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Significance of Serum Albumin in Patients with Acute Coronary Syndrome

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Aim: The aim of the study was to determine the serum albumin levels in patients of acute coronary syndrome and to determine the correlation between serum albumin levels and development of ST segment elevation myocardial infarction (STEMI) or non-ST segment elevation myocardial infarction (NSTEMI) or new onset heart failure or cardiogenic shock.

Material and Methods: Present prospective observational study was conducted in the department of medicine, tertiary care institute of India for the duration of 9 months. A total of 100 patients of ACS were enrolled in this study. Serum albumin levels of the patients were recorded and clinical outcomes based on the albumin levels were compared between the patients.

Results: The mean age of the study population was found to be 60.48±9.90 years. Out of these 100 patients, 44 were in the hypoalbuminemia group and 56 were in the normoalbuminemia group. There were 24 and 34 females respectively in hypoalbuminemia and normoalbuminemia group. The males were 20 and 22 in numbers respectively. This association between gender wise distribution among the two groups was not found to be significant ($p<0.05$). Mean serum albumin level in hypoalbuminemia group who presented with STEMI was 2.90±0.12 g/dl and who presented with NSTEMI was 3.16±0.26 g/dl and this relation was found to be statistically significant ($p=0.05$).

Conclusion: Low serum albumin levels on admission are associated with worse in hospital outcomes in ACS patients and also that patients with low serum albumin levels are more likely to present with STEMI. Accordingly, we consider that albumin is a simple and easily measured biomarker for predicting the increased risk of mortality in these patients.

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Key Words: Acute Coronary Syndrome, Hypoalbuminemia, Myocardial Infarction, Serum Albumin

Introduction

Coronary artery disease (CAD) is one of the major causes of death and mortality in the developed world.[1] Coronary atherosclerotic disease involves the epicardial coronary arteries and may manifest as an acute or chronic coronary syndrome. ACS arises from atherosclerotic plaque rupture leading to coronary thrombosis and/or spasm. It results in occlusion of the coronary arteries which leads to intense myocardial ischaemia or even myocardial necrosis which eventually manifests as unstable angina or myocardial infarction.[2] ACS patients with acute myocardial infarction are classified into two main groups based on their presenting electrocardiogram (ECG) as ST segment elevation myocardial infarction (STEMI) or non-ST segment elevation myocardial infarction (NSTEMI).[3]

Albumin is the major protein in human plasma and the extracellular compartment, taking part in multiple important physiological functions. These include: maintaining plasma osmotic pressure and capillary permeability, serving as a ligand for many endogenous and exogenous substances, affecting pharmacokinetics of many drugs, coagulation pathways and comprising antiplatelet aggregation, anti-inflammatory, and anti-oxidative activities.[4-10] Evidence is growing, identifying hypoalbuminemia as a powerful prognostic marker in the full spectrum of cardiovascular diseases, even after adjusting for traditional risk factors and potential confounders. Hypoalbuminemia was found to be associated with increased risk for development of coronary artery disease, stroke, and acute myocardial infarction (AMI) and heart failure.[12-14] Furthermore, hypoalbuminemia was found to be a negative shortand long- term prognostic marker in patients with the latter cardiovascular entities in patients with ACS, presence of hypoalbuminemia has been associated with increased severity of coronary lesions, no-reflow, increased in-hospital, and long-term mortality as well as development of heart failure.[14-19]

Plasma albumin concentration is related to inflammatory and hemostatic processes.[20] ACS is considered an inflammatory condition and in response to an inflammatory state, there will be a decline in serum albumin concentration.[21,22] The aim of the study was to determine the serum albumin levels in patients of acute coronary syndrome and to determine the correlation between serum albumin levels and development of STEMI or NSTEMI or new onset heart failure or cardiogenic shock or in-hospital mortality in these patients.

