Original Research Article

Association of hyperuricemia and microalbuminuria in acute myocardial infarction in non-diabetic and non-hypertensive patients

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Abstract

Background: Hyperuricemia and micro albuminuria are known to occur independently in diabetes and hypertension. Of late the cardiovascular implication of Hyperuricemia and microalbuminuria in the non-diabetic, non-hypertensive patients has received focus. Hyperuricemia and microalbuminuria are independent risk indicators of ischemic heart disease, also indicates severity of the disease and has been considered as important prognostic indicator.

Objectives: To measure and compare serum uric acid levels and microalbuminuria in either of patient and control groups and to identify the association of hyperuricemia and microalbuminuria in acute myocardial infarction in non-diabetic and non-hypertensive patients in a tertiary hospital.

Materials and methods: A prospective study was conducted for a period of 8 months from February 2011-September 2011. We included 32 MI patients (diagnosed based on the clinical history and ECG changes) along with 32 age and sex matched healthy controls. A p-value of <0.05 was considered to be statistically significant. Serum uric acid and micro albuminuria were measured in these patients by colorimetric and immunoturbidimetric methods respectively.

Results: The study group consisted of 50 patients, among them 32 participants were selected for our study. Our results showed significant change in serum uric acid levels and microalbuminuria when compared to healthy volunteers. In addition to that we observed positive association between serum uric acid and microalbuminuria; serum uric acid and body mass index in AMI patients. Combination

of Killip class and serum uric acid level after acute myocardial infarction was a good predictor of mortality after AMI.

Conclusion: These results indicate that assessment of these novel markers should be undertaken so that effective treatment and appropriate life-style changes can be implemented early to prevent morbidity and mortality.

Key words

Hyperuricemia, Microalbuminuria, Killip class, Myocardial infarction, Morbidity, Mortality.

Introduction

The amount of urinary albumin excretion (UAE) is considered to be a reflection of generalized endothelial dysfunction associated with a variety of risk factors [1]. Therefore, microalbuminuria is a useful biological marker for the identification of people who are at high risk of cardiovascular events [2]. Microalbuminuria is associated with an increased risk of cardiovascular morbidity in the general population as well as in patients with diabetes and hypertension [1, 2]. Furthermore, several large epidemiological studies have reported that elevated serum uric acid levels are associated with cardiovascular disease [3-7]. The association of uric acid with cardiovascular disease appears to be stronger in individuals with hypertension than in the general population, and seems to be further increased when blood pressure (BP) is higher and the target organ damage is more evident [8]. Whether uric acid plays a significant role in the development of cardiovascular disease or merely reflects other concomitant risk factors, such as hypertension, insulin resistance, obesity, or lipid abnormality, has been a matter of debate for years. The relationship between uric acid and microalbuminuria has been observed previously in hypertensive [7, 8] and prehypertensive subjects [9, 10], mostly related to BP values. However, the pathophysiological mechanism underlying this association remains elusive. In fact, obesity, lipid abnormalities and insulin resistance are related to Hyperuricemia as well to microalbuminuria.

Need of work

- Serum uric acid (UA) levels reflect circulating xanthine oxidase activity and oxidative stress production. Hyperuricemia has been identified in patients who have congestive heart failure and is a marker of poor prognosis in such patients. We have to investigate the relation between serum UA levels and Killip's classification suggestive of the severity of heart failure and whether Hyperuricemia influences mortality of patients who had acute myocardial infarction (AMI).
- Hyperuricemia has a positive association with obesity. In our study we have to identify the association between serum uric acid Vs obesity.
- Microalbuminuria is a cardiovascular risk factor in the non-diabetic and nonhypertensive patients and a sensitive indicator of non-renal disease so we have investigated microalbuminuria.
- Serum uric acid levels are associated with prevalence of microalbuminuria. Hence we correlate the association in acute myocardial infarction (AMI).

Aim and objectives

The aim of the present study was to evaluate the association between uric acid levels and the presence of microalbuminuria in a group of middle-aged, non-diabetic subjects, with no history of cardiovascular disease, renal dysfunction or prior treatment for hypertension.

The prime objectives of our study were as follows:

- To measure microalbuminuria and serum uric acid in the acute myocardial infarction patients, admitted to ICCU of M.G.M. Hospital, Warangal.

