HAEMATOLOGICAL AND HORMONAL RESPONSES OF TRAFFIC POLICEMEN

N. Roohi*, S. Irfan* and T. Bashir**

*Department of Zoology, University of the Punjab, Lahore-54590
**Institute of Nuclear Medicine and Oncology, Lahore

ABSTRACT: Hormonal and hematological responses in serum and whole blood specimens, were analyzed in traffic policemen (n=42) and comparable control subjects (n=20), respectively, Hormonal analysis included the determination of serum cortisol level (ng/ml) using Enzyme Linked Immunosorbant assay (ELISA). Hematological profile, as determined by automated hematology analyzer, included white blood cells count ($x10^3\mu l$), red blood cells count ($x10^6\mu l$), hemoglobin concentration (g/dl), hematocrit (%), mean cell volume (fl), mean cell hemoglobin (pg), mean cell hemoglobin concentration (g/dl) and platelets count ($x10^3\mu l$). Serum Cortisol indicated highly significant elevation ($P<0.01$) in policemen compared to control group. White blood cells and platelets count were also found to be significantly elevated ($P<0.05$) in policemen compared to control group. Work stress, in particular environment, to which traffic policemen are basically exposed, was found to be the main factor for the observed responses.

Key words: *Haematology, Hormons, Enzyme Linked Immunororbant assay Cortisol.*

INTRODUCTION

Stress is a condition of mental and physical exertion brought about as a result of dissatisfying elements in the environment. Work stress has emerged as a major psychosocial influence on physical and mental health over recent decades. Many hormones and biological systems are associated with stress (Boor, 2006).

The factors that increase stress include noise, overcrowding and extremes of temperature, toxic fumes, chemicals and depression. A Japanese research study has reported that stress caused by long working hours and unfavorable conditions can indeed be hazardous to health (Karahalil *et al.*, 1999).

Multi methodological, international data shows that traffic operation is an unhealthy occupation (Evans and Johansson, 1998). Exposure to urban pollutants, physical & possible psycho-social stressors may cause alterations of cortisol level in traffic policemen (Tomei *et al.*, 2003 a). Occupational exposure to such stressors could cause a change in (adrenocorticotropic hormone) ACTH levels in traffic policemen followed within minutes by greatly increased adrenocortical secretion of cortisol (Tomei *et al.*, 2003 b). Cortisol is vital for the resistance of humans to stress. It is produced in responses to physical and mental stress (Guyton and Hall, 2006). Chronic stress is the result of continued vigilance that releases cortisol and testosterone (Raggat and Morrissey, 1997).

Piercecchi *et al.* (1999) studied the relation between behavior and the activity of the main hormonal systems implicated in stress management, in police officers. During stressful states, not only did peripheral secretion of catecholamines increase but the ratio of epinephrine to nor-epinephrine was a detrimental factor. Cortisol secretion seemed to depend upon anticipation of the stressful event more than its actual happening. Hematology is a screening test, used to diagnose and manage numerous blood diseases. The result can reflect the problems with fluid volume (dehydration), underlying infection, anemia, etc. It also shows abnormalities in production, life span and destruction of blood cells (National Institute of Health and Medical Encyclopedia, 2004).

White blood cells count is an important hematological parameter. White blood cells help to defend the body against infectious diseases and foreign materials as a part of immune system (Dacie and Lewis, 1995). Blood contains a variety of white blood cells.

Elevated white blood cells count indicates infection, inflammation or some form of leukemia. Variation in the number of different types of white blood cells help to identify the effect of medication or some chemical (McPherson and Pincus, 2007). Stress can also activate the platelets in the blood (Lederbogen *et al.*, 2009). Physiological studies have shown that stress could alter the blood parameters in healthy individuals. The study was, therefore, planned to investigate the influence of environmental hazards and stress on cortisol and hematological parameters and their relationship with self-evaluating traffic policemen job stress.

MATERIALS AND METHODS

The study is based on blood samples of traffic policemen (n=42) taken from different heavy traffic and most polluted areas of Lahore. The control samples (n=20) were also obtained from the same locality. Sampling was done in the morning between 8.00 to 10.00 a. m. with the help of registered technician. A part of each sample was processed to obtain serum for cortisol assessment. Hematological parameters were analyzed in whole blood specimens.

Hormonal Assay: The estimation of serum cortisol (ng/ml) level was done by using DRG Cortisol ELISA Kit (EIA-1887).

