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Original Article

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Correlation between Levels of Serum Gamma – Glutamy1 Transpeptidase(GGT) In Patients With Acute Myocardial Infarction and Its Potential As A Predictive Indicator

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ABSTRACT

BACKGROUND: Gamma-glutamyl transferase (GGT) plays an important role of an enzyme responsible for breaking down glutathione, a vital antioxidant within mammalian cells.Coronary artery disease (CAD) stands as the primary reason of global mortality. Atherosclerosis stands as the primary factor behind Acute Coronary Syndrome (ACS)The pro-oxidant reactions facilitated by GGT subsequently accelerate LDL cholesterol oxidation, leading to peroxidation of lipids mainly LDL. This oxidative-stress brought about by GGT could potentially assume an important role in the formation of atheroma leading to atherosclerosis.

METHODOLOGY: The goal of this research is to measure the correlation amongst serum GGT levels in patients diagnosed with Acute Myocardial Infarction & to analyse how these levels relate to their medical outcomes.

RESULTS: In our analysis, a serum GGT level equal to or exceeding 52.5 U/L was identified as a predictor factor for coronary atherosclerosis with a significance level of P<0.022. The sensitivity of this predictor was found to be 72%, while the specificity was 71.4%.

CONCLUSION: GGT serves as a convenient, rapid, and effective marker of atherosclerosis. It provides insight into the extent of atherosclerosis among patients with myocardial infarction. Therefore, GGT can be employed as a supplementary marker for predicting atherosclerosis in individuals at risk.

Key Words: *Serum Gamma, Glutamy1, Transpeptidase(GGT).*

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INTRODUCTION:

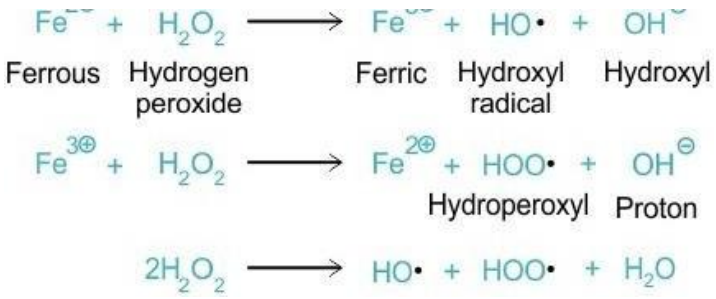
Gamma-glutamyltransferase (GGT) plays an important role of an enzyme responsible for breaking down glutathione, a vital antioxidant within mammalian cells. GGT can be found on the outer surface of the plasma membrane in a variety of cell types. It also circulates in the blood and in the bloodstream, it forms partnerships with different components of plasma , notably albumin and lipoproteins. Measuring GGT activity in the serum has become a good diagnostic tool in detecting hepatobiliary ailments, serving as a sensitive indicator of alcohol consumption and its excessive use. Multiple studies have highlighted prognostic trait of S.GGT in relation to overall mortality & cardiovascular health.

Coronary artery disease (CAD), also recognised as Ischemic Heart Disease (IHD), stands as the primary reason of global mortality. Regardless of the developed or developing status of a country, CAD maintains its position as the chief contributor to disease burden and fatalities.

Atherosclerosis stands as the primary factor behind Acute Coronary Syndrome (ACS), with most instances being linked to the rupture of an atherosclerotic plaque within a coronary artery, creating a nidus for blood clot formation. This resultant clot brings about blockage in the coronary artery, consequently impeding the blood flow to the myocardium. Multiple pathways are linked with the development of atherosclerotic plaques in blood vessels, and among them, oxidative stress and inflammation play major part.

s.GGT, also referred to as gamma glutamyl transpeptidase, represents a 2nd generation liver function assessment test . Thistest now found to be having a widespread use as a diagnostic indicator for liver dysfunction since it participates in

the breakdown of glutathione. The disintegration of glutathione on the outer cell membrane releases precursor molecules(amino acids), which are then transported into the cell where they recombine to ultimately form glutathione.



In meantime, the active thiol within the cysteinyl-glycine segment created by GGT in this process on the outer cell membrane then induces Fentons reaction and Heber-Weiss reaction subsequently leading to conversionof ferric ions(Fe3+) to ferrous ions (Fe2+). These reactions generate reactive oxygen free radicals, which trigger pro-oxidant reactions setting of a cascade.

These pro-oxidant reactions facilitatedby GGT subsequently accelerate LDL cholesterol oxidation, leading to peroxidation of lipids mainly LDL. This process contributes to the development of atheroma within the sub-endothelial connective tissue of the tunica intima of vascular wall.Henceforth , the oxidative-stress brought about by gamma glutamyl transferase could potentially assume an important role in the formation of atheroma leading to atherosclerosis.

Here strong connection amongst GGT levels and cardiological incidents remains noteworthy, even after accounting for cardiac risk factors and potential confoundingvariables, including alcohol consumption. This has prompted the proposition that GGT is able to be regarded a robust biochemical serum marker indicating the advancement of atherosclerosis even before the symptoms develop.

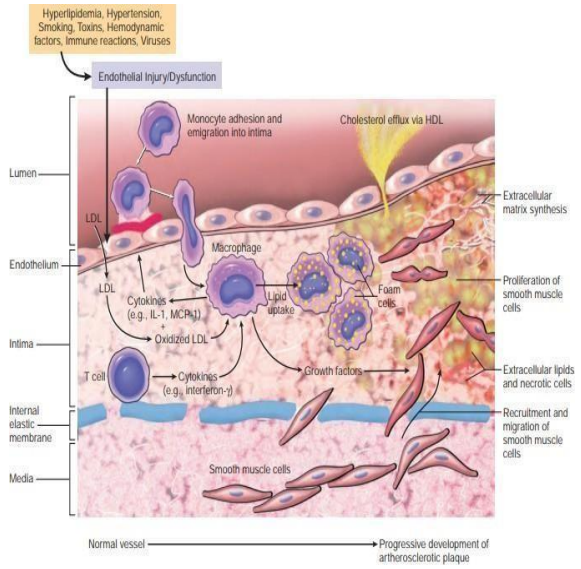
Consequently, gamma-glutamyl transferase also exertsa significant influence on the progression of cerebrovascular accident(stroke),Syndrome of Central Obesity, Insulin Resistance, and Dyslipidemia and Type 2 DM. Identifying individuals at risk of atherosclerosis of coronary arteries prior to the emergence of clinical features poses challenges. However, estimating GGT levels in high-risk patients can aid in identifying premature coronary artery disease.

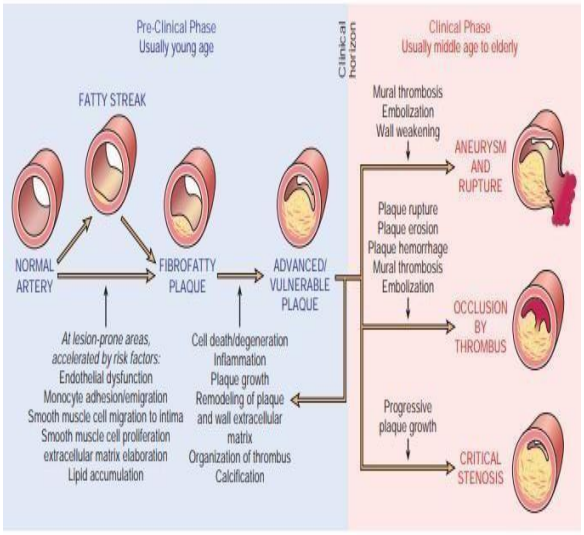
By specifically targeting the reduction of GGT, it becomes feasible to address it like one of the modifiable risk factors. Therefore, lowering s.GGT titres in vulnerable individuals has the potential to prevent myocardial infarction. This investigation will demonstrate the correlation between GGT and the evolvement of atherosclerotic lesions, which subsequently leads to myocardial infarction.

