Biochemical Physical and Psychological Effects of Stress on Emergency Biochemistry Laboratory Staff

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Abstract: **Stress is a general response of individual to various environmental stressors. The reach to damaging dimension of stress can cause to the emergence of many diseases. Nowadays, stress which has become an important part of business life, is a factor faced everyday of employees especially in the health sector. In this study, the results were evaluated by measuring blood samples and vital signs of health staff at various times, so the biochemical, physical and psychological reactions shown in the face of stress were determined. STA-I (State Anxiety Inventory) and STA-II (Trait Anxiety Inventory), filled by the health staff at intense working hours and rest times were analysed. Among the observed findings that were defined as statistical significant were evaluated. Though the limitation has become due to the biochemical and vital evaluations were not analyse at the same hours, biochemical effects caused by the fatigue have become significant findings. It is required to examine elaborately the stress factors by effects of working conditions on health staff.**

Keywords: **health staff, stress, shift, working conditions.**

1. INTRODUCTION

Stress is defined as a general response of individual to various environmental stressors. (Selye, 1950). After the response to the first time of a person who faced with stress which known as an adaptation problem, a person tries to adapt to cope with stress; but as it is unable to cope with stress, cases that can result in diseases even death, may occur (Selye, 1955).

Stress arises due to the intrinsic motivation process (Vogel, et al, 1959). At this point, it is also important the perception and personality traits of people on the stress (Batıgün & Şahin, 2006). With stress, certain symptoms have been shown to arise such as headache, fatigue, rise of blood pressure, digestive disorders and sweating (Okutan & Tengilimoğlu, 2002;). During the stress, blood pressure increases immediately, and then hyperacidity and hypersecretion consist in the gastrointestinal system (GIS) (Yurdakoş, 2005). The hormone that causes hyperacidity is determined as cortisol (Kocatürk, 2000). Cardiovascular system (CVS) and gastrointestinal tract are damaged by the indirect effects of stress. This situation may lead to coronary and acute (Meisel, 1991;) heart disease (Yurdakoş, 2001; Brydona et al 2010) and stomach ulcers (Yurdakoş, 2001). Furthermore, when it becomes chronic stress, the adaptability of central nervous system (CNS) may be insufficient. In this case, many psychiatric diseases can occur in the quality of neurons and neuronal organization as a result of negative restructuring (Kocabaşoğlu, 2005; Arıbal, 2000; Daş, 2000). It should be noticed that the negative effects of stress, in addition to causing long-term chronic disorders, reduces the quality of life due to the creation daily physical discomfort (Daş, 2000)

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Chronic stress is thought to be important in working life as well as in everyday life. The effects of stress have been investigated at business performance in different sectors and on the health of workers in this field. (Chandola, et al., 2006; Batıgün & Şahin, 2006). Related to the chronic stress in business life, it has been found to cause the problems such as sleep disorders, drug use (antidepressants, sleeping pills etc.) and anxiety (Behar, et al., 1990; Moore and Cooper, 1996). It has been observed that the probability of metabolic syndrome was doubled on people who exposed to long time chronic job stress (Chandola, et al., 2006;). However, there are few studies available on the subject of the effect of job stress on health workers. Particularly, considering the negative effects of stress factors by which created day and night work in the shift form on cardiovascular system (Kario, et al., 2002), it can be significant to know the effects of chronic stress on employees in an environment such as an emergency laboratory, served in the shift system. However, the data on this topic is very limited. In the present study it is aimed to investigate in terms of psychological, antropometric and biochemical data the stress of working as 24 hours shift system on health employees in the laboratory that is served to an emergency service of a large-scale hospital.

2. METHODS AND MATERIALS

Study Design:

The study group was composed of people in the same working place to eliminate other confounding factors and all staff stated that the shift is a stress factor for them. This study was conducted with 15 laboratory staff that keeps guard in Emergency Biochemistry Laboratory for at least 6 months and agreed to participate in this study between 6 June 2011 and 8 August 2011. One of participants was excluded in the middle of the study because of the intense acute stress experience. The average age is 39, 9 ± 9 with 7 women and 7 men, a total of 14 people were included in the cohort study (Table 1). The average professional experience was 15 years ± 10. 71% of staff indicated that they had not a chronic disease, while 79% of staff stated that they had not use a drug constantly.

