Oxidative stress and antioxidant status in coronary artery disease patients before percutaneous transluminal coronary angioplasty

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Abstract

Introduction: Oxidant lead to cell death through apoptosis and necrosis. The effects of reactive oxygen radicals are balanced by the antioxidant action. The aim of the study was to assess oxidative stress and antioxidant status in coronary artery disease patients before percutaneous transluminal coronary angioplasty and in healthy controls.

Materials and Method: 120 patients of coronary artery disease, before PTCA and 120 healthy controls were included in the study. Malondialdehyde (MDA), Superoxide Dismutase (SOD), Vitamin C, Creatine Phosphokinase total (Cpk total) and Creatine Phosphokinase-MB (Cpk-MB) levels were measured before PTCA in patents and in controls.

Result: There were increased levels of MDA, Cpk-total and Cpk-MB, 9.42 ± 1.07 nmole/ml, 105.95 ± 45.44 U/L, 12.20 ± 6.03 U/L ($p < 0.001$, $p < 0.001$ & $p > 0.05$) respectively, however oxidative stress significantly increased in patients than that of controls. Activity of SOD was 3.19 ± 0.45 ($p > 0.05$) and Vitamin C was 0.88 ± 0.32 ($p > 0.05$), decreased in patients before PTCA as compared to controls.

Conclusion: These findings suggest that cardial lipo peroxidation may be a common event following brief episodes of myocardial ischemia and support a role for antioxidant therapy in patients with ischemia heart disease.

Keywords: Percutaneous Transluminal Coronary Angioplasty, Oxidative Stress, Antioxidant.

Received: 6th April, 2017 **Accepted:** 22nd August, 2017

Introduction

Coronary artery disease (CAD) is caused by atherosclerosis of coronary arteries that leads to restriction of blood flow to the heart. As people age, their atherosclerosis becomes more likely to involve the arteries of the heart and to become CAD. Thrombus limiting blood flow leads to an imbalance between oxygen demand and supply, and if it becomes permanent, it leads to acute myocardial infarction.(1) Previous studies have shown that the imbalance between formation of reactive oxygen species and antioxidant defence together with conventional risk factors play an important role in the pathogenesis of atherosclerosis. The production of reactive oxygen species are start during ischemia.

The excessive production of reactive oxygen species plays a role in the pathogenesis of atherosclerosis leading to oxidation of low density lipoprotein, endothelial dysfunction, growth of vascular smooth muscle & monocyte migration.(2) Percutaneous transluminal coronary angioplasty (PTCA) is the leading method among mechanical revascularisation procedure. Ischemia can increase the production of oxidants which can overcome antioxidant capacity. Increase of oxidant leading to lipid peroxidation in cell membrane, damage of membrane protein and DNA fragmentation with myocardial cell injury, causes loss of contractile function of heart.(3) Studies on oxidative stress before and after PTCA had controversial results. Therefore we have undertaken this research project, to study oxidative stress and antioxidant status in coronary artery disease patients before percutaneous transluminal coronary angioplasty.

Materials and Method

The present study was performed in department of Biochemistry in association with Cardiology department Bharati Vidyapeeth Deemed University Medical College and Hospital, Sangli. The study protocol was confirmed by the Institutional Ethical Committee. Inclusion criteria were coronary artery disease patients had indications of PTCA like acute ST - elevation myocardial infarction, non ST – elevation, acute coronary syndrome, unstable angina, stable angina, arrhythmia & high risk stress test finding. Exclusion criteria were, chronic kidney injury, chronic inflammatory disease, heart failure, recent major surgical procedure, use of diuretics, alcoholic and liver diseases. Patients with prior myocardial infarction, in past 48 hours before admission and cardiomyopathy were also excluded. Informed consent was obtained from all subjects. Controls subjects were selected among those who did not use any medication, antioxidants or alcohol on regular basis.

