

Gamma Glutamyl Transferase levels in patients with Acute Coronary Syndrome: An Analytic Study

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Abstract

Background & Objectives: Oxidative stress is believed to play a central role in the development and progression of atherosclerosis. Gamma-glutamyl transferase (GGT) has been recognized in several studies as an indicator of oxidative stress and has shown an association with coronary artery disease (CAD). However, information regarding the variation of GGT levels in patients with acute coronary syndrome (ACS) remains limited. The present study aimed to determine the proportion of ACS patients with elevated GGT levels and to identify factors associated with this elevation.

Methods: An Analytical study was conducted in the Intensive Cardiac Care and Medicine Department SMS Medical college and hospital Jaipur. All consecutive ACS patients aged above 18 years were enrolled. Diagnosis of ACS was based on clinical history, ECG findings, and relevant biochemical markers. Serum GGT was measured using an enzymatic colorimetric method. The prevalence of elevated GGT in ACS was presented as a percentage. Unadjusted odds ratios (ORs) and multivariate logistic regression were used to evaluate the

association between independent variables and raised GGT levels.

Results: In present study STEMI was the most common presentation of ACS (40% cases). Among these patients, 61.3% had raised serum GGT levels. Increase in GGT was more significant in NSTEMI than STEMI groups (60.60 IU/L in NSTEMI versus 55.8 IU/L in STEMI) and the difference between NSTEMI and STEMI on GGT level and prevalence was significant. The prevalence of raised GGT in NS TEMI was higher than STEMI (84.48% in NSTEMI versus 61.29 %in STEMI).

Interpretation and Conclusion: Serum GGT activity is higher among individuals presenting with ACS. Elevated GGT at admission correlates with the extent of atherosclerotic burden in ACS patients.

Keywords: Acute coronary syndrome, Coronary artery disease, Gamma-glutamyl transferase, Oxidative stress

Introduction

The term acute coronary syndrome (ACS) includes unstable angina (UA), non -ST-segment elevation myocardial infarction (NSTEMI) and ST -segment myocardial infarction (STEMI). ACS is generally the

first presentation of coronary artery disease (CAD), the leading cause of mortality and morbidity in many parts of the world. The underlying cause of ACS is a sudden rupture of a pre-existing atherosclerotic plaque. Patients who survive acute phase of myocardial infarction remain at risk of recurrent cardiac events, including sudden death.¹⁻³ Gamma-glutamyl transferase (GGT), catalyse the first step in the degradation of extracellular glutathione (GSH), allowing for the precursor amino acids to be assimilated and reutilized for intracellular GSH synthesis. Thus in this way, GGT activity favors the cellular supply of GSH, the most important non-protein antioxidant of the cell. Serum GGT has been proposed as a marker of oxidative stress. Several mechanisms are known to regulate the pathogenesis of coronary artery disease and oxidative stress is one of them. GGT contributes to oxidative stress pathways in several organ systems, localizes to atheromatous plaques containing oxidized LDL, and is pro-inflammatory, further implicating this protein in atherogenesis⁴⁻⁵. Several studies demonstrated that an elevated serum GGT activity can be used as a marker for increased oxidative stress in humans.⁶⁻⁷ High levels of serum GGT have been shown to be associated with the development of CAD risk factors such as diabetes mellitus (DM), hypertension and metabolic syndrome.⁸

Aims and Objectives of the Study

1. The Aim of study is to determine the frequency of raised serum Gamma Glutamyl Transferase levels in cases presenting with acute coronary syndromes.
2. To determine the association between raised GGT levels and risk factors for acute coronary syndrome.

Materials and Methods

Study Design: Hospital based observational study

Study Type: Analytical study

Study Place: Medicine department of SMS Hospital Jaipur.

Study Duration: From April 2024 till the sample size achieved plus 1 month for Data compilation and statistical analysis.

Sample Size: Sample size was calculated at 95% confidence level & Alfa error of 0.05 and a relative error 20% of assuming prevalence of GGT among ACS was 41.80% (as per article). The required sample size would be 141.55, after further rounded off 155 subject as a final sample size with 10% attrition.

Inclusion Criteria

All patients admitted with an episode of Acute Coronary Syndrome in the Emergency care unit of SMS Hospital. Willing to give consent.

Exclusion Criteria

1. History of alcohol intake
2. History of ongoing chronic hepatobiliary disease including cirrhosis
3. Surgical conditions causing obstructive jaundice
4. History of Neoplasia
5. Enrolled in other study

Results

In our study population out of 155 patients, STEMI Patients were 62, NSTEMI patients were 58 and Unstable Angina patients were 35.

Here, age-wise distribution demonstrated that the majority of patients belonged to the 60–69 years age group (38.71%), followed by 50–59 years (32.90%). Only 1.29% of the patients were younger than 40 years. The prevalence of raised GGT levels varied slightly across age groups, with the highest mean GGT level noted in the 40–49 years age bracket (61.68 IU/L).

