

Correlation between uric acid/HDL ratio and total calcium score in coronary CT angiography

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ABSTRACT

Aim: Coronary artery disease (CAD) is a common manifestation of cardiovascular disease (CVD). The identification of reliable biomarkers for early CAD detection and risk assessment is crucial for effective prevention and management. This article examines the correlation between the uric acid to HDL cholesterol ratio (UHR) and the total calcium score (TCS) obtained from coronary CT angiography (CCTA) in the assessment of CAD.

Methods: The study included 60 patients (34 males and 26 females) without endocrine diseases or relevant medications to ensure a homogeneous population. Blood samples collected after an eight hour overnight fasting were analyzed for laboratory parameters. CCTA was performed using a standardized protocol. The total calcium score was calculated using established methods.

Results: The analysis showed a significant positive correlation between UHR and TCS ($r=0.479$, $P=0.0001$). Patients with coronary artery plaque had significantly higher UHR values compared to those without it ($p = 0.001$).

Conclusion: These findings suggest that UHR could serve as a promising biomarker for predicting CAD presence and severity, although further research is necessary to validate its clinical utility in CAD diagnosis and management.

Keywords: coronary artery disease, total calcium score, uric acid to HDL cholesterol ratio

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INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death and morbidity worldwide (1). Atherosclerotic plaque in coronary arteries is a common feature of coronary artery disease (CAD) (2). Effective prevention and treatment strategies depend on the identification of accurate biomarkers that can help early detection and risk stratification of CAD (3). The total calcium score (TCS) is typically identified by coronary CT angiography (CCTA). The presence and extent of calcified plaque are evaluated using specialized software, and the TCS is calculated based on the quantity and density of calcification (4). TCS can be calculated from CCTA images and it is a reliable predictor of CAD (5). TCS was firstly described by Arthur Agatston and it can be measured by Agatston score. It considers the size and density of the calcifications in the coronary arteries. The score is often divided into four categories: 0 (no calcium), 1-10 (minimum calcification), 11-100 (mild calcification), and 101-400 (moderate calcification) (6).

METHODS

Participants and study design

The study was a retrospective, cross-sectional study that was approved by the University Ethics Council with number 2023/141. The study comprised 60 patients who met the following criteria: having none of the endocrine disorders, taking none of these drugs: anti hypertensives, anti hyperlipidemics and anti gout medications. Patients having these diseases or using these drugs were excluded from the trial to create a homogeneous study population with few confounding factors.

Biochemical examination

Following an eight hour overnight fasting, blood samples were collected from each participant. An autoanalyzer was used to measure serum levels of glucose, uric acid, total cholesterol, triglycerides, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), urea, and creatinine. The analyzer measures these biochemical parameters precisely and reliably, allowing for an accurate

assessment of UHR. As previously published in the literature (7,8), UHR was calculated as $UHR = HDL-C \text{ (mg/dL)} / \text{uric acid (mg/dL)}$.

Total calcium score measuring

All subjects had CCTA in accordance with a defined imaging technique. Images were taken with a multidetector computed tomography (MDCT) scanner. TCS, reflecting of coronary artery calcification, was calculated using standard procedures. The Agatston scoring system was utilized to assess the amount and severity of coronary artery calcification. The total calcium score was obtained by summing the individual calcium scores of all calcified coronary artery lesions (9-11).

Statistical analysis

SPSS 20.0 statistical software (IBM Inc., Chicago, IL, USA) was used to analyze the data. Descriptive statistics such as means, standard deviations, and frequencies were determined to summarize the demographic and clinical features of the study population. The Spearman correlation coefficient was used to analyze the relationship between the UHR and the TCS. Adjustments were made as needed for potential issues such as age, gender, and other relevant factors. A p value equal or less than 0.05 was accepted as statistically significant.

RESULTS

This study involved 60 patients, 34 males and 26 females, to evaluate the relationship between UHR and TCS in CCTA. The mean age of the study population was 50.1 ± 13.8 years. Uric acid (5.2 ± 1.1 mg/dL), HDL-C (54 ± 12.8 mg/dL), HbA1c ($5.6 \pm 0.6\%$), and UHR ($10.3 \pm 3.9\%$) were the mean values of key variables (Table 1).

The primary goal of this study was to investigate the link between UHR and TCS. Spearman correlation analysis revealed a statistically significant positive connection ($r = 0.479$, $p = 0.0001$) between these two variables. There was also a significant association between the presence of coronary artery plaque and UHR ($r = 0.368$, $p = 0.003$) (Table 2).

Table 1. Patients' characteristics.

Age (year)	50.1 ± 13.8
Gender	34 males/26 females
Uric acid (mg/dl)	5.2 ± 1.1
HDL -C (mg/dl)	54 ± 12.8
UHR (%)	10.3 ± 3.9
HbA1C (%)	5.6 ± 0.6
Smoking	Yes, n=25 No, n=35
Hypertension	Present, n=24 Absent, n=36
Diabetes Mellitus	Present, n=6 Absent, n=54

HDL-C: High density lipoprotein cholesterol, UHR: uric acid/HDL-C ratio

Table 2. Correlation of UHR with study parameters.

