ORIGINAL ARTICLE

Relationship between Monocyte to High-Density Lipoprotein Ratio and Contrast-Induced Nephropathy in Patients with Acute Coronary Syndrome Treated by Primary Percutaneous Coronary Intervention

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Abstract

Background: ***In patients with acute coronary syndromes (ACS), contrast-induced nephropathy (CIN) is a common consequence of using contrast during percutaneous coronary procedures. It is significantly linked to high rates of death and morbidity. Protective measures and better clinical outcomes can only be achieved if individuals with ACS who are at high risk of CIN are identified and treated early.***

Aim and objectives: ***To examine the relationship between CIN and the ratio of monocytes to high-density lipoprotein (HDL) in patients who have undergone primary percutaneous coronary intervention (PCI) for ACS.***

Patients and methods: ***One hundred fifty patients hospitalized at Damanhur Medical National Institute with acute coronary syndrome between October 2023 and July 2024 and who were treated with primary PCI were included in this retrospective study.***

Results: ***Twenty individuals (13.33%) experienced CIN. Compared to the non-CIN group, the CIN (+) group had a substantially higher monocyte to high-density lipoprotein cholesterol ratio (MHR) (0.023±0.01) 108/mg. With a p-value of less than 0.001, a strong positive connection was found between MHR and creatinine levels after 24, 48, and 72 hours. To predict contrast-induced nephropathy with an 80% sensitivity and 76.6% specificity, ROC statistical analysis demonstrated that MHR>0.0171 was the optimal cutoff value.***

Conclusion: ***It is possible to predict the development of CIN in patients with ACS who are undergoing primary PCI by measuring preprocedural MHR, which is a simple inflammatory marker that is readily available upon admission at most centers. This will allow us to take adequate precautions and improve clinical outcomes.***

Keywords: Monocyte; HDL; CIN; ACS; Primary PCI

1. Introduction

TACS has a 4% to 28% chance of experiencing CIN following PCI, and it is strongly associated with high mortality and morbidity rates. This highlights the critical need for early intervention in identifying high-risk individuals with acute ACS of CIN, allowing for the implementation of preventive interventions and the improvement of clinical outcomes.[1]

Although several risk factors for CIN have been identified, including CKD, diabetes mellitus (DM), decreased left ventricular systolic function, nephrotoxic medications, and age greater than 70 years, the primary pathophysiology of CIN is yet to be determined.[2]

Some of the factors that might lead to CIN include inflammation, endothelial dysfunction, increased oxidative stress, vasoconstriction, and direct tubular toxicity.[3]

There have been numerous risk score models created for the prediction of CIN since early identification and intervention in patients with ACS who are at high risk is critical for enabling preventative steps and improving therapeutic results. However, these scores are using variables that can't be obtained at the time of admission.[2]

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The monocyte-to-high-density lipoprotein cholesterol (HDL-C) ratio is a novel inflammatory marker that has recently surfaced as a straightforward and readily accessible sign of systemic inflammation. Numerous studies have established a significant correlation between MHR and various detrimental cardiovascular outcomes.[4]

The study aimed to examine the relationship between CIN following primary PCI and the ratio of monocytes to HDL in patients who presented with ACS.

2. Patients and methods

After obtaining approval from the medical ethics committee and securing signed informed permission, 150 patients admitted to Damanhur Medical National Institute with ACS who underwent primary PCI from October 2023 to July 2024 were included in this study. Patients were categorized into two groups based on the presence of CIN within 48-72 hours post-intravenous administration of contrast media, defined as a 25% elevation from baseline in serum creatinine or an absolute rise of 0.5 mg/dL.5 Patients who suffered CIN are classified as Group A, whereas those who did not are classified as Group B.

Inclusion criteria:

Patients with ACS (STEMI and NSTE-ACS) who are eligible for primary PCI.

Exclusion criteria

Patients experiencing cardiac arrest, cardiogenic shock, or severe left ventricular dysfunction (EF ≤ 40%), patients who have recently taken contrast medium (within the last 10 days), patients with end-stage renal disease or who need dialysis, patients with cancer or advanced liver disease, patients taking lipid-lowering medications, patients with acute or chronic infections, and patients with any inflammatory disease, whether chronic or acute, that can change laboratory parameters.

Methods:

We took careful notes on each patient's age, gender, and any relevant medical history, including but not limited to smoking, diabetes mellitus, high blood pressure, coronary artery bypass graft (CABG), myocardial infarction (MI), and PCI.