- To compare microalbuminuria and serum uric acid levels in the patients of AMI and healthy volunteers. Thus we want to evaluate microalbuminuria and serum uric acid in the diabetic, non-diabetic, hypertensive, non-hypertensive acute myocardial infarction patients, in the local population.
- To study if microalbuminuria and serum uric acid could predict mortality, for which we planned to record deaths during the hospital stay amongst the patients. We termed this in-hospital mortality and wanted to see if the level of microalbuminuria and serum uric acid could predict in-hospital mortality in the local population.

Materials and methods

Chemical kits

Serum uric acid Kit: Crest Biosystems, India

Micral Kit: Aptech Diagnostics, Belgium

Instruments

Colorimeter: Ensure Biotech Ltd, Hyderabad, India

Clinical chemistry analyzer (HITACHI 911)

Centrifuge: Remi Motors Ltd, Mumbai, India

Accupippettes (100 µl, 1000 µl): Himedia Labs Ltd, Mumbai, India

Eppendroff's tubes

Test tubes

Methods

The present study was conducted at the Intensive Care Cardiology Unit (ICCU) and Departments of Cardiology (Male and Female) of a tertiary care teaching hospital, i.e., Mahatma Gandhi Memorial Hospital, Warangal, Andhra Pradesh, India, which is a 1200 bedded multidisciplinary government hospital. The study was carried out for the period of one year. The patients included in the study who were suffering with Acute Myocardial Infarction. Sample/ Data collection was performed according to hospital regulations after approval by the Hospital administration/ Ethical committee. Patients between 30 to 75 years were selected. The study population consisted of 32 Acute Myocardial infarction cases admitted between the months of June 2011 to September 2011, and 32 healthy subjects.

The study was conducted in various phases.

Phase I

Step - 1: Identify or selection of Patient inclusion in the study

All patient subjects diagnosed as case of Acute Myocardial Infarction, on the basis of history of the patient along with the clinical features like chest pain, retrosternal squeezing type pain, sweating, shortness of breath were included in our study. All subjects attendee completed a detailed standardized questioner. The victims were also sorted for different epidemiological factors like age, gender, marital status, socio-economic status, representative area (Rural/ urban) and life style pattern. All patients were observed in the Emergency department of our hospital by specialized in Emergency medicine. The treatment included with Streptokinase, Low molecular weight heparin, Atorvastatin, Clopidogrel, Isosorbate dinitrate etc. and supportive treatment like IV fluids.

The outcome was compared with patient condition and initiation of the therapy. If patients needed advanced treatment they were sent to other service like super specialty hospital.

Step - 2: Design of the study

Study period: The study was planned to be carried out for a period of one year consent from the hospital authority. The Protocol of the study which includes the Introduction, objective and methodology was submitted to the Superintendent of our hospital and to Kakatiya Medical College to obtain the Ethical Committee approval and was obtained to carry out the study.

Step - 3: Defining Criteria, standards and design of data entry format.

Inclusion Criteria

- The patients with Acute Myocardial Infarction

- Age 30-75, either sex.

Exclusion criteria

- Pregnancy and lactation.
- Pediatric population.
- Positive urine dipstick for Hb, glucose, leucocytes/nitrites. 4. Histories of renal disease, UTI, inflammatory rheumatic disease, cancer, gout, fever. 5. Overt albuminuria > 200 mg/dL. 6. Patient with missing measurements of serum uric acid and microalbuminuria.

Phase II

Step - 1: Literature Survey

The literature supporting the study was collected and analyzed. The different sources used to collect the literature were Micromedex drug information databases, various websites like plumed, science direct, DOAJ, Medline, etc.

Step - 2: Data collection

Data were collected from inpatients records available in Emergency department of the hospital, including the clinical characteristics such as chest pain, Shortness of breath, retrosternal squeezing type pain, headache, dizziness, blood pressure, pulse rate, ECG etc.

Step - 3: Sample Collection

Venous blood samples were collected from the patients after obtaining the Informed consent form from the patient or the attendee. 5ml blood was collected after overnight fasting in different vials. The samples were collected in 5 ml EDTA vials (for serum) and 5ml heparin tubes (for plasma). The samples were immediately centrifuged at 3000 rpm for 30 minutes and upper layer is separated in labeled Eppendroff's tubes and kept at 40C till biochemical analysis.