	TCS	Presence of Coronary Artery Plaque
UHR		
r	0.479	0.368
p	0.0001	0.003

Furthermore, a significant difference in mean UHR was identified when comparing patients with and without coronary artery plaque. Patients with coronary artery plaque had a significantly higher mean UHR compared to those without plaque (13.2 ± 4.7% vs. 9.3 ± 3.2%, respectively) (p = 0.001).

DISCUSSION

In this study, we investigated the correlation between the uric acid to HDL-C ratio (UHR) and the TCS, as gauged by CCTA. The results elucidated a noteworthy relationship between these two parameters, suggesting a probable connection between elevated UHR and an increase in coronary artery calcification.

The observed correlation is consistent with previous research that probed the association between UHR and diverse cardiovascular risk factors and outcomes. For instance, Aktas et al.¹² identified a correlation between unregulated hypertension and elevated UHR, while Yazdi et al.¹³ found a positive correlation between UHR

and metabolic syndrome. These insights bolster the proposition that UHR may serve as a predictive marker for cardiovascular risk.

Moreover, UHR has been shown to predict metabolic syndrome in patients with type 2 diabetes mellitus (8). This information accentuates UHR's potential importance in pinpointing individuals with elevated susceptibility to metabolic disorders, which in turn have been tied to the onset of CAD.

Beyond the specific focus of our study on the connection between UHR and TCS, there has been wider research into the relationship between uric acid and coronary artery disease. For example, Mansiroglu et al.¹⁴ examined serum uric acid levels and UHR in relation to coronary artery fistulae, highlighting their possible relevance in coronary artery anomalies. Additionally, Kaya et al.¹⁵ revealed that serum uric acid levels could predict the extent and configuration of coronary artery atherosclerosis, as assessed by multidetector computed tomography. Li et al.¹⁶ further revealed that UHR could be a predictive tool for the diagnosis of functionally significant coronary artery stenosis.

These collective findings suggest that UHR could be instrumental in determining the severity and clinical relevance of coronary artery disease, thus underscoring its potential utility in the broader context of cardiovascular health assessment. This study emphasizes UHR's potential utility as a prognostic marker in coronary artery disease. Nonetheless, we must evaluate the intricate relationship between uric acid, inflammation, and cardiovascular disease. Uric acid has been identified as a pro-inflammatory chemical that contributes to systemic inflammation and endothelial dysfunction, both of which are substantial risk factors for coronary artery disease. Elevated UHR levels may thus reflect an inflammatory condition, which contributes to coronary artery calcification (17,18). The study conducted by Kanbay et al.¹⁹ which demonstrated that uric acid-induced inflammation and oxidative stress may contribute to cardiovascular disease, supports the connection between uric acid and inflammation. Furthermore, Krishnan et al.²⁰ discovered that greater blood uric acid levels were linked to a stronger inflammatory

response as evaluated by C-reactive protein. According to these findings, uric acid is not only a marker but also a possible mediator in the development of coronary artery disease. However, these elements were not addressed in the current study, and future research should focus on better understanding the function of uric acid and inflammation in the development of coronary artery disease.

The total calcium score derived from CCTA is a useful technique for measuring coronary artery calcification and the presence and extent of CAD (5). Our research contributes to the existing body of knowledge by revealing a substantial relationship between UHR and TCS. According to this correlation, an elevated UHR may indicate increased coronary artery calcification and, as a result, a higher risk of CAD.

It is critical to recognize that additional factors may play a role in the association between UHR and coronary artery calcification. For example, inflammatory markers including the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have been linked to the severity of coronary calcium score (21-23). Furthermore, lipid ratios such as total cholesterol/HDL cholesterol and LDL cholesterol/HDL cholesterol have been investigated as predictors of coronary artery calcification (24). More research into these parameters and their potential interactions would provide a more complete picture of the relationship between UHR and coronary artery calcification.

The current study adds to the growing body of evidence suggesting a relationship between UHR and coronary artery disease. The study, however, has significant limitations, including a cross-sectional design and a small sample size. Furthermore, significant confounding factors such as age, gender, smoking status, and medication use were not taken into consideration in the study. As a result, larger sample sizes and adjustments for potential confounding factors are required in prospective studies to corroborate the findings of this investigation.

In conclusion, our study discovered an association between UHR and TCS in CCTA, implying that UHR may be a valuable biomarker for predicting the presence and

severity of CAD. However, further research is required to validate our findings and to study the clinical value of the UHR in the diagnosis and treatment of CAD.

Ethical approval

This study has been approved by the Bolu İzzet Baysal University, Faculty of Medicine, Clinical Researches Ethics Committee (approval date 16/06/2023, number 267). Written informed consent was obtained from the participants.

Author contribution

Surgical and Medical Practices: MFB; Concept: MFB; Design: MFB; Data Collection or Processing: MFB; Analysis or Interpretation: MFB; Literature Search: MFB; Writing: MFB. The author reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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