STUDY OBJECTIVE :

The goal of this research is to measure the correlation amongstserum.GGT levels in patients diagnosed with Acute MyocardialInfarction & who are admitted to KATURI MEDICAL COLLEGE AND HOSPITAL, GUNTUR, and to analyse how these levels relate to their medical outcomes.

LITERATURE





Acute coronary syndrome denotes a sudden reduction in bloodflow within the heart's coronary arteries, resulting in myocardial ischemia and cell death. This condition arises from the partial or complete blockage of a coronary blood vessels, typically because of the rupture of an mature atheroma. Acute coronary artery syndrome is categorized into 3 primary groups.

Atherosclerosis stands as a most prevalent factor of acute coronary artery syndrome. It presents itself when a previously stable lesion ruptures. Tragically, nearly half of patients with this syndrome do not survive to reach the hospital. The mortality rate within a year following survival from an acute myocardial infarction (heart attack) is approximately 15%.

To diagnose this syndrome, elevated baseline values that remain stable or decline are essential. Moreover, any one of the following criterion is required: (1) clinical features indicating myocardial ischaemia (2) new ischaemic changes visible on an ECG(electrocardiogram), (3) angiographic results consistent withcomplications or procedural issues, or (4) imaging displaying new loss of healthy viable heart tissue or segmental wall motion abnormality.

Stent thrombosis associated with a heart attack can be identified through coronary angiography or autopsy. This is seen in conjunction with a increase and/or decrease in cardiological biomarker levels, with any one of the value surpassing the 99^{th} percentile upper reference limit.

Regarding cardiac infarction (heart attack) in association with coronary artery bypass grafting surgery (CABG), it is defined by elevated cardiologic serum biomarker values in patients with normal baseline levels of cTn (cardiac troponin). Additionally, oneof the following criteria is required: (1) new pathologic Q waves on ECG or new left bundle branch

block (LBBB) on an ECG, (2) angiographically documented new graft blockage or new native coronary artery blockage, or (3) imaging evidence of new loss of a healthy viable heart tissue or abnormal motion of a new heart wall segment.

Gamma-glutamyl transferase, also named as gamma-glutamyl transpeptidase (GGT), is part of "Peptidases" enzyme group. GGTis an enzyme situated within the cell membrane, with its active site facing outward from the cell. Its activity is primarily focused on peptide compounds or peptide-like compounds containing a glutamate residue end that links with rest of the compound via its γ-carboxy terminal. Notably, Glycylglycine serves as a more efficient acceptor than either Glycine or the tripeptide, resulting in a significantly faster rate of peptidase transferreaction compared to simple hydrolysis reactions.

LOCATION

While primarily located in the cell membrane, some instances ofthe enzyme are present in the cytosol as well. Its presence is observed in various tissues such as:

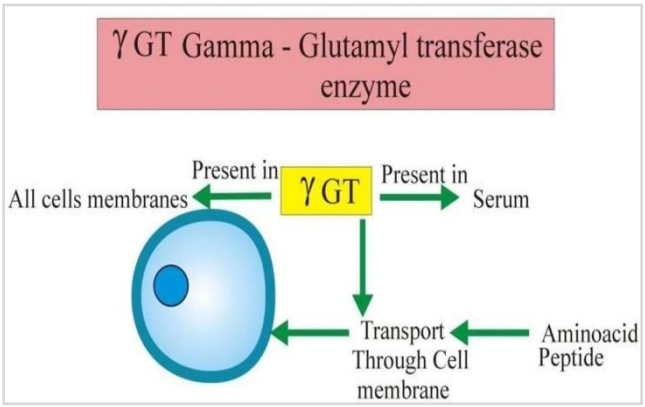
- Kidneys
- Liver cells (Canalicular portion)
- Exocrine Pancreas (Acinar cells)
- Prostate
- Bile duct

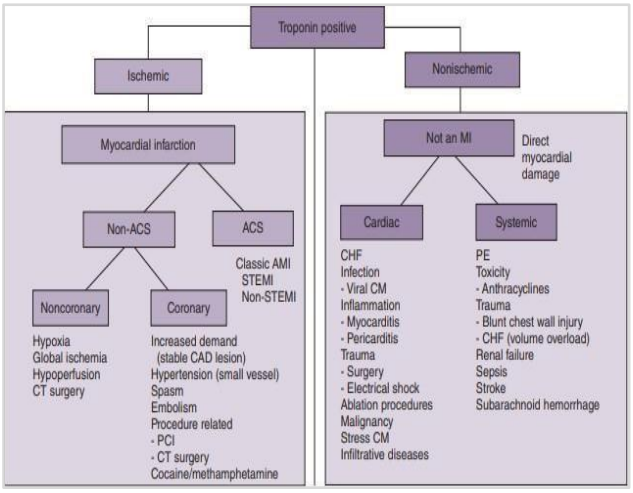
The kidney exhibits the highest tissue activity of this enzyme.

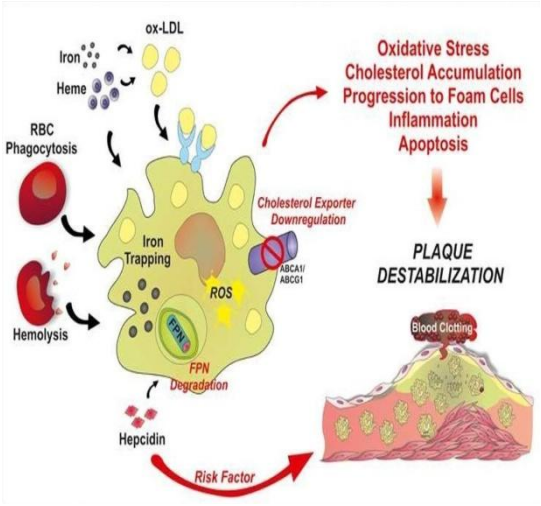
FUNCTIONS

GGT plays an important role in the transport of amino-acidsacross cell membrane. It is responsible for:

- Facilitating the absorption of the amino acids from the intestinallumen and reabsorption of amino acids from the PCT of the nephrons.
- Participatingin glutathione metabolism by creating glutamylmoiety which transfers to a range of acceptor molecules.
- Contributing to synthesis of leukotrienes.
- Assisting in the detoxification of drugs and xenobiotics.




Troponin positive
Ischemic
Nonischemic
Myocardial infarction
Non-ACS
ACS
Classic AMI
STEMI
Non-STEMI
Noncoronary
Coronary
Hypoxia
Global ischemia
Hypoperfusion
CT surgery
Increased demand
(stable CAD lesion)
Hypertension (small vessel)
Spasm
Embolism
Procedure related
- PCI
- CT surgery
Cocaine/methamphetamine
Not an MI
Direct
myocardial
damage
Cardiac
Systemic
CHF
Infection
- Viral CM
Inflammation
- Myocarditis
- Pericarditis
Trauma
- Surgery
- Electrical shock
Ablation procedures
Malignancy
Stress CM
Infiltrative diseases
PE
Toxicity
- Anthracyclines
Trauma
- Blunt chest wall injury
- CHF (volume overload)
Renal failure
Sepsis
Stroke
Subarachnoid hemorrhage


ox-LDL
Iron
Heme
RBC
Phagocytosis
Iron
Trapping
ROS
Hemolysis
FPN
FPN
Degradation
Hepcidin
Risk Factor
Cholesterol Exporter
Downregulation
ABCA1/
ABCG1
Oxidative Stress
Cholesterol Accumulation
Progression to Foam Cells
Inflammation
Apoptosis
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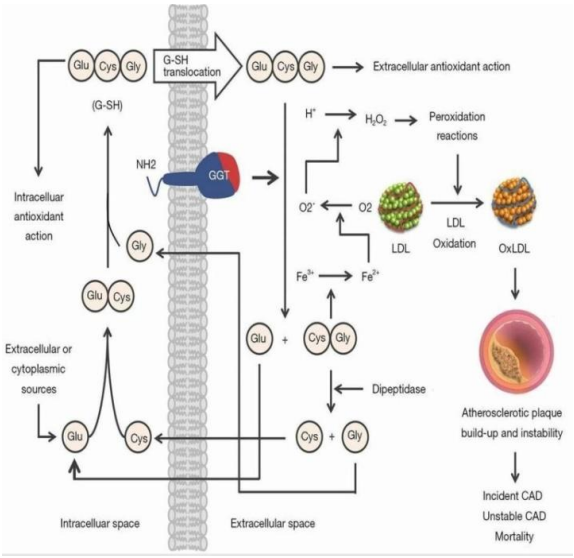
DESTABILIZATION
Blood Clotting