Phase III

Estimating the parameters

1. Serum uric acid (Uricase / PAP method) [9, 10]

Uric acid is the end product of purine metabolism. Uric acid is excreted to a large degree by the kidneys and to a smaller degree in the intestinal tract by microbial degradation. Increased levels are found in Gout, arthritis, impaired renal functions, and starvation. Decreased levels are found in Wilson's disease, Fanconis syndrome and yellow atrophy of the liver.

Principle

Uricase converts uric acid to allantoin and hydrogen peroxide. The hydrogen peroxide formed further reacts with a phenolic compound and 4 aminoantipyrine by the catalytic action of peroxidase to form a red coloured quinoneimine dye complex. Intensity of the colour formed is directly proportional to the amount of uric acid present in the sample.

Uric acid + H2O Uricase Allantoin + H2O2

H2O2 + 4Aminoantipyrine Peroxidase Red quinoneimine dye + H2O

+ Phenolic Compound

Normal Values

Serum/plasma (Males): 3.4 - 7.0 mg/dl

(Females): 2.5 – 6.0 mg/dl

It is recommended that each laboratory establish its own normal range representing its patient population.

Reagent Preparation

Working reagent: Pour the contents of 1bottle of L2 (Enzyme Reagent) into 1 bottle of L1 (Buffer Reagent). This working reagent is stable for at least 4 weeks when stored at 2-8 ˚C. Upon storage the working reagent may develop a slight pink color however this does not affect the performance of the reagent.

Alternatively for flexibility as much of working reagent may be made as and when desired by mixing together 4 parts of L1 (Buffer Reagent) and 1 part of L2 (Enyme Reagent). Alternatively 0.8 ml of L1 and 0.2 ml of L2 may also be used instead of 1 ml of the working reagent directly during the assay.

Sample material

Serum, plasma Uric acid is reported to be stable in the sample for 3-5 days when stored at 2-8 ˚C.

Procedure

Wavelength/filter: 520nm (Hg 546nm)/Yellow Green

Temperature: 37 ˚C/R.T.

Light path: 1 cm

Pipette into clean dry test tubes labeled as Blank (B), Standard (S), and Test (T):

Addition Sequence	B(ml)	S(ml)	T(ml)
Working reagent	1.0	1.0	1.0
Distilled water	0.02	--	--
Uric acid Standard (S)	--	0.02	--
Sample	--		--
	0.02		

Mix well and incubate at 37 ˚C for 5 min. or at R.T. (25 ˚C) for 15 min. Measure the absorbance of the standard (Abs.S), and Test Sample (Abs.T) against the Blank, within 30 min.

Calculations

$$\text{Uric Acid in mg/dl} = \frac{\text{Abs.T}}{\text{Abs.S}} \times 8$$

2. Microalbuminuria

Albumin refers generally to any protein that is water soluble, which is moderately soluble in concentrated salt solutions, and experiences heat coagulation (protein denaturation). They are unique to the other plasma proteins in the way they are not glycosylated (are not glycoproteins).

Serum albumin is the most abundant blood plasma protein and is produced in the liver and forms a large proportion of all plasma protein. It normally constitutes about 60% of human plasma protein.

Serum albumin is important in regulating blood volume by maintaining the oncotic pressure (also known as colloid osmotic pressure) of the blood compartment. They also serve as carriers for molecules of low water solubility this way isolating their hydrophobic nature, including lipid soluble hormones, bile salts, unconjugated bilirubin, free fatty acids (apoprotein), calcium, ions (transferrin), and some drugs like warfarin, phenobutazone, clofibrate and phenytoin. For this reason, it's sometimes referred as a molecular "taxi". Competition between drugs for albumin binding sites may cause drug interaction by increasing the free fraction of one of the drugs, thereby affecting potency.

Specific types include:

- Human serum albumin
- Bovine serum albumin (cattle serum albumin) or BSA, often used in medical and molecular biology labs.

The presence of albumin in the urine, in all probability, indicates some change, however slight and transient, in the epithelium of the glomeruli or the capillaries of the tuft, which permits the escape of the normal constituents, serum-albumin and serum-globulin, from the vessels into the renal tubules.

