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Biochemical Parameters in Acute Myocardial Infarction with or Without Co-Morbidities

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Abstract
Acute myocardial infarction is one of the most common cause of death and one of the most frequent causes of hospitalization. Acute Myocardial Infarction occurs when there is an imbalance between supply and demand for oxygen in the heart muscle resulting in injury and eventual death of muscle cells. Various risk factors for acute myocardial infarction have been reported, including age, family history, smoking, serum cholesterol, diabetes and hypertension.
The present study was planned to measure oxidative stress markers as malondialdehyde as lipid peroxidation product and serum lipids such as total cholesterol, triglycerides, low density lipoprotein- cholesterol and high density lipoprotein- cholesterol in acute myocardial infarction with and without co-morbidities. Study includes 140 patients with acute myocardial infarction and 50 normal healthy control. The data were evaluated statistically. We found significantly increase in serum malondialdehyde ($p<0.05$) in patients as compared to control. Whereas highly significant increase in total cholesterol, triglycerides and low density lipoprotein-cholesterol ($p<0.001$) and significantly decreased high density lipoprotein- cholesterol ($p<0.001$) in patients as compared to control.
Our study revealed that myocardial infarction patients have elevated levels of serum lipid peroxidation product, total cholesterol, triacylglycerol and low density lipoprotein cholesterol and reduced high density lipoprotein in patients as compared to healthy subjects. High concentration of serum oxidative stress marker and lipids may strongly associated with the risk for coronary heart disease.
Key Words: *Acute myocardial infarction, Lipid peroxidation, Triacylglycerol.*

Introduction

Acute myocardial infarction is one of the most common cause of death and one of the most frequent causes of hospitalization [(1,2)]. Acute Myocardial Infarction occurs when there is an imbalance between supply and demand for oxygen in the heart muscle resulting in injury and eventual death of muscle cells [(3)].

Various risk factors for acute myocardial infarction have been reported, including age, family history, smoking, serum cholesterol, diabetes and hypertension [2,3]. There are several ways by which reactive oxygen species (ROS) are formed. Normally these ROS are converted to less reactive compounds by the use of antioxidant. In normal cell, there are appropriate pro-oxidants (ROS): antioxidant balance. However, this balance can be shifted toward the pro-oxidants when production of oxygen species is increased greatly or when levels of antioxidants are diminished. This is called as "oxidative stress" and can result in serious cell damage if the stress is massive or prolonged [4].

AMI is associated with oxidative stress by ischemia reperfusion. Reactive oxygen species (ROS/oxidants) are major initiators of myocardial damage during ischemia [3].

Lipid oxidation and formation of oxygen radicals are main fundamentals of arterial plaque formation and atherosclerosis and involved in patho-physiology of coronary artery disease [5].

With this background in mind the present study has been undertaken to investigate the biochemical parameters in serum such as oxidative stress markers as malondialdehyde as lipid peroxidation product, total cholesterol, triacylglycerol (TG), Low Density Lipoprotein cholesterol (LDL-C) and High Density Lipoprotein cholesterol (HDL-C) levels in patients with AMI. This may help in better understanding of diagnosis and recovery process in AMI.

Materials and Methods

The present study was carried out in the Department of Biochemistry, Government Medical College and Hospital, Miraj (Maharashtra, India). Study protocol was approved by ethical committee, Government Medical College. Miraj.

Selection and distribution of subjects

Sample size: The study includes total 140 subjects, with age 38- 85 years. This includes patients and control.

Patients:- Includes 90 patients with Acute Myocardial Infarction (AMI) hospitalized at Government Medical College and Hospital, Miraj. The diagnosis of the patient was done on the basis of the patient's condition, clinical history, personal history, physical examination, etc.

Patients were classified into four groups are:

i. Group I: Plane AMI (20 Patients).
ii. Group II: AMI with Diabetes Mellitus (DM) (30 Patients).
iii. Group III: AMI with Hypertension (20 Patients) and
iv. Group IV: AMI with DM and Hypertension (20 Patients).

Patients of typical chest pain and having ECG changes of AMI were included in this study. Whereas the patients having other heart diseases were excluded from this study.

Control: Consists of 50 normal healthy individuals with age and sex matched with patients were selected from staff members and those who were attaining OPD of Government Medical College Hospital.

