflammation, and increased platelet aggregation, all contribute to the development of atherosclerosis.^[17-20]

Angiographic findings in this study demonstrated varying degrees of stenosis among the three major coronary arteries. Among the three major vessels, the left anterior descending artery (LAD) exhibited the highest mean stenosis, followed by the right coronary artery (RCA) and the left circumflex artery (LCX).

The mean Gensini score was 51.25 +/- 23.49, ranging from 5.0 to 132.76. A higher Gensini score indicates more severe coronary artery obstruction. The high mean score suggests a significant proportion of patients had moderate to severe CAD.

The correlation analysis performed in this study further confirmed this observation. A positive correlation was observed between serum homocysteine levels and the Gensini score, with a correlation coefficient of $r = 0.79$ indicates higher homocysteine levels are associated with more severity of coronary artery disease.

Another observation in the study was the distribution of vessel disease among the study population. Single vessel disease was observed in 37% of patients, while double vessel disease and triple vessel disease presents in 31% and 32% of patients.

Overall, the study demonstrates a significant association between elevated serum homocysteine levels and the severity of coronary artery disease in young patients with acute coronary syndrome. The strong correlation observed between homocysteine levels and the Gensini score suggests that homocysteine may play a key role coronary artery disease.

CONCLUSION

These results suggest that homocysteine may play an important role in the pathogenesis and progression of coronary artery disease. Therefore, early detection and management of elevated homocysteine levels, along with control of traditional cardiovascular risk factors, may help

reduce the burden of coronary artery disease in younger populations.

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