The enzyme-linked immunosorbent assay (ELISA) is based on the principle of competitive binding. The micro titer wells are coated with a monoclonal antibody directed towards unique antigenic site on the cortisol molecule. Endogenous cortisol of a subject sample competes with a cortisol horseradish peroxide conjugate for binding to the coated antibody. After incubation the unbound conjugate is washed off. The amount of bound peroxide conjugate is reverse proportional to the concentration of cortisol in the sample.

Hematological Assessment: Hematological assessment of blood samples was done with automated hematology analyzer Sysmex K- 1000 (TOA Med.elect.Co.LTD, KOBE Japan).

The Sysmex K-1000 is a fully automated, quantitative hematology analyzer for *in vitro* diagnostic use in clinical laboratories. It provides a quick, accurate screening for hematological testing. It determines the following 7 hematological parameters:

- White blood cells count (WBC)
- Red blood cells count (RBC)
- Hemoglobin concentration (Hb)
- Hematocrit percent (HCT)
- Mean corpuscular hemoglobin (MCH)
- Mean corpuscular hemoglobin concentration (MCHC)
- Platelets volume (PLT)

Statistical analysis: Data so obtained were subjected to statistical analysis by Student t–test at $P<0.05$ and $P<0.01$ using a computerized software program 'Minitab 11.12' to compare the means in various parameters. (Steel *and torrie,* 1997)

RESULTS AND DISCUSSION

Cortisol level and hematological parameters, in control subjects (n=20) and traffic policemen (n=42), were studied. Hematological parameters included white blood cells (WBC) count, red blood cells (RBC) count, hemoglobin (Hb) level, hematocrit (HCT) percent, mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC) and platelets (PLT) volume.

Cortisol level: The comparison of cortisol level in control subjects and traffic policemen indicated highly significant elevation of 45% ($P<0.01$) in cortisol level in traffic policemen, when compared with control group with average values 74.90±3.90 ng/ml and 51.60±4.20 ng/ml, respectively (Fig. 1).

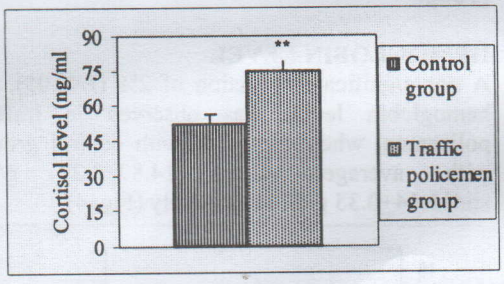

Fig. 1. Average cortisol level (ng/ml) in control group and in traffic policemen group. Values are mean±SEM. **Significance at P<0.01.

White blood cells count: An average white blood cells count in control subjects was 7.00±0.26 $x10^3/\mu l$ and in traffic policemen was 8.03±0.29 $x10^3/\mu l$, respectively. This had indicated significant elevation of 14% ($P<0.05$)

in white blood cells count in traffic policemen, when compared with control group (Fig. 2).

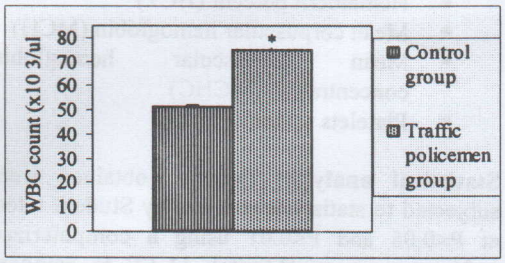

Fig. 2. Average white blood cells count ($x10^3/\mu l$) in control group and in traffic policemen group. Values are mean±SEM. *Significance at P<0.05.

Red blood cells count: Red blood cells count indicated a non-significant elevation of 2% (P<0.05) in traffic policemen as compare to control group with average values of 4.84±0.10 $x10^6/\lrcorner l$ and 4.78±0.11 $x10^6/\lrcorner l$, respectively (Fig. 3).

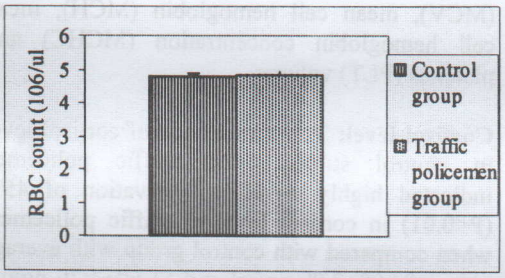

Fig. 3. Average red blood cells count ($x10^6/\mu l$) in control group and in traffic policemen group.

