Original article:

Effect of acute myocardial infarction on serum zinc level

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Abstract:

Introduction: Myocardial infarction is a common presentation of coronary artery disease. The diagnosis of acute myocardial infarction (AMI) is of vital importance from the management and prognosis point of view.

Objective: The purpose of this study was to investigate serum zinc level in acute myocardial infarction patients and to correlate it with biochemical parameter SGOT.

Methods: In the present study 30 patients suffering from acute myocardial infarction were taken as a study group with inclusion & exclusion criteria & were compared with the healthy control group. The serum zinc levels of both the groups were estimated on G.B.C.932 model atomic absorption spectrophotometer. The data were analyzed by student unpaired t-test.

Results: The serum zinc level in acute myocardial infarction patients was significantly low as compared to healthy controls. In patients with AMI, there was good correlation between the serum zinc level and the biochemical marker of AMI like SGOT.

Conclusion: A fall in plasma zinc is a reliable diagnostic test for acute myocardial infarction, and the extent of the fall has prognostic implications. Oral zinc administration to the patients of AMI may be helpful in the prognosis.

Key words: Acute myocardial Infarction, Serum zinc

INTRODUCTION

Myocardial infarction is one of the dangerous manifestations of coronary artery disease and is one of the commonest causes of mortality. It has now become an important health problem despite advancement in diagnosis and management over the last few decades. The World Health organization estimated in 2004, that 12.2% of worldwide deaths were from ischemic heart disease (1). The disease is often premature and severe, with serious complications. Because of its frequency of occurrence and potentially dreaded complications, the diagnosis of acute myocardial infarction (AMI) is of vital importance from management and the prognosis point of view.

Myocardial infarction results in death of myocardial cells. The acute inflammatory response due to cell death, results in the liberation of intracellular enzymes in the circulation several hours later. The intracellular enzymes routinely measured in the clinical laboratory for the purpose of diagnosing and monitoring myocardial infarction include creatine kinase (CK), aspartate amino transferase (SGOT or AST), and lactate dehydrogenase (LDH). These enzymes are present in sufficiently high content in myocardial tissue so that the death of a relatively small amount of tissue results in a substantial increase in measured enzyme activity in serum (2).
Zinc is one of the essential trace elements in man. It is involved in nearly all aspects of cellular metabolism and is essential for cell division and DNA synthesis. Availability of zinc regulates the rate of synthesis of nucleic acids and proteins suggesting that its availability may critically influence tissue reparative processes \(^3\,^4\,^5\). Estimation of serum zinc levels can be diagnostic of various diseases. Serum zinc levels have been observed to fall after acute tissue injury irrespective of its origin, including myocardial infarction, which produces some of the most striking falls. Levels of zinc fall by 30% within one or two days following acute myocardial infarction. At the same time the extent of the fall also correlated with the complications of acute myocardial infarction. Therefore it may serve as a yet another indicator in assessing the prognosis following acute myocardial infarction \(^6\,^7\,^8\). The present study was undertaken to evaluate serum zinc levels in acute myocardial infarction patients and to correlate it with one of the important biochemical parameters like SGOT.

**MATERIALS & METHODS**

In the present study, 60 subjects (both males and females) were studied and they were divided in 2 groups, Healthy Control (30) and Acute Myocardial infarction (30) group. The study was conducted at Sir J. J. Group of Hospitals, Mumbai during the year 2002-03. Thirty normal healthy staff personnel working in the basic sciences departments with no history of any medical illness were included in this group as a control. Thirty Acute Myocardial infarction patients satisfying the inclusion criteria, irrespective of age and sex, admitted at Medical Intensive Care Unit, Dept. of Medicine, Sir J. J. Hospital, Mumbai were randomly selected for this study. Diagnosis of AMI was made using general guidelines based on WHO criteria for MI \(^9\) which includes:

- History of prolonged and severe characteristic chest pain lasting more than half an hour with associated symptoms,
- Characteristic electrocardiographic abnormalities of acute MI on standard 12 lead ECG like abnormal ‘Q’ or ‘QS’ wave, ST segment elevation, T wave inversion,
- Raised cardiac specific serum enzymes like CPK-MB, CPK (T), SGOT etc.
- Clinical examination of the patient,
- Patients having following conditions were excluded from the study:
  - Patients having a previous history of AMI or IHD or Diabetes mellitus
  - Patients with non-Q wave infarct,
  - ECG showing left ventricular hypertrophy, bundle branch block,
  - Patients with other medical illness like diabetes mellitus, hypertension, alcoholic liver disease, hepatitis, cerebro-vascular episode.
  - Patients on supplemental zinc

Detailed history as per the proforma and clinical examination of every subject involved in the study was done including electrocardiogram. Serum zinc level and SGOT were estimated in all the groups on the second day of hospitalization to ICU. The individuals were given an explanation about the relevance of the study and the procedures. The participants gave informed written consent to participate in the experiment which was approved by a human research ethics committee of the institute.

