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EXAMINATION STRESS : CHANGES IN SERUM CHOLESTEROL, TRIGLYCERIDES AND TOTAL LIPIDS

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Abstract : Serum cholesterol, triglycerides and total lipids were estimated in twelve students exposed to varying degree of examination stress. Serum cholesterol and triglycerides exhibited a rise proportional to degree of examination stress whereas total lipids exhibited an initial rise followed by a fall. Values of all these parameters attained control level when the stress was over. The rise in serum cholesterol and triglycerides seems to be due to stress induced changes in hormonal levels and peripheral lipolysis respectively.

Key words : examination stress, serum triglycerides, serum cholesterol, serum total lipids

INTRODUCTION

Stress has become an inevitable companion of today in all walks of life. The influence of various forms of stress on cholesterol level is of increasing interest and importance. A number of investigators have found that cholesterol levels are appreciably higher during periods of stress than at other times (1-3). Mental stress is one of the numerous factors which have been casually linked with hypertension and atherosclerosis. The biochemical features reflecting the stress levels in serum cholesterol and hypercholesteremia is now recognised as a major risk factor in coronary artery disease (4, 5). There are, however, few studies establishing relationship between mental stress and serum lipid profile (5-9). Examination stress is a well documented stress (7, 9). Therefore, the present study is aimed to see changes in lipid levels during examination stress, if any, and its relationship with levels of stress.

METHODS

Twelve healthy medical students including 8 male and 4 females aged between 19-23 yrs were selected for the study. Average weight of males was 57.1 kg (48-63 kg) and that of females was 49.75 kg (40-56 kg). Exclusion criteria were habit of tobacco chewing, smoking or addiction to any drug and hypertension and/or anxiety neurosis. Written informed consent was obtained from the participants. The students were instructed to take arbitrarily isocaloric diet of 2000 Cal. with a maximum of 50 g of

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fats in 24 hrs for two days prior to each sample collection to avoid the influence of diet on serum lipids. Fasting blood samples were drawn in the morning from antecubital vein, serum separated and cholesterol was determined by ferric chloride method of Chiamori and Henery (10). Serum triglycerides and serum lipids were determined by the method of Van Handle and Zilversmith (11) and Phosphovanilline method (12) respectively.

The first sample was collected two months before the examination when students were busy in participating in college cultural week and it served as control. The second sample was drawn two days prior to commencement of IIIrd terminal examination (Pre-terminal sample), the third sample was taken two days prior to commencement of 1st professional examination (Pre-professional sample) and the fourth sample was drawn 20 days after professional examination following the declaration of results (post-professional sample). All the participants were declared successful in examination.

The mean of the difference of values obtained at four occasions were calculated and statistically analysed by utilising the paired Students 't' test.

RESULTS

In the present study, serum cholesterol, serum lipids and serum triglycerides levels of 12 healthy medical students were estimated on 4 occasions (control, preterminal, preprofessional and postprofessional periods).

In these subjects, the mean control serum cholesterol increased before preterminal examination and exhibited a further increase before preprofessional examination. The levels of serum cholesterol attained near control level after the examination stress was over (Table I). The mean of difference of these values was highly significant ($P < 0.001$) when comparison were made between control and preterminal, preterminal and preprofessional and control and preprofessional levels of serum cholesterol (Table II). However, this difference in serum cholosterol level between control and postporfessional values was not significant ($P > 0.05$).

Similarly the mean serum triglyceride levels exhibited an increase before preterminal examination and before preprofessional examination while returning to near control values after the professional

TABLE I : Mean and SEM of individual values observed at 4 occasions (Control, Preterminal, Preprofessional and Postprofessional) of serum cholesterol, serum triglycerides and serum lipids of medical students (n=12).