A comprehensive evaluation of chest pain, with a focus on time (from pain to initial medical contact and from that point onwards to intervention). In order to rule out the possibility of a chronic or acute inflammatory condition that could affect the laboratory data, previous medical records, medications, and a thorough medical history were gathered.

Clinical examination: arterial blood pressure (ABP), heart rate, neck veins, cardiac examination to detect the occurrence of mechanical complication, and finally, chest auscultation to detect fine basal crepitation.

Investigations:

Twelve lead surface ECG: to detect ischemic changes associated with STEMI and NSTE-ACS. Laboratory investigations: including Highly sensitive troponin I (hs cTn I), CBC and monocytes count are obtained.

Lipid profile: blood samples obtained after fasting from 9-12 hours within the first 24 hours of hospitalization to measure total cholesterol, LDL, HDL, and Non-HDL. MHR is obtained by dividing monocytes by HDL.C.

Trans-thoracic echocardiography was done for all patients before primary PCI (without delay); left ventricular ejection fraction was measured using 2D (eyeball) and M-mode.

MEHRAN CIN risk score was calculated for each patient; it is used for the prediction of CIN after PCI and includes 8 clinical and procedural variables: age >75 years, hypotension, congestive heart failure, intra-aortic balloon pump, serum creatinine, diabetes, anemia, and volume of contrast.[2,6]

Coronary angiography and intervention procedural details (primary PCI):

All patients were prescribed an aspirin 300 mg, ticagrelor 180 mg, or clopidogrel 600 mg. Every patient had a femoral artery puncture using the Seldinger technique, and two images were taken of each coronary artery. The diagnostic catheter was used to perform coronary angiography, which involved identifying the culprit artery. We also utilized an approximated amount of contrast, which was relatively little (Low osmolar nonionic contrast medium, iohexol or lopromide). Following evaluation of other coronaries, the culprit lesion was treated utilizing a 6 French guiding catheter and drug-eluting stents in accordance with the conventional procedure for PCI. Relevant outcomes include the development of CIN and the ratio of monocytes to high-density lipoproteins (MHR).

Statistical analysis

Data was analyzed using IBM Inc.'s Chicago-based SPSS v26. The Shapiro-Wilks test and histograms verified data normality. We compared the two groups' quantitative parametric variables (means and SD) using an unpaired Student's t-test. Quantitative non-parametric data were presented using the median and IQR and tested with the Mann-Whitney test. Qualitative variables were shown as percentages and frequencies (%) using the Chi-square or Fisher's exact test. Statistical significance was a two-tailed P-value below 0.05.

3. Results

The age was significantly higher in the CIN group (58.7 ± 10.62) years than in non-CIN group (49.79 ± 10.54) years with P value <0.001. Also, DM and hypertensive patients are significantly more in CIN group, (table 1).

Table 1. Demographic data, clinical history and risk factors of the studied groups.

VARIABLE		GROUP A (CIN) (N = 20)	GROUP B (NO CIN) (N = 130)	P VALUE
AGE (YEARS)		58.7 ± 10.62	49.79 ± 10.54	< 0.001*
SEX	Males	14 (70%)	100 (76.9%)	0.500
	Females	6 (30%)	30 (23.1%)	
BMI (KG/M²)		27.1 ± 2.19	26.59 ± 1.86	0.271
DM		11 (55%)	29 (22.3%)	0.002*
HTN		12 (60%)	33 (25.3%)	0.002*
SMOKING		10 (50%)	74 (56.9%)	0.561
PREVIOUS MI		1 (5%)	2 (1.5%)	0.351

There is no significant difference between the two groups as regard to EF, contrast amount and culprit artery, while patients with MVD were significantly more in the CIN group, (table 2).

Table 2. Echocardiographic and angiographic data in the studied groups.

VARIABLE		GROUP A (CIN) (N = 20)	GROUP B (NO CIN) (N = 130)	P VALUE
EF (%)		51.05 ± 6.14	53.63 ± 6.13	0.082
CONTRAST AMOUNT (ML)		170.5 ± 23.05	166 ± 32.66	0.311
CULPRIT ARTERY N (%)	LAD	10 (50%)	64 (49.2%)	0.375
	LCX	4 (20%)	22 (16.9%)	
	RCA	6 (30%)	44 (33.8%)	
MULTIVESSEL DISEASE, N (%)		13 (65%)	51 (39.23%)	0.049*

Patients with CIN had a considerably higher MEHRAN risk score and killip class of 2 or above whereas the mean value of SBP and DBP were significantly lower, (table 3).

