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Study of lipid profile, enzymatic antioxidant and oxidative stress in cardiovascular diseases

Binod Mahato*[1], Chaudhary B. L.[2] and Brij Nandan Singh[3]
[1]Department of Biochemistry, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh, India.
[2]Department of Microbiology, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh, India.
[3]Department of Microbiology, G.S.V.M. Medical College, Kanpur, India.

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Abstract: Cardiovascular disease is one of the major causes of death in the India, therefore present study, was aimed to study the lipid profile, enzymatic antioxidant and oxidative stress in cardiovascular diseases. The study was carried out in the Department of Biochemistry and Medicine MGM Medical College and Hospital, Mumbai. 5ml. Blood sample was drawn into plain vacutainers and was utilised for estimation of lipid profile, oxidative stress markers concentration and antioxidant enzymes activities. The mean values of Total cholesterol, LDL TG, and MDA were significantly increased in CVD patients as compared to control ($p<0.0001$) and HDL, NO, SOD, CAT in CVD patients were significantly decreased as compared to control ($p<0.0001$). The present study reveals the importance of determining the lipid profile, free radicals and antioxidant status in CVD to enable the formulation of specific therapies for early intervention and better management of disease.

Key words: Cardiovascular disease; Lipid profile; Enzymatic antioxidants; Oxidative stress.

Introduction

Cardiovascular diseases (CVD) refer to any disorders affecting the heart. It includes hypertension, ischemic heart diseases, cerebrovascular diseases, congestive heart failure, rheumatic heart diseases, non-rheumatic valvular diseases, aortic aneurysm and peripheral arterial disease [1]. According to the World Health Organization, cardiovascular disease (CVD) is the leading cause of death in the world killing 17 million people annually (WHO, 2008). This translates to one in every three deaths. By 2020 CVD will become the leading cause of both death and disability worldwide and India, with the number of fatalities projected to exceed 20 million a year and many more incapacitated by stroke and heart attack (WHO, 2008) [2].

Cardiovascular diseases are the largest cause of mortality, accounting for around half of all deaths resulting from NCDs. Overall, CVDs accounted for around one-fourth of all deaths in India in 2008. [3] Cardiovascular disease is a leading cause of disability and premature death. This chronic degenerative disorder has become a growing health problem worldwide. During the past years, several observational studies and clinical trials have revealed the adverse effects of abnormal blood lipid and lipoprotein levels in the pathogenesis and progression of atherosclerosis and cardiovascular disease [4-8]. Numerous population studies have shown an inverse correlation between plasma high density lipoprotein (HDL) levels and risk of cardiovascular disease [9-11]. Epidemiological studies have also shown that elevated concentrations of total or low-density lipoprotein (LDL) cholesterol in the blood are powerful risk factors for coronary disease [12].

In view of the pathological role of increased lipid profile, Oxidative stress and decrease antioxidants status in the development and progression of cardiovascular disease (CVD), Hence, the present study is designed to determine level of lipid profile, markers of oxidative stress (MDA, NO) and status of enzymatic antioxidants (SOD & CAT) in CVD patients, so that study would be helpful in assessment and prevention of cardiovascular disease.

Materials and Methods

The study was carried out in the Department of Biochemistry and Medicine, MGM Medical College and Hospital, Mumbai. Patients attending cardiovascular OPD and admitted in ward during the period of January 2011- January2012 were enrolled in the study.

The diagnosis of cardiovascular diseases was based on echocardiogram, stress test and angiography. Informed consent form was taken from all patients involved in the study and the study was approved by the Institutional Ethical Committee.

Exclusion criteria

Cigarette smokers and alcoholics as well as patients on antioxidant supplements, lipid lowering drugs were excluded from the study.

***Corresponding Author:**
Binod Mahato,
Department of Biochemistry,
Mayo Institute of Medical Sciences,
Barabanki, Uttar Pradesh, India.
Email: mahatobinod587@gmail.com

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Inclusion criteria

Hyperlipidemic subjects with other complications like hypertension, diabetes mellitus and CVD were included in the study.

Sample collection

5ml. blood sample was drawn into plain vacutainers from the antecubital veins of healthy persons as control and patients. Serum was separated by centrifugation and was utilized for estimation of lipid profile, free radicals concentration and antioxidant enzymes activities.

Biochemical Analysis

a) Serum lipid profile (the level of total cholesterol, TG, LDL & HDL) was measured by kit supplied by Randox Laboratories Ltd, using fully automated clinical chemistry analyzer (Transasia EM-360, Boehringer Mannheim, Germany). Low-density lipoprotein cholesterol was calculated by the Friedewald formula.
b) Serum Malondialdehyde (MDA) was estimated by Satoh K method.
c) Serum Nitric oxide (NO) was estimated by Naiwa Cortas and Nabil Wakid method.
d) Serum Superoxide dismutase (SOD) was estimated by Marklund and Marklund method.
e) Serum Catalase was estimated by Sinha K. method.

Statistical analysis:

Statistical analysis between group I (control) and group II (cardiac patients) was done by using unpaired Student's t- test and results were expressed as Mean (M), standard deviation (S.D.). Difference between the control and study groups were considered significant when the p value determined by unpaired student's t- test was less than 0.05 ($p<0.05$).

Results and Discussion

Table 1: Gender wise distribution of control and study group.

Gender	Study group (N = 180)	
	Control group (n=90)	CVD Patients (n=90)
Male	48 (53.3%)	66(73.33%)
Female	42 (46.6%)	24(26.67%)

Table 2: Age wise distribution of control and study group.