Material and Methods

Present prospective observational study was conducted in the department of medicine, tertiary care institute of India for the duration of 9 months. A total of 100 patients of ACS were enrolled in this study. They were diagnosed as ACS on basis of clinical symptoms, cardiac biomarker levels and/or ECG findings. The patients were divided into two groups based on serum albumin levels as hypoalbuminemia group (serum albumin 3.5 g/dl) and normoalbuminemia group (serum albumin> 3.5 g/dl). The endpoint of the study was the association between serum albumin levels and development of ACS in the form of NSTEMI, STEMI and the complications

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in the form of new onset heart failure, cardiogenic shock and in-hospital mortality in these patients.

Inclusion criteria Patients with acute myocardial infarction both STEMI and NSTEMI proven by cardiac enzymes, ECG and symptoms suggestive of acute coronary syndrome were included in the study. Exclusion criteria: Acute renal failure on admission, pregnancy, chronic liver disease, end stage renal disease (ESRD), malignancy, septicemia, malnutrition and nephrotic syndrome.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

Total of 100 patients were enrolled in the study. The mean age of the study population was found to be 60.48±9.90 years. The age groups were divided as 30-40, 41-50, 51- 60, 61-70 and >70 years. Maximum numbers of patients were in the age group of 61-70 years which included 36 patients. Out of these 100 patients, 44 were in the hypoalbuminemia group and 56 were in the normoalbuminemia group. There were 24 and 34 females respectively in hypoalbuminemia and normoalbuminemia group. The males were 20 and 22 in numbers respectively. This association between gender wise distribution among the two groups was not found to be significant ($p<0.05$).

In hypoalbuminemia group, serum albumin level in those who developed new onset heart failure was 2.82±0.06 g/dl and those who didn't develop it was 3.21±0.20 g/dl and this was found to be statistically significant ($p<0.05$). Mean serum albumin level in hypoalbuminemia group who developed and didn't develop cardiogenic shock was 2.90±0.11 g/dl and 3.10±0.19 g/dl respectively and this relation was found to be statistically insignificant ($p=0.2$). The mean serum albumin level in normoalbuminemia group was 5.43±1.98 g/dl in those who developed cardiogenic shock and 4.79±0.90 g/dl in those who didn't develop and this was statistically insignificant ($p=0.09$). Mean serum albumin level in hypoalbuminemia group who had mortality and who didn't have was 2.85±0.06 g/dl and 3.19±0.21 g/d respectively and this relation was found to be statistically significant ($p=0.02$)

Mean serum albumin level in hypoalbuminemia group who presented with STEMI was 2.90±0.12 g/dl and who presented with NSTEMI was 3.16±0.26 g/dl and this relation was found to be statistically significant ($p=0.05$). In normoalbuminemia group the mean serum albumin level in patients of STEMI was 4.84±0.84 g/dl and that of those with NSTEMI was 4.85±1.05 g/dl and this was statistically insignificant ($p=0.88$).

Table 1: Age wise Distribution of study Participants

Age (Years)	Number	Percentage (%)
30-40	8	8
41-50	16	16
51-60	25	25

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61-70	36	36
>70	9	9
More than 70	6	6
Total	100	100

Table 2: Gender wise distribution of between two groups

Gender	Hypoalbuminemia N (%)	Normoalbuminemia N (%)
Male	20 (45.45)	22 (39.28)
Female	24 (54.54)	34 (60.71)
Total	44 (44)	56 (56)

Discussion

Albumin selectively inhibits tumor necrosis factor-alpha induced VCAM-1 expression, monocyte adhesion and nuclear factor-kappa B activation in endothelial cells of human aorta, suggesting its role as an anti-inflammatory and anti-thrombogenic substance.[23] Low serum albumin level has been linked with worse clinical outcomes and mortality in patients of ACS.

In the present study Maximum numbers of patients were in the age group of 61-70 years. Mean age in the study of Hartopo et al was 57.5±10.0 years.[24] In their study Sujino et al recorded the mean age to be 88.1±2.5 years.[25] Hypoalbuminemia was seen in 44 (44%) patients and normoalbuminemia was seen in 56 (56%) patients out of total 100 patients. In study conducted by Hartopo et al out of total of 82 patients, 35 (43%) were in hypoalbuminemia group and 47 (57%) were in normoalbuminemia group.[24] In another study conducted by Polat et al hypoalbuminemia was detected in 34% of the patients.[26] Findings of our study were similar to these studies.

