

Frequency of High Total Cholesterol to HDL Ratio with Acute Myocardial Infarction

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ABSTRACT

Objective: To evaluate the frequency of high total cholesterol/HDL ratio in patients with acute coronary syndrome who present with acute myocardial infarction.

Methodology: This Cross Sectional Study was conducted at POF Hospital wah cantt and a total of 100 patients who fulfilled the inclusion criteria and presented with acute myocardial infarction to the POF Hospital in Medicine department Wah cantt participated via non probability consecutive sampling. All patients underwent electrocardiography and the high sensitivity Troponin I levels were checked for confirmation of acute myocardial infarction. Once the diagnosis was confirmed, all patients underwent testing for serum total cholesterol, serum HDL levels and total cholesterol levels. The data were collected in a specially designed proforma.

Results: A total of 100 patients were included in our study and their mean age was 46.89 ± 9.04 years. Forty-five patients out of total had high total cholesterol/HDL ratio. The stratification further revealed that high total cholesterol/HDL was more prevalent in females and those suffering from STEMI as compared to NSTEMI.

Conclusion: High total cholesterol/HDL ratio is common among patients presenting with acute MI and hence its utilization can be done as an important diagnostic tool for screening dyslipidemia, a major risk factor for atherosclerosis.

Keywords: Cholesterol, HDL, Lipoprotein, Myocardial infarction

Authors' Contribution:

^{1,2}Conception; Literature research; manuscript design and drafting; ^{2,3}Critical analysis and manuscript review; ^{5,6}Data analysis; Manuscript Editing.

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Introduction

Coronary artery disease (CAD) is among the most prevalent medical conditions that affects more than 120 million individuals globally with 9 million with significant mortality.¹ The occurrence of cardiovascular disease in Pakistan is quite high with approximately above 900 per 100000 as compared with the worldwide incidence of approximately 680 per 100000 highlighting the increased disease burden. The condition involves narrowing and blockage of the coronary vasculature hence leading

to impairment in pumping of heart. Timely identification and the addressing of the preventable determinants is helpful for reducing disease incidence and burden.² Hypertension, poorly controlled diabetes, chronic kidney disease, smoking and dyslipidemia are among the major risk factors for atherosclerotic coronary vascular disease.³ Dyslipidemias have been considered as one of the major risk factors for coronary vascular disease and comprises elevated total, triglycerides and low-density lipoprotein levels. Various studies

have been done highlighting the association of lipid abnormalities with ischemic heart disease however the total cholesterol/HDL ratio has gained a special importance,^{4,5} that is often neglected in clinical practice.

Numerous factors have been attributed with dyslipidemias including smoking, alcoholism, poor dietary and lifestyle habits.⁶ Literature review has revealed that a ratio of Total cholesterol/HDL more than 4.0 is linked with increased cardiovascular thrombosis therefore target is to keep it below that range.⁷ Lab tests for evaluation of dyslipidemias includes fasting lipids profile while management involves dietary, lifestyle modification and lipid lowering drug therapy like Statins and fibrates etc. Dyslipidemias is among one of the important risk factors for coronary artery disease which includes myocardial infarction commonly known as heart attack. Studies revealed atherosclerosis as a primary risk factor myocardial infarction that is associated with lipid abnormalities and hence prevention and management of dyslipidemias is pivotal to minimize the incidence of acute ischemic events.⁸ Acute myocardial infarction can manifest on ECG with abnormalities that may be either elevation of ST segment or non-elevation along with elevated troponin levels.⁹ Patient with acute myocardial infarction may develop complications including impairment in cardiac function, arrhythmia and long term effects.¹⁰

Diagnosis of acute myocardial involves history, physical examination, ECG findings and elevation of cardiac biomarkers including troponins.¹¹ The main goals of treatment after an acute myocardial infarction is directed towards restoring the balance between the oxygen supply versus requirement so as to avoid progression of ischemia, relief from symptoms particularly pain and treatment of complications.¹² All patients with acute attack are given anti platelets including Aspirin, Clopidogrel, sublingual nitrates, pain relief and statin as initial basic management.¹³ The mainstay of treatment of ST elevation MI involves either thrombolytic

treatment or percutaneous angioplasty(PCI) depending on door-to-balloon time. The goal of treatment for acute ST elevation myocardial infarction is the desired door to needle time of less than 30 minutes while the door to balloon time should be less than 90 minutes.¹⁴ The guidelines do not recommend immediate primary PCI in patients with non-ST elevation MI however anti platelet therapy should be immediately started and urgent PCI can be considered during hospital stay in certain circumstances.¹⁵