**Collection of blood sample**

Taking usual aseptic precautions, 5 ml of fasting blood sample was collected from an antecubital
vein into plastic test tubes taking care to prevent the hemolysis and contamination. The sample was centrifuged at 3000 RPM for 15 minutes at Hematology Laboratory, Dept. Of Physiology, GMC, Mumbai. The supernatant serum (about 3 ml) was taken and delivered into plastic tubes with screw caps. The serum thus collected from all the groups was subjected for estimation of serum zinc and SGOT on the same day. SGOT were measured by the colorimetric method.

**Preparation of sample for estimation of serum zinc level**

The serum prepared by above method was processed in the following way.

1) 1 ml serum + Add 5 ml of cons. Nitric acid boil the sample till Evaporation
   In Corning’s beaker
   (This step is repeated 3 times)

2) Sample + Add 2 ml of Perchloric acid boil the sample till Evaporation

3) Sample + Add 25 ml of dil. Nitric acid boil the sample to reduce volume for 10-15 minutes
   (2 M HNO₃)

4) Sample + Add distilled water Sample ready for analysis by
   To make the volume 25 ml AAS

In our study, the analysis was performed by G. B. C. 932 model atomic absorption spectrophotometer at B.A.R.C Institute of Science, Colaba, Mumbai and the instrument was used in accordance with the manufacturers operating manual. The zinc level was determined by comparing the signal from diluted serum with the signal from aqueous standards. First the zinc standard solutions were aspirated sequentially from most dilute to most concentrate. Then the diluted specimen serum samples were aspirated into the atomic absorption flame and analyzed and their absorbance’s recorded. The resulting values were used to establish the working curve. A graph of Absorbance Vs Concentration is plotted. Concentrations of zinc in specimen samples were derived from comparison of sample absorption with the standard zinc curve. The results were expressed in micrograms per 100 ml (mcg/dl).

**Statistical analysis:** After the data was obtained and tabulated it was subjected to statistical analysis using student’s unpaired’ t’ test and the significance of values obtained was found by determining ‘p’ value. The ‘p’ value obtained was in comparison with the control group. The results obtained on analysis were presented as Mean ± Standard Deviation for each of the parameters.
RESULTS

In the present study, total 60 subjects both male and female were studied. They were divided into the following groups.

Table 1: Showing distribution of study group subjects and their serum zinc levels

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Group</th>
<th>No. of cases (n)</th>
<th>Male</th>
<th>Female</th>
<th>Serum zinc levels (In mcg/dl)</th>
<th>Mean ± S.D.</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Group A- Control</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>104 to 130</td>
<td>114.46 ± 7.63</td>
<td>1.39</td>
</tr>
<tr>
<td>2</td>
<td>Group B – AMI</td>
<td>30</td>
<td>19</td>
<td>11</td>
<td>55 - 120</td>
<td>81.1 ±16.09</td>
<td>2.93</td>
</tr>
</tbody>
</table>

Group A: Serum zinc was estimated in 30 apparently healthy volunteers consisting of 20 males and 10 females with an age range from 25 yrs to 48 yrs (mean age was 37.2 ± 12.4 yrs). It is evident from the above table that serum zinc level in normal subjects was ranging from 104 to 130 mcg/dl with a mean value of 114.46 mcg/dl.

Group B: Serum zinc was estimated in 30 acute myocardial infarction patients consisting of 19 males and 11 females with an age range from 36 yrs to 71 yrs. (Mean age was 54.16 yrs.) The serum zinc level in AMI patients was ranging from 55 to 120 mcg/dl with a mean value of 81.10 mcg/dl.

Table 2: Showing mean and S.D. of serum zinc level in control and AMI group

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Serum zinc in control and AMI group</th>
<th>No. of cases</th>
<th>Serum zinc levels (mcg/dl)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean</td>
<td>S. D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Zinc in control</td>
<td>30</td>
<td>104 - 130</td>
<td>-8.99</td>
<td>0.000 ^S</td>
</tr>
<tr>
<td>2</td>
<td>Zinc in AMI</td>
<td>30</td>
<td>55 - 120</td>
<td>16.09</td>
<td></td>
</tr>
</tbody>
</table>

^S - Significant

The above table shows that serum zinc level in control and AMI group show statistically significant difference.
Graph showing serum zinc level in control and AMI

![Graph showing serum zinc level in control and AMI](image)

Table 3: Showing mean and S.D. of SGOT and serum zinc level in AMI group

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>SGOT/ Zinc level</th>
<th>No. of cases</th>
<th>Serum zinc levels (mcg/dl)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
<td>Mean</td>
<td>S. D.</td>
</tr>
<tr>
<td>1.</td>
<td>SGOT in AMI</td>
<td>30</td>
<td>18 - 189</td>
<td>64.33</td>
<td>35.24</td>
</tr>
<tr>
<td>2.</td>
<td>Zinc in AMI</td>
<td>30</td>
<td>55 - 120</td>
<td>81.10</td>
<td>16.09</td>
</tr>
</tbody>
</table>

* N. S. - Not significant

The above table shows that serum zinc level and SGOT level in the AMI group do not show a statistically significant difference.