People who participate in the study were informed before the start of the study. All participants were informed about not to consume alcohol from the study day until 48 hours ago and it was confirmed by the question that they had not consumed alcohol before the study. At the end of the shift, a questionnaire was filled including evaluations of shift (the intensity of shift, whether there have been discussions with the patient or patient's relative, during the period of shift a total number of sample analysis, whether technical problems have being experienced or not in any device, etc.) in consultation with participants. Total study time including the collection of samples and surveys was about two months. It was tried to determine psychological, antropometric and biochemical changes developed against the stress with versatile evaluations.

Research Review Committee Approval:

Before the study, Ministry of Health Göztepe Training and Research Hospital Research Review Committee Approval (8-F 28/12/2010) were taken and the study was conducted in accordance with Declaration of Helsinki. Furthermore, all participants were informed about study procedures with "Informed Voluntary Form" and then their signatures and permissions were taken about their voluntary.

3. STATISTICAL ANALYSIS

Statistical analysis of the data was realised with using SPSS 16.0 (SPSS Inc., USA). Because of its smallness, the study group was accepted as non-parametric. The data obtained in consequence of the analysis of biochemical and antropometric measures was analysed with the Friedman Test. According to the Friedman Test, for significant variables paired comparisons were analysed with Wilcoxon Test. $p < 0.05$ was considered statically significant.

Psychological Measures:

Psychological evaluation was realised with STA-I State and STA-2 Trait Anxiety Inventory (Spielberg et al., 1970; Öner & Le Compte 1985). Psychological evaluations were performed both on shift time (Measure-I) and on off-shift time, out of hours (Measure-II). Measure-II was carried out at 21:00-23:00 hours at least one month after the Measure-I. The day of filling the inventory was determined as Saturday and with the condition that not to be in shift on Sunday. Participants were asked to stay away from cases (such as heavy work load, exercises, sudden stress, etc.) which will create intense stress on Saturday that they answer the inventory. Psychological assessments were evaluated by comparing the same inventory applied both on Saturday and between 21:00 and 23:00 hours at which is accepted the busiest time of the shift.

Table 1 : Psychological Findings **

	Measurement -I ±SD	Measurement -II ±SD	χ^2	p
STA I	37.6±3.8	43.5±3.5	3.19	**0.001**
STA II	43.9±5.4	44.7±5.3	0.32	0.750

**Wilcoxon Test

Physiological Measures:

Before antropometric measures, employees were warned not to have consumed alcohol within 48 hours before the measure, not to have started to shift sleeplessly, not to have drunk or eaten anything before measure time until at least 4 hours ago, they were also warned to have resolved urine and defecation needs before one hour from the measure, to have passed resting the last half hour. Measurements of arterial blood pressure, pulse and partial oxygen saturation was made 08:00-08:30 pm at the beginning and at the end of the shift, before the bloodletting process. Systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse were measured with digital arm blood pressure monitor (Microlife-Turkey); partial oxygen saturation (SpO_2) was carried out with finger pulse oximeter. The results of pre-shift (Measure-I) and post-shift (Measure-II) were compared with the measures realised at off-shift (Measure-III) working hours.

Table 2 : Physiological Findings*

	Measurement I	Measurement II	Measurement III	χ^2	p
SBP (mmHg)	118±14.0	115±13.4	119±12.5	0.50	0.779
DBP (mmHg)	76±10.1	72.6±10.0	74±9.7	1.89	0.390
Pulse (beat/min)	71.1±8.0	66,9±8,5	71,6±9,2	3.53	0.171
SpO2 (%)	97.2±1.3	97.5±1.3	96.9±2.3	1.03	0.598

*Friedman Test

Biochemical Measures:

Blood samples of all employees were taken for Measure-I, Measure-II and Measure-III. Blood samples of employees for Measure-I and Measure-II were taken in the morning at 08:00-08:30 pm while the participants were hungry. For Measure-II blood samples, it was provided to stay hungry the employees after 02:00 pm in the morning. The bloodletting process was realised in a day that there was no infection including pain and influenza infections and has not encountered recently with a major stress factor. Two blood samples, including anticoagulant-free flat tube and EDTA tube were taken. The samples were centrifuged at 2000 g for 10 minutes to obtain plasma and serum, so the sample of serum and plasma was separated. These separated serums and plasmas were stored at -20 Cº till analysis. All analysis were realised on the same day for all samples.