As there is significant and strong link between dyslipidemias and ischemic coronary vascular disease, for evaluation in high-risk patients the testing of lipids panel is commonly advised focusing on total cholesterol, triglycerides and HDL levels during the workup of patient however the ratio of total cholesterol to HDL is not widely used parameter especially in our setting. It has been observed that the elevated total cholesterol to HDL ratio is an effective and better indicator to predict chances of ischemic heart disease and acute myocardial infarction.¹⁶ A ratio of < 3.5:1 is considered as normal while value above 5:1 is associated with increased risk of ischemic coronary vascular disease. We conducted this study to observe the significance of total cholesterol to HDL ratio in acute myocardial infarction in our population so that this simple parameter can be utilized in our patients, hence promoting timely management to prevent complications linked with acute myocardial infarction and ischemia.

Methodology

This cross-sectional study was conducted at POF hospital Wah cantt from July 10, 2022 to January 15, 2023 after taking approval from the hospital ethical committee. A total number of 100 patients between age 18 to 70 years, of either gender, diagnosed with acute myocardial infarction in the inpatient department of POF hospital were included in the study. The sample size was calculated using the WHO sample size calculator

with Confidence Level 95%, Anticipated population proportion (P) = 0.461, Absolute Precision= 0.1, the sample Size was 100. Nonprobability convenient sampling technique was used. Patients who had a history of familial disorders of lipid metabolism such as familial combined hyperlipidemia, familial hyper abetalipoproteinemia, familial hypertriglyceridemia, past history of myocardial infarction, cardiac intervention for acute coronary syndrome, taking therapy for deranged lipid profile, past or current history of other disorders causing dyslipidemias such as hypothyroidism, diabetes mellitus or Cushing's Syndrome, history of alcohol abuse or recreational drug use were excluded from the study. All patients underwent electrocardiography and testing of high sensitivity Troponin I levels for confirmation of acute myocardial infarction. All patients underwent testing for serum total cholesterol and serum HDL levels after an 8-hour over-night fasting period. Serum total cholesterol, total cholesterol to HDL cholesterol ratio and serum HDL cholesterol were checked whereas ratio of 5:1 or more was considered as elevated. We used SPSS Version 26 to analyze our data. Descriptive statistics were analyzed for all the variables. Numerical variables specifically age, height, weight, body mass index, serum total cholesterol level, serum HDL cholesterol and ratio of total cholesterol to HDL were analyzed by mean and standard deviation. Categorical variables particularly gender, body mass index, smoking status, type of myocardial infarction present and ratio of total cholesterol to HDL was high or normal was analyzed as percentages and

frequency. The effect modifiers particularly age, gender, body mass index and smoking status were controlled by stratification. Chi square test was applied post stratification with of p value of less than 0.05 taken as statistically significant.

Ethical approval for the study was obtained from the ethical review board of POF Hospital, Wah Cant (No. IRB/POFH/05-2022Med/22) on 01-05-2022.

Result

In total 100 patients were included in our study with 78 male and 22 female patients. Mean age of the patients was 46.89 ± 9.047 year with majority (66%) of the patients between 41-80 years. Patients having BMI $>25 \text{ kg/m}^2$ (55%) were slightly more in number as compared to patients having BMI $<25 \text{ kg/m}^2$ (45%). Approximately 67% patients had NSTEMI while the remaining patients had STEMI. The overall frequency of high total cholesterol/HDL ratio in patients presenting diagnosed with acute MI was 45%. The female patients had significantly higher frequency of elevated total cholesterol/HDL ratio as compared with male patients (95.5% vs 30.8%). Among patients with STEMI (n=67), 37.3% (25) had high total cholesterol to HDL ratio. Contrarily among patients with STEMI, this high ratio was seen among 60.6% (n=20 out of 33 patients). There was no significant statistical difference related to age groups. Among patients with BMI $<25 \text{ kg/m}^2$, 51.1 % (n=23 out of total 45) had high total cholesterol to HDL ratio while 22 out of 55 patients with BMI $>25 \text{ kg/m}^2$ had elevated ratio.