The principal causes giving rise to albuminuria are acute and chronic congestion of the kidneys, acute and chronic nephritis, the various degenerations of the kidneys, the toxin of scarlet fever, diphtheria, typhoid fever, measles, influenza, and numerous infectious diseases, certain blood changes that occur as the result of arsenic poisoning and poisoning from other minerals, and of certain diseases, such as scurvy, leukemia, syphilis, and others of like character. Pregnancy and certain lesions of the nervous system, as epileptic seizures, apoplexy, etc., may also be attended by albuminuria.

Immunoturbidimetric method

- Measurement of antigen-antibody reaction by the end-point method.

In this process turbidity is produced by an immune complex reaction. This causes a reduction in the intensity of light as it passes through the solution. Turbidimetry is the measurement of this loss in intensity because of scattering, absorption or reflection of the incident light in the angle/direction of the incident light.

Most colorimeters and spectrophotometers can measure turbidity with good precision and accuracy. This is the most widely used test as it can be done on most semi auto chemistry

analyzers. It can even be done on automated chemistry analyzers.

Reagents [11, 12]
Antiserum, Phosphate buffered saline, Polyclonal goat anti-human albumin (variable), Sodium azide (0.95g/L), Buffer, Saline (9g/L), Accelerator and Sodium azide (0.95 g/L) were used.

Preparation and stability of reagents
Reagent preparation: Liquid reagents, ready for use.
Stability and storage:
The reagents are stable until expiry date when kept at 2-8 ˚C. Stability in the instrument is atleast 4 weeks if contamination is avoided. Do not freeze.

Procedure
Sample/control: Ready for use.
Reference curve: Generate a reference curve by successive 1:2 dilutions of the microalbumin standard in saline. Alternatively use the Microalbumin Standard Set.
Use saline as zero point.
Test: Mix 60 mcL of standard, control(s) and samples with 900 mcL of MAL buffer. Read optical density (OD1) of standards, control(s) and samples at 340 nm. Add 150 mcL of antiserum. Mix and incubate for 5 minutes at room temperature. Read optical density (OD2) of standards, control(s) and samples at 340 nm.
Calculate OD's, plot a standard curve and read the concentration of control(s) and samples.

Normal values
0-20mg/L

Performances
The performance characteristics for the microalbumin-2 reagents were measured on a clinical chemincal analyzer (HITACHI 911).
Measuring range: 0-400mg/L
Specificity: Monospecific

Phase IV
Step - 1: Statistical analysis
Statistical analysis was carried by student t-test using GraphPad prism 5. Results were expressed in mean ± SD. Probability values of $P < 0.05$ were considered to be statistically significant. R2 value represents the correlation between the biological parameters.

Results

The study was conducted on acute myocardial infarction patients admitted to the ICCU of MGM Hospital, Warangal.

Sample Description
The study groups included 50 patients of acute myocardial infarction in which 32 patients are AMI, 4 patients are AMI with Diabetes mellitus, 8 patients are AMI with Hypertension and 6 patients are AMI with Diabetes and Hypertension respectively. Hence AMI patients (n=32) with no co morbidities were included in the study with a mean age of 54.03 ±13.30 years. The gender distribution was found to be 24 males and 8 females. The control group consisted of 27 males and 5 females with a mean age 52.28 ± 14.14 years.

Blood Pressure
Systolic ('p' value 0.0875) and diastolic blood pressure ('p' value 0.1247) was significantly high in AMI as compared with control.
The age and gender distribution are presented in **Table - 1**.

In AMI cases, 5 patients were vegetarians whereas 27 patients had a mixed diet. In control group, 16 individuals had a vegetarian diet, whereas 16 individuals had a mixed diet. Amongst the AMI cases 4 were smokers, 5 were alcoholic, 13 were both smokers and alcoholics and 10 were neither smokers nor alcoholic. In the control group 13 were smokers, 3 were both alcoholic and smokers and 16 were neither smokers nor alcoholic. These values are also presented in **Table - 2**.

In the AMI cases, 5 patients had a family history of hypertension, 2 were had a family history of

cardiovascular disease. Moreover 25 patients had no significant family history. In the controls had 2 diabetes mellitus, 3 family histories of hypertension, and remaining 27 patients' gives no significant family history. These values are also shown in **Table - 3**.