Glu Cys Gly
G-SH
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Extracellular antioxidant action
(G-SH)
NH2
GGT
Intracelluar
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Gly
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cytoplasmic
sources
Glu
Cys
Intracelluar space
Extracellular space
H+
H2O2
Peroxidation
reactions
O2-
O2
LDL
LDL
Oxidation
OxLDL
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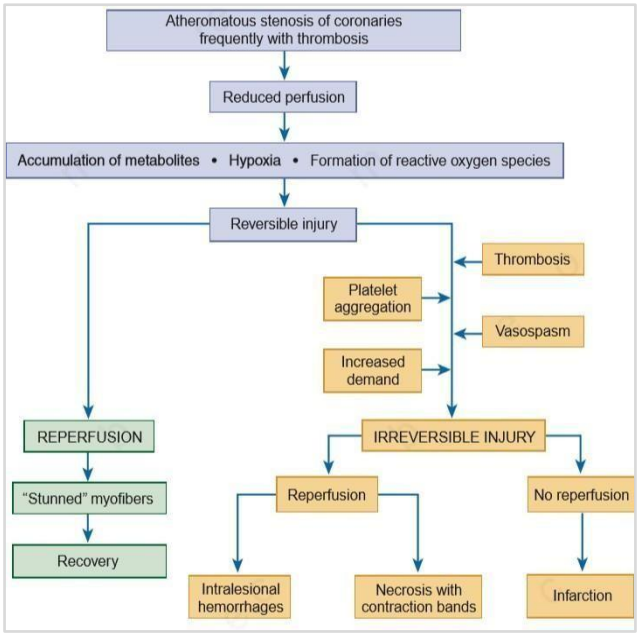
Fe2+
Glu + Cys Gly
Dipeptidase
Cys + Gly
Atherosclerotic plaque
build-up and instability
Incident CAD
Unstable CAD
Mortality



ELECTROCARDIOGRAPHIC MANIFESTATIONS OF ACUTE MYOCARDIAL ISCHEMIA (IN THE ABSENCE OF LEFT BUNDLE BRANCH BLOCK)

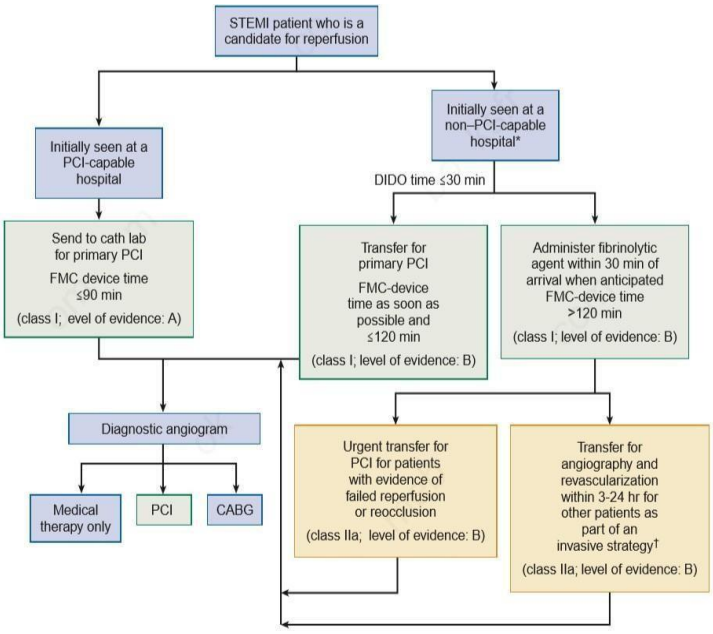
ST Elevation

New ST elevation at the J point in two contiguous leads with the following cut points:

- ≥0.1 mV in all leads (except V_2-V_3)
- In leads V_2-V_3 the following cut points apply:
  - ≥0.2 mV in men ≥40 years
  - ≥0.25 mV in men <40 years
  - ≥0.15 mV in women

ST Depression and T Wave Changes

- New horizontal or downsloping ST depression ≥0.05 mV in two contiguous leads
- T-wave inversion ≥0.1 mV in two contiguous leads with a prominent R wave or R/S ratio >1



MATERIALS AND METHODS

RESEARCH SUBJECTSDATA SOURCE

The research will be conducted on a group of 50 individuals displaying clinical symptoms indicative of Acute Myocardial Infarction. These individuals will be admitted to Katuri MedicalCollege and Hospital within the time frame of May 2022 to October 2022.

Inclusion Criteria

- Individuals showing signs of acute coronary syndrome
- Adults aged between 30 and 80 years, of any gender.

Exclusion Criteria

Consumption of alcoholic beverages

Presence of chronic Hepatitis B or C infection

Others established with hepatic, biliary, renal disorders

Utilisation of any drugs harmful to theliver

Pregnancy

EXPECTED OUTCOME

Patients displaying symptoms of Acute Myocardial Infarction arelikely to have heightened levels of Serum Gamma Glutamyl Transferase.

DATA COLLECTION

All patients participating in the study will provide informed written consent. Pertinent data will be gathered using a predetermined form. Patient selection will be based on clinical assessments and biochemical tests. The study will include adult patients, aged 30 to 80, admitted to the Department of General Medicine at Katuri Medical College and Hospital having indicativefeatures of Acute Myocardial Infarction.

LABORATORY TESTS

-BIOCHEMISTRY.
-LFT(s bilirubin ,D bil, Ibil,SGOT,SGPT,ALP)
-RFT(s creatinine,b urea,s uric acid)
-Serum Gamma Glutamyl Transferase.
-HbsAg.
-Anti-HCV. Antibody
-ECG
-CoronaryAngiogram.(CAG)

STUDY DESIGN: Prospective investigation.

STUDY DURATION

6 MONTHS (May 2022 to October 2022)COLLABORATING DEPARTMENTS IN STUDY

Department of BiochemistryDepartment of Cardiology

ETHICAL APPROVAL: Ethical clearance has been obtained.
CONSENT: Individuals will provide written, informed consent.
ANALYSIS: Statistical analysis shall be conducted utilising relevant tests as based on necessityby the data.
CONFLICT OF INTEREST: None.
FINANCIAL SUPPORT: Self-financed.

PARTICIPATING SUBJECTS

The study involves 50 patients, aged 30 to 80, admitted into the Department ofGeneral Medicine at Katuri Medical College and Hospital, exhibiting clinical features suggestive of Acute Myocardial Infarction.

RESULTS AND ANALYSIS

STATISTICAL ANALYSIS

Entire statistical analyses prevailed here are performed using SPSS version 16 (SPSS Inc., Chicago, IL). These findings are displayed as the mean, standard deviation, median, & interquartile range (IQR) for continuous data, and as percentagesfor qualitativedata. Data was examined for normality applying the Shapiro-Wilk normality test. Given such skewed distribution of the data, the Mann- Whitney U-test has been utilized in consideration of comparing two variables, while the Kruskal- Wallis test was employed regarding greater than two variables.

For each patient, Spearman rank correlation coefficient was used for evaluating such relationship among each predictor variable & coronary atherosclerosis. Bivariate logistic regressionanalysis have been employed to calculate the predictive ability of various markers for coronary atherosclerosis.

Variables with a significant p-value < 0.10 in the univariate analysis are considered for insertion in the model. The Receiver Operating Characteristic(ROC) Curve was employedto determine the cutoff point of separate markers in estimating coronary atherosclerosis. Results occurred are considered statistically significant if the p-value was lower than 0.05.