Table 3. Vital signs, Killip class ≥ 2 and MERHAN risk score and STEMI% in the study groups

VARIABLE		GROUP A (CIN) (N = 20)	GROUP B (NO CIN) (N = 130)	TEST OF SIG.
SBP (MMHG)		111.25 ± 13.94	123.65 ± 13.71	<0.001*
DBP (MMHG)		69 ± 9.95	75.27 ± 7.96	0.002*
KILLIP ≥ 2		6 (30%)	12 (9.2%)	0.017*
MEHRAN RISK SCORE	Median	6	2	<0.001*
	IQR	2-8	2-5	
STEMI N (%)		15 (75%)	104 (80%)	0.565

Hemoglobin level was significantly lower in group A (13.2 ± 1.99g/dl) than in group B (14.43 ± 1.89 g/dl) with P value = 0.008. As regards Monocytes count it was significantly higher in group A (0.79 ± 0.23 (103/fl) than in group B (0.62 ± 0.24 (103/fl) with P-value = 0.002. While HDL level was significantly lower in group A (36.16 ± 9.1 mg/dl) than in group B (0.62 ± 0.24) with P-value < 0.001. While Monocytes/HDL ratio was significantly higher in group A (0.03 ± 0.01 (108 /mg) than in group B (0.01 ± 0.01 (108/mg) with P-value < 0.001, (table 4).

Table 4. Laboratory data in the studied groups.

VARIABLES		GROUP A (N =20)	GROUP B (N =130)	P VALUE
S.CR	At admission day	0.81 ± 0.54	0.77 ± 0.22	0.132
	After 24 hours	1.25 ± 0.73	0.77 ± 0.22	<0.001*
	After 48 hours	1.45 ± 0.97	0.79 ± 0.24	<0.001*
	After 72 hours	1.47 ± 0.87	0.8 ± 0.25	<0.001*
GFR		90.6 ± 32.95	95.85 ± 23.88	0.231
HEMOGLOBIN (G/DL)		13.2 ± 1.99	14.43 ± 1.89	0.008*
PLATELETS (109/L)		258.8 ± 89.8	231.55 ± 62.33	0.090
WBCS (109/L)		12.55 ± 4.78	11.44 ± 3.53	0.215
MONOCYTES (109/L)		0.79 ±	0.62 ± 0.24	0.002*
LDL (MG/DL)		134.07 ± 36.85	130.42 ± 39.84	0.701
HDL (MG/DL)		36.16 ± 9.1	46.3 ± 8.02	< 0.001*
TOTAL CHOLESTEROL (MG/DL)		198.57 ± 32.67	194.75 ± 42.73	0.702
MONOCYTE HDL RATIO		0.023 ± 0.01	0.013 ± 0.01	< 0.001*

The ROC curve determined that an MHR > 0.0171 was the optimal threshold for identifying contrast-induced nephropathy with a sensitivity of 80% and a specificity of 77.6%, (table 5; figure 1).

Table 5. Predictive value of Monocytes/HDL in differentiating cases who developed CIN (N = 20).

DIAGNOSTIC CRITERIA	MONOCYTES/HDL
AUC	0.853
CUT OFF POINT	> 0.0171
P	< 0.001*
SENSITIVITY	80%
SPECIFICITY	77.69%
PPV	35.6 %
NPV	96.2 %

PPV: positive predictive value, NPV: negative predictive value, AUC: area under the curve.

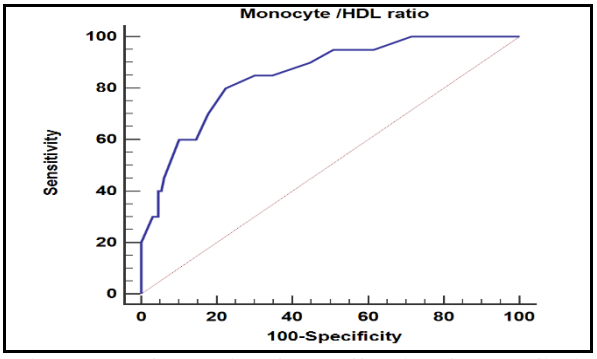

Figure 1: The optimal cutoff point for predicting contrast-induced nephropathy, according to the receiver operating characteristic (ROC) curve, was MHR > 0.0171, which had a sensitivity of 80% and a specificity of 77.6%.