Table - 1: Demographic data.

Age in years	**Control (n=32)**		**AMI (n=32)**	
	Male	**Female**	**Male**	**Female**
31-40	7	2	7	1
41-50	6	2	7	0
51-60	3	1	5	3
61-70	9	0	2	3
71-80	2	0	3	1
Sex (M/F)	27/5		24/8	
Systolic BP(mm of Hg)	118.4±6.773		127±28.74	P value 0.0875
Diastolic BP(mm of Hg)	76.88±4.703		81.25±15.19	0.1247

Table - 2: Diet and Personal History of Cases.

Subjects	**Diet**		**Personal history**			
	Vegetarian	**Mixed**	**Smokers**	**Alcoholic**	**Both**	**None**
Controls (n=32)	16	16	13	0	3	16
Cases (n=32)	5	27	4	5	13	10

Table - 3: Family History of Cases.

Subjects	**Family history**				
	DM	**HTN**	**BOTH**	**CVD**	**NONE**
Cases (n=32)	2	3	0	0	27
AMI (n=32)	0	5	0	2	25

Table - 4: Religion & Education Status of Cases.

Subjects	**Religion**			**Educational status**	
	Hindu	**Muslims**	**Christian**	**Literates**	**Illiterates**
No of patients	31	0	9	9	23

Table - 5: Marital, Region and Lifestyle of cases.

Subject	**Marital status**		**Region**		**Lifestyle**	
	Married	**Widow**	**Rural**	**Urban**	**Sedentary**	**Non sedentary**
No of patients	29	3	15	17	22	10

Table - 6: Length of stay and Outcome of Cases.

Subjects	**Length of stay (in days)**										**Outcome**			
	<_1		**2-6**		**7-11**		**12-16**		**>16**		**Alive**		**Death**	
No of patients	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
	1	2	9	3	11	3	2	0	1	0	21	6	3	2

Table - 7: Killip's Class and Serum Uric Acid levels of Cases.

Serum uric acid	**Quartile I ≤4**		**Quartile II 4.1-5.5**		**Quartile III 4.6-7.0**		**Quartile IV >7.0**	
Killip's class	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
I	1	2	4	0	3	1	2	2
II	0	0	3	0	0	1	3	0
III	1	0	1	1	0	0	3	0
IV	1	0	1	0	0	0	1	1

Table - 8: Serum Uric Acid levels and Microalbuminuria levels of Cases.

Micral	**Serum Uric acid**			
	<_4	**4.1-5.5**	**5.6-7.0**	**>7.0**
10≤20	0	3	1	0
20-200	5	6	4	12
>200	0	1	0	0

Table - 9: Gender wise variables.

Variable	**Males**	**Females**	**Mean+_ SD**
CPK-MB (U/L)	18	4	100.5 ± 121.6
0-100	3	2	
100-200	2	0	
200-300	0	1	
300-400	1	1	
400-500			
Random Blood Sugar (mg/dl)			122.3 ± 54.05
50-100	9	3	
100-150	12	4	
150-200	1	0	
200-250	1	0	
250-300	1	1	
Serum creatinine (mg/dl)			0.8031 ± 0.1823
0.4-0.6	7	0	
0.6-0.8	9	4	
0.8-1.0	7	3	
1.0-1.2	0	1	
1.2-1.4	1	0	
Blood Urea nitrogen (mg/dl)			36.75 ± 6.183
0-20	0	0	
20-40	18	5	
40-60	6	3	

Table - 10: Treatment with Streptokinase in cases.

STK	**No of patients**
Yes	13
No	19

Table - 11: Age distribution, BMI, serum uric acid values and microalbuminuria values between cases and controls.

Variable	Mean ± SD	't' value	'P' value
Age distribution			
Cases	52.28 ± 14.14	0.5099	0.6119 ns
Controls	54.03 ± 13.30		
Body mass index (Kg/m^2)			
Cases	21.72 ± 2.385	1.521	0.7626 (ns)
Controls	21.98 ± 2.792		
Serum uric acid values (mg/dl)			
Cases	4.391 ± 1.342	3.646	< 0.0005***
Controls	6.536 ± 3.046		
Microalbuminuria values (mg/L)			
Cases	16.00 ± 2.540	4.614	<0.0001****
Controls	62.88 ± 57.42		

Table - 12: Correlation between Serum Uric Acid and Microalbuminuria, BMI.