Average age of study participants happened to be 49.72 years. The average Gamma glutamyl transferase (GGT) value obtained inthe study happened to be 65.48 U/L with a standard deviation approximately 21.93. Average value of CK-MB in the study happened to be 70.5 IU/L, accompanied by a standard deviation around 20.42, depicted in the following table 1.

Table 1: Distribution of variables among the study participants

Variable	Mean	Std. Deviation	Minimum	Maximum	Median	IQR
AGE	49.72	10.81	28	75	49	18
GGT	65.48	21.93	22	139	61.85	18.2
CK-MB	71.34	20.42	34	132	70.5	27.2

The age distribution is presented in table 2. Among the subjects, 13 (26%) were below 40 years old, 29 (58%) were in the 41-60 years age group, and 8 (16%) were above 60 years old. The mean GGT value for those below 40 years was 58.15 U/L, and the mean CK-MB value in the same age group was 63.31 U/L. In the 41-60 years age group, the mean GGT and CK- MB values happened to be 68.65 U/L and 74.69 U/L, accordingly. Similarly, within those above 60 years age group, the mean GGT and CK-MB values were 65.89 U/L and 72.25 U/L, accordingly.

	< 4o yrs (N= 13)			**41-6o yrs (N=29)**			**> 6o yrs (N=8)**			
	Mean	**Std. Deviation**	**Median**	**Mean**	**Std. Deviation**	**Median**	**Mean**	**Std. Deviation**	**Median**	**p value**
GGT	58.15	29.7o4	51.3	68.65	16.871	68.3	65.89	23.978	68.8	o.112

CK-MB	63.31	2o.467	63	74.69	18.546	72	72.25	25.689	69	o.242

The bar graph in figure 1 displays the age-related distribution of GGT and CK-MB values. The p-values obtained from the Kruskal-Wallis test for GGT and CK-MB values based on age distribution were 0.112 and 0.242, respectively. These results suggest that there isn't a significant connection between the age distribution and GGT or CK-MB values within this study's population.

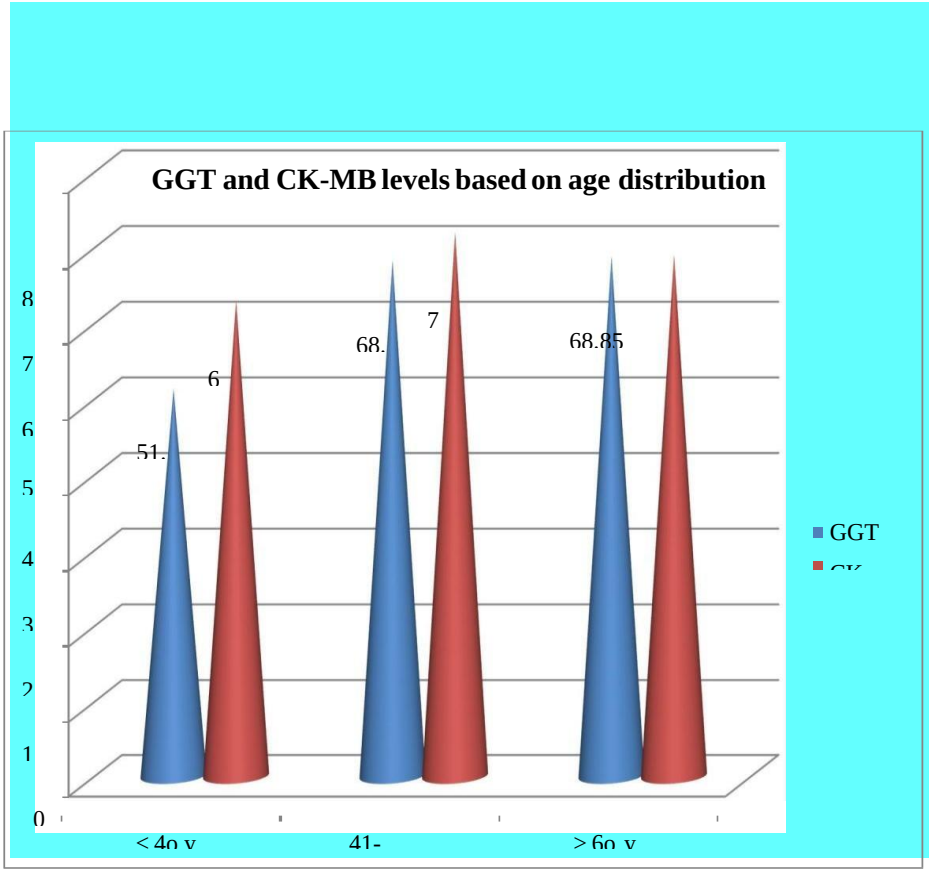


Figure-1 illustrates the correlation between GGT andCK-MB in relation to age distribution, as well as a connection between GGT and CK-MB centred on gender.

Association of GGT AND CK-MB AMONG GENDER

Among the FIFTY participants within our study , 35 (70%) were males and 15 (30%) were females, as indicated in table 3. The p-valuesfor GGT and CK-MB, based on sex, happenedtobe 0.735 for males & 0.478for females, as per the Mann Whitney U test. This suggests that sex does not have a notable influence on GGT and CK-MB values. The breakdown by gender can be observed in figure 2. Below is table 3, which presents the relationshipbetween GGT and CK-MB levels in accordance with gender identity distribution.

VARIABLES	**Male (N=35)**			**Female (N=15)**			
	Mean	**Std. Deviation**	**Median**	**Mean**	**Std. Deviation**	**Median**	**p value**

GGT	64.15	19.224	64.7	68.57	27.78	59	o.735
CK-MB	69.54	18.581	68	75.53	24.395	72	o.478

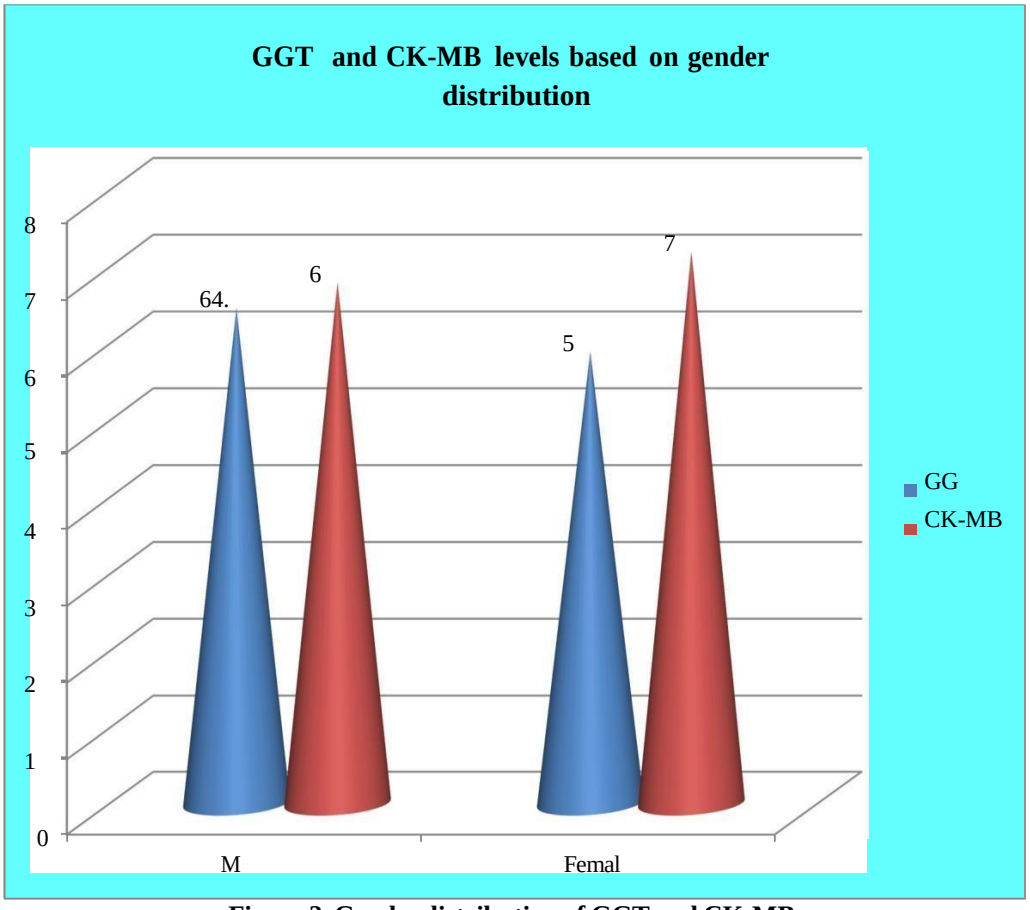


Figure 2. Gender distribution of GGT and CK-MB.