Table 1: Association of Raised GGT with various parameters

Parameters	Total cases	% Of cases	GGT Raised cases	% Out of total cases
Male	116	74.84	77	66.38
Female	39	25.16	32	82.05
DM Yes	76	49.03	60	78.95
DM No	79	50.97	49	62.03
Smoking Yes	59	38.06	50	84.75
Smoking No	96	61.94	59	61.46
HTN Present	64	41.29	49	76.56
HTN Absent	91	58.71	60	65.93
Dyslipidaemia Yes	66	42.58	46	69.70
Dyslipidaemia No	89	57.42	63	70.79
STEMI	62	40.00	38	61.29
NSTEMI	58	37.42	49	84.48
UA	35	22.58	22	62.86

In our study of 155 patients 62 had ST elevation in their Ecgs, 58 subjects suffered from NSTEMI, and 35 patients had unstable angina. 38 out of 62 patients with STEMI were positive for GGT. 49 out of 58 patients were positive for GGT while 22 out of 35 patients of unstable angina subset had a positive GGT value. Therefore, there is a highly significant correlation between type of ACS and GGT levels with STEMI, NSTEMI and Unstable Angina showing positive values. Out of the 155 subjects, 64 were hypertensive. 49 out of 64 hypertensives were positive for GGT. There is a significant correlation between hypertension and GGT. 76 patients out of 155 in the study population were diabetics and 79 non-diabetics. 60 patients out of the diabetic group were positive for GGT. There is a significant correlation between diabetic status and GGT levels in this study.

59 subjects in the study population were chronic smokers. 50 of them turned out to be positive for GGT. There is a significant correlation between smoking status and the rise in GGT.

66 patients out of 155 in the study population were with Dyslipidemias and 89 non-dyslipidaemic. 46 patients out of the dyslipidaemic group were positive for GGT. There is significant correlation between dyslipidemias and GGT levels in this study. There is no significant correlation between gender and GGT positivity in this study

Figure 1:

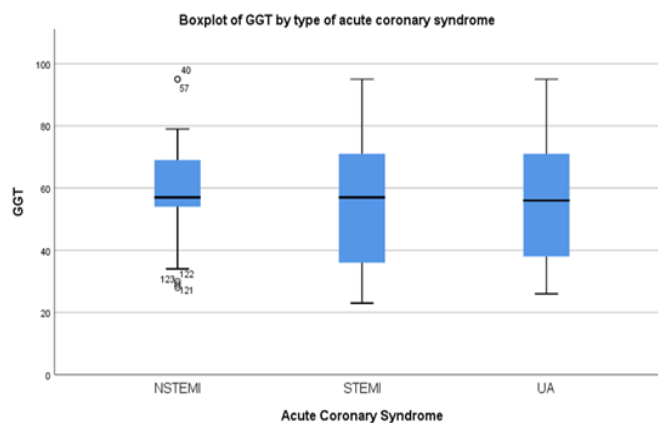


Table 2: Correlation with GGT with various parameters

Parameter	Correlation with GGT	
	“r”	P value
Gender	-0.017	0.798
DM	-0.391	<.001
Smoking	-0.237	<.001
HTN	-0.393	<.001
Dyslipidaemia	-0.147	0.029
Age	0.14	0.082
Total Cholesterol	0.1	0.215
LDL	0.171	0.034
HDL	-0.29	<.001
Vitamin B12	-0.197	0.014

Table 3: Likelihood Ratio Tests

Parameter	P value
Age	.477
ACS Type	.003
Gender	.053
DM	.209
Smoking	.002
HTN	.788
Dyslipidemias	.929

ACS type and Smoking have a significant overall effect on the GGT

Table 4: Regression Model for GGT Raised with various parameters

	Parameters	B	Std. Error	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
						Lower Bound	Upper Bound
GGT Raised	Age	-.014	.020	.483	.986	.948	1.026
	STEMI	.157	.504	.756	1.170	.435	3.143
	NSTEMI	1.547	.550	.005	4.696	1.599	13.786
	UA	0	.	.	.	.	.
	Male	-.933	.506	.065	.393	.146	1.060
	Female	0	.	.	.	.	.
	DM Present	.645	.521	.215	1.906	.687	5.292
	DM Absent	0	.	.	.	.	.
	Smoking Yes	1.440	.501	.004	4.222	1.583	11.265

Smoking No	0	.	.	.	.	.
HTN Present	-.154	.574	.788	.857	.278	2.640
HTN Absent	0	.	.	.	.	.
Dyslipidemias yes	-.037	.417	.929	.964	.425	2.184
Dyslipidemias No	0	.	.	.	.	.

Correlation Analysis

Correlation tests showed:

- Significant negative correlations between GGT and DM, smoking, HTN, HDL, and Vitamin B12 ($p < 0.05$).
- Positive but weaker correlations with age, total cholesterol, and LDL, though not consistently significant.