All 120 patients had coronary artery disease & required PTCA. Their average range age was 41-60 years. Out of 120 patients 78 were males and 42 were females. 120 healthy volunteers control were included in the study. Blood samples were taken from each patient, just before PTCA. Blood samples were also

obtained from control group. Blood samples were immediately analysed after collection. Malondialdehyde (MDA) were measured by Kei Satoh method,[4] Superoxide Dismutase (SOD) by Marklund and Marklund method,[5] Vitamin C by Ayekaw method,[6] Creatine Phosphokinase Total (Cpk total) by NAC-activated kit method[7] and Creatine Phosphokinase-MB (Cpk-MB) IFCC kit method.[7] All parameters were estimated in serum. Analysis of the data was carried out by using ANOVA and difference between controls and patients was determine by student 't' test.

Result and Discussion

The Cpk total and MDA were significantly increased than that of controls. It is statistically highly significant ($p < 0.001$). Cpk-MB was borderline increased than that of controls. It is statistically insignificant ($p > 0.05$).

The levels of SOD and vitamin 'C' were borderline decreased than that of controls. It is statistically insignificant ($p > 0.05$).

Oxygen free radical generation as well as lipid peroxidation remain at a low level during myocardial ischemia-reperfusion injury. It represents a combination of factors namely the intrinsic cellular response to ischemia, and intrinsic acute inflammatory response, that is a sudden massive supply of oxygen to previously hypoxic tissue, leads to an unbalanced burst of oxygen free radicals production.[8,9] Subsequently, reperfusion injury is manifested by an increase in infarct size.[10,11] As free radicals are difficult to an estimate directly because it is said to be high reactivity and short half life. Stable product of lipid peroxidation is malondialdehyde (MDA). MDA has become the most widely used marker of oxidative stress. Hence, serum MDA concentration was significantly elevated in early myocardial ischemia-reperfusion injury patients before PTCA.[12]

SOD is involved in the primary mechanism for clearance of superoxide anions. It is catalyses dismutation of superoxide anions to hydrogen peroxide and molecular oxygen. However, after that the SOD activity is decreased in reperfusion patients, and it causes increase in concentrations of oxidants.[13] Therefore SOD activity was decreased in patients group. We also observed that non enzymatic antioxidant; vitamin C was decreased in patients before PTCA due to it does not cope with very high concentration of oxidants.[11]

Cpk total released from damaged myocardial cells is Cpk-MM form during ischemia.[14] Cpk-MB is mainly found in the heart muscle, where more than 20% of the total activity is presents as Cpk-MB and nearly 80% as Cpk-MM.[15] Hence CPK total was significantly increased in patients group than that of CPK – MB.

Table 1: MDA, SOD, Vitamin C, CPK- Total & CPK- MB in coronary artery disease patients subjected to PTCA

Sr. No.	Parameter	Patients n= 120 Mean std	Control n= 120 Mean	p value	Significance
1	MDA nmole/ml	9.42 ± 1.07	5.32 ± 1.13	0.000	Highly significance
2	SOD Units/ml	3.19 ± 0.45	3.27 ± 0.29	0.088	Not significant
3	Vitamin C mg/dl	0.88 ± 0.32	0.90 ± 0.33	0.602	Not significant
4	Cpk Nac U/L	105.95 ± 45.44	75.96 ± 21.47	0.000	Highly significant
5	Cpk-MB U/L	12.20 ± 6.03	11.19 ± 4.15	0.130	Not significant

Conclusion

Serum level of MDA, SOD, Vitamin C, Cpk-total and Cpk-MB represent sensitive markers of cardial oxidative stress. Short episodes of myocardial ischemia induced a consistent and sustained lipid peroxidation which is detectable in venous effluent of reperfused myocardium. These findings suggest that cardial lipo peroxidation may be a common event following brief episodes of myocardial ischemia and support a role for antioxidant therapy in patients with ischemic heart disease.

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