Uric acid as a biomarker in acute myocardial infarction

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ABSTRACT

Acute Myocardial Infarction (AMI) is a global threat to health, particularly for developing countries. Every year about 17 million of the world population die of cardiovascular disease. The activity of the enzyme xanthine oxidase and the oxidative stress level is reflected by the levels of serum uric acid. Uric acid, an independent marker in populations with AMI has been shown to reflect the short and long term adverse cardiac outcomes. Elevated uric acid levels are associated with reduced glomerular filtration rate, hypertension, arterial stiffness, cardiac hypertrophy and heart failure. There exists a five to six-fold rise in uric acid concentration in atherosclerotic patients. The mortality index in patients with cardiovascular disease can be predicted by high uric acid levels. The aim of our study was to correlate the increased uric acid levels with the severity and prognosis in myocardial infarction patients. Our study included 55 patients with AMI, including both ST-segment elevation myocardial infarction (STEMI) and non-ST segment elevation myocardial infarction (NSTEMI), in whom serum uric acid was measured. The results were analyzed using the Statistical Package of Social Sciences (SPSS) software. A statistically significant ($p < 0.001$) increase in the serum uric acid levels were noted in the patients diagnosed with Myocardial Infarction (MI). The increase in uric acid levels helps to predict mortality in acute MI patients.

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INTRODUCTION

AMI accounts for 12.7% of mortality across the world (Behera and Samal, 2018). It has been estimated that in the year 2020, as many as 31.5% of all deaths will be due to cardiovascular diseases. Indians have the highest prevalence of MI which is seen in younger than 45 years of age compared to those older than 60 years of age (Jayaraj *et al.*, 2018).

Epidemiological studies have shown that there is a significant association of uric acid with mortality due to coronary artery disease. The events of increasing platelet reactivity, inflammation and smooth muscle cell proliferation leading to acute thrombosis in MI is aggravated by high serum uric acid levels. Previous studies showed that uric acid might be an indirect marker and predictor of major adverse cardiovascular events in patients with coronary artery disease. The necrotic heart muscle releases Troponin-T and Creatine phosphokinase MB (CPK-MB) and other cardiac markers in large quantities after an episode of MI. However, CPK-MB, Troponin-T, Troponin-I and myoglobin have a spe-

cific relationship with MI; they do not correlate with myocardial function. Several studies have recently shown that cardiovascular disease risk increases with increased uric acid levels and a negative prognostic marker for mortality in subjects with pre-existing heart failure.

The objective of this study was to correlate the disease prognosis and its severity with increased uric acid levels in MI patients.

MATERIALS AND METHODS

In our study, uric acid levels in serum were estimated in 55 patients with STEMI or NSTEMI. A detailed clinical history regarding symptoms and duration of chest pain, kidney disease, hypertension, diabetes, smoking, alcoholism, drug intake and treatment was elicited. ECG changes and cardiac biomarkers were recorded in all the patients who participated in this study at Saveetha Medical College and Hospital.

Written consent was obtained from the patients. Serum uric acid was estimated by the uricase method (Uricase and Peroxidase) in Erba Mannheim. The results were statistically analyzed using SPSS windows software (version 16.0).

RESULTS AND DISCUSSION

Patients were followed up until the 7th day of their hospital stay. Serum uric acid levels were measured on the day of admission, the third and the seventh day of myocardial infarction. A detailed statistical analysis was carried out. The results were analyzed statistically using the Chi-Square test.

Serum uric acid level was elevated on the 3rd and 7th day with mean $\pm$ SD (0.550$\pm$0.360) and (1.061$\pm$0.655), respectively. This increase was highly statistically significant with a p-value of <0.001, as depicted in Table 1 and Figure 1.

Table 1: Mean and Standard deviation of uric acid on 3rd and 7th day

S. No	Parameter	Mean$\pm$SD	p-Value
1	Uric Acid (3rd day)	0.550$\pm$0.360	p<0.001
2	Uric Acid (7th day)	1.061$\pm$0.655	p <0.001

High serum uric acid is predictive of mortality in patients with coronary artery disease (Nadkar and Jain, 2008). Due to reduced intracellular pH and
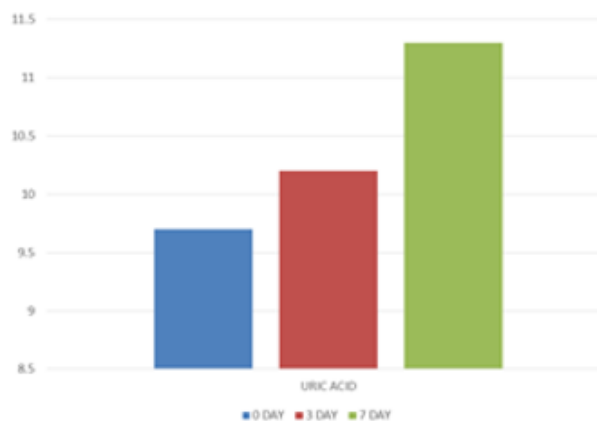

Figure 1: Bardiagram of uric acid on 0, 3rd and 7th day

negative membrane potential, uric acid is rapidly refluxed to the vascular lumen. Uric acid synthesis is elevated under ischaemic conditions and hence a marker of ischemia. Endothelial dysfunction, oxidative metabolism, platelet adhesiveness and aggregation are influenced by high uric acid level (Kroll *et al.*, 1992). An increase in 1mg/dl serum uric acid levels might lead to a 26% increase in mortality (Granger *et al.*, 2004).

Hyperuricemia is associated with the low-density lipoprotein (LDL-C) oxidation, peroxidation of lipid and free oxygen radicals formed during an inflammatory reaction.

In our study, there is a significant increase in the serum uric acid levels in patients with MI, which is in accordance with the study done by Nadkar et al. study. Moreover, Baruah *et al.* also reported a high serum uric acid level in patients with AMI (Baruah *et al.*, 2012; Bonora *et al.*, 1996) study with 957 young men and Sokhanvar *et al*. proved the positive relationship between hyperuricemia and MI (Sokhanvar and Maleki, 2007). Elevated uric acid is associated with increased xanthine oxidase activity (Reddy and Ghanekar, 2015). The oxygen-free radicals generated during uric acid synthesis are a useful indicator of excess oxidative stress, which is involved in the no-reflow phenomenon during reperfusion therapy. High serum uric acid level also leads to decreased production of nitric acid (NO), endothelial dysfunction, myocardial microvascular disease and local inflammation (Akpek *et al.*, 2011). Elevated uric acid levels in NSTEMI patients can be a result of reduced elimination through the kidney or raised production of serum uric acid in vivo or cellular injury to the heart caused by decreased cardiac output and tissue hypoxia (Ejaz *et al.*, 2007).

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Conflict of Interest

None.

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