Original Research Article

Random blood sugar and serum albumin as prognostic markers in patients with ST segment elevation myocardial infarction

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Abstract

Background: Decreased serum albumin level was reported to be associated with increased risk of cardiovascular events and short term-mortality in patients with AMI. There are evidences that the concomitant occurrence of hyperglycaemia in patients with an AMI enhances the risk of mortality and morbidity. **Objective:** To study Random Blood Sugar and Serum Albumin as prognostic markers in patients with ST segment Elevation MI.**Methodology**: The study was conducted on 51 cases of AMI admitted at VIMS Ballari between year 2018-2020. The cases were divided into 3 groups (group I to III) and 2 groups (group I and II) based on admission RBS and serum albumin respectively. All cases were subjected to investigations, and in-hospital complications were noted. In hospital complications and mortality was analysed using appropriate statistical methods across the groups.**Results:** All 51 cases had ST segment elevation myocardial infarction with comparable age and sex between the groups. With progressive rise in RBS at admission, there was a statistically significant rise in the mean systolic BP (P=0.019*), mean diastolic BP (P=0.0001*) and mean heart rate (**P=0.036***), higher Killip's class (P=0.035*) and development of LV failure (P=0.002*) at admission. There was also statistical significance in the development of LV failure and mean Serum Albumin value (P=0.05*) at admission. There was statistical significance between mortality and serum albumin values at admission (P=0.04*).**Conclusion**: It was observed that Hypoalbuminemia on admission is a strong independent predictor for short term mortality and overall in-hospital complications were more common in subjects with high admission RBS

Keywords: Acute Myocardial Infarction; Mortality; Serum Albumin; Prognosis

Introduction

Cardiovascular diseases are the number one cause of death globally, taking an estimated 17.9 million lives each year, representing 31% of all global deaths. Acute coronary syndrome (ACS) is a complex heterogeneous clinical syndrome including unstable angina, non-ST elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction (STEMI). Despite the great advancement in medical care, ACS remains a leading cause of considerable morbidity and mortality. [1]The pathogenesis of atherosclerosis involves a number of mechanisms, including inflammation, endothelial dysfunction, oxidative stress, and platelet activation.

Serum albumin, the most important protein of the human serum, has several important physiological functions in the body. Increased inflammatory response has been associated with decreasing synthesis and increasing catabolism of the albumin. Lower SA levels may increase blood viscosity and disrupt endothelial functions. Additionally, it is an important inhibitor of platelet activation and aggregation and an important mediator of platelet- induced coronary artery narrowing. Moreover, one of the most important functions of albumin is its antioxidant activities. It is well known that lower concentrations of SA can predict increased morbidity and mortality risks in a range of cardiovascular diseases including ACS. [2]

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Hyperglycaemia is a frequent condition in patients with acute coronary syndromes (ACS). Hyperglycaemia during ACS is caused by an inflammatory and adrenergic response to ischemic stress, when catecholamines are released and glycogenolysis induced.

Although the involved pathophysiological mechanisms have not yet been fully elucidated, it is believed that hyperglycaemia is associated with an increase in free fat acids (which induce cardiac arrhythmias), insulin resistance, chemical inactivation of nitric oxide and the production of oxygen reactive species leading to microvascular and endothelial dysfunction, a prothrombotic state, and vascular inflammation. [3] So the present study was conducted to study Random Blood Sugar and Serum Albumin as prognostic markers in patients with ST segment Elevation MI

Materials and Methods

This prospective study was conducted in patients admitted in the Vijayanagara Institute of Medical Sciences and hospital, Bellary. Duration of study was two year (December 2018 to April 2020.

Variable considered for calculation of sample size: Mortality amongst STEMI patients for the calculation of sample size calculation. According to the et al Mortality amongst STEMI patients were seen upto 17%. [4]

Confidence level: conventional =95% = 1-α; therefore α = 0.05 and Z(1- α/2) =1.96 = value of the standard normal distribution corresponding to a significance level of 0.05 (1.96 for a 2 sided test at the 0.05 level)

n = sample size

d = absolute precision = 0.04

q = expected mortality in STEMI patients= 0.17 (17%)

p= expected proportion in the population = 1-q = 0.83 (83%)

$$n = \frac{1.96 \times 0.83 \times 0.17}{(0.04)^2} = 172.25$$

Since many patients, doesn't fit into inclusion criteria and didn't give informed consent for the study, only 51 cases were taken up and was studied.