Table I: Comparison of High total cholesterol/HD according to age

			Total cholesterol to HDL ratio		P-value
			Normal total Cholesterol to HDL Ratio	High total Cholesterol to HDL Ratio	
Age Category	13-40 years	Number	22.0	12.0	1.00
		Percentage	64.7	35.3	
	41-80 years	Number	33.0	33.0	
		Percentage	50.0	50.0	

Table II: Comparison of High total cholesterol to HDL according to gender.					
			Total cholesterol to HDL ratio		P-value
			Normal total cholesterol to HDL Ratio	High total cholesterol to HDL Ratio	
Gender	Female	Number	1.0	21.0	0.000
		Percentage	4.5	95.5	
	Male	Number	54.0	24.0	
		Percentage	69.2	30.8	

Table III: Comparison of High total cholesterol to HDL ratio according to BMI.					
			Total cholesterol to HDL ratio		P-value
			Normal total Cholesterol to HDL	High total Cholesterol to HDL Ratio	
BMI (kg/m ²)	< 25	Number	22.0	23.0	0.267
		Percentage	48.9	51.1	
	> 25	Number	33.0	22.0	
		Percentage	60.0	40.0	
Total		Number	55.0	45.0	
		Percentage	55.0	45.0	

Table IV: Comparison of High total cholesterol to HDL ratio according to type of MI					
			Total cholesterol/HDL ratio		P-value
			Normal total cholesterol/HDL ratio	High total cholesterol/HDL ratio	
Type of MI	Non-STEMI	Number	42.0	25.0	0.028
		Percentage	62.7	37.3	
	STEMI	Number	13.0	20.0	
		Percentage	39.4	60.6	
Total		Number	55.0	45.0	
		Percentage	55.0	45.0	

Discussion

We conducted this study to see the trends of elevated serum total cholesterol to HDL ratio in acute MI and noted high values. Calling S. et al found elevated total cholesterol/HDL ratio in patients with IHD and their study results indicated that the prognostic capability of total cholesterol to HDL ratio was better as compared with non-HDL cholesterol emphasizing the role of this useful tool for evaluation of patients with ischemia.¹⁵ Khan MA et al. also found that total cholesterol to HDL ratio was high in diabetic patients who had coronary

artery disease highlighting the importance of this parameter in screening those patients who are at high risk.¹⁶

An interesting point to note here is that total cholesterol to HDL ratio incorporates serum HDL level, which seems to be very vital in preventing atherosclerosis and cardiovascular diseases owing to its anti-inflammatory properties. Stratification on the basis of gender revealed that female patients presenting with myocardial infarction had a much higher frequency of high total cholesterol/HDL as compared to male patients. Pei G, Qin A, Dong L et

al revealed in their study that the higher total cholesterol to HDL ratio was more associated with the disease severity and even risk of acquiring advanced kidney failure and hence highlighting its importance in various conditions associated with thrombosis and inflammation.¹⁷ A study conducted in China uncovered that people with syndrome X had elevated total cholesterol to HDL ratio and syndrome X is linked with elevated risk of atherosclerotic coronary vascular disease.¹⁸

Total Cholesterol and lipids panel test is widely used in clinical practice in our country for evaluation and screening of patients with dyslipidemia and total cholesterol to HDL ratio is not adequately utilized despite its usefulness and predictive efficacy. Quispe R et al, observed that the ratio of serum total cholesterol to HDL cholesterol provides added information while evaluating patients who have elevated risk of acquiring IHD when compared with routinely used single lab parameters like HDL or non-LDL cholesterol.¹⁹ Keeping in view with our study results and the review of literature, utilization of this useful ratio as a tool for screening at risk population would be helpful in limiting the overall burden of IHD. We observed that elevated ratio of total cholesterol to HDL was more common in female patients so there may be genetic or gender related differences in lipids or metabolic profile, however further studies from different regions would be helpful to confirm this observation. Similarly, the elevated ratio was more frequently seen in patients who had ST elevation MI as compared with those having non-ST elevation myocardial infarction.

We had some limitations in our study, first of all it was conducted in one hospital covering one specific area, and therefore, generalization of these results cannot be made. Further studies preferably multi-centric or involving different regions of the country would be more helpful to determine whether rigorous attempts to normalize the initially high

total cholesterol/HDL levels have a positive impact in terms of decreasing cardiovascular events. Moreover, screening strategies targeting the specific age groups can include both total cholesterol and the HDL levels for better risk stratification.

Conclusion

- The ratio of total cholesterol to HDL is a useful parameter for assessment of atherosclerotic coronary vascular disease as evidenced by the observation that it is a pertinent collective parameter of the various metabolic derangements observed in people with dyslipidemia.
- This ratio is a useful, simple and effective tool to screen patients at risk of developing acute myocardial infarction and ischemic heart disease as compared to total cholesterol levels. Currently the use of this ratio in evaluation of ischemic heart disease is not routinely practiced, however we believe this simple parameter can be useful and effective for screening patients with dyslipidemias to reduce the incidence of acute coronary syndrome by timely management.
- Community based studies could be conducted to further strengthen the observation and people with high cholesterol/HDL ratio should be offered lifestyle modifications and statin therapy to reduce the burden and morbidity associated with coronary artery disease.

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