Low levels of serum albumin have been shown to be associated with stable CAD and poor outcome in long- and short-term follow-up in patients with ACS.[27-30] A recent study reported that a serum albumin level 3.50 g/dL is an independent predictor of new-onset heart failure and in-hospital mortality in patients with ACS.[27] Kurtul et al found that low albumin levels were associated with no-reflow in patients who had undergone primary PCI.[29] In another study, serum albumin level was found to be associated with high SYNTAX score and increased in-hospital mortality in patients with ACS.[30]

In hypoalbuminemia group out of 44 patients, 24 (54.54%) presented with STEMI and 20 (45.45%) presented with NSTEMI. In normoalbuminemia group of 56 patients, STEMI was seen in 26 (46.42%) patients and NSTEMI in 30 (53.57%) patients. González-Pacheco et al also found that the patients with serum albumin levels. A study conducted by Oduncu et al included STEMI patients who underwent primary PCI and were followed up for an average of 40 months and reported that hypoalbuminemia on admission was an independent and strong predictor of long-term mortality and advanced heart failure.[30] In the same study, in a similar way to our study, low albumin levels were associated with increased age, female gender, presence of HT,

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high creatinine levels, and low HGB levels. Additionally, CRP levels were significantly higher and LVEF was significantly lower in the group with hypoalbuminemia.

Human serum albumin is a 65-kDa protein that accounts for >50% of the total plasma protein concentration.[3] The albumin plasma concentration depends on various factors such as albumin synthesis, rate of degradation, distribution of albumin, hemodilution, and exogenous albumin loss.[31-33] Albumin synthesis is affected by nutritional intake, colloid oncotic pressure changes, insulin, diabetes, liver disease, presence of systemic inflammation, and sepsis.[9,31,32] Albumin is the serum protein responsible for maintaining in travascular colloid osmotic pressure and also has multiple physiological properties including anti-inflammatory, antioxidant, anticoagulant, and antiplatelet aggregation activity.[5]The prognostic importance of hypoalbuminemia in patients with ACS may be due to the fact that hypoalbuminemia is associated with other comorbidities such as inflammation, malnutrition, and cachexia.[34,35]

In our study population in hypoalbuminemia group, the mean serum albumin level association was statistically significant in patients of STEMI and NSTEMI group. The mean serum albumin levels in patients of hypoalbuminemia group who developed new onset heart failure was 2.86±0.06 g/dl and those who didn't develop was 3.11±0.92 g/dl and this association was found to be statistically significant. Oduncu et al also concluded that hypoalbuminemia on admission was a strong independent predictor for longterm mortality and development of advanced Heart Failure in patients with STEMI undergoing p-PCI.[12]

Serum albumin has been reported to be an important inhibitor of platelet activation and aggregation and a mediator of platelet-mediated CAD.[36-38]In addition, serum albumin has been shown to be an endothelial prophylactic agent against endotoxins and endothelial apoptosis inhibitor.[39,40] Therefore, low serum albumin may be associated with an increased risk for endothelial damage and for thrombotic events associated with platelet activation and aggregation. The mean serum albumin level in hypoalbuminemia group who had mortality was 2.87±0.06 g/dl and who didn't was 3.19±0.21 g/dl. This association was found to be statistically significant (p=0.02). Plakht et al, Zhu L et al and Xia M et al also observed that low serum albumin level was associated with increased mortality among the ACS patients.[28,41,42]

The limitation of our study was the small sample size which may limit the clinical applicability of our results and this needed to be confirmed by a large-scale study.

Conclusion

Low serum albumin levels on admission are associated with worse in hospital outcomes in ACS patients and also that patients with low serum albumin levels are more likely to present with STEMI. Accordingly, we consider that albumin is a simple and easily measured biomarker for predicting the increased risk of mortality in these patients.

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