Inclusion criteria:
1. All patients with ST segment elevation myocardial infarction
2. Age group >18years

Exclusion criteria:
1. Patients who have renal/ hepatic disorders.
2. Cases of non ST segment elevation myocardial infarction
3. Non cardiac chest pain
4. Diabetes mellitus
5. Malnourished patient
6. Hyperthyroid patient

Informed consent was taken from all the patients who participated in the study. The study was conducted as per the guidelines of the institute, after departmental peer review and approval by Ethics committee.

Instruments / Tools
1. Socio demographic and clinical data sheet: This sheet was used to collect the patient's socio demographic data, including age, gender, residential status, complaints at presentation, past history, family history and details of general physical examination.
2. Killip's class grading: In 1967 prior to invasive monitoring, Killip and Kimball[5] devised a clinical classification based on physical findings present on admission, which provided a prognostic guide.

Table 1: Killip Classification

Killip class	Hospital mortality (%)
I -No congestive heart failure	6
II - Mild congestive heart failure, rales, S3, congestion on chest radiograph	17
III - Pulmonary edema	38
IV - Cardiogenic shock	81**

** It is important to note that with modern therapy, the mortality of those in cardiogenic shock has improved from 81 percent to approximately 60 percent.

Procedure
- The study included all the non-diabetic patients admitted to the ICCU with any or all of symptoms suggestive of myocardial infarction for at least 30 minutes and ST Elevation in ECG.
- All patients who had no history of or treatment for diabetes mellitus at entry, were included.
- The patient's cardiovascular history, medication at the time of admission, risk factors, in-hospital clinical course, including Killip's class, and the initial diagnostic and therapeutic management was recorded.
- On admission, vital signs [pulse rate, respiratory rate, blood pressure, saturation of peripheral oxygen (SpO2)], were recorded.
- Following routine lab tests were included: Hemoglobin , TC (total count), DC (differential count), Platelet Count , Blood Urea, Serum Creatinine , Liver function test, Urine Albumin and Urine sugar were sent at admission.
- All patients, on admission, RBS was measured by a single standard calibrated glucometer and serum albumin was measured with bromocresol green method.
- ECG of all patients was read and recorded (territory of infarct, STEMI, Rhythm Disturbances), left ventricular ejection fraction and regional wall motion abnormality was assessed by echocardiography at any time during the first 2 days, and recorded.
- The end points of study were 3 days or till death during hospitalization.
- The patients were subjected to routine investigations as per protocol and in case patient refused the investigations required for this study, the cost of the investigations was borne by the principal investigator (Dr. Bhargava Rama).

Statistical methods:
Data obtained was tabulated using version 22 of the Statistical Package for Social Sciences (SPSS, published SPSS Inc.) and subjected to appropriate statistical analysis. Chi- square test and F TEST were used to identify differences between 3 groups of RBS and 2 groups on serum albumin at admission.

Results

The study patients are divided into Three groups (I to III) depending on the admission RBS into Group I- 23 patients, Group II- 14 patients and Group III- 14 patients respectively.

Two groups (I to II) depending on the admission Serum Albumin into Group I- 36 patients and Group II – 15 patients respectively.

The majority of patients in both the groups were males (78.4%) when compared to females (21.60%). The mean RBS at the time of admission is higher in group III (298.79) which is statistically significant the mean serum albumin values on admission is higher in group II (4.006) which is statistically significant.

age distribution and mean age of patients among the three groups of RBS at admission. The mean age group of the patients in the three groups are as follows – Group I – 59.57, group II – 57.36 and group III – 51.43.The above figures show the Age distribution and Mean age of patients among the two groups of Serum albumin at admission. The mean age in group I was 53.6 and group II was 56.

There is a statistically significant rise in the mean systolic BP (P=0.019),mean diastolic BP (P=0.0001) and mean heart rate at admission as we move from Group I to Group III.

There is no significant changes in the mean systolic, diastolic BP and heart rate in groups of serum albumin

There is statistically significant difference between groups in Killip's class I,II, III, IV at admission. There is presence of higher Killip's class at admission as admission value of RBS increases.

There is no statistically significant difference between groups in Killip's class at admission and serum albumin groups at admission.