Glucose, urea, creatinine, total HDL-LDL-VLDL cholesterol, triglycerides, uric acid, SGOT, SGPT, ALP, CK, CK-MB, total direct and indirect bilirubin, total protein, albumin, globulin, amylase, lipase, LDH, serum iron, total iron binding capacity (TIBC), unsaturated iron binding capacity (UIBC), calcium, phosphorus, magnesium, sodium, potassium, chlorine analysis were measured in Olympus autoanalyzer (Olympus AU 2700, USA); adrenocorticotropic hormone (ACTH) level was measured in Immulite 2000 autoanalyzer (Siemens, USA), cortisol, insulin, free T4, TSH, dehydroepiandrosterone sulfate (DHEA-S) levels were measured in DxI 800 Access autoanalyzer (Beckman Coulter, USA). Adrenaline, noradrenaline and antidiuretic hormone (ADH) were measured with ELISA method, aldosterone were measured with RIA method.

Table 3: Biochemical Findings*

	Measurement I	Measurement II	Measurement III	χ^2	p
Glucose (mg/dL)	94.3±8.1	92.9±4.8	95.0±7.6	2.93	0.232
Urea (mg/dL)	27.9±5.4	28.5±4.7	28.7±6.9	0.00	1.000
Creatinine (mg/dL)	0.91±0.15	0.88±0.14	0.92±0.16	9.77	**0.008**
T.Cholestrol (mg/dL)	198±33	196±33	206±29	3.00	0,223
Triglycerides (mg/dL)	124±60	138±78	122±41	0.57	0.751
Uric Asid (mg/dL)	4.68±1.65	4.52±1.48	4.65±1.64	1.71	0.424
AST (U/L)	25.1±30.3	22.9±25.2	23.9±24.7	8.12	**0.017**

ALT (U/L)	21.8±44.9	20±40.2	21.5±39	2.24	0.327
GGT (U/L)	21.9±27.66	20.8±23.9	21.7±24.4	2.12	0.346
ALP (U/L)	53.2±16.7	52.6±16.7	54.9±17.1	8.38	**0.015**
Total Bilirubin (mg/dL)	0.55±0.17	0.57±0.2	0.54±0.17	0.59	0.744
Total Protein (g/dL)	7.22±0.43	7.3±0.39	7.4±0.43	4.69	0.096
CK (U/L)	165±301	125±137	114±83	4.59	0.101
CK-MB (U/L)	16.1±17.6	15.7±17.9	14.1±12.5	0.29	0.867
Amylase (U/L)	78.9±19.8	77.2±18.4	78.6±18	1.89	0.390
Lipase (U/L)	24.9±5	24.5±5.4	24.9±5.3	0.91	0.636
LDH (U/L)	155±35	158±31	162±25	5.29	0.071
Ca (mg/dL)	9.23±0.31	9.3±0.38	9.23±0.31	0.33	0.849
P (mg/dL)	3.29±0.41	3.71±0.34	3.43±0.31	5.49	0.064
Mg (mg/dL)	2.08±0.20	2.06±0.15	2.02±0.15	0.94	0.624
Fe (µg/dL)	84.2±39.1	75.5±28.6	73.2±19.8	0.57	0.751
DIBK (µg/dL)	255±58	269±53	272±55	4.43	0.109
TIBC (µg/dL)	334±49	344±43	346±49	8.33	**0.016**
Na (mEq/L)	139±2.6	140±1.5	140±2.1	2.71	0.258
K (mEq/L)	4.42±0.45	4.38±0.24	4.49±0.34	2.82	0.245
Cl (mEq/L)	106±2.4	107±2.2	107±3	2.98	0.226
Cortizol (µg/dL)	13.4±3.9	10.2±2.5	12.3±5.3	8.14	**0.017**
DHEA-S (µg/dL)	177±103	191±96	184±96	2.29	0.319
Free T4 (ng/dL)	0.95±0.15	0.91±0.13	0.90±0.14	2.70	0.259
Insulin (µU/mL)	7.96±6.32	6.71±3.68	7.35±3.3	4.00	0.135
TSH (µIU/ml)	2.04±1.77	2.33±1.56	1.72±1.02	6.86	**0.032**
ACTH	17.2±7.4	16.7±7.4	16.0±8.7	1.85	0.397
Adrenalin (pg/mL)	75.4±29	74.7±13.4	70.2±19.2	2.71	0.257
Noradrenalin (pg/mL)	426±294	310±224	278±106	1.71	0.424
Aldosterone (pg/mL)	167±177	123±73	132±35	1.00	0.607
ADH (pg/mL)	1.83±2.13	3.63±3.24	2.32±3.32	3.57	0.168

