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Original Article

Relationship of Acute Myocardial Infarction with Increased Uric Acid Levels

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ABSTRACT

Objective: To determine the relationship between hyperuricemia and acute myocardial infarction and its correlation with gender, smoking, and diabetes mellitus in the context of acute myocardial infarction.
Study Design: Cross-sectional analytical study
Place and Duration of Study: Cardiology Department of Mardan Medical Complex, Pakistan from August to October 2023.
Methodology: Inclusion of 307 patients suspected of acute myocardial infarction, with demographic data collected via a predesigned proforma and uric acid levels measured in the Hospital laboratory. Non-probability convenient sampling was utilized. Informed consent was obtained from all patients to ensure confidentiality and safety.
Results: Of 307 patients, 214(69.7%) were males, and 93(30.3%) were females, with a mean age of 56.82±11.71 years. Hyperuricemia was observed in 160 patients (52.1%). Among 191 subjects (62.21%) diagnosed with MI, 142(74.34%) had hyperuricemia. Additionally, 116 patients (37.78%) presented with unstable angina or alternative diagnoses, with 18(15.51%) showing hyperuricemia. Statistical analysis revealed a significant association between hyperuricemia and acute MI (p<0.001) and diabetes mellitus (p=0.001). However, no significant relationship was found between hyperuricemia and sex, hypertension, or smoking.
Conclusion: The study established a significant association between hyperuricemia and myocardial infarction, as well as diabetes mellitus. Despite a high prevalence of hypertensive patients, a significant association with hyperuricemia was not observed. These findings underscore the importance of considering hyperuricemia as a potential risk factor for acute myocardial infarction, particularly in individuals with concomitant diabetes mellitus.

Keywords: Acute MI, Diabetes mellitus, Hyperuricemia.

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INTRODUCTION

Acute myocardial infarction is myocardial necrosis secondary to myocardial ischemia. It may be characterized by troponin elevation beyond the reference limit's 99th percentile (0.03 ng/ml) in conjunction with any one of the subsequent features: angina, dynamic ischemic changes, new Q waves, new wall motion hypokinesia on imaging, and thrombus seen on coronary angiography. It can be categorized into STEMI and NSTEMI.[1] Apart from traditional risk factors, hyperuricemia is an isolated determinant for cardiovascular diseases.[2,3] Generally, hyperuricemia in adults can be defined as raised serum uric acid levels of more than 6.8 mg/dl. Above 7 mg/dl is considered symptomatic hyperuricemic levels.[4] Hyperuricemia results from either increased production of uric acid levels due to excessive intake of protein-rich food or under excretion in case of deranged kidney function due to any cause.[5] Uric acid is the by-product of purine metabolism and plays a part in aggravating oxidative damage response to inflammation and generating redox species that damage endothelium and promotes the development of MI.[6]

Hyperuricemia has been found to be an isolated determinant for cardiovascular diseases with high Framingham Risk Scoring in non-diabetic and non-hypertensive individuals.[7] Also, it has been studied that elevated uric acid is a separate predictor of fatality in STEMI and an easily accessible parameter for identifying high-risk individuals.[8] Fenofibrates, statins, and losartan have been shown to reduce UA levels and hence decrease the incidence of cardiovascular morbidity and mortality.[9] SGLT-2 inhibitors work by reducing the absorption of glucose by kidneys. Subsequently, it has a uricosuric effect, which in turn reduces the prevalence of cardiovascular disease, overall mortality, and heart failure hospitalizations.[10]

Various studies have been done all over the world to assess the relationship between increased uric acid levels and MI, but in our tertiary health care setting, there is a lack of information on this subject. In addition, results may vary due to demographic and

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lifestyle differences, such as more intake of purine-rich foods in KPK; we conducted this study to identify hyperuricemic individuals and assess if acute MI and elevated uric acid levels are related or not. Besides that, an association of gender-specific differences and coexisting factors like diabetes, hypertension, and smoking with raised uric acid levels will be assessed.

METHODOLOGY

The cross-sectional analytical study was carried out at the Cardiology Department of Mardan Medical Complex, Pakistan from August to October 2023. Approval from the Ethical Board (ERC # 0348/BKMC, dated 12/07/23) was taken. WHO sample size calculator was used for the calculation of the approximate sample size by taking a reported prevalence of hyperuricemia as 25.13%.[11]

Inclusion Criteria: Patients of either gender, aged > 18 years, presented with typical chest pain (substernal chest discomfort that has been provoked by emotional stress) and no previous history of chronic kidney disease (CKD) were part of this study.

Exclusion Criteria: Patients with chronic kidney disease, gout, or other conditions known to affect uric acid metabolism, individuals taking uric acid lowering drugs, pregnancy, and malignancy were excluded.

The approximate sample size came out of 290 subjects. Sampling was done via nonprobability convenient sampling, and 307 patients with suspected MI who matched the inclusion and exclusion criteria were included in this research. Informed consent was obtained from all patients, and they were assured that data would be used only for research purposes. Blood samples were taken to measure serum uric acid levels from all patients who presented to the cardiology department with sudden onset typical chest pain. Patients were categorized after relevant investigations like ECG and troponins I into MI and unstable angina/alternative diagnosis. We defined hyperuricemia as serum uric acid levels of more than 7.0 mg/dl in men and 6.0 mg/dl in women. Serum uric levels were measured by a biochemical analyzer in an enzymatic assay (Uricase-POD) using a commercial uric acid kit. Demographic information of patients and laboratory tests were collected and endorsed in predesigned proforma.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22.00. Continuous variables were expressed as Mean±SD. We divided our study population into two groups, i.e., Group A and Group B, based on normal and increased uric acid levels, respectively. Frequencies (percentages) were calculated for categorical variables like uric acid, diagnosis, diabetes mellitus, hypertension, and smoking. The chi-square test was applied to look for an association of variables with hyperuricemia, and a *p*-value of ≤0.05 was considered statistically significant.