Chest pain was the predominant symptom among the three groups followed by symptom of breathlessness.

In our study it was observed that there was statistical significance in left ventricular failure and higher RBS values (0.04). However, there was no significance noted between parameters of death and arrhythmias with RBS values.

In our study it was seen that there was no statistical significance between the outcomes of arrhythmias, left ventricular failure and death with serum albumin levels.

In our study, it was seen that there was statistical significance in the outcome of LV failure and mean RBS value at admission (0.002).

There was no significance in outcome of arrhythmias and death with RBS values.

Table 2: Admission RBS values as outcome predictors

	RBS on admission			
Outcome variable	**Mean**	**SD**	**F test**	**P value**
Arrhythmia				
Yes	188	111.479	0.41	0.53
No	162.38	89.742		
LV failure				
Yes	222.63	110.154	10.89	0.002*
No	139.23	68.941		
Mortality				
Yes	202.8	139.202	0.922	0.342
No	161.33	86.244		

In our study it was seen that there was statistical significance between LV failure (0.059) and mortality (0.04) with serum albumin values at admission

Table 3: Admission Serum albumin values as outcome predictors

	Albumin on admission			
Outcome variable	**Mean**	**SD**	**F test**	**P value**
Arrhythmia				
<3.5	3.2	0.4604	0.243	0.624
>3.5	3.322	0.5788		
LV failure				
<3.5	3.088	0.441	3.76	**0.05***
>3.5	3.408	0.59		
Mortality				
<3.5	2.82	0.3493	4.43	**0.04***
>3.5	3.36	0.5593		

Table 4: Summary Of Study According To Rbs Groups

Variable Admission RBS	**Group1 (N=23) <120 mg%**	**Group2 (N=14) 120-167 mg%**	**Group 3 (N=14) >167 mg%**	**F/ χ2**	**P**
Age	51.43	57.36	59.6	1.74	0.184
Sex- Male Female	6 17	2 12	3 11	0.717	0.72
Systolic BP (mmHg, mean)	115.65	125	142.31	4.29	**0.019***
Diastolic BP	68.7	76.43	85.38	10.38	**0.0001***
Heart Rate	84.61	98.36	93.46	3.56	**0.036***
Admission RBS	97.74	143.14	298.79	147.8	**<0.0001***
Killip class admission I II III IV	17 3 0 3	6 4 2 2	4 1 7 2	18.45	**0.035***
Arrhythmias	2	2	2	0.38	0.83
LVF (no of cases)	4	4	8	6.4	**0.04***
Mortality	1	2	1	1.96	0.591

Table 5: Summary Of Study According To Serum Albumin Groups

Variable Admission Serum albumin	**Group1 (N=36) <3.5**	**Group2 (N=15) >3.5**	**F/ χ2**	**P**
Age	56	53	0.311	0.574
Sex Male Female	26 10	14 1	2.71	0.091
Systolic BP (mm Hg)	124.86	126	0.017	0.896
Diastolic BP(mm Hg)	74.86	76	0.086	0.77
Heart Rate	89.69	93.27	0.485	0.489
Killip's class on admission I II III IV	20 4 7 5	7 4 2 2	2.08	0.569
Mean serum albumin	3.02	4.006	92.18	**0.000**
Arrhythmia	4	2	0.05	0.822
LVF (no of cases)	12	4	0.22	0.64
LVF (mean serum albumin)	3.088	3.408	3.76	**0.05***
Death (mean serum albumin)	5	0	2.3	**0.04***

Discussion

51 patients admitted with ST Elevation Myocardial Infarction were selected and included in the study after taking their informed consent and serum albumin and random blood glucose levels were estimated in them on admission and for two days thereafter ie, Day 0—at the time of admission, Day 1- the following day (12 to 30hrs after collecting the first sample), Day2 (32 to 54hrs after collecting first sample). The mean age group of the study was 55.29. There was no statistically significant difference in age distribution between the groups. The mean age was highest in group III which correlated with a higher RBS levels. According to a study done by Marfella et al, the mean age group was 57 which also correlates with our study. [6]

The mean age in albumin groups in years were 56 (Group I) and 53 (Group II). There was no statistically significant difference in age distribution between the groups. The following data correlated with the other studies also.