RELATIONSHIP BETWEEN GGT and CK-MB ACCORDING TO CORONARY ANGIOGRAPHY LESION SEVERITY

In the sample of 50 patients, there were 22 (44%) patients had single vessel disease within their coronary angiographylesions. Additionally, 7 (14%) patients with double vessel disease, & 10 (20%) patients with triple vessel disease.

Furthermore, 11 (22%) patients exhibited minimal diseaselesions in their coronary angiography.This distribution is visualized in figure 3.

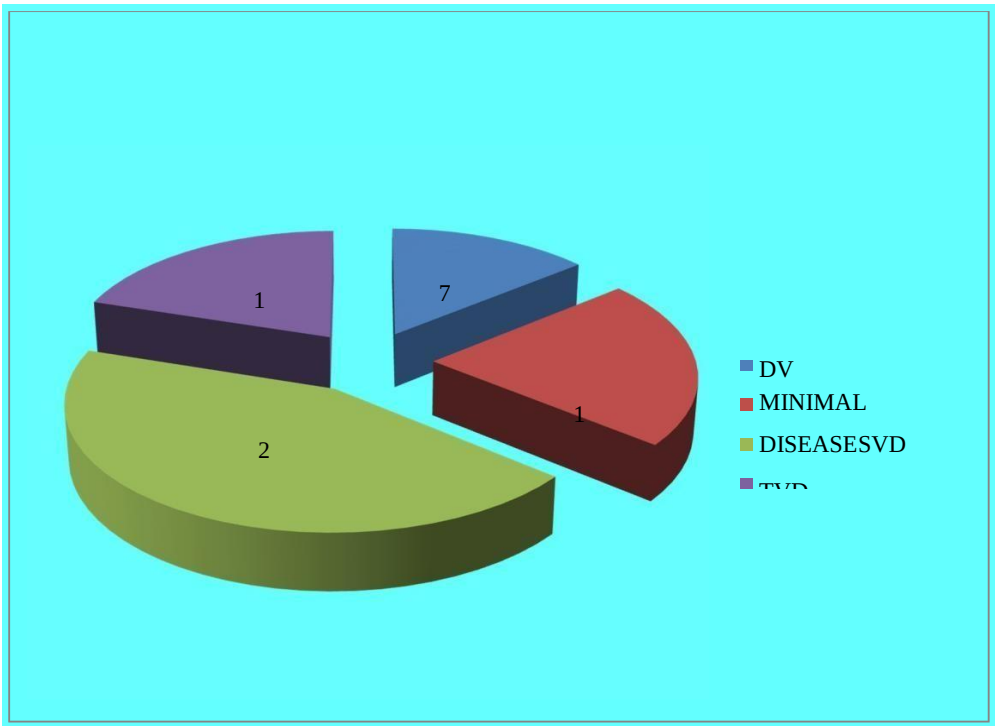


Figure-3. Frequencyof Number of vessels disease

Average GGT and CK-MB values for patients having single vessel disease within their coronary angiography lesions happened to be 67.96 U/L & 73.14 U/L, respectively. For patients with double vessel disease, the mean GGT and CK-MB values were 66.79 U/L & 69.71 U/L. In the same way, for patients with triple vessel disease, the mean GGT and CK-MB values happened to be 69.27 U/L and 77.8 U/L. Patients having minimal disease lesions within their coronary angiography exhibited mean GGT & CK-MB values of 56.23 U/L and 62.91 U/L, accordingly, as displayed in table 4. This table presents the connection between GGT & CK-MB stemming from vessel lesions in coronary angiography.

Number		Mean	Std dev	Median	P value
GGT					
MINIMAL DISEASE	11	56.23	31.21	51.3	
SVD	22	67.96	19.oo3	68.75	
DVD	7	66.79	2o.84	68.3	O.15
TVD	10	69.27	16.371	69	
CK-MB					
MINIMAL DISEASE	11	62.91	20.142	65	
SVD	22	73.14	20.469	7o	O.541
DVD	7	69.71	17.895	72	
TVD	1o	77.8	22.o65	73	

Out of these 50 patients who received treatment for acute myocardial infarction, 5 underwent primary coronary intervention, 40 received thrombolysis with fibrinolytics, & 5 had delayed presentations with Evolved myocardial

infarction. The latter group underwent percutaneous coronary intervention after anticoagulant treatment. The coronary angiography lesions in these 50 patients were analyzed in relation to GGT and CK- MB values. The Kruskal-Wallistest yielded p values of 0.15 and 0.541 for these variables concerning the coronary angiographylesions. These test results suggest that there isn't a significant connection among the number of coronary vascular lesions and GGT as well as CK-MB values. The distribution of vessel diseases in relation to GGT and CK-MB is showed in figure 4.

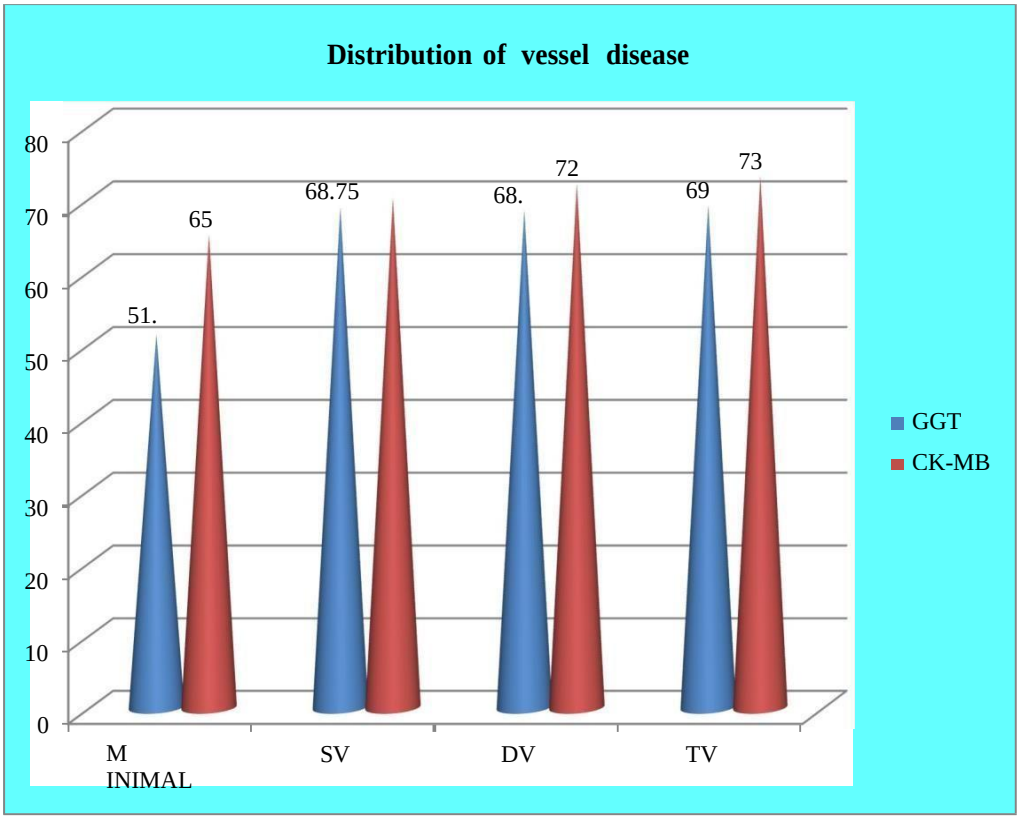


Figure 4. Association of GGT and CK-MB with number of vessel disease

CORRELATION BETWEEN GGT and CK-MB AND CORONARY ANGIOGRAPHY LESIONS

The coronary angiography lesions in the group of 50 patients have been examined alongside GGT and CK- MB levels. The occlusive lesions on coronary angiography varied ranging 30% to 95%. Those lesions were classified within the two groups: one with stenotic lesions below 50% and the other with stenotic lesions exceeding 50%. GGT, CK-MB levels, and age distribution were compared between these 2 groups based on their respective stenotic lesions in the coronary angiography. The outcomes of this analysis are presented in table 5, which illustrates the association between GGT and CK-MB levels and the percentage of stenotic lesions within coronary angiogram.