4. Discussion

When treating patients with acute coronary syndrome, primary PCI is a crucial therapy for restoring coronary perfusion.[3] CIN is a common risk factor for death and disability in patients undergoing PCI for ACS.[1]

Various risk score models have been developed for predicting CIN, as early diagnosis and management in high-risk ACS patients is essential for facilitating preventive measures and enhancing therapeutic outcomes. However, these

scores are using variables that can't be obtained at the time of admission.[2]

Unrestrained inflammatory reactions, which may speed up atherosclerosis, raise the risk of severe cardiovascular events, and enhance the likelihood of CIN, could be indicated, theoretically, by an elevated monocyte count and lower HDL-C levels.

There is strong evidence linking the MHR to a number of adverse cardiovascular events, and this has led to the MHR's emergence as a new prognostic indicator.[4]

This study set out to determine whether there was a connection between MHR and CIN in patients with ACS who had undergone primary PCI.

Two groups were established according to the incidence of CIN among the 150 individuals who were enrolled: Group A, Individuals who developed contrast-induced nephropathy, and Group B, patients who didn't develop CIN.

This study demonstrated that MHR was significantly higher in CIN-group (0.023 ± 0.01) than non-CIN-group (0.013 ± 0.01) with P-value = <0.001.

This coincides with the study of Ulus et al.,[7]. There is strong evidence linking the MHR. The study looked at 674 patients who had ACS and were treated with primary PCI. It indicated that preprocedural MHR might be used as a simple indicator of CIN with a p-value of less than 0.001.

Also, agreeing withSağ et al.,[8] researchers looked at 209 STEMI patients who underwent primary PCI and examined the correlation between MHR and CIN. They discovered that the CIN (+) group had significantly higher MHR, with a p-value of less than 0.01.

Therefore, monocytes play a crucial role in the development of atherosclerosis at every step, including foam cell production in the sub-endothelial region, fibrous cap destabilization, and plaque rupture.[9]

In contrast, HDL-C has several atheroprotective benefits due to its anti-inflammatory, antioxidant, and reverse cholesterol transport functions[10], and inflammation may be a cause of CIN.

Unlike what we found in Zehir et al.,[11] determined that MHR was not a viable predictor of CIN formation in patients with STEMI who underwent primary PCI, and they examined the predictive efficacy of the monocyte to HDL-C ratio for CIN in these patients.

The reason behind this could be that compared to other studies; this one had a lower percentage of patients with CIN (6.6%); in the study of Ulus et al.[7], Our investigation found a value of 13.3%, while it was 10.8% in the study of Ulus et al. [7]

We showed that the optimal cutoff value of MHR for predicting CIN is > 0.0171, with a sensitivity of 80% and a specificity of 77.6% by statistical analysis.

According to the research carried out by Ulus et al.,[7] The sensitivity and specificity were 65.7 and 67%, respectively, with an MHR cutoff value of 0.0174 and a P-value of less than 0.01.

In research carried out bySağ et al.,[8] with 209 patients diagnosed with STEMI, the MHR cutoff value for CIN prediction was 0.025, with a sensitivity of 75.1% and a specificity of 74.9%.

Age, monocyte count, and MEHRAN risk score were all considerably greater in the CIN group, according to our study. In addition, the CIN group had a significantly higher number of patients with DM, hypertension, and MVD while significantly lower levels of HDL, hemoglobin, SBP, and DBP.

There are some limitations in our study: Because it was a single-center trial, the findings might not apply to other settings. Because HDL-C and monocyte counts might fluctuate over time, relying on a single preprocedural blood sample to determine MHR might not reveal any trends. Also, a multivariant analysis of the results was needed to determine whether MHR is an independent index or not.

Furthermore, we were unable to examine how different drugs affected MHR levels. Although our results show a link between MHR levels and CIN risk, this does not necessarily prove a cause-and-effect relationship.

4. Conclusion

It is possible to predict the development of CIN in patients with ACS who are undergoing primary PCI by measuring preprocedural MHR, which is a simple inflammatory marker that is readily available upon admission at most centers. This will allow us to take adequate precautions and improve clinical outcomes.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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There are no conflicts of interest.

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