*Friedman Test

Tablo 4: Biochemical Significant Findings

	Measurement I	Measurement II	Measurement III	χ^2	P**
Creatinine	0,91±0,15 [a]	0,88±0,14 [a,b]	0,92±0,16 [b]	**2,50**	**0,012**
AST	25,1±30,3 [c]	22,9±25,2 [c,d]	23,9±24,7 [d]	**2,05**	**0,040**
ALP	53,2±16,7 [e]	52,6±16,7 [e,f]	54,9±17,1 [f]	**1,73**	**0,045**
TIBK	334±49 [g,h]	344±43 [g]	346±49 [h]	**2,20**	**0,028**
Cortizol	13,4±3,9 [t]	10,2±2,5 [t,i]	12,3±5,3 [i]	**3,11**	**0,002**
TSH	2,04±1,77 [j]	2,33±1,56 [j,k]	1,72±1,02 [k]	**2,04**	**0,041**

**Wilcoxon Testi

4. RESULTS

Some questions were asked to participants to evaluate their stress perception on shift. 21 % of participants stated that their shift as dense, while 29% of participants stated it as good and 50% of participants stated as normal. During the shift, the number of daily samples studied in the laboratory was nearly 367, 0±65, 0. Half of the participants stated that they experienced minimum (1-3) technical problems. The excess of the number of samples were appeared to reinforce the negative perception of shift. (Fisher's Exact Test, p=0,027) There is no relation between technical problem and shift intensity perception. (Fisher's Exact Test, p=0,096).

In terms of antropometric findings (systolic and diastolic pressure, pulse, SpO_2) the significance has not determined in statistical analysis between the measurements (Table 2).

It was indicated that at STA-I situational anxiety level of the employees, the scores of Measure-I was observed noticeably significant difference than those Measure-II (p=0.001), while at their STA-II level was not (p>0.05) (Table 3). In

comparison biochemically between the measures, a significant difference was constated among creatinine, AST, ALP, TDBK, Cortisol, TSH (p<0.05) (Table 4). In accordance with the creatinine level in Measure-II, Measure-I and Measure-III levels were found to be significantly higher (by order p=0.012; p=0.006). In accordance with the AST levels, Measure-III levels were found to be significantly higher (p=0.040). In accordance with ALP levels in Measure-II, Measure-I levels were found to be significantly higher (p=0.045). In accordance with TIBC levels in Measure-II, Measure-I levels were found to be significantly lower (p=0.028). In accordance with the cortisol levels in Measure-II, Measure-I levels were found to be significantly higher (p=0.002). In accordance with TSH levels in Measure-II, Measure-I levels were found to be significantly lower (p=0.041).

5. DISCUSSION

Stress has become a phenomenon that its importance is growing day by day and that affects other disciplines, also. Anxiety disorder, due to the stress, has a 5% in a total health expenses. This proportion includes the productivity and loss of labour (Balcıoğlu, 2002). Stress, not only anxiety disorder but also it should be considered with all negative situations that appeared the stress can not be controlled. For this reason, the psychological and physiological effects of stress on daily life should be further examined. In parallel with this, in the present study it is aimed to investigate in terms of psychological, antropometric and biochemical data the stress of working as 24 hours shift system on health employees in the laboratory that is served to an emergency service of a large-scale hospital.

Effects of stress on metabolism are quite complex and are not yet fully explained and these effects are very significant. Due to acute stress, it is known to increase hormones including mainly cortisol, adrenocorticotropic hormone (ACTH) and dehydroepiandrosterone (DHEA) (Lennartsson, et al., 2012). The cortex which is alerted by stressor stimulates the limbic system and its stimulation of the hypothalamus, corticotrophin releasing factor (CRF) of hypothalamus starts to secrete (Balcıoğlu & Savrun, 2001 Hatungil, 2008). In this process, the amount of released ACTH can reach up to 20 times than normal value (Balcıoğlu & Savrun, 2001). Increased ACTH stimulates the cortisol secretion and cortisol levels rise (Arıbal, 2000; Balcıoğlu & Savrun, 2001; Opperhuizen et al, 2000). Thyroid stimulating hormone (TSH) is a hormone that increases instantly in a time stressful (Balcıoğlu & Savrun, 2001; Balcıoğlu & Savrun, 2005). In this study, although there was no significant difference between the measures of ACTH levels, the significant difference between the measures of cortisol levels was determined; the after the shift cortisol levels were found to be more significantly lower than the before the shift cortisol levels (p=0.002). The stress factor that we considered to be there during the shift has not been seen as the measure can not be realised during the shift; however, the determination of cortisol levels were significantly lower after the shift can be considered as an indication of the alienation of stress. It was also observed that measures in blood samples taken after the shift were significantly higher than the other measures taken before the shift in TSH levels, also (p=0.041). In the two stress parameters, between measures, especially measures taken after the shift was observed as a significant difference than other measures taken before the shift; this difference indicate that the shift has a negative effect on employees and it considered as an important stress factor.