Parameter	't' value	'P' value	R^2
Serum Uric Acid Vs Microalbuminuria of Cases	5.543	< 0.3313	0.0001****
Serum Uric Acid Vs Body Mass Index	21.06	<0.0001****	0.8774

In the AMI cases, 31 patients were Hindu and one patient is Christian. Among the AMI cases, 23 patients were illiterates and 9 patients were literates. The values are shown in **Table - 4**.

In AMI cases, 29 patients were married and 3 patients are widow; whereas 15 patients belong to rural region and 17 patients belong to urban region; meanwhile 22 patients leads sedentary lifestyle while 10 patients leads non-sedentary lifestyle. The values were shown in **Table - 5**.

Among AMI cases, 5 patients were died while 27 patients are survived and length of stay of patients in the hospital was shown in the **Table - 6**.

In our study, 15 patients were under Killip's class I, among them 10 are males and 5 are females; 7 patients are under Killip's class II, among them 6 are males and one female; 6 patients are under Killip's class III, among them 5 are males and one female and 4 patients are under Killip's class IV among them 3 are males and one female. The serum uric acid levels were also provided in the **Table - 7**.

Table - 8 represents, 5 patients were microalbuminuria with Quartile 1 level of Serum uric acid, 3 patients are high normoalbuminuric with Quartile 2 level of SUA, 6 patients are microalbuminuric with Quartile 2 level of SUA, one patient had macroalbuminuria with Quartile 2 level of SUA, one patient is high normoalbuminuric with Quartile 3 level of SUA, 4 patients were microalbuminuric with Quartile 3 level of SUA, whereas 12 patients were microalbuminuric with Quartile 4 level of SUA respectively.

Table - 9 depicts the Creatinine phosphokinase-MB values in U/L, Random blood sugar values in md/dl, Serum creatinine values in md/dl, Blood urea values in md/dl, and the mean values of CPK-MB (U/L), RBS (mg/dl), Serum creatinine (mg/dl) and Blood urea (mg/dl) of cases.

In AMI cases, 19 patients were not under the treatment of Streptokinase and 13 patients were under the treatment of Streptokinase.

Analysis (Descriptive statistics)

Table - 11 represents the values of mean ± SD of age (in years) and Body Mass Index (kg/m^2) of cases and control. Whereas, the value of 't' statistic to test the hypothesis that there is no significant difference between the mean age values and Body Mass Index of cases and control. As seen from the table the 'P' value for the't' test is >0.0001. The mean age value and BMI present in cases was therefore not significantly more (1% level) than the age value of the controls.

Uric acid is higher in cases (6.536 ± 3.046 mg/dl) Vs control (4.391 ± 1.342 mg/dl), whereas 'p' value for the't' test is <0.0005***. Therefore mean serum uric acid values present in cases is therefore significantly more (1% level) than the serum uric acid values of the control. Microalbuminuria is higher in cases (62.88 ± 57.42 mg/L) Vs control (16.00 ± 2.540 mg/L), whereas 'p' value for the't' test is <0.00001****. Therefore mean microalbuminuria value present in cases is therefore significantly more (1% level) than the microalbuminuria value of the control.

Table - 12 represents a positive correlation between serum uric acid concentration and microalbuminuria (r2= 0.3313, p < 0.0001****), and serum uric acid and body mass index (r2 = 0.8774, p < 0.0001****)

Discussion

Myocardial infarction is a common presentation of ischemic heart disease. Worldwide more than 3 million people have STEMIs and 4 million have NSTEMIs a year. Coronary heart disease is responsible for 1 in 5 deaths in the world wide. The mean age of AMI cases in our study was 50.98 ± 13.74 and male to female ratio of 2:1.

Eberhard, et al. [13] (2007), considered that most of the cardiovascular events occur in individuals aged at 60 years or more. Controversially, our study shows that the more number of cardiovascular events are above 40 years.

All the cases in the present study had a normal renal function (Urea ≤ 56 mg/dl; creatinine ≤ 1.4 mg/dl). Microalbuminuria, in these patients was therefore not related to renal dysfunction. Our study in this respect has similar views of Peter Gosling [14] (1995), who considered it to be a sensitive indicator of non-renal disease.