Multinomial Logistic Regression

Model fitting results indicated a significantly better fit compared to the null model ($p = 0.000$). In the likelihood ratio tests:

- ACS type ($p = 0.003$) and smoking status ($p = 0.002$) showed significant overall effects on raised GGT levels.
- Other variables such as age, diabetes, hypertension, gender, and dyslipidemias did not show significant effects.
- NSTEMI patients had a statistically significant higher likelihood of raised GGT (OR = 4.696, $p = 0.005$).
- Smoking was also a strong predictor of raised GGT (OR = 4.222, $p = 0.004$).

Discussion

In recent years emerging evidence has shown that serum GGT is more than a mere marker of alcohol consumption or hepatobiliary dysfunction. Baseline serum GGT concentration appears to be an independent risk factor for development of cardiovascular disease. The rupture of an atherosclerotic plaque is the cause of acute coronary syndrome. Inflammation plays a key role in the

development of atherosclerosis and acute coronary syndromes. GGT was found to play a role in the pathogenesis of atherosclerosis because it was detected in atheromatous plaques of carotid and coronary arteries triggering the oxidation of LDL. Relatively few studies have been performed in past to formally assess the usefulness of GGT Levels in ACS and evaluate the association between serum GGT level and risk factors of CAD like Diabetes Mellitus, hypertension, Dyslipidemia and smoking and to Compare the serum GGT level in UA, NSTEMI and STEMI patients. The present study was conducted on patients of ACS admitted in SMS and attached hospitals, Jaipur on 155 ACS patients admitted at SMS Medical College, Jaipur. In our study we recruited 62 cases of STEMI, 58 cases of NSTEMI and 35 cases of UA.

GGT and DM in the present study the mean GGT was higher in Diabetics than non-diabetics (65.07IU/ml in DM patients versus 50.47 IU/ml in non-diabetics) In our study the increased GGT level show significant association with DM ($p < 0.001$).

Similarly, Lee DH et al.¹⁰ (2003) in their study found that mean GGT level in DM patients was higher than non-diabetic patients which is similar to our results.

Similarly, Shabbir S et al.¹¹ (2011) in their study found that mean GGT level in DM patients was higher than non-diabetic patients which is similar to our results.

Similarly, Desai GMRR et al.¹² (2014) found that the increased GGT level show significant association with DM.2 56 Discussion Similarly our results are consistent

with results of Mao Y et al.¹³ And Emiroglu et al.^{14,15}, Puukka K et al.

GGT and Smoking

In the present study the mean GGT was higher in smokers than non-smokers. (63 IU/ml in smokers versus 54.32 IU/ml in non-smokers) In our the increased GGT level show significant association with smoking ($p < 0.001$). Puukka K et al.¹⁴ also found that GGT level show significant association with smoking which is consistent with our results.

GGT and Lipid profile

In the present study the mean GGT was higher in patients with abnormal lipid profile in comparison to patients with normal lipid profile. (61.00 IU/ml versus 55.12)

In our study, significant association of GGT was found with dyslipidemia (association was not found with raised TG, cholesterol, LDL but show significant association with low HDL levels). However, Jyoti et al.⁹ (2017) in their study found no significant association of dyslipidemia and GGT levels. Shabbir S et al.¹¹ (2011) in their study found significant association of dyslipidemia and GGT levels which is consistent with our results. Ruttman E et al. (2005) in their study found significant association of lipid profile and GGT levels which is consistent with our results.

GGT and ACS Category

In present study STEMI was the most common presentation of ACS (40% cases), among these patients 61.3% had raised serum GGT levels. Increase in GGT was more significant in NSTEMI than STEMI groups (60.60 IU/L in NSTEMI versus 55.8 IU/L in STEMI) and the difference between NSTEMI and STEMI on GGT level and prevalence was significant. The prevalence of raised GGT in NSTEMI was higher than STEMI (84.48% in NSTEMI versus 61.29 % in STEMI).

Jyoti et al.⁹ (2017) in their study found that subjects with NSTEMI had higher prevalence of raised GGT, compared to subjects with STEMI and UA which is consistent with our results. Similarly Emiroglu et al.¹⁵ in their study found that GGT value varies with category of ACS and was higher in NSTEMI than STEMI which is consistent with our results. Some studies had found that major adverse cardiac events (cardiovascular mortality) were independently associated with raised GGT level.¹⁴⁻²³. However, our study lacked the follow up analysis of cardiovascular event and mortality.

Conclusion

The Analytical study was conducted in Medicine SMS Medical College and attached Hospital from April 2024 to 10 December 2024 on 155 patients of ACS. The mean and standard deviation of all parameters was calculated in accordance to accepted statistical methods. The difference in mean of various parameters was tested for significance using unpaired 't' test and Chi square test. From the observation it has been concluded that:

1. GGT activity is increased in subjects with ACS. High levels of serum GGT on admission were associated with the burden of atherosclerosis in patients with ACS.
2. As serum GGT is a cost effective and simple vascular risk marker, its routine measurement on admission may be helpful in determining high risk patients of ACS in clinical practice.
3. Further studies with larger numbers of patients will provide more informative data on this subject.

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