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RELATIONSHIP OF REMNANT CHOLESTEROL WITH BODY MASS INDEX IN PATIENTS OF MYOCARDIAL INFARCTION

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ABSTRACT:

BACKGROUND: *Remnant cholesterol is not only a link in the chain between obesity and ischemic heart disease, but also a direct contributor to the risk of cardiovascular illness. Remaining cholesterol's potential to increase cardiovascular risk is gaining attention. Although observational and genetic data suggests that higher levels of residual cholesterol in triglyceride-rich lipoproteins are associated with an increased risk of ischemic heart disease, direct measurements have not been able to determine what proportion of plasma cholesterol is present in remnant particles.*

AIMS & OBJECTIVE: *The focus of this study is to determine whether there is a correlation between body mass index and the quantity of cholesterol in the body after a heart attack.*

MATERIAL & METHODS: *The study was conducted at Department of Cardiology, Punjab Institute of Cardiology, Lahore from October 20, 2020 to April 20, 2021. Total 100 patients with myocardial infarction were enrolled in the study. Blood samples were taken through a disposable syringe under aseptic measures. Then all the samples were sent to the laboratory of the hospital for assessment of cholesterol level. Reports were assessed and remnant cholesterol was calculated. All patients were assessed of BMI i.e. height and weight were measured with the help of a staff nurse. The information was put into SPSS v25.0 for statistical analysis. The association between body mass index and residual cholesterol was determined using Pearson's correlation coefficient. The cutoff for significance was set at 0.05.*

RESULTS: *Total 100 patients with myocardial infarction were enrolled in the study. Gender distribution showed that 67(67.0%) were males while 33(33.0%) were females. The mean age of the patients was 50.53±14.90 years. The mean BMI of the patients was 29.83±4.33 kg/m^2 and remnant cholesterol index as 40.07±11.99 mg/dl. There was a positive correlation between remnant cholesterol and body mass index with a Karl Pearson correlation coefficient of 0.654 with p-value 0.00001.*

CONCLUSION: *Myocardial infarction risk is increased across the board when residual cholesterol is high, regardless of body mass index. This data implies that even in lean individuals, remnant cholesterol poses a risk for myocardial infarction. There is a favourable relationship between BMI and remnant cholesterol.*

KEY WORDS: *Myocardial Infarction, Body Mass Index, Remnant Cholesterol Index.*

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Author's Contribution: AA: Data collection, study design, concept. MU: Data analysis. BJ: Data collection. SA: Literature search. AF: Questionnaire design. NA: Data collection.

INTRODUCTION:

Dyslipidemia is a prevalent condition seen in individuals with diabetes, and it has been associated with a heightened susceptibility to both mortality and morbidity. Remnant cholesterol is a distinct category of lipoproteins that are characterised by their high triglyceride content. These lipoproteins have been shown to be closely linked to an elevated susceptibility to cardiovascular disease. Hyperlipidemia, a condition characterised by the excessive buildup of lipids inside the arterial endothelium, resulting in inflammation and subsequent development of coronary artery heart disorders, is mostly of hereditary origin.[1-2]

Nevertheless, the presence of elevated amounts of triglyceride-rich lipoproteins in some individuals has the potential to trigger the onset of acute pancreatitis. Cardiovascular illness arises due to heightened concentrations of low-density lipoprotein (LDL), remnant lipoproteins, and lipoprotein(a). Conversely, the occurrence of acute pancreatitis might be attributed to high levels of lipoproteins rich in triglycerides. The cholesterol that is carried by HDL-C, which primarily contain apolipoprotein A-I, can be easily separated from the cholesterol that is carried by a range of atherogenic lipoproteins including LDL-C and triglyceride-rich lipoproteins (also known as remnant cholesterol), which primarily all contain apolipoprotein B (apoB). This can be done by simply separating the total cholesterol content in the blood into these two categories.[3-4]