HEMOGLOBIN LEVEL

A non-significant reduction of 2% (P<0.05), in hemoglobin level, was observed in traffic policemen, when compared with control group with average values 14.87±0.22 g/dl and15.14±0.35 g/dl, respectively (Fig. 4).

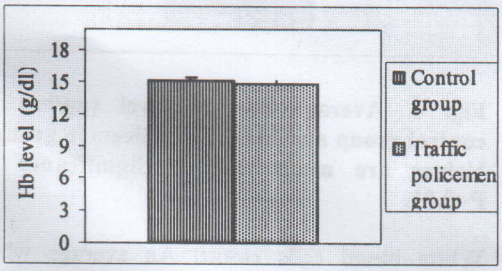

Fig. 4. Average hemoglobin level (g/dl) in control group and in traffic policemen group.

Hematocrit percent: The comparison of hematocrit percent in control subjects and traffic policemen indicated non-significant elevation of 2% (P<0.05) in traffic policemen, when compared with control group with average values of 36.79±0.45% and 36.36±0.40%, respectively (Fig. 5).

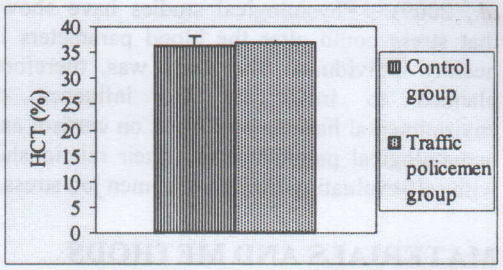

Fig. 5. Average hematocrit (%) in control group and in traffic policemen group.

Mean cell volume:
The mean cell volume in control subjects and traffic policemen indicated non-significant reduction of 3% (P<0.05) in traffic policemen, with average values of 75.60±0.96 fl and 77.30±1.20 fl, respectively (Fig. 6).

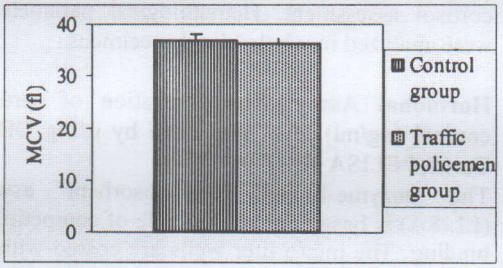

Fig. 6. Average mean cell volume (fl) in control group and in traffic policemen group.

Mean cell hemoglobin: Mean cell hemoglobin indicated non-significant reduction of 3% (P<0.05) in traffic policemen, when compared with control group with average values of 31.03±0.57 pg and 31.74±0.55 pg, respectively Fig. 7).

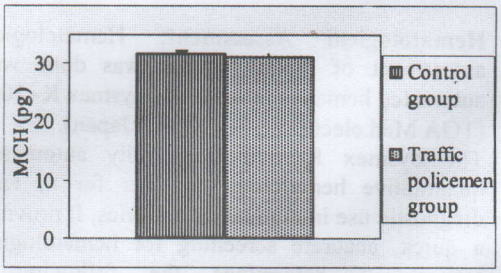

Fig. 7. Average mean cell hemoglobin (pg) in control group and in traffic policemen group.

Mean cell hemoglobin concentration: A non-significant reduction of 1% ($P<0.05$) had been observed in traffic policemen when compare with control group in mean cell hemoglobin concentration in traffic policemen, with average values of 41.00±0.48 g/dl and 41.28±0.57 g/dl, respectively (Fig. 8).

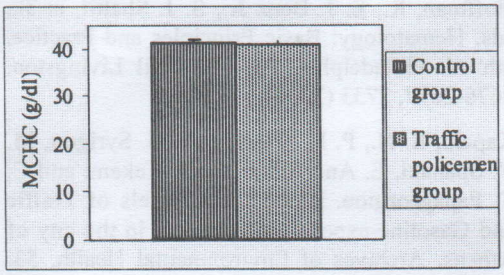

Fig. 8. Average mean cell hemoglobin concentration (g/dl) in control group and in traffic policemen group.

Platelets volume : The platelets volume indicated significant elevation of 15% ($P<0.05$) in traffic policemen, when compared with control group with average values of 201.8±8.80 $x10^3/\mu l$ and 174.30±6.50 $x10^3/\mu l$, respectively (Fig. 9).