	Coronary angiogram lesion(< 5o%)				Coronary angiogram lesion(≥5o%)				
	Mean	Std. Deviation	Std. Error	Median	Mean	Std. Deviation	Std. Error	Median	P value
Agein yrs	37.86	9.155	3.46	35	51.65	9.863	1.5o4	5o.1	o.oo1*
GGT	47.56	18.757	7.o89	49.4	68.4	21.185	3.231	68.3	O.o19*
CK-MB	56.71	17.96	6.788	65	73.72	19.983	3.o47	72	O.o73

The average GGT, CK-MB levels, & age distribution among patients having coronary angiography lesions of less than 50% stenosis were 47.56 U/L, 56.71 U/L, and 37.86 years, respectively. Similarly, patients with stenotic lesions of more than 50% had average GGT, CK-MB levels, and age distribution of 68.4 U/L, 73.72 U/L, and 51.65 years, accordingly. Many patients exhibited both double & triple vessel disease lesions within respective coronary angiograms. To compare variables, the highest percentage of lesion within one vessel was considered in relation to the other vessels.

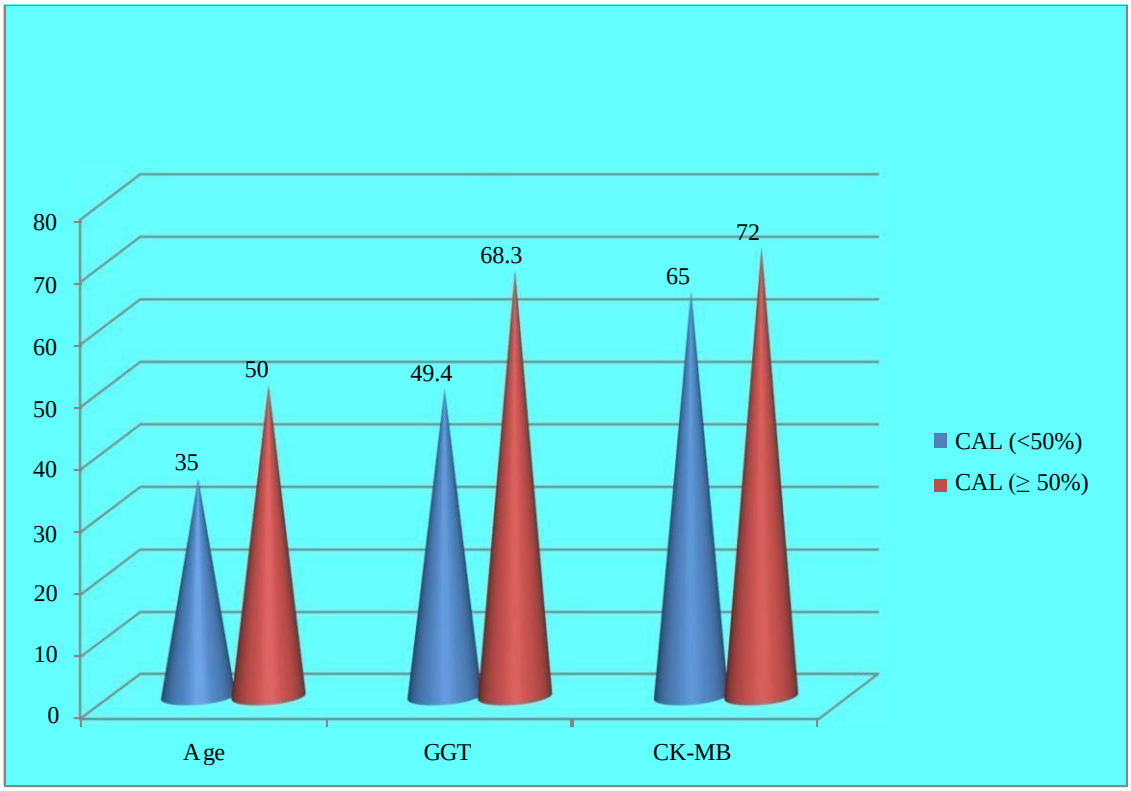


Figure 5. Distribution of GGT, CK-MB and Age based on Coronary Angiography lesion(CAL).

The significance of the association between coronary angiography lesions and GGT, CK-MB, and age distribution was assessed using Mann-Whitney U tests, yieldingp-values of 0.019, 0.073, and 0.001, respectively, as indicated in the table. The p-value of 0.019 (<0.05) for GGT indicatesa significant association with the severity of stenotic atherosclerotic lesions in the coronary angiogram. Similarly, the p-value of 0.001 (<0.05) for age distribution also demonstrates a significant association with the extent of stenotic atherosclerotic lesions in the coronary angiogram. The distribution of GGT and CK-MB based on coronary angiographic lesions was depicted and presented in Figure 5.

	Coronary angiogram lesion [CAL] (%)	
	r value	**p value**
AGE in yrs		
GGT		
CK- MB	O.436	o.oo2**
Ejection fraction	O.443**.	O.oo1**
GGT and CK- MB	0.350*	o.o13*
	-0.241	o.o92
	O.81o	0.001**

Spearman rank correlation *(p<0.05)

The comparison of these variables with coronary angiography lesions was conducted using Spearman correlation coefficients. The results were organized and displayed in Table 6. The data reveals a noteworthy relationship between the variables GGT, CK-MB, and Agewith the coronary angiography lesion.