Blood collection:

Informed consent was obtained from all participants. To avoid contamination blood samples were withdrawn by using 20 gauge stainless steel disposable needles attached to 5 ml polythene disposable syringes, from anticubital vein with aseptic precautions. Needle was removed and, 3 ml blood was collected in plain bulb and serum was separated and used for the estimation of malondialdehyde as lipid peroxidation product, Lipid profile. And remaining 1 ml blood was collected in heparin bulb. The blood sample from heparinized bulb was centrifuged at 3000 rpm for 5 minutes. Clear plasma was separated and used for estimation of ascorbic acid (Vitamin C).

Serum MDA levels were measured by thiobarbituric acid reaction described by Kai Satoh [6] and the levels were expressed as nmol/ml. Total cholesterol estimated by Enzymatic colorimetric (Trinder – Endpoint) [7, 8], triglycerides by Enzymatic-colorimetric

(Endpoint) method (9), High density lipoprotein cholesterol (HDL-C) (10) and direct Low density lipoprotein cholesterol (LDL-C) (11) on semi-autoanalyzer. The data were evaluated statistically by using student 't' .

Results

Table No. 1 show biochemical parameters in subjects. We found significantly increased ($p<0.05$) MDA level in AMI patients as compared to control. Whereas highly significant increase ($p<0.001$) was found in total cholesterol, triacylglycerol, LDL-C and highly significant decrease ($p<0.001$) in HDL-C in AMI patients as compared to control.

Table N0. 2 show biochemical parameters in subjects in different groups. We found highest level of serum MDA in group III, total cholesterol and TG in group III and highest LDL-C level and lowest HDL-C level in group IV as compared to other group.

Table No.1: Biochemical parameters in patients with AMI and Control

Parameters	AMI pooled patients (n=90) Mean ± SD	Control (n=50) Mean ± SD
MDA (nmol/ml)	4.2636 ± 1.012**	3.85 ± 1.03
Total Cholesterol (mg/dl)	262.26 ± 52.10*	150.57 ± 8.21
TG (mg/dl)	233.21 ± 126.59*	106.32 ± 15.30
HDL-C (mg/dl)	30.64 ± 4.84	50.67 ± 6.89
LDL-C (mg/dl)	175.98 ± 50.26*	130.83 ± 14.47

* P < 0.001, Highly Significant,
**P<0.05, Significant

Table No.2: Biochemical parameters in subjects with different groups

Parameters	Group I (n=20) Mean ± SD	Group II (n=30) Mean ± SD	Group III (n=20) Mean ± SD	Group IV (n=20) Mean ± SD	Control (n=50) Mean ± SD
MDA (nmol/ml)	3.97 ± 1.08^{NS}	4.44 ± 0.69**	4.47 ± 1.12**	4.33 ± 1.03**	3.85 ± 1.03
Total Cholesterol (mg/dl)	260.90 ± 58.27*	246.76 ± 34.62*	296.2 ± 44.42*	236.6 ± 50.12*	150.57 ± 8.21
TG (mg/dl)	204.77 ± 109.14*	235.23 ± 116.13*	256.15 ± 142.38*	230.1 ± 134.66*	106 ± 18.98
HDL-C (mg/dl)	34.25 ± 4.37^{NS}	29.4 ± 4.23^{NS}	32.95 ± 3.71*	26.6 ± 3.20*	44.04 ± 5
LDL-C (mg/dl)	178.75 ± 32.81*	173.26 ± 33.14*	168.45 ± 69.89*	184.8 ± 63.51*	131.52 ± 14.47

* P < 0.001, Highly Significant,
**P<0.05, Significant, NS- Nonsignificant

Discussion

Acute myocardial infarction (AMI) is a disease of maltifactorial origin. Apart from the other factor, free radicals are believed to be involved in the chemical pathology of AMI [(12)].

We found significantly increased ($p<0.05$) MDA level in patients as compared to control (Table No. 1). This may indicate increased oxidative damage occurs soon after acute myocardial infarction, there is indication of greater damage to membrane lipids and proteins in patients AMI [(13)].

We found highest level of MDA in group II and III. Group II is AMI with Diabetes Mellitus and Group III is AMI with Hypertension (Table No. 2). Several risk factors for coronary heart disease have been well documented, including hypertension, hyperlipidemia, diabetes, a positive family story, smoking, obesity and inactivity. However, these factors explain only part of attributable cardiovascular disease. Evidence suggests that reactive oxygen species (ROS) may play important role in the pathogenesis in myocardial infarction. Following ischemia, ROS are produced during reperfusion phase. ROS are capable of reacting with unsaturated lipids and of initiating the self- perpetuating chain reaction of lipid peroxidation in the membranes. Free radicals

may also cause destruction of proteins and nucleic acids [12,14,15].