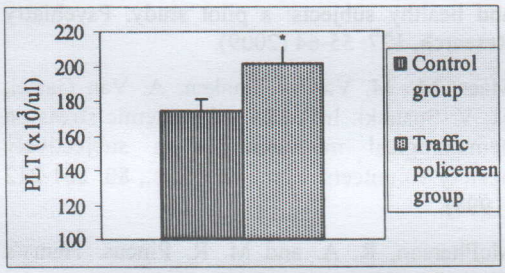

Fig. 9. Average platelets count ($x10^3/\mu l$) in control group and in traffic policemen group. Values are mean±SEM. *Significance at $P<0.05$.

When we experience stress our body's psychological defenses are mobilized to meet it. The result is known, as tension. As the brain perceives stress, the resulting tension releases adrenocorticotropic hormone from anterior pituitary that in turn releases a second hormone cortisol from adrenal cortex (Guyton and Hall, 2006).

Cortisol is a stress hormone. Several relations were observed between cortisol level and job stress. According to several researches, a stressful job may lead to high cortisol level. Traffic policemen exposed to urban pollutants and possible psychosocial stressors could be at risk change on plasma adrenocorticotropic hormone and the resultant increase in the cortisol level (Tomei *et al.*, 2004). Cortisol level, in present study, has also shown a 45% highly significant increases in traffic policemen as compared to control group. Cortisol is produced in response to physical and mental stress. This includes lack of quality sleep and job pressure (Guyton and Hall, 2006).

Exposure to heavy traffic is similar to the effect of exposure to noise and other irritants. Thus even though a large increase in background noise at a constant, steady level is experienced as less intrusive as time passes, prolonged exposure produces lasting elevations in cortisol level (Frank, 2004). High cortisol level can increase muscle protein breakdown and inhibit protein synthesis (Guyton and Hall, 2006). In the present study, muscular pains, headache and stomach problems were found to be more frequent in traffic policemen as compared to control. Use of nicotine and consumption of caffeine may affect the stress hormone secretion rates. The mental stress and smoking increases the level of cortisol (Raggat and Morrissey, 1997). In present study, traffic policemen were observed to consume nicotine in smoking and caffeine in tea, again and again during duty hours.

Physiological studies have shown that stress from any source can influence the hematological parameters, including white blood cells count, red blood cells count, hemoglobin level, hematocrit percent, mean corpuscular volume, mean corpuscular hemoglobin concentration and platelets count.

Platelets are not cells in conventional sense but are the fragmented pieces of the cytoplasm of megakaryocytes in bone marrow, released from the bone marrow into the blood stream (Wikipedia Encyclopedia, 2004). Platelets count, in present study, has indicated significant increase in traffic policemen as compared to control subjects. Lederbogen *et al.* (2009) has also reported activation of platelets during stress. Qureshi *et al.* (2002) investigated that stress produces changes in blood cells parameters, which include increase in neutrophils and platelets, while eosinophils, monocytes, basophils and lymphocytes decrease in number. No significant changes were observed in red blood cells. Maes *et al.*, (1998) concluded that stress could affect the blood cell parameters. Previous studies have been reported that the total

number of white blood cells in animals increase when they are subjected to stress (Hoffman *et al.*, 2005). In our present study, white blood cells count in traffic policemen indicated 14% significant increase as compared to control subjects. Red blood cells varied, non significantly, in traffic policemen as compared to control group. In order to elucidate the health effects of occupational exposure to traffic fume, a few biomarkers of early genetic effect were investigated in Rome traffic policemen. The results indicated that exposure to moderate air pollution levels does not result in a detectable increase of genetic damage in blood cells (Carere *et al.*, 2002). Hemoglobin level in the present study, when compared to control group, exhibited a non-significant reduction, in traffic policemen as compared to control group. Kapaki *et al.* (1998) have also reported no change in hemoglobin level in traffic policemen. Such type of study is scarce and almost non existent in the population of Pakistan. It might be helpful in providing awareness amongst traffic policemen, in Pakistan, and in carrying out the necessary measures to protect them from environmental hazards, which cause a great damage to their health. Further, the concerned departments might be suggested to modulate the work shifts of policemen and to reduce the job pressure by introducing computerized control of traffic. The study is a preliminary work and there is still a need to extend the study on a larger scale in order to generate more elaborate database to improve the occupational environment, in Pakistan.

