Effect of Dietary Fish Oil (Omega-3- Fatty Acid) Against Oxidative Stress in Isoproterenol Induced Myocardial Injury in Albino wistar Rats

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Abstract: In the present study, the protective effect of fish oil against Isoproterenol (IPH)-induced myocardial infarction was studied in male albino Wistar rats. Fish oil was administered orally at 5% v/w for 30 days and IPH (8.5 mg/Kg, s.c) were injected with twice at an interval for 24hrs to induce myocardial infarction at the end of the day, then serum biochemical parameters in cardiac tissues were assayed for clinical marker enzymes, the remaining tissue were subjected for histopathological studies. The serum enzymes were significantly elevated in the rats administered IPH, the fish oil treatment groups decreased the levels of cardiac markers and reversed the biochemical lesions induced by IPH. In conclusion it was concluded that supplement with fish oil protects myocardium against oxidative stress through its antioxidant defense mechanism and anti thrombotic activity and thereby restores the structural and functional integrity of myocardium.

Key words: Isoproterenol (IPH) • Omega-3- fatty acid • Fish oil • Antioxidant

INTRODUCTION

Cardiovascular diseases is a major health concern in recent years, causing severe illness and death throughout the world [1]. According to the statistics given by WHO (2004) about 16.7 million people around the globe die of myocardial infarction every year and stroke will become the leading cause of death and disability world-wide by the year 2020 [2]. A change in human behavior and lifestyle over the last century has resulted in dramatic increase in incidence of CHD [3].

Fish oil is most widely used as food supplements. Owing to its wide array of biological actions public and scientific interest has been directed towards the role of fish oil in health promotion and disease prevention. Prospective studies show that there is an inverse relation between fish intake and mortality from coronary heart disease [4]. Fish oil inhibits the oxidative modification of LDL that is responsible for development and progression of atherosclerosis, decreased platelet aggregation and arterial superoxide generation [5]. It is hypothesized that the highly unsaturated fatty acids, Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) present in substantial quantities in fish oil are the active components responsible for the beneficial effect [6]. Hence present study was focused on the cytoprotective action of dietary fish oil in myocardial stress injury induced in experimental animals.

MATERIALS AND METHODS

The institutional animal ethical committee (Register No.160/1999/CPCSEA), Annamalai University, Annamalai Nagar, India approved the experimental design (Proposal No.434, dated 21.03.2007). The albino Wistar male rats with body weights in the range 140-160gms, housed for 30 days and were divided into 4 groups were used for the study.

Table 1: Grouping of animals

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
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<tbody>
<tr>
<td>Group - I</td>
<td>Control group. (Rats were fed with normal diet)</td>
</tr>
<tr>
<td>Group - II</td>
<td>Isoproterenol induced group</td>
</tr>
<tr>
<td>Group - III</td>
<td>5 % w/v fish oil treated group.</td>
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<tr>
<td>Group - IV</td>
<td>10% w/v fish oil treated group.</td>
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Table 2: Effect of fish oil on serum ALT, AST, LDH and CPK in rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group-I Control</th>
<th>Group-II ISP-treated</th>
<th>Group-III 5% fish oil + ISP-treated</th>
<th>Group-IV 10% fish oil + ISP-treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT(µmol/L)</td>
<td>89.4±7.42</td>
<td>346±27.4</td>
<td>246±21.3***</td>
<td>103±7.64***</td>
</tr>
<tr>
<td>AST(µmol/L)</td>
<td>99.4±6.74</td>
<td>384±22.6</td>
<td>296±19.4***</td>
<td>114±6.14***</td>
</tr>
<tr>
<td>LDH(µmol/L)</td>
<td>124±9.64</td>
<td>298±18.6</td>
<td>198±22.6***</td>
<td>129±8.64***</td>
</tr>
<tr>
<td>CPK(µmol/L)</td>
<td>107±8.48</td>
<td>294±23.4</td>
<td>201±14.6**</td>
<td>124±8.76***</td>
</tr>
</tbody>
</table>

The values of Serum ALT, AST, LDH and CPK were compared, all values were expressed as mean ±SEM, n=6 in each group, *** = P<0.001 highly significant, **= P<0.01 moderately significant when group IV were compared with Group II, group III were compared with Group II.

Groups I and II were fed with normal diet and acts as control, group III and IV rats were fed with 5 and 10% v/w fish oil mixed with standard diet for 30days, IPH was given at a dose of 8.5mg/Kg s.c twice at an interval of 24 hrs at the end of treatment period. After 48 hrs of the first dose of IPH, rats were sacrificed by cervical dislocation under i.m. ketamine. Blood samples were collected, serum was separated and subjected for diagnostic marker enzymes such as ALT, AST, LDH and CPK [7]. The heart tissue were immediately excised and were subjected for histopathological analysis. The data were analyzed by applying students “t” test. All values were reported as mean ±SEM. The statistical significance was set at P<0.05.

RESULTS AND DISCUSSION

The present study the (Table no : 2) shows ISP administration resulted in marked rise in lipid peroxidation as indicated by increase in ALT,AST,LDH and CPK. Following pretreatment with fish oil, (both 5, 10% V/W of diet) there was significant reduction in the levels of lipid peroxides indicating that fish oil inhibit the lipid oxidation. Reactive oxygen species formation need the activation of the arachidonic acid cascade via the enzyme 5-lipoxygenase (5-LOX) [8]. Fish oil which is rich in n-3 PUFAs i.e. EPA and DHA interfere with arachidonic acid cascade by inhibiting 5-LOX. Incorporation of the n-3 PUFAs with biological membrane, increased antioxidant status normalizes the excited state, controls the physical status of membrane lipids and prevents rises in intracellular Ca^2+ in response to oxidative stress [9].

The ISP intoxicated rats show rise in serum ALT, AST, LDH and CPK which are well known diagnostic markers of myocardial infarction. This present observation is in line with earlier reported studies, which have shown that the amount of diagnostic markers present in plasma is directly proportional to the number of necrotic cells present in cardiac tissue [10]. Fish oil pretreatment shows a significant reduction in these serum enzyme markers. The cardio protective activity of fish oil against ISP induced stress injury is also due to its antithrombotic effect mediated through release of prostacyclin (PGI2) and reduction in activity of plasminogen activator inhibitor. It has been shown that the PGI2 is a valuable agent for protecting myocardial tissue during and after ischemia. The results obtained from the above study indicate that supplementation of fish oil along with feed helps the myocardium to withstand the stress generated by ISP, prevents myocardial necrosis and restores the normalcy of the structural and functional integrity of the myocardium.
Fig. 3: Rats treated with ISP + fish oil 5% v/w showed less infiltration and edema, less disarrangement and degeneration of myocardial fibers.

Fig. 4: Rats treated with ISP + fish oil 10% v/w showed less infiltration, edema, disarrangement and degeneration of myocardial fibers.

In conclusion, fish oil supplementation with diet protects myocardium against oxidative stress through its antioxidant defense mechanism, anti thrombotic activity and thereby restores the structural and functional integrity of myocardium.

REFERENCES