We found highly significant increase ($p<0.001$) in total cholesterol, triacylglycerol, LDL-C and highly significant decrease ($p<0.001$) in HDL-C in AMI patients as compared to control (Table No. 1). We found highest serum total cholesterol and TG in group III and highest LDL-C level and lowest HDL-C level in group IV as compared to other group (Table No.2).

Dyslipidemias are one of the major modifiable risk factor for coronary heart disease. Low HDL-C is the most common lipoprotein abnormality in patients with CHD and is predictive of CHD events even when total cholesterol levels are normal [16].

Elevated serum cholesterol has depended on elevated consumptions of fat and genetic basis. LDL carries the most of cholesterol in the plasma. Level of LDL may depend on the level total cholesterol. LDL-C level may be increase as a result of reducing in refining or excessive production of LDL-C. LDL cell surface receptors cleaned LDL-C from the circulation. These receptors may be changed as a result of coronary heart disease. Which may leads to decrease uptake of LDL-C by LDL receptor [2].

It is well established that a lifestyle, a high fat, high calorie diet, physical inactivity and tobacco smoking plays a major role in the causes and risk of MI. The biochemical or physiological consequences of this lifestyle include elevated blood pressure, elevated plasma cholesterol, low plasma high density lipoprotein (HDL) cholesterol, elevated plasma TG, diabetes, obesity and thrombogenic factors [17].

There is different mechanism by which TG level elevated after MI [17,18]. It may depend on genetic and nutritional factor. Inherited abnormality of very low density lipoprotein metabolism may cause increased flowing of fatty acids and impaired elimination of VLDL from the plasma [17].

Oxidative stress leading to modification of LDL may be an essential pattern of atherogenesis and plaque destabilization. The deposition of LDL into the sub-endothelial space creates a tendency for LDL to be exposed to oxidation. Under conditions of high oxidative stress there is increased peroxidation of lipoprotein phospholipids, thereby increasing the LDL-uptake by macrophages with increased foam cell formation and atherosclerosis [19]

Atherosclerosis is a chronic disease caused by excessive accumulation of lipids in macrophages and smooth muscle cells, resulting in the formation of foam cells and in cell death. Oxidative alteration of low-density lipoproteins (LDL) is supposed to play a key role in the atherogenesis. Oxidation of polyunsaturated fatty acids (PUFA) is followed by formation of breakdown products of lipid hydroperoxides, mostly aldehydes (malondialdehyde). Malondialdehyde may react with LDL-apolipoprotein B (apoB). This oxidized/ modified LDL may not recognized by the LDL receptor. It may ingested by macrophages via the scavenger receptor pathway and resulting in the formation of foam cells. Oxidized LDL also involved in destabilization of the atherosclerotic plaque and its rupture, in the thrombotic process, and in endothelial dysfunction [20]. On the other hand HDL particles are supposed to be antiatherogenic. HDL has capacity to make reverse cholesterol transport and antagonize pathways of inflammation, thrombosis, and oxidation [21].

Morbidity and mortality are high in patients of CHD with diabetes than in patients without diabetes. Uncontrolled level of blood glucose is the main cause of macrovascular complication (atherosclerosis) in diabetes. Constant hyperglycemia may cause formation of the advanced glycation end products (AGES), which may having receptors on the macrophages. This AGES-macrophages complex may act on the DNA causes transcription and generation of various inflammatory compounds in diabetes [22].

K. Satya Narayana et al [1] and Ahmad Shirafkan et al[2] found significant increase in total cholesterol, TG, LDL-C and significant decrease in HDL-C levels in patients with AMI as

compared to control. Whereas study of H.K. Tamang et al [23] showed no significant differences in Total Cholesterol, TG and LDL-C and significant difference in HDL-C level. High concentration of serum oxidative stress marker and lipids may strongly associated with the risk for coronary heart disease.