This was in correlation with other studies like the one by Kadri et al[7] where the percentage of females were 22%. However it did not correlate with other studies like 25% in study done by Vecih Oduncu et al. [8]There occurred a statistically significant difference in heart rate at admission across the groups (0.036). This correlated with previous studies where the mean DBP and heart rate were higher for high RBS groups[6] Mean systolic BP at admission was 124.86 mmHg and the diastolic BP was 74.86 mmHg in the group of patients with serum albumin of <3.5 g/dl. Mean systolic BP at admission was 126 mmHg and the diastolic BP was 76 mmHg in the group of patients with serum albumin of >3.5 g/dl. There was no statistically significance in both of them. This correlated with other studies like Oduncu et al [8] and Suzuki et al. [9] Killip's classification was used in patients presenting with acute MI for the purpose of risk stratification. At admission, there were 27 patients in Killip's class 1 and 8 in Killip's class 2 while 9 in Killip's class 3 and 7 patients in Killip's class 4. We observed that patients in RBS under Group III and Group IV had higher admission Killip class, which was statistically significant (p=**0.005**). It was inferred that Killip class was high in subjects with higher admission RBS values. Similar result was reported by Kadri et al. [7]

In case of patients with serum albumin group, there were 27 patients in Killip's class1, 8 patients in Killip's class 2 , 9 patients in Killip's class 3 and 7 patients in Killip's class 4 .There was no statistically significant among the patients in various Killip's class. But Goro Yoshioka et al[10] showed that there is significant association between development of higher Killip's class and low Serum albumin levels at admission.Patient outcomes were observed under three complications as follows:

Development of Arrhythmia: In our study 6 patients had developed arrhythmia with 2 in each RBS group patients. There was no statistically significant association between the RBS groups and arrhythmia development. Amongst the patients who developed arrhythmia, mean RBS was 188 mg/dl with SD of 111.49. But there was no statistically significance between the development of arrhythmia and RBS group

It was also observed that amongst the 6 patients who developed arrhythmia, 4 patients had serum albumin <3.5g/dl and 2 patients had serum albumin >3.5 g/dl. There was no statistically significant association between the development of arrhythmia and serum albumin levels. It was also seen that Mean serum albumin of 3.2g/dl had no statistically significant association with development of arrhythmia. The same observation was made in Suzuki et al[9] where development of atrial fibrillation was not statistically significant with serum albumin level.

Development of left ventricular failure: In our study 16 patients developed acute LVF and maximum number of patients were seen in Group 3 RBS (50%). There was a statistically significant association between development of LVF and RBS values (0.04). It was observed that with higher values of RBS, there was more chance of development of Acute LVF. The mean RBS value was 222.63 mg/dl with SD of 110.154 mg/dl and was statistically significant with development of Acute LVF. Similar observations were made in Aljohar A et al [11]. It has also been considered in a study by Michael R. MacDonald et al[12] that it is an independent risk factor for the development of Acute LVF Out of 16 patients who developed acute LVF 12 patients had serum albumin of <3.5g/dl which even though constituted 75% of patients, was statistically insignificant. However it was observed that mean serum albumin level of 3.088g/dl with SD of 0.441 g/dl was considered statistically significant with development of acute LVF (p value of 0.05). Similar observations were made in studies done by Goro Yoshioka et al. [10]

Mortality: The raised admission RBS is an important correlate of short term mortality in our study. However, we observed that it is not an independent predictor of death in our study. In our study , out of 5 deaths 2 belonged to group 1 and group 3 each and 1 belonged group 2 RBS groups. There was no statistically significant association noted between RBS values and death. In case of serum albumin levels , all 5 deaths of the patients had serum albumin level of <3.5 g/dl. But this was not statistically significant in our study. In contrast to the above finding, mean serum albumin value of 2.82 g/dl with SD of 0.3493 g/dl , at admission had statistically significance related to the short term mortality(p value 0.04). Same observations were made in others studies like Oduncu et al[8], Goro Yoshioka et al [10].

Conclusion

Hyperglycemia during ACS is a common finding and also an adverse prognostic marker that increases the risk of immediate and long-term complications in patients even without diabetes mellitus. Despite hyperglycemia as a factor of worse outcome is documented in several prospective studies, many gaps in knowledge currently exist in our understanding of the association between elevated glucose levels and adverse outcomes in patients with ACS.

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