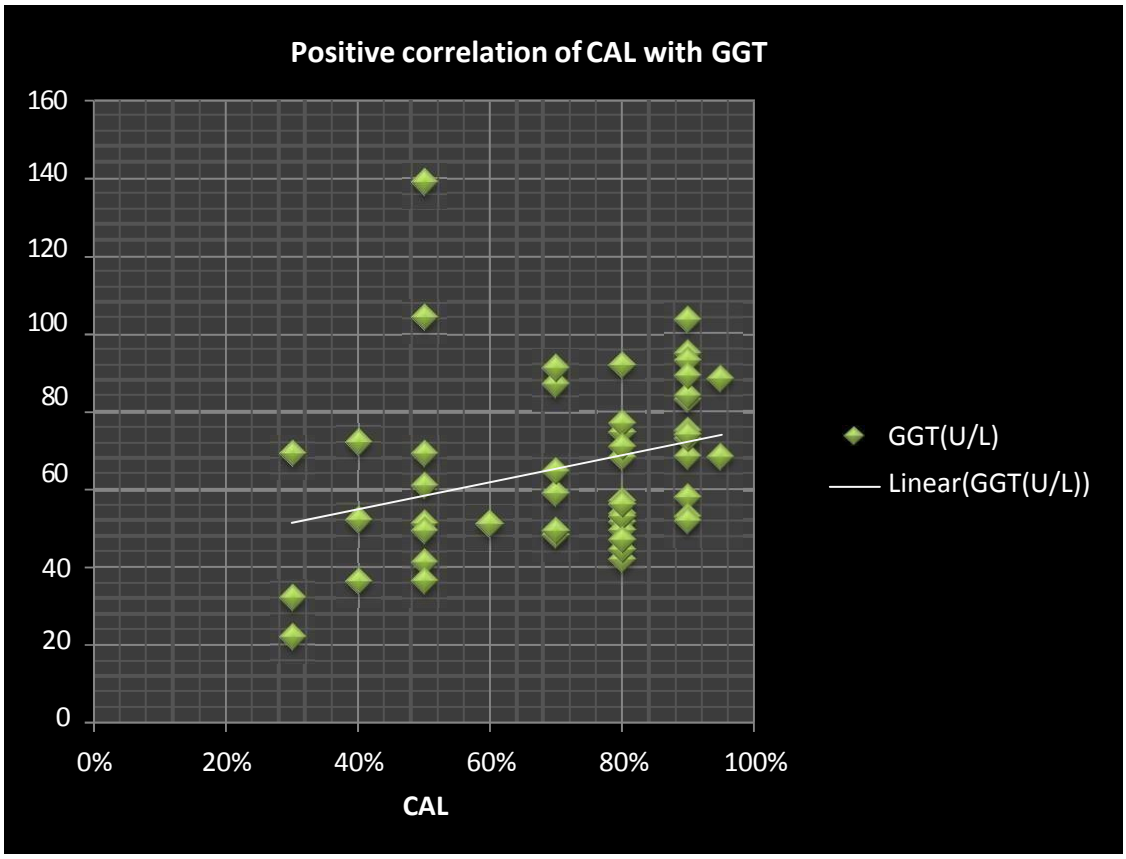


Figure 6 illustrates the Spearman correlation between the GGT variable and coronary angiography lesions. The Y-axis represents GGT values, while the X-axis represents the percentages of coronary angiography lesions. The graph portrays GGT values on the Y-axis corresponding to the respective values of coronary angiography lesions on the X-axis for all 50 patients. The outcomes of this correlation analysis are displayed in Figure 6.

The X-axis displays the coronary angiography lesion percentages for all 50 patients in the graph. The outcomes of the correlation analysis are depicted in Figure 6.When comparing GGT with coronary angiography lesion, the obtained r value is 0.443 and the p value is 0.001. The positive r value of 0.443, as shown in the linear correlation in Figure 6, indicatesa positive linear relationship between the variable GGT and coronary atheromatouslesions in the coronary angiography. This suggests that GGT levels increase with the formation of atheromatouslesions in the coronary vessels.

Certainly, an increase in GGT levels among patients, especially after accounting for and excluding confounding factors, could serve as an indirect indicator of a higher risk for atherosclerotic coronary vascular disease in the future. This information could prompt the initiation of preventive measures aimed atreducing the risk of further progression of atheromatousplaque formation. By taking action before complicationsarise, the patient's health can besafeguarded.

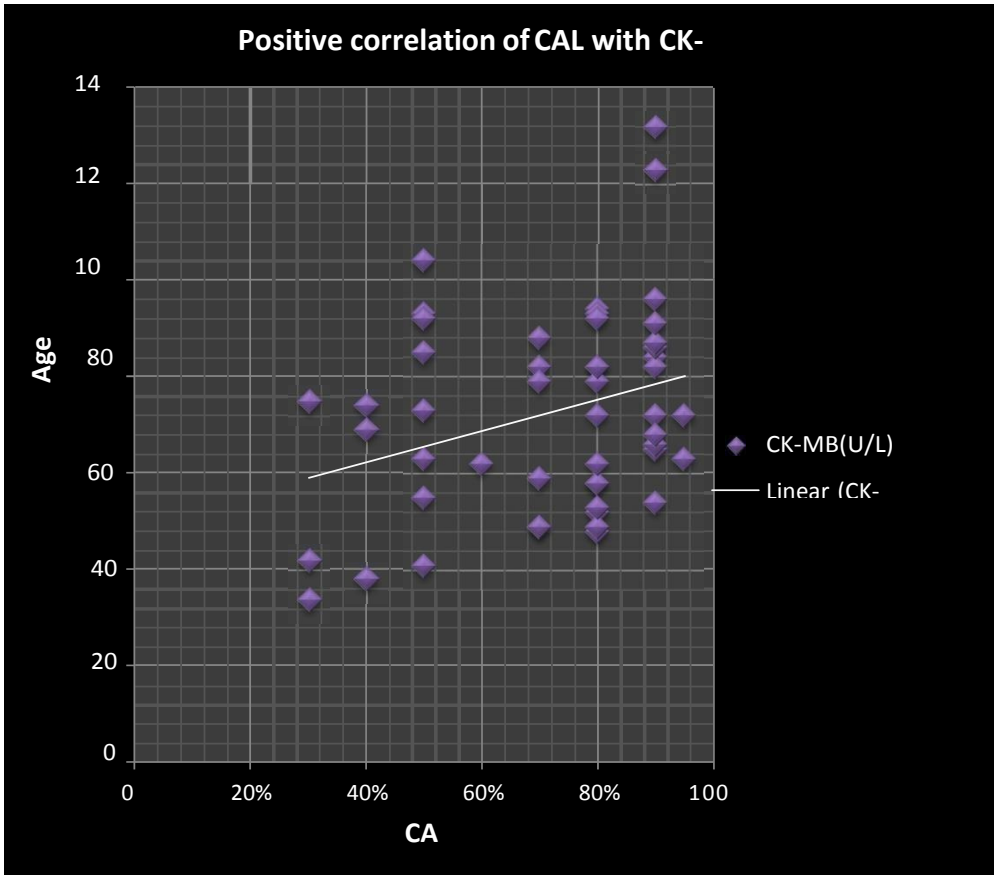
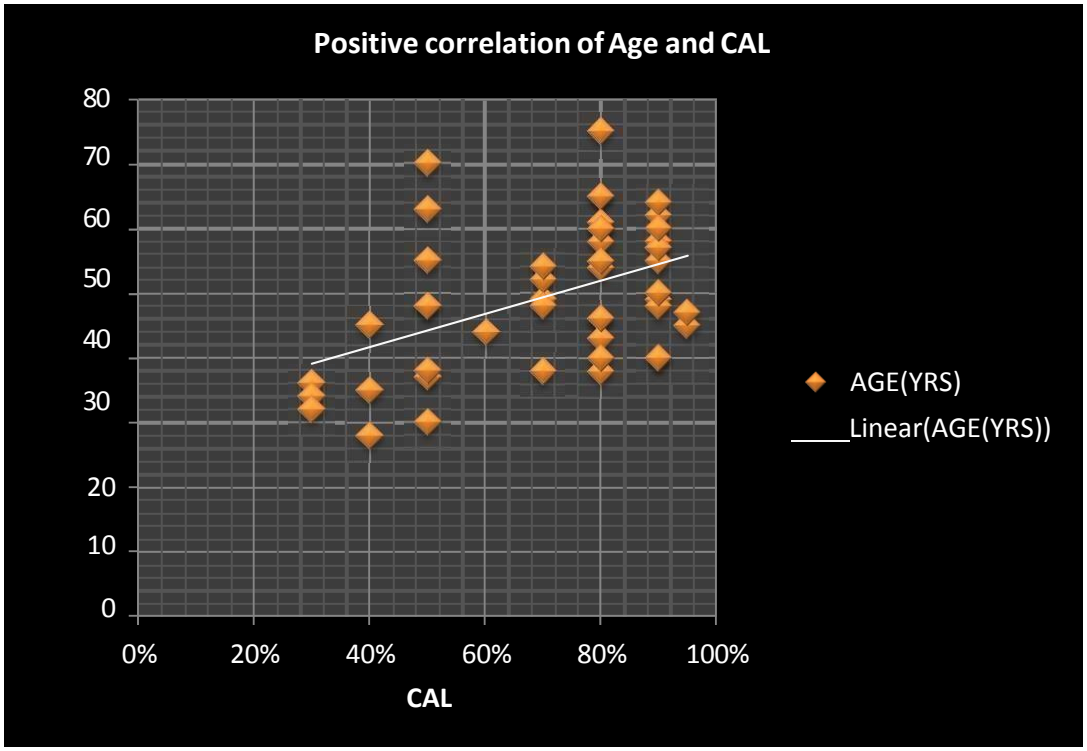


Figure 7. Correlation of CK-MB with Coronary Angiography Lesion.