Age group (25- 65 years)	Study group (N=180)	
	Control (n=90)	CVD Patients (n=90)
20-30		12(13.33%)
31-40	30	18(20%)
41-50	21	27(30%)
51-60	9	18(20%)
61-70	6	15(16.66%)

Table 3: Comparison of serum lipid profile in control and CVD patients

Parameters	Control (n=90) Mean ±SD	CVD patients (n=90) Mean ±SD	P-values
Cholesterol (mg/dl)	169.9 ± 16.97	228.13 ± 94.34	p< 0.001
LDL (mg/dl)	106.06 ± 18.57	158.26 ± 18.46	p< 0.001
HDL (mg/dl)	58.46 ± 13.6	33.46 ± 5.6	p< 0.001
Triglyceride (mg/dl)	136.36 ±10.68	227.80 ± 26.80	p< 0.001

P< 0.05 is considered as significant and p<0.001 is highly significant

Table 4: Comparison of serum MDA, NO, SOD and CAT levels in Control and CVD patients.

Parameters	Control (n=90) mean ±SD	CVD patients (n=90) mean ±SD	P-values
MDA (nmol/L)	1.30 ± 0.28	3.26 ± 0.37	p< 0.005
NO (µmol/L)	48.74 ± 6.75	37.16 ± 6.60	p< 0.001
SOD (U/L)	1.22 ± 0.47	0.90 ± 0.27	p< 0.005
CAT (U/mg of protein/ml)	2.57±1.08	1.77 ± 0.72	p< 0.005

P< 0.05 is considered as significant and p<0.001 is highly significant

The study was included total 180 subjects. All the subjects were divided into two groups, first group consists of 90 patients with cardiac diseases and second group consists of 90 healthy control subjects. Table no. 1 shows male patients were more risk in cardiovascular disease 66(73.33%) compare to female patient 24(26.67%), may be because of high body mass index and this study is also supported by Rama Krishna Reddy [13], but the recent study by Anbuselvan V. *et al.,* [14] shows females were in high risk for prevalence of cardiovascular disease. Table no 2 shows the age wise distribution of control and study group in which 41-50 years of age group was in high risk 27(30%) and 20-30 was in least risk 12(13.33%).

Table no 3 shows that the mean levels of lipid profile in CVD patients were T.chol (228.13±94.34 mg/dl), LDL (158.26 ± 18.46 mg/dl), HDL (33.46± 5.6 mg/dl), TG (227.80 ± 26.80). In control group the mean levels were T. chol (169.9 ± 16.97 mg/dl), LDL (106.06 ± 18.57 mg/dl), HDL (58.46 ± 13.6 mg/dl), TG (136.36 ±10.68 mg/dl). We found, mean values of Total cholesterol, LDL TG were significantly increased in CVD patients as compared to control ($p<0.0001$). The mean level of HDL in CVD patients were significantly decreased as compared to control ($p<0.0001$). Our results of lipid profile are concurrent with the findings of Bansi lal *et al.,* [15] Hultquist *et al.,* [16]., Ma *et al.,* [17] and Lorenzo Gordon *et al.,* [18].

Table no 4 In the present study, serum MDA level in CVD patients (3.26 ± 0.37 nmol/L) were found to be significantly increased ($p<0.005$) as compared to control (1.30± 0.28 nmol/L). This result was concurrent with findings of Rajesh K G *et al.,* [19] Serdar Soydinç *et al.,* [20]. The serum level of nitric oxide in CVD patients (37.16 ± 6.60 µmol /L) were found to be decreased compare to controls (48.74 ± 6.75 µmol/L). Our results of nitric oxide are concurrent with the findings of Abdul Kayyum Shaikh, *et al.,* [21] Sadia Ishaque, *et al.,* [22]. The serum SOD activity in CVD patients (0.90 ± 0.27 U/L) was found to be decreased as compared to controls (1.22 ± 0.47 U/L). Our results of SOD are concurrent with findings of Mohammad Assad Piranfa *et al.,* [23] E. P. Kumar *et al.,* [24]. The mean values of serum CAT activity (1.77± 0.72 Units/mg of protein), was significantly ($p<0.005$) decreased in CVD patients as compared to controls (2.57 ± 1.08 Units/mg of protein). Study by M. Firoozari *et al.,* had also observed a significant decrease in the activity of catalase in patients with coronary artery disease, as compared to controls. [25]

Conclusion

It was found that, the level of total cholesterol, triglyceride, low density lipoprotein in CVD patients were significantly high as compared to control ($p<0.001$). Level of high density lipoprotein was significantly low as compared to controls ($p<0.001$).

Level of nitric oxide (NO) was significantly lower in CVD patients as compared to controls ($p<0.001$, $p<0.005$). The marker of free radical induced injury i.e. Malonaldehyde (MDA) was significantly high ($p<0.005$) in CVD patients as compared to controls. The levels of enzymatic antioxidants were also significantly lower in CVD patients as compared to controls ($p<0.005$). It appears that, both increase in lipid profile and MDA with subsequent decline in NO, SOD and CAT shows that CVD patients.

The present study therefore reveals the importance of determining the lipid profile, free radicals and antioxidant status in CVD to enable the formulation of specific therapies for early intervention and better management of disease. The detection of risk factors in early stage and correction of disease condition will help the patients to improve, reduce further complications and morbidity rate.

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