RESULTS

The study included three hundred and seven (n=307) patients, with an age range of 31 to 100 years and a mean age of 56.82±11.71 years. A relationship between acute myocardial infarction and elevated uric acid levels was determined in two different groups based on uric acid levels. Group A consisted of 147(47.9%), while Group B consisted of 160(52.1%) subjects. Table-I describes the individuals' baseline characteristics and their relationship with uric acid levels. Serum uric acid levels were significantly associated with Type 2 diabetes (*p*-value 0.001). There were no significant relationships between uric acid concentrations and gender, arterial hypertension, or smoking. Moreover, data suggested that serum uric acid levels were significantly associated with diabetes mellitus (*p*-value 0.001).

Table-I: Baseline Characteristics and Association with Uric Acid Levels (n=307)

Baseline Characteristics	Uric Acid Level		*p*-value
	Group A Normal n= 147	Group B Increased n=160	0.641
Gender			
Males: 214(69.7%)	104(33.87%)	110(35.83%)	
Females: 93(30.3%)	43(14%)	50(16.28%)	0.703
Hypertension			
Yes: 184(59.9%)	90(29.31%)	94 (30.61%)	
No: 123 (40.1%)	57(18.56%)	66 (21.49%)	0.658
Diabetes Mellitus			
Yes :131(42.7%)	48(15.63%)	83(27.03%)	0.001
No: 176(57.3%)	99 (32.24%)	77(25.08%)	
Smoking			
Yes 113(36.8%)	49(15.96%)	64(20.84%)	
No 194 (63.2%)	98 (31.92%)	96 (31.27%)	0.238

At the same time, no significant association was found for serum uric acid levels with gender, hypertension, and smoking. Table-II illustrates an association between acute myocardial infarction (AMI) and uric acid concentrations. Of 191 acute MI victims, 142(46.25%) had increased uric acid levels, while only 49(15.96%) had levels that were normal ($p<0.001$). This suggests a strong link between acute MI and excessive

uric acid concentration. In comparison, only 18(5.86%) of 116 patients with unstable angina had elevated uric acid levels, indicating a lesser correlation between unstable angina and hyperuricemia.

Table-II: Association of Acute Myocardial Infarction with Increased Uric Acid levels (n=307)

Diagnosis	Uric acid Level		*p*-value
	Normal (n=147)	Increased (n=160)	
Acute Myocardial			
Infarction: 191(62.2%)	49(15.96%)	142(46.25%)	<0.001
Unstable Angina: 116(37.8%)	98(31.92%)	18(5.86%)	

DISCUSSION

As stated earlier, the primary goal of our study was to determine the relationship between elevated uric acid levels and acute myocardial infarction. The secondary objective was to find any association between increased uric acid levels with sex, hypertension, diabetes mellitus, and smoking.

As per the primary objective of our study, the relationship between hyperuricemia and acute MI was assessed, which showed that the majority of our study population who suffered from acute MI had hyperuricemia. 62.2% of our study population had MI, among which 74% had increased uric acid levels. This was comparable to results established by a case-control study performed in Karachi. It stated that mean UA levels were higher in patients with acute MI.[12] Besides that, we also looked for the relationship of increased uric acid levels with age and gender in our study, which showed no statistical significance. Similar to our results, another study performed in 2021 demonstrated that statistically, there was no significant association between sex and serum uric acid in relation to MI.[13] Yet, contrary to our results, one of the cross-sectional studies determined the association between uric acid levels and coronary artery disease (CAD) in different ages and genders, which reflected a significant correlation between hyperuricemia and CAD in advancing-aged females but not males.[14] In line with the latter report, another study demonstrated a protective effect of estrogen in younger females, which plays a significant part in maintaining endothelial integrity and, hence, decreasing cardiovascular risk.[15]

We could not substantiate a statistically significant relationship between hypertension and hyperuricemia. Contrary to our results, various epidemiological studies have outlined this association. One of the studies done to sustain the relationship between elevated uric acid levels and cardiovascular risk highlighted that hyperuricemia is an isolated risk factor for high blood pressure. A similar study also depicted that uric acid levels were lower in younger age groups.[16,17] Furthermore, the current study showed that there was a statistically significant association between diabetes mellitus and hyperuricemia. However, a negative correlation exists between the two variables. In this regard, literature varies from some establishing a non-linear correlation between glycemic index and increased uric acid levels,[18] while others proposed an independent association between the glycemic index and hyperuricemia.[19] Additionally, another study inferred that uric acid and HbA1c are negatively correlated without statistical significance.[20]

In a nutshell, hyperuricemia was found in a significant population of Mardan KPK with acute myocardial infarction. In addition, raised uric acid levels were also present in people with diabetes mellitus and carried statistical significance. The current study could not establish a temporal relationship between acute MI and raised uric acid levels. Although uric acid levels were determined upon admission, we could not establish if hyperuricemia preceded MI or vice versa. In the future, studies should be conducted to establish temporal or causal relationships between myocardial infarction and uric acid levels.

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CONCLUSION

The study established a significant association between hyperuricemia and MI, as well as diabetes mellitus. Despite a high prevalence of hypertensive patients, a significant association with hyperuricemia was not observed. These findings underscore the importance of considering hyperuricemia as a potential risk factor for acute MI, particularly in individuals with concomitant diabetes mellitus.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AS & MF: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

NUH & SR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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