Remnant cholesterol is not only a link in the chain between obesity and ischemic heart disease, but also a direct contributor to the risk of cardiovascular illness. The debate over whether or not remnant cholesterol really increases cardiovascular risk is debatable. It is unknown whether patients with type 2 diabetes and remnant cholesterol who undergo percutaneous coronary intervention are at a higher risk for peri-procedural myocardial injury.[5-6]

Although observational and genetic data suggests that higher levels of residual cholesterol in triglyceride-rich lipoproteins are associated with an increased risk of ischemic heart disease, direct measurements have not been able to determine what proportion of plasma cholesterol is present in remnant particles.[7] Varbo et al., reported that there is significant positive correlation exist between BMI and remnant cholesterol, although weak ($r=0.346$). The history of myocardial infarction was positive in 1.5% patients with low remnant cholesterol, 2.2% in moderate remnant cholesterol, 2.7% in patients with moderately high remnant cholesterol and 2.7% in patients with severely high remnant cholesterol ($p<0.001$).[8]

Rationale of this study is to determine the correlation between BMI and remnant cholesterol level and compare the frequency of myocardial infarction in patients with different remnant cholesterol level. It has been observed through literature that there is significant correlation present between BMI and remnant cholesterol, although it was very weak.

But still there is a need to conduct further studies to confirm this relationship, as not much work has been done in this regard and no local data available in literature. So we wanted to conduct this study to get local evidence which could help us in determining the pattern of remnant cholesterol and BMI and its impact on myocardial infarction in local population. This will help us to alter the preventive strategies and better prognosis of candidate at risk of cardiovascular accidents.

METHODOLGY:

The research was carried out in the Department of Cardiology, Punjab Institute of Cardiology, Lahore, spanning from October 20, 2020 to April 20, 2021. Total 100 patients with myocardial infarction were enrolled in the study. The inclusion criteria were patients of ages between 35-65 years, either gender and patients presenting with myocardial infarction. The exclusion criteria were patients with valvular heart diseases, rheumatic heat disease, congenital heart disease, congestive heart failure (on medical record), underwent liposuction (on medical record).

With a type I error of 5%, a type II error of 10%, and the estimated correlation coefficient of $r=0.346$ between remnant cholesterol and BMI, a sample size of 100 patients was determined.8 The researchers acquired informed permission from the participants. The researchers also recorded the participants' personal information, including their name, age, gender, smoking status, diabetes status, BMI, and presenting complaint. Then blood

samples were taken through a disposable syringe under aseptic measures.

Subsequently, all the specimens were sent to the hospital laboratory for the purpose of evaluating the cholesterol levels. Reports were assessed and remnant cholesterol was calculated (as per operational definition). All patients were assessed of BMI i.e. height and weight were measured with the help of a staff nurse. Medical records were assessed for previous myocardial infarction as per operational definition.

Remnant cholesterol was calculated as total cholesterol – LDL – HDL. Unit used was mg/dl. BMI was defined as ratio of weight over height (square) i.e. kg/m2. Myocardial infarction was defined as patients having positive history of chest pain >30 minutes on rest, ST-segment elevation >1 mm on ECG with positive troponin >100 mIU and positive CK-MB >25 mIU.

The information was put into SPSS v25.0 for statistical analysis. Age, body mass index, cholesterol, and residual cholesterol levels were among the quantitative variables provided as means and standard deviations. Frequency and percentage presentations of qualitative characteristics such as gender, smoking, and diabetes were provided.

The association between body mass index and residual cholesterol was determined using Pearson's correlation coefficient. The cutoff for significance was set at 0.05. Data was stratified by age, gender, diagnosis of diabetes, and smoking habits. After stratification, the relationship between BMI and residual cholesterol was evaluated using Pearson's correlation coefficient. The cutoff for significance was set at 0.05.