REFERENCES

Boor, K . J. Stress responses: What doest kill them can make then stronger. Plos Biol., 4: 1-23 (2006).

Carere, A., C. Andreoli, R. Galati, P. Leopardi, F. Marcon, M. V. Rosati, S. Rossi, F. Tomei, A. Verdina, A. Zijno, and R. Crebell. Biomonitoring of exposure to Urban air pollutants: Analysis of sister chromatid exchanges and DNA lesions in peripheral lymphocytes of traffic policemen Mutat. Res., 25: 215-224 (2002).

Dacie, J. V and S. M. Lewis. Practical Hematology.8th ed. Churchill Livingstone. pp. 98-118 (1995).

Evans, G.W. and G. Johansson. An international arena for the study of occupational health psychology. J. Occup. Psychol., 3: 99-108 (1998).

Frank, R.H. How not to buy happiness. Daedalus, 133: 69-79 (2004).

Guyton, C. A. and E. J. Hall. Text book of Medical Physiology, 11th ed. W.B. Saunders Company, Philadelphia (2006).

Hoffman, R., E. J. Benz Jr., S. J. Shattil, et al., eds. Hematology: Basic Principles and Practice. 4th ed. Philadelphia, Pa: Churchill Livingston, 2676-2677, 2733 (2005).

Kapaki, E. N., P. N. Varelas, A. N. Syrigou, M. V. Spanaki, E. Andreadou, A. E. Kakami and C. T. Papageorgiou. Blood Lead Levels of Traffic and Gasoline-expose professionals in the city of Athens. Archives of Environmental Health, 53: 287-291 (1998).

Karahalil, B., A. E. Karakaya and S. Burgaz. Application to occupational to poly cyclic aromatic hydrocarbons. Mutat. Res., 7: 29-35 (1999).

Lederbogen, F., R. Baranyai, M. Gilles, B. Menart-Houtermans, D. Tschoepe and M. Deuschle. Effect of mental and physical stress on platelet activation markers in depressed patients and healthy subjects: a pilot study. Psychiatry Research, 127: 55-64 (2009).

Maes, M., M. Vander Planken, A. Van Gastel, M. V. Spanaki. Influence of academic stress on hematological measurements in subjectively healthy volunteers. Psychiatry Res., 80: 201-212 (1998).

McPherson, R. A. and M. R. Pincus. Henry's Clinical Diagnosis and Management by Laboratory Methods. 21st ed. Pa: WB Saunders, Philadelphia, 461-462 (2007).

National Institute of Health and Medical encyclopedia. Complete Blood Count. Available http://www.medlineplusmedicalencyclopedia.com (2004).

Piercecchi - Marti, M. D., G. Leonetti, A. L. Pelissier, J. Convath, F. Cianfarani, and M. Valli. Evaluation of biological stress markers in police officers. Med. Law., 18: 125-144 (1999).

Qureshi, F., J. Alam, M. Ahmad and G. Sheraz. Effect of examination stress on blood cell parameters of students in a Pakistani Medical College. J. Ayub Med. Coll., 14: 20-22 (2002).

Steel, R.G.D. and J.H. Torrie. Principal and Procedures of Statistics: A Biometrical

Approach (3rd Ed.). Mc Graw-Hill Book Co., New York.

Raggat, P. T. F. and S. A. Morrissey. A field study of stress and fatigue in long distance bus drivers. Behav Med., 23:122-129 (1997).

Tomei, F., M. V. Rosati, T. P. Baccolo, A. Bernardini, M. Ciarrocca and E. Tomao. Plasma Concentration of adrenocorticotropic hormone is traffic policemen. J. Occupation. Health, 45: 242-247 (2003 b).

Tomei, F., M. V. Rosati, T. P. Baccolo, M. Gaballo, M. Ciarrocca, M. and E. Tomao. Exposure to Urban pollutants and serum levels of lgG antitterpes simplex virus type 1. Ind. Health., 42: 4018 – 414 (2004).

Tomei, F., M. V. Rosati, T. P. Baccolo, P. Morelli., V. Anzelmo, M. Ciarrocca and E. Tomao. Occupational exposure to urban pollutants and plasma growth hormone (GH). J. Environ. Sci. Health, 38: 1017-1024 (2003 a).

Wikipedia encyclopedia. Available at http://en.wikipedia.org/wiki/haematology (2004).