STUDY OF BLOOD LIPIDS, CORTISOL AND HAEMODYNAMIC VARIATIONS UNDER STRESS IN MALE ADULTS

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Background: Increased cholesterol in blood plays the role in atherosclerosis formation. It is observed that stress increases cholesterol level. Most of previous studies were conducted on biological risk factors like blood lipids under stress in middle aged persons who remained under investigations for heart problems. **Objective:** The study was conducted to evaluate the changes in blood lipids and blood cortisol along with sympatheo-adnergic responses determined by selected haemodynamic parameters during psychological stress. **Methods:** Male participants (n=114) were randomly selected. They were examined two times**,** for stress task of *viva-voce* (degree examination) and during non-stress period. Final selection of participants was depending on stress assessment and their well being. **Results:** Cortisol, systolic and diastolic blood pressures (SBP and DBP) and heart rate (HR) were significantly increased during stress period with $p<0.001$ for each parameter. But different blood lipids levels (TC, LDL-C, HDL-C and TG) were detected with different significant levels. The correlations of changed lipids with raised findings of haemodynamics and cortisol were also evaluated. **Conclusion:** Further studies in our population are needed to evaluate the relation of changes in various biological risk factors including IL-9 and sympatho-adernergic activities with stress factors related to our social/ environmental problems, especially genetically based psychological factors.

Keywords: Cholesterols, Haemodynamics, Cortisol, psychological stress.

INTRODUCTION

Both, psychological factors, e.g., hostility and blood lipids are considered as risk factors.[1–2] Generally, the choice of risk factors remained predetermined by researcher's specialty. For instance clinicians may underestimate the importance of stress as they have no effective means by which to judge the ability of an individual to respond to stress appropriately[2], and health psychologist use a much wider range of psychological tests yet tend to consider only a few biological risk factors, e.g., total cholesterol level, high blood pressure and cigarette smoking etc.[3] While studying the mechanisms of atherosclerosis under stress, majority of researches conducted to date failed to consider simultaneously both biological and physiological responses of body to psychological stress.[2,3] The fact that possible physiological and/or pathological mechanisms of stress-induced blood changes that lead to early atherogenesis, little is known about affects of anxiety on blood constituents like blood cells, coagulation factors, blood lipids, interleukins etc. in relation with cardio-vascular activities. On the other hand most common life proceedings which produce routine stresses and hassles during life since earlier age are stressful events, occupational stress, job strain and work stress. But in this regard there is very limited knowledge about the role of pre-employment risk factors of IHD, and also there is lack of studies conducted on young adults with no apparent IHD.[4–5] The question whether stress affects blood and body systems has not been vastly probed into. The objective of this study was to see if stress affects blood parameters and haemodynamics in young adult males.

MATERIALS AND METHODS

Male medical students (n=114), having age in between 18–23 years (Mean= 19.45 years) and studying in 1st or 2nd year MBBS, were randomly selected from 397 volunteers at Chandka Medical College Larkana. Informed consent was taken before starting stress task (*viva voce*). The volunteers were registered who agreed to give blood samples at both instances**;** the stress and non-stress sessions. The selected subjects were studied twice**:** first time for stress task as 'stress study' and then during non-stress 'control' period, i.e., when they were away from any serious academic activity. They were instructed to avoid heavy exercise and were restricted to take proposed diet. No medication was allowed one day before or on the day of blood sampling.

Selection Criterion

Preliminary clinical check-up and completion of two questionnaires: Spielberg's State Trait Anxiety Questionnaires of modified version (STAI-Q) to asses task anxiety; and Medical Health-Questionnaires (MH-Q) for detecting their health condition. Blood level of cortisol was also used to confirm the presence of stress in selected subjects for experiments of stress-study to finalize their selection. ECG was recorded to exclude any cardiac abnormalities.

Lab-Experiments

The SBP, DBP, Pulse and heart rate (PR & HR) along with Electrocardiography (ECG) were recorded by

standard methods. The radioimmunoassay was done on gamma counter to estimate blood cortisol. Cholesterols were determined by using spectronic-21 from Interlabs Instruments of Bausch and Lomb USA. The standards and reagents for estimating LDL-C, HDL-C, TC and TG were available in concerned kits, and the methods were applied, accordingly.

RESULTS

The means of differences were evaluated statistically by 'paired *t*-test' to find out the affects of stress on parameters and percentage changes in parameters during stress were analysed. The correlations between observations were estimated by correlation–coefficient under Pearson's Product Co-relation technique for stress affects.

Level of blood cortisol during stress was, on an average 22.780 ηg/ml higher from that of after stress. Heart Rate, SBP and DBP were increased in order of 12.097 beats/minutes, 13.590 mm Hg and 11.009 mm Hg respectively during stress period, (Table-1).