	Serum cholesterol (mg/dl)	*Serum triglycerides (mg/dl)*	*Serum* lipids *(mg/dl)*
Control	149.83 ± 4.05	67.83 ± 8.52	410.04 ± 16.85
Preterminal	155.17 ± 4.38	71.83 ± 7.84	423.67 ± 17.81
Preprofessional	174.00 ± 4.99	78.50 ± 8.39	355.83 ± 18.95
Post-professional	148.92 ± 4.88	65.42 ± 8.78	413.08 ± 17.94

TABLE II : Mean and SEM of difference of individual values observed at 4 occasions (Control, Preterminal, Preprofessional and Postprofessional) of Serum Cholesterol, Serum Triglycerides and Serum Lipids of each Medical Student (n = 12).

	Serum cholesterol (mg/dl)	*Serum triglycerides (mg/dl)*	*Serum lipids (mg/dl)*
Control vs Preterminal Examination	5.67 ± 1.62***	5.83 ± 2.23**	14.83 ± 2.01***
Preterminal vs Preprofessional Examination	15.0 ± 4.14***	5.83 ± 4.96	63.08 ± 15.36***
Control vs Preprofessional Examination	19.75 ±16.58***	13.5 ± 4.28**	49.33 ± 18.14*
Control vs Postprofessional Examination	0.916 ±22.02	1.58 ± 2.41	1.25 ± 3.023

*P < 0.05; **P < 0.02; ***P < 0.001

examination i.e. when the examination stress was over (Table I). On comparing the mean of difference of these values, the rise in serum triglycerides levels was significant (P < 0.02) between control and preterminal examination and control and preprofessional examination. However, the increase in serum triglycerides levels were insignificant between preterminal and preprofes-sional examination and control and postprofessional periods (P > 0.05; Table II)

The serum lipids showed an increase before preterminal examination and then a decline before preprofessional examination followed by a rise to near control values after the professional examinations were over (Table I). Both the increase and decrease in serum lipid levels before preterminal examination and preprofessional examination were significant as compared to control level (P < 0.001 and P < 0.05 respectively). The levels of serum lipids attained near control level after the professional examination (P > 0.05; Table II).

DISCUSSION

The incidence of ischaemic heart disease has shown an increase during past few years. Several biochemical, physiological and environmental factors have been attributed for its pathogenesis. Attention has been focused for past many years on the possible role of behavioural factors in the development of atherosclerosis and coronary heart disease. These behavioural factors have been labelled as an all inclusive term "stress" and includes anxiety, hostility, depression, emotional status and tension. WHO research group (13) has recommended the need of exploration of these behavioural factors as the probable cardiovascular risk factors. Considerable evidence has now been accumulated indicating that rise in serum cholesterol and serum cortisol are closely linked with stress and this rise is a risk factor of atherosclerosis.

It is observed that during the periods of stress there is alterations in the levels of serum lipids, in particular of cholesterol, to meet the extra metabolic demands of body tissues. There is increase in the blood levels of a number of hormones during stressful period like cortisol due to stimulation of pituitary adrenocortical axis, epinephrine, nor-epinephrine and growth hormones. These hormones are lipolytic in nature and

they mobilize the lipid stores of adipose tissue and liver to meet the extra-caloric requirement of tissue (3, 8).

The effect of stress on serum cholesterol seems to be variable. In a study on 55 volunteers, Kuhl (14) found an increase in serum cholesterol level following brief immersion in cold water. However, Beischer (15) did not find any significant change in serum cholesterol in persons subjected to human centrifuge ride. Both these stresses were physical and mental. In the present study there was a significant rise in serum cholesterol with increasing examination stress from control to pre-terminal period reaching at its peak at pre-professional examination ($P < 0.001$; Table II). These levels returned to normal after examination stress was over (post-professional period, $P > 0.05$). Similar findings were reported by Wertlake et al. (3). The precise nature of response of cholesterol during periods of stress is elusive. In view of the fact that serum cholesterol level has been shown to be the subject of hormonal influence specially the level of glucocorticoids, it is probable that changes in its level depends upon the type of stress-physical, mental or both.