Previous studies have shown that serum uric acid increases in cardiac failure (Anker SD, et al. [15], 2003). In a study done in Japan in 2005 by Kojima, et al. [16], it was shown that serum uric acid levels correlate with Killip classification. Combination of Killip class and serum uric acid level after acute myocardial infarction is a good predictor of mortality in patients who have acute myocardial infarction. Using this study as referral study, we tried to find correlation between serum uric acid and Killip class and their prognostic value in our patients.

Present study was conducted in 32 patients of acute myocardial infarction, who admitted to ICCU of MGM hospital with in 24 hrs of onset of symptoms.

Out of 32 patients, 20 had ST-elevation myocardial infarction (STEMI), while 12 patients were of non-ST elevation myocardial infarction (NSTEMI). Thirteen patients were thrombolysed while nineteen were not thrombolysed due to delayed presentation. Uric acid was treated as a continuous variable and as a categorical variable, and variables were divided into quartiles according to serum uric acid concentrations same as in referral study by Kojima, et al. [16] 2005.

Our patients and controls were age and sex matched as shown in **Table - 1**. The patients had higher serum uric acid level probably because of acute myocardial infarction.

In our study there was no difference in uric acid levels between male and female patients (**Table - 2**); however in referral study (by Kojima, et al. [16] 2005) males had higher uric acid levels as compared to females.

Out of 32 patients, five expired during more than 7 day follow up. 2 patients who died had serum uric acid level more than 7.0 mg/dL. Of these five patients, two were in Killip class I, one in Killip class III and two were in Killip class IV at the time of admission. Thus, 60% of patients who died were in higher class i.e. class III and IV at time of admission. One patient expired on day 3 was in Killip class I on day 0 and one patient expired on day 6 was in Killip class I on day 0. Out of these 5 patients two had serum uric acid level in quartile 4 on day of admission. Two patients who were in Killip class I and had uric acid in 1st quartile and 2nd quartile respectively, on the day of admission however they had shifted to Killip class IV who died later. Therefore it shows that serum uric acid concentration is significantly correlated with Killip class. However, because of small number of patients statistical significance could not be proved.

Our result shows that serum uric acid & microalbuminuria estimated in AMI was highly significant, in addition to that serum uric acid & body mass index was also highly significant.

In the present study, we found a stronger relationship between albuminuria and mortality from CV causes. In view of this finding, albuminuria appears to be a marker of generalized vascular disease and indicates an incremental risk for CV mortality.

Conclusion

Serum uric acid levels are higher in patients of acute myocardial infarction as compared to normal healthy persons.

Serum uric levels are correlated with Killip class; patients in higher Killip class have higher serum uric acid levels.

Serum uric acid levels and Killip class are influenced significantly by previous myocardial infarction. Patients who had myocardial infarction in past have higher serum uric acid levels and are in higher Killip class. Combination of Killip class and serum uric acid level after acute myocardial infarction is a good predictor of mortality after AMI.

Microalbuminuria was present in approximately 84.3% of this population. It was independently associated with cardiovascular risk factors and prevalent cardiovascular disease. Microalbuminuria is an independent predictive indicator for future events.
In present study it was observed that uric acid and microalbuminuria was significantly increased in Acute Myocardial Infarction as compared to healthy volunteers.

We found positive association of uric acid and microalbuminuria in patients with Acute Myocardial Infarction.

Limitations

The present study has a number of limitations, and to appreciate the findings, some issues need to be addressed.

- Small sample size of the study.
- We measured Serum Uric Acid and Urinary Albumin Concentration only once and without correcting for potential variability in urine concentration.
- In addition, we were unable to perform detailed measurements of the CV risk factors.
- Self-reported histories have limitations because of certain degree of misclassification; therefore, bias may occur. Because we do not expect this misclassification to be related to the risk factors or to the fasting blood samples and morning urinary albumin measurements themselves, misclassification would dilute the estimated effects; i.e., it would make the estimated risk ratio closer to 1.

Therefore, our analysis may have underestimated the true association between serum uric acid, urinary albumin excretion and mortality.

We conclude from this prospective cohort study that serum uric acid and albuminuria are important markers for CV mortality.

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