The CK-MB values are represented on the Y-axis, whilethe percentages of coronary angiography lesions are plotted on the X-axis. The plotted values in Figure 7 indicate a positive linear correlation between CK-MB and coronary angiogram lesions. The calculated r valueis 0.350 and the p value is 0.013, as displayed in Table-4 These results signify a significant positive relationship between the CK-MB variable and coronaryangiographylesions.



On the Y-axis, the patient's age is depicted, while the percentages of coronary angiography lesions are represented on the X-axis. The plotted values in Figure 8 illustrate the percentage of coronary lesion corresponding to each age, revealinga significant linear positive correlation between the age of the patient and the coronary angiography atheromatouslesion. The computed r value is 0.436, and the associated p value is 0.002, as indicated in Table 6. This information emphasizes a noteworthy relationship between the patient's age and the extent of coronary angiography atheromatouslesions.

Table 7. Univariate logistic regressionfor CKMB and GGT valuestaking Coronary Angiographic lesionas dependent variable.

variables	Beta coefficient				Odds ratio	95.o% C.I. for Odds ratio	
						Lower	Upper
AGE in yrs	O.137	O.o67	4.228	O.o4*	1.147	1.oo6	1.3o8
GGT	O.o51	O.o59	O.733	O.392	1.o52	O.937	1.182
CK- MB	-o.o13	O.o58	O.o51	O.822	O.987	O.882	1.1o5
Constant	-6.397	2.868	4.977	O.o26	O.oo2		

Variables with a significant p-value of less than 0.10 in the univariate analysis were considered for inclusion in the model. As indicated by the notation *($p < 0.05$), Table 7 presents the outcomes of bivariate logistic regression analyses, comparing patients based on predictor factors in coronary atherosclerosis. The logistic regression model, as a whole, exhibited statistical significance ($\chi^2 = 14.01$, $p = 0.03$*), implying that the predictor variables integrated into the model effectively distinguish between subjects in a consistentmanner concerning mortality.

In our study, among the 50 patients, 4 patients experienced fatalitiesdue to complications. Specifically, one patientpassed away from cardiogenic shock, two patients succumbed to arrhythmia,and one patient's demise resulted from left ventricular failure. On the other hand, 46 patients were discharged from the hospital withoutmajor complications. Notably, the GGT value did not exhibit a correlation with the patient outcomes. The patientwho passed away due to cardiogenicshock did so on the third day of admission, while those who died from arrhythmia did so on the second and third days of admission. The patient who experienced left ventricularfailure passed away on the fifth day.

Area Under the Curve					
Variables	Areaunder curve	Std.Error	P value	95% Confidence Interval for AUC	
				Lower Bound	Upper Bound
GGT	.772	.o99	.o22*	.578	.967
CK-MB	.713	.1o3	.o74	.51o	.915

(* significant at $p < 0.05$)

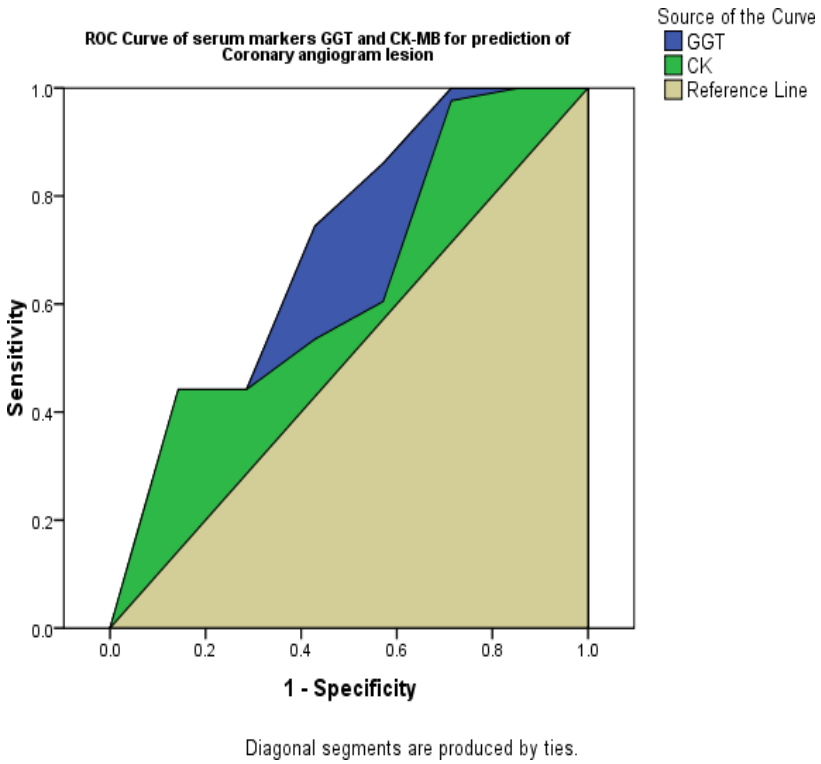


Figure 9. ROC Curve of GGT and CK-MB

Table 9. ROC curve for initial prediction of markers foratherosclerosis

Atherosclerosis Markers	Cut-off value	Sensitivity(%)	Specificity(%)
GGT	≥52.50*	72	71.4
CK-MB	≥65.5	58.1	57.1

In our analysis, a serum GGT level equal to or exceeding 52.5 U/L was identified as a predictor factor for coronary atherosclerosis with a significance level of $P < 0.022$. The sensitivity of this predictor was found to be 72%, while the specificity was 71.4%. The area under the ROC curve (AUC) for this predictor was calculated to be 0.772, indicating its discriminatory power in distinguishing individuals with coronary atherosclerosis.

The study has several limitations:

1. Lack of Intervention: The study did not involve any intervention, potentially limitingthe exploration of cause-and-effect relationships.
2. Small Patient Group: The study had a limited number of patients admitted to a single hospital, which might reduce the generalizabilityof findings
3. Focus on Acute Coronary Syndrome: The study exclusively concentrated on certain forms of acute coronary syndrome, possibly excluding insights intoother variationsof the condition
4. Incomplete Risk Factors Assessment: The study did not comprehensivelyaddress all risk factors associated with myocardial infarction, potentiallyaffecting the overall understanding of the condition'scomplexity.
5. Lack of PopulationComparison:GGT levels were not compared to those of a broader populationatrisk, which could limit the context and interpretation ofthe results.
6. Limited Scope in AtheroscleroticDiseases: Thestudy did not explore GGT in relation to other atherosclerotic diseases, such as Stroke or Metabolic Syndrome, potentially missing broaderinsights into GGT's role in these conditions.

Conclusion

In conclusion, Gamma glutamyl transferase (GGT) serves as a convenient, rapid, and effective marker of atherosclerosis. It provides insight into the extent of atherosclerosis among patients with myocardial infarction. While

coronary angiography remains the definitive investigation for myocardial infarction, GGT can serve as an indirect screening tool for atherosclerotic burden in these patients. Its widespread availability and cost-effectiveness make it a valuable addition to clinical practice. Therefore, GGT can be employed as a supplementary marker for predicting atherosclerosis in individuals at risk. It also holds potential as a marker for identifying premature coronary artery disease. Our study specifically identified a serum GGT level of 52.5 U/L or greater as a predictor factor for coronary atherosclerosis with a p- value of <0.022, sensitivity of 72%, and specificity of 71.4%. However, further investigations involving largerpopulation groups across multiple hospital centers areessential for comprehensive validation.

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