Acute stress cause increase catecholamines, cortisols, vasopressors, endorphines and aldosterones on the body. This situation is partly explained by the augmentation of blood pressure (Zimmerman & Frohlich; 1990). This situation can be also explained by there has been no difference among biochemical changes related to stress after the shift (ACTH, Adrenalin, Noradrenalin, Aldosteron ve ADH; p>0.05); there has been no significant increase or difference at blood pressure levels which are antropometric parameters and that it can be explained by disappearing of acute stress factors during bloodletting. It should not be ignored cortisol and other stress parameters could be affected during bloodletting. Moreover, during normal sleep and wake cycles, circadian rhytme of ACTH secretion is known to be caused by the high cortisol levels in the morning at 04.00-09.00 am (Tietz, 2005). However, we believe that getting by the same procedure of blood samples taken at three other times minimizes the factor of stress and the effect of circadian rtyhme related to the blood sample in difference between the measures in cortisol levels.

AST, ALP and creatinine levels are in the normal range and the difference between the measures was found significant (by order p=0.012, p=0.040 and p=0.045). Though this result does not include clinical significance in terms of stress, the presence of exchange between measures in these parameters that have increased during extreme muscle activity shows how exhausting working and guarding in an emergency labaratory.

The studies which biochemical and physiological changes were analysed that caused by reaction of employees opposite to stress and fatigue are very limited. Therefore, in the studies, realised by Ulaş T. and his friends that oxydatif stress

conditions of nurses which are on day shift and night shift were evaluated, there has not seen significant difference between the systolic blood pressure and diastolic blood pressure values of nurses who has been on the day shift and those who has been on the night shift (Ulaş et al, 2012; Ulaş et al 2013). However, Zimmerman and Frohlich report that pcysiological symptoms should be considered as the more changeable during the acute stress (Zimmerman & Frohlich, 1990). But, in this study because of measures did not realise during the shift, so there has been no significant difference on systolic blood pressure, diastolic blood pressure, pulse and PaO_2 values (p>0.05).

Despite these data obtained, in order to being understood the effect revealed by the stress on people who stated that they had exposed to stress, it will be more significant to do measure during acute stress, so during the shift. Because the body may have to maintain a balance, the absence of some biochemical changes should not be interpreted as reactionary changes does not occur in the organisme during exposure to stress.

One of the studies which is applied on health personels realised that among employees have been found to be a significant relation between depression and job satisfaction. When the satisfaction is not provided by working, the anxiety appears (Demiral et al., 2006). Accordingly, the determination of the level of state anxiety as lower develop a thought that employees become more resistant to the perception of anxiety, thanks to their past shift experience.

The effects of stress vary from person to person. The reaction of a person in the face of stressors depends on many factors such as organism's condition, environmental factors, past experiences, age, gender, and genetic structure and personality traits (McQueary et al, 2009). Without being ignored that stress perception has a connexion with the attitudes of people, the reaction of different individuals against the same stressors may also be different (Balcıoğlu & Savrun, 2001). According to this, the low number of participants constitue limitation both in terms of statistical analysis and development of stress due to the significant factors of individual differences in response to stress.

The stress, as a multifonctional phenemenon and inclusion of many factors and also having great differences individually of stress effects can be considered as a limitation of studies, related to stress. The impossibility of taking samples and measures of antropometric parameters at intense hours are considered as one of the restrictions for the study.

The only factor that create stress on health workers are not the quality of work and long hours (Sarıcaoğlu et al, 2005). Being together with patients and their relatives constantly increases also the pressure on health workers. It should be also reduced the psychological damage caused by attitudes and behaviours of patients and their relatives, including anger (Doğan et al., 1999; Arcak et al., 2006).

ACKNOWLEDGMENTS

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