Table 4: Showing the correlation between serum zinc level and SGOT level in AMI

<table>
<thead>
<tr>
<th>Mean SGOT level in AMI</th>
<th>Mean serum zinc level in AMI</th>
<th>Correlation coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>64.33</td>
<td>81.10</td>
<td>-0.585</td>
<td>P = 0.001 *S</td>
</tr>
</tbody>
</table>

*S - Significant

The above table shows that there is an inverse correlation ship of serum zinc and SGOT in AMI group.
DISCUSSION
The present study was carried out to evaluate the role of serum zinc in Acute myocardial infarction.

I. Serum zinc in control group: In this study, serum zinc was estimated in 30 healthy individuals. The serum zinc level in the control group was ranging from 104-130 mcg/dl (mean value of 114.46 mcg/dl). These values are comparable with studies done by various workers viz. Rosner et al (5), Halstead et al (8), Prasad et al (10). The average serum zinc in our study in normal individuals was a little higher than reported by these authors. The difference in the values of normal serum zinc may be due to different geographical and environmental factors, dietary intake and different methods of estimation used.

II. Serum zinc in Acute Myocardial Infarction:
The serum zinc level in the control group was ranging from 104 to 130 mcg/dl (mean value of 114.46 mcg/dl). Whereas the serum zinc in AMI group was ranging from 55 to 120 mcg/dl (mean value of 81.1 mcg/dl). We observed a statistically significant low serum zinc level estimated on the 3rd day of infarction in the AMI group as compared to normal healthy controls. The same was observed by studies done by Wendy et al (2), Halstead et al (8), Lindeman et al (12), Mishra et al (13), Surana et al (14). These workers did serial estimation of zinc from the first day of acute myocardial infarction and they found out the significantly lowest serum zinc level in AMI after 48 hrs. of an acute attack and the level rises gradually as the patient recovers becoming normal 2 weeks later. In the present study, serum zinc estimation was therefore, done on the third day of AMI which was found to be low.

Bailey et al (15) suggested the mechanism for the fall in serum zinc level in AMI patients to be an adrenal-cortical response to the stress of AMI. Halstead et al (8) suggested the fall in the plasma zinc level as a nonspecific response to acute stress. Flynn et al (16) supported the hypothesis of adenohypophyseal - adrenocortical system which maintains the circulating zinc and mobilizes body zinc stores. It is possible that fall in zinc level after AMI may be steroid related. During stress, there is a release of a humoral factor produced by polymorphs i.e. Leukocyte Endogenous Mediator (LEM) which depresses plasma zinc levels and increases zinc uptake by the liver (17). An increase in such a humoral agent after infarction might well explain the observed fall in serum zinc levels. Whatever the etiopathology, the fall in serum zinc level in reliable and hence useful diagnostic index in cases of AMI.

In our study, we also tried to correlate the extent of fall in serum zinc with that of SGOT level in AMI. The estimation of SGOT levels was carried out in AMI patients on the third day of acute infarction. The SGOT level was ranging from 18 to 189 IU/ml (mean value of 64.33 IU/ml). The serum zinc level was ranging from 55 to 120 mcg/dl) mean value of 81.10 mcg/dl). This study has found an inverse correlationship between the rise in SGOT level and fall in serum zinc level but it was not statistically significant. In contrast to our study, various studies done by Wendy et al (2), Mishra et al (13), Surana et al (14) have found a statistically significant difference in the mean zinc level and the peak of SGOT level. They also observed an inverse correlationship between the low level of serum zinc and the peak value of SGOT level which is in accordance with our study. The difference in the observations of these studies may be due to time of estimation of serum zinc and SGOT level. In the previous studies, serial estimation of serum zinc and SGOT level was carried out. Whereas, in the present study, the serum zinc and SGOT level were measured on the third day of acute infarction.
The data presented in this study indicate that a fall in serum zinc is a useful diagnostic test for AMI. It also suggests that anti-oxidant medication containing zinc may be beneficial in myocardial infarction and is highly recommended to improve patient outcome. The limitation of the present study was that this could not find the correlation of the extent of the fall with the complications of acute myocardial infarction.

CONCLUSION

1. Normal serum zinc level was ranging from 104 to 130 mcg/dl (mean value of 114.46 mcg/dl). There was no change in the values according to age and sex.

2. Serum zinc levels in acute myocardial infarction patients were ranging from 55 to 120 mcg/dl (mean value of 81.10 mcg/dl) which was significantly lower as compared to healthy control values.

3. This study has found an inverse correlation between the rise in SGOT levels and fall in serum zinc level but it was not statistically significant.

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This study was undertaken for dissertation purpose to appear for MD (Physiology) examination of Mumbai University. The author himself had borne the cost of estimation of serum zinc level. Hence there was no extra funding received for this study from any outside source.

REFERENCES