Both TC and HDL-C were decreased due to effect of stress with the percentage decrease of 0.29% and 7.94%, respectively. The TC was decreased by 0.5 mg/dl, HDL-C decreased by 3.14 mg/dl. LDL-C and TG were increased in stress in order of 2.64 mg/dl and 2.18 mg /dl. The percent change of LDL-C and TG increments were found to be 2.88% and 1.94% respectively (Table-2).

The correlation coefficient (r) for increased LDL-C with increased DBP was +0.20 and with SBP it was +0.28. Correlation between raised level of LDL-C and HR was not significant.

The decreased level of HDLC was negatively correlated with increments in SBP and DBP (r= -0.35 and r= -0.27, respectively). Correlation between increased HDL-C and increased HR was not significant. Correlation between TC and HR, SBP and DBP were non-significant.

Table-1: Affect of stress on blood cortisol and haemodynamics along percentage increments in levels of the parameters among subjects due to stressful life event (n=114)

Variables	During Stress Mean±SEM	After Stress Mean±SEM	Mean Difference	Increment % during stress
Blood Cortisol (ηg/ml)	179.55 ±2.680	156.77 ±2.210	22.780**	14.53%
Heart Rate per min	83.360 ±0.776	71.263 ±0.618	12.097**	16.97%
Systolic BP (mm Hg)	135.960 ±1.080	122.37 ±0 .790	13.590**	11.11%
Diastolic BP (mm Hg)	86.930 ±0.792	75.921 ±0.796	11.009**	14.15%

**p<0.001

Table-2: Affect of stress in blood lipid profile along percentage increments in levels of the parameters among subjects due to stressful life (n=114)

Variables	During Stress Mean±SEM	After Stress Mean±SEM	Mean of Difference	% change in stress
TC (mg/dl)	170.65±1.69	171.15±1.73	-0.5	0.29% Decrease
LDL-C (mg/dl)	94.20±1.53	91.56±2.0	+2.64*	2.88% Increase
HDLC (mg/dl)	36.41±1.07	39.55±0.76	-3.14**	7.94% Decrease
TG (mg/dl)	114.49±1.48	112.31±1.63	+2.18*	1.94% Increase

*p<0.01, **p<0.001

Table-3: Correlation of lipid profile variations with haemodynamic responses and blood cortisol changes in 114 subjects due to stressful life

Variables for correlation		STATISTICAL ANALYSIS	
		Co-Relation Coefficient (r)	*p*-value
Total cholesterol (TC)	HR	-0. 001	NS
	SBP	-0. 001	NS
	DBP	-0 .004	NS
LDL cholesterol (LDL-C)	HR	+0.16	NS
	SBP	+0 .28	<0.01
	DBP	+0.20	<0.05
HDL cholesterol (HDL-C)	HR	-0.17	NS
	SBP	-0 .35	<0.001
	DBP	-0. 27	<0.01
Blood cortisol	LDL-Cl	+0 .27	<0.048
	HDL-C	-0.294	<0.05

NS= Non Significant

DISCUSSION

There is strong evidence (p<0.001) to conclude that HR, SBP, DBP and blood cortisol were significantly increased in participants at the time of mental stress. These raised findings were consistent with results of studies conducted among foreign people, and which were supporting the work showing release of endogenous catecholamines and cortisol secreted by neuroendocrines.[6–7] Various studies have been conducted to examine lipids and lipoproteins under different stressors. Some of those have shown increase and others detected the decrease of same blood lipids and lipoproteins.[1,8–12] However, generally TG, LDL-C, TC and HDLC were found to be increased due to effect of stress in most of recent past studies.[13] In present study, although LDL-C and TG were increased by different percentage with different values of positive mean of differences but *p*-value for raised observations of both parameters were found the same, i.e., p<0.01 as shown in Table-2. While, TC was decreased by negative mean of difference and such findings were observed as non-significant change in stress task. The HDL-C was decreased during stress period by negative mean of differences with p<0.001. The results of LDL-C and

TG were consistent with the results of some of previous works.[1,12]

Some of investigators argued that the increase in concentration of circulating lipoproteins were because of haemoconcentration due to vascular fluid shifts. The changes appeared to be of short duration along with increased blood viscosity and haematocrit, indicating the occurrences of haemoconcentration under stress.[9,14,15] As we did not calculate Packed Cell Volume and Hb%, reason of haemoconcentration cannot be ruled out. Although, lipid findings in a few subjects were not in consistent with results detected in a study conducted in medical students at the time of exam-stress by Joseph *et al*, we are in agreement with his suggestions that 'the increments of lipids and lipo-protein may not be solely due to haemoconcentration.[1] From correlation values (Tabe-3) we observed that the responses of blood lipid changes may not be only due to haemoconcentration.