RESULTS:

Total 100 patients with myocardial infarction were enrolled in the study. Gender distribution showed that 67(67.0%) were males while 33(33.0%) were females. The mean age of the patients was 50.53±14.90 years. According to age distribution, 43(43.0%) of the patients had ages ≤50 years,

Table-1: Frequency distribution of gender

Gender	Frequency	Percent
Male	67	67.0
Female	33	33.0
Total	100	100.0

Table-2: Frequency distribution of age groups

Age groups	Frequency	Percent
≤50 years	43	43.0
>50 years	57	57.0
Total	100	100.0

Table-3: Frequency distribution of diabetes mellitus

Diabetes mellitus	Frequency	Percent
Yes	49	49.0
No	51	51.0
Total	100	100.0

Table-4: Frequency distribution of smoking

Smoking	Frequency	Percent
Yes	30	30.0
No	70	70.0
Total	100	100.0

Table-5: Correlation between remnant cholesterol and body mass index		
Correlation between remnant cholesterol and body mass index	n	100
	r	0.654
	p-value	0.00001

Table-6: Stratification of correlation between remnant cholesterol and body mass index with respect to gender.		
Correlation between remnant cholesterol and body mass index in male	n	67
	r	0.629
	p-value	0.0001
Correlation between remnant cholesterol and body mass index in female	n	33
	r	0.716
	p-value	0.0001

Table-7: Stratification of correlation between remnant cholesterol and body mass index with respect to age.		
Correlation between remnant cholesterol and body mass index in ≤50 years	n	43
	r	0.665
	p-value	0.0001
Correlation between remnant cholesterol and body mass index in >50 years	n	57
	r	0.657
	p-value	0.0001

Table-8: Stratification of correlation between remnant cholesterol and body mass index with respect to diabetes mellitus.		
Correlation between remnant cholesterol and body mass index in diabetic	n	49
	r	0.639
	p-value	0.0001
Correlation between remnant cholesterol and body mass index in non-diabetic	n	51
	r	0.681
	p-value	0.0001

Table-9: Stratification of correlation between remnant cholesterol and body mass index with respect to smoking.		
Correlation between remnant cholesterol and body mass index in smokers	n	30
	r	0.587
	p-value	0.0001
Correlation between remnant cholesterol and body mass index in non-smokers	n	70
	r	0.682
	p-value	0.0001

while 57(57.0%) patients had ages >50 years. Among 100 patients with myocardial infarction, 49(49.0%) were diabetic, while 30(30.0%) were smokers. The mean BMI of the patients was 29.83±4.33 kg/m^2 and remnant cholesterol index as 40.07±11.99 mg/dl.

The Karl Pearson correlation between residual cholesterol and BMI was 0.654 (p 0.0001),

suggesting a favourable relationship between the two. The correlation coefficient between residual cholesterol and BMI after gender stratification was 0.629 (p0.0001) in men and 0.716 (p0.0001) in women. The patients were categorised into two distinct groups according to their age, and the correlation between residual cholesterol and BMI was found to be 0.665 ($p<0.0001$) and 0.657 ($p<0.0001$) for each group, respectively.

After stratifying the data by diabetes status, it was shown that the relationship coefficient between residual cholesterol and body mass index was 0.639 ($p<0.0001$) in diabetic patients and 0.681 ($p<0.0001$) in non-diabetic persons. After stratifying the data based on smoking status, it was shown that the relationship coefficient between residual cholesterol and body mass index was 0.587 ($p<0.0001$) for smokers and 0.682 ($p<0.0001$) for nonsmokers.