In the present study there was a clear and significant rise in the levels of serum triglycerides from control to preterm period and to pre-professional period ($P < 0.02$; Table II). However, between the preterm to preprofessional there was no significant increase in triglyceride levels. Kenon Francis (4) studied serum triglycerides levels in 20 young medical students and observed a significant rise within three weeks of stress but subsequent observations showed wide fluctuations. The cause of rise in serum triglyceride levels is uncertain but it may be due to peripheral lipolysis under the hormonal influence.

Moreover, an initial significant rise ($P < 0.001$) in total serum lipids from control to pre–term period was observed with a significant decline ($P < 0.001$) thereafter just before the professional examination (Table II). Since total lipids includes a variety of lipids viz. simple (fats and waxes), complex (phospholipids, glycolipids, sulfolipids, aminolipids, lipoproteins) and precursor and derived lipids (fatty acid, glycerol, steroids, fatty aldehydes and ketone bodies, lipid soluble vitamins and hormones) (16), the rise and fall in the total lipid levels shall depend upon the variation in the values of individual constituent. Unless each constituent is individually assessed for its role in stress, it may be premature to submit explanation for the findings in the present study.

REFERENCES

1. Friedmann M, Rosenmann RH Carroll V. Changes in serum cholesterol and blood clotting time in men subjected to cyclic variation of occupational stress. *Circulation* 1958; 17: 852–861.

2. Mann GV, White HS. The influence of stress on plasma cholesterol levels. *Metabolism* 1953; 2: 47–58.

3. Wertlake PT, Wilcox AA, Haley MI, Peterson JE. Relationship of mental and emotional stress to serum cholesterol levels. *Proc Soc Exp Biol Med* 1958; 97: 163–165.

4. Francis KT. Psychological correlates of serum indicators of stress in man: A longitudinal study. *Psychosomatic Medicine* 1979; 41 (8): 617–628.

5. Levy RI, Feinleib M. Risk factors for coronary artery disease and their management. In: Braunwald E (Ed), Heart Diseases: A Textbook of Cardiovascular Medicine. WB Saunders Co., Philadelphia, 1980; 1246–1278.

6. Rahe RH, Rubin RT, Arthur RJ, Clerk BR. Serum uric acid and cholesterol variability. *JAMA* 1969; 206: 2975.

7. Thomas CB, Murphy EA. Further studies on cholesterol levels in the Johns Hopkins medical students, the effect of stress at examination. *J Chronic Dis* 1958; 8: 661–668.

8. Friedman M, Rosenman RH. Association of specific overt behaviour pattern with blood and cardiovascular findings. *JAMA* 1959; 169: 1286–1296.

9. Bijlani RL, Gandhi BM, Tandon BM. Effect of examination stress on serum lipid profile. *Tropical Gastroenterology* 1983; 4 (3): 168–170.

10. Chiemori N, Henry RJ. Study of the ferric chloride method for determination of total cholesterol and cholesterol esters. *Am J Clin Path* 1959; 31: 305.

11. Von Handle E, Zilversmith DB. Determination of serum triglycerides. *J Lab Clin Med* 1957; 50: 152.

12. Annio JS. Total lipid estimation by phosphovanillin method. In : Clinical Chemistry, Principles and Procedures 4th edition 1976, 268.

13. Cardiovascular Disease Risk Factors: New Areas for Research. Report of WHO Study Group/Geneva, World Health Organisation 1994 (WHO Technical Report Series No. 841).

14. Kuhl WJ, Beck EM, Gersjberg H, Street E, Ralli EP. Effect of cold water stress on blood and urine constituent in 55 normal male subjects. *Metabolism* 1955; 4: 143–152.

15. Beischer DE. *J Av Med* 1955; 27: 260.

16. Mayes PA. Lipid transport and storage. In: Murray RK, Mayes PA, Granner DK, Rodwell VW, eds., Harper's Biochemistry, 22nd edn, Connecticut,. Appleton and Lange Publications 1990; p. 234.