Apart from haemoconcentration the other links of various pathways like effect of hormones on lipid metabolism have also been implicated and claimed.[16] Both epinephrine and cortisol were claimed by some authors to be linked in humans to serum cholesterol elevation.[17] But in present work the co-relationship of altered findings were somewhat different. LDL-C and HDL-C with increased value of blood cortisol were determined by correlation co-efficient of r=+0.27and r=**-**0.294, respectively (Table-3), and the results also indicated the probable hormonal association with said alteration of lipoproteins due to stress. In a study, altered response of lipids in anger has been correlated with epinephrine, cortisol, and cardiovascular reactivity.[7] Similarly, WOLF study was devised to specifically examine stress of routine life, namely 'work-stress', and found adverse relationship in ratio of low density to high-density lipoprotein cholesterol only in younger men and women.[18] This ratio was not observed in our study but observed changes in favour to atherogenesis have been detected in participants during stressful event**;** in sense that the risk factor or LDL-Cholesterol was not only increased (2**.**88%) than TG (1**.**49%) but such increment of LDL-C was significantly and positively correlated with haemodynamic responses of SBP and DBP (Table-2 & 3). While, the protective or good lipids for example HDL-C was reduced with 7**.**94% than and became negatively correlated with increased SBP and DBP responses. Hence, findings were found in atherogenic form, i.e., prone to atherogenesis at the time of real life stressful situation.

It is suggested that CNS may be directly involved in regulation of fat storage and lipolysis. The CNS innervates adipose tissue through efferent pathways of sympathetic nervous system (SNS), and the oscillations of plasma free fatty acids (FFAs) and glycerol were completely removed by β-blockade indicate that rapid bursts of lipolysis may be generated by SNS. Whether efferent pathways of CNS including SNS play any role in moment-to-moment regulation of such lipid metabolism under stress remains to be clarified.[19] Although, conclusion about after mentioned CNC-activity related to metabolic analysis can not be drawn from present available data. It is suggested by many authors that consequences of changes in blood lipids levels may be due to increased mental stress.[1] On one hand, in this study mental stress alters lipids adversely (in atherogenic form) and such changes were found to be correlated with haemodynamic responses during psychological stress, but on the other hand, exact mechanism influences cholesterol metabolism is not fully known. The possibility that stress affects plasma lipid concentrations has been the subject of recent investigation.[11]

First study conducted in 2006 for interactions of neuregulin-1 genotype with common life proceeding like job strain on coronary artery activity had shown that stress and atherosclerosis may be complicated by genetic influence. We postulate that genotype may vary in different population with different affects. For instances, T/T or NRG-1 gene may protect the persons from negative health effect of stress.[20–21] Therefore, the mechanisms and consequences of stress induced alterations not only for lipids but also for other biological risk factors like IL-6 may differ from country to country and from population to population. There may be several potential mechanisms through which stress can affect cardiac health, and IHD that produces clinically significant changes relatively late in life is considered as a multi-factorial disease by many authors. Only a few studies about relation of daily stress and hassles, like work stress or job strain and atherosclerosis, have been conducted so far. Most of studies were carried out on participants of middle age, usually over 40, stem from the lack of techniques for assessing sub-clinical stages of IHD, such as atherosclerotic process.[21] Even, this work was conducted on apparently healthy young age group but there are some limitations, and most important was that we could not continue a follow-up study for long period. Irrespective of this, present study may help as a baseline for future researcher scholars who want to do further work or review our findings. Although, possible clinical significance of acute lipid stress responses is not known,[8] we are of the opinion that probable mechanisms that contribute to initiate, develop and speed up atherogenesis in humans may underlie with

associations of atherogenic changes in lipids, haemodynamic, hormonal and other risk factors due to routine stress and hassles of 'stressful-real-life' events, occurring from time to time in life.

CONCLUSION

From this study it was revealed that atherogenic changes in levels of blood lipids and lipoproteins occurred, and the alterations were found in association with cardiovascular activity in healthy young persons due to routine mental stress (anxiety-task) during real life stressful situation.

Further work is needed for evaluating specific details, especially exact mechanisms of lipid alteration and consequences of such variations, e.g., possible role in atherogenesis from earlier stages. It is suggested that a follow up study for a long period may be conducted not only on blood lipids but also on other biological risk factors like interleukins, haemodynamics and psychological factors related to socio-environmental problems, especially genetically based psychological factors in young age group.

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