References

1. K. Satya Narayana, Sravanthi Koora, Dr. Ivvala Anand Shaker, S. Saleem Basha and K. Suresh Babu. Comprehensive levels of Serum Enzymes and Lipid Profile testing in MI and Stable Angina Subjects. Indian Journal of Basic & Applied Medical Research; December 2011;1 (1):13-20.
2. Ahmad Shirafkan, Abdoljalal Marjani and Farhad Zaker. Serum lipid profiles in acute myocardial infarction patients in Gorgan. Biomedical Research 2012; 23(1): 119-124.
3. K. N. Kalaivanam, N. Santhosh Kumar, R. Bheemasen and Dinesha Ramadas. Evolution of protein carbonyl content as a marker of AMI. IOSR Journal of Biotechnology and Biochemistry 2016; 2(5):21-23.
4. K. N. Pujari and S.P. Jadkar. Superoxide dismutase levels in leukemias. International Journal of Basic Medical Sciences july 2011; 2(2):96-100.
5. Parveen Shaikh, N. R. Hazari and A. P. Thorat. Role of serum bilirubin as an antioxidant and lipid profile in acute myocardial infarction. BCAIJ 2012; 6(6):209-211.
6. K. Satoh. Serum lipid peroxide in cerebrovascular disorders determined by a new colorimetric method. Clinica. Chimica Acta1978; 90: 37-43.
7. Rifai N. et al. Lipids, Lipoproteins, and Apolipoproteins. Teitz Fundamentals of Clinical chemistry, 5th Ed, Burtis, C.A. & Ashwood, E.R. by W. B. Saunders Philadelphia USA), 2001,463.
8. H. K. Naito. Coronary Artery Disease and Disorders of Lipid Metabolism. Clinical Chemistry: Theory, Analysis, Correlation, 4th Ed., Kaplan, L.A., Pesce, A J., Kazmierczak, S C by Mosby, Inc. eds. St Louis USA, 2003,603.
9. P. Fossati and J.R. Crouse. Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. Clin Chem. Oct 1982;28 (10):2077-80
10. M. Dominiczak and J. McNamara. The system of cardiovascular prevention: in 103-125; Nauk M, Wiebe D, Warnick G. Measurement of high density lipoprotein cholesterol. 221-244. In: handbook of lipoprotein testing (eds. Rifai, Warnick and Dominiczak), 2nd edition.
11. Hongbing Xiao. Method and composition for determining low density lipoprotein cholesterol. Chinese Patent CN 1379234A (2002).
12. J. Loeper Goy and L. Rozenstajin. Lipid peroxidation and protective enzymes during myocardial infarction. Clin Chim Acta.1991; 196:119-126.
13. R.S. Cotran, V. Kumar and S.L. Robbins (eds): Robbins Pathologic Basis of Disease. 5th ed. Philadelphia: WB Saunders, 1994.
14. J.L. Zweier, J.T. Flahertly and M.L. Weisfedt. Direct measurement of free radical generation following reperfusion of ischemic myocardium.Proc.Natl Acad Sci. USA 1987; 84:1404-1407.
15. T. Slater. Free-radical mechanism in tissue injury.Biochem.J. 1984; 222:1-15.
16. Harish Rao. Glycemic and lipideic status in patients with acute myocardial infarction. NUJHS, Mar 2014; 4(1):9-14.
17. M. Venkateshwarlu, and Chelmakuri Gayathri. Study of significance of estimation of lipid profile in patient with acute myocardial infarction. International Journal of Information Research and Review, Aug 2015; 2(08):1028-1030.

18. P.K. Nigam, V.S. Narain and M. Hasan. Serum lipid profile in patients with acute myocardial infarction. Indian Journal of Clinical Biochemistry 2004; 19 (1): 67-70.
19. Anees Syyeda, Jabeen Fatima and Abbas M. Hyder. Acute phase reactants and lipid profile in acute chest pain presentations: a multimarker approach. Int J Res Med Sci Aug 2016;4(8):3336-3342.
20. O. Fainaru, M. Fainaru, A. R. Assali, I. Pinchuk and D. Lichtenberg. Acute Myocardial Infarction Is Associated with Increased Susceptibility of Serum Lipids to Copper-Induced Peroxidation in Vitro. Clin Cardiol 2002; 25:63–68.
21. Haseeb A. Khan, Abdullah S. Alhomida and Samia H. Sobki. Lipid profile of patients with acute myocardial infarction and its correlation with systemic inflame-mation. Biomarker Insights 2013; 8: 1–7.
22. Fuleshwor Mandal, Pratik Adhikary and Deepak Kafle. Study of lipid profile and the effect of cardiac enzymes in type 2 diabetes mellitus patient developing coronary heart disease. Int Res J Pharm App Sci 2013; 3(4):51-54.
23. HK Tamang, U Timilsina, KP Singh, R Shrestha, K Bist, L Maharjan and S Shakya. Serum lipoprotein (a) concen-tration is a better predictor of myocardial infarction than traditional lipid profile and lipid ratios. Int J Appl Sci Biotechnol, Vol. 1(3): 106-109.