DISCUSSION:

The findings of our study indicate that the association between elevated levels of residual cholesterol and an augmented risk of myocardial infarction cannot be solely attributed to an individual's degree of body fat. Mechanistically, high levels of remnant cholesterol in the circulation drive a process in which remnant cholesterol accumulates in the artery wall, producing atherosclerosis. This is the case even if other factors, such being overweight or obese, are to blame for the elevated residual cholesterol levels.[9-12]

Macrophages may take up and process remains in atherosclerotic lesions without any pretreatment. Atherosclerotic lesions are characterised by the transformation of these cells into foam cells. The process of hydrolyzing triglycerides inside the residual particles located at the surface of the endothelium or within the intima of the artery has the potential to induce local inflammation, which is an additional characteristic of the atherosclerotic lesion.[13-16]

Hence, the association between heightened residual cholesterol levels and raised body mass index may provide valuable insights into the established connection between obesity and persistent low-grade inflammation. The presence of a potential causative association between elevated residual cholesterol levels and low-grade inflammation has been postulated by scientists for a considerable period of time, based on genetic and observational evidence.[17-18]

Myocardial infarction mediated by residual cholesterol is more likely to occur in obese people because their remaining cholesterol concentrations are higher on average. This is true even if body mass index and obesity did not play a major role in elevating the risk of myocardial infarction for increased residual cholesterol. Myocardial infarction risk remains elevated in the obese despite these efforts.

Importantly, the researchers found that at a body mass index cutoff of around 35 kg/m^2, the quantity of remaining cholesterol stabilised at about 1 mmol/L (39 mg/dL). There is currently no known explanation for this phenomenon.

There is a notion suggesting that when the body mass index exceeds 35 kg/m^2, the capacity to transport cholesterol reaches its maximum level, even while overall body fat continues to increase. The distribution of both calculated and directly measured residual cholesterol exhibited a secondary peak within the highest body mass index (BMI) category, ranging from 1 to 1.7 mmol/L (39-66 mg/dL). Notably, the second peak was more prominent in the case of direct measurements. This phenomenon was seen in the group with the greatest body mass index.

The explanation for this second peak is not understood at this time; however, it has been hypothesised that it may be due to genetic variations that influence residual cholesterol amounts differently in obese individuals. According to the findings of earlier studies, a robust correlation was shown to exist between high levels of residual cholesterol and high body mass index. This is significant since the BMI of people all around the world is rising, which means that a larger percentage of the population will have high quantities of residual cholesterol.[19]

The cholesterol that is contained in triglyceride-rich lipoproteins is referred to as remnant cholesterol. Triglycerides and residual cholesterol have a strong correlation with one another. To this day, there has not been a comprehensive randomised clinical intervention study that has looked at the possibility of reducing the risk of cardiovascular disease by lowering residual cholesterol in those who have high quantities of it. There have been previous research that have been published on the topic of decreasing triglycerides; however, the findings of these studies have been inconclusive. This may be due to the manner in which participants were recruited for these studies.[20-22]

The association between elevated levels of remnant cholesterol in lipoproteins containing triglycerides and the heightened susceptibility

to ischemic heart disease has been shown by observational and genetic data. However, the precise proportion of plasma cholesterol that exists inside remnant particles remains uncertain due to a lack of direct measures.[7]

Varbo et al., reported that there is significant positive correlation exist between BMI and remnant cholesterol, although weak (r=0.346). The h/o myocardial infarction was positive in 1.5% patients with low remnant cholesterol, 2.2% in moderate remnant cholesterol, 2.7% in patients with moderately high remnant cholesterol and 2.7% in patients with severely high remnant cholesterol ($p<0.001$).[8]

Studies conducted after the fact, focusing on individuals with initially elevated triglyceride levels, have identified a positive association between reducing triglyceride levels and mitigating the risk of cardiovascular diseases. However, it is worth noting that a significant proportion of studies have not encompassed individuals with moderate to high triglyceride levels, who are more likely to experience the advantages of triglyceride reduction. Individuals exhibiting triglyceride levels within the average to high range were often omitted from clinical studies.[9,23-24]

CONCLUSION:

There is a positive correlation between elevated remnant cholesterol levels and an increased risk of myocardial infarction across the various body mass index (BMI) categories examined. The aforementioned discovery indicates that residual cholesterol poses a risk for myocardial infarction, regardless of an individual's overweight or obese status. There exists a favourable association between remnant cholesterol levels and body mass index (BMI).

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