Effect of Examination Stress on Parameters of Autonomic Functions in Medical Students

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Abstract: _Background & Objectives: Pre-examination Stress is a common condition faced by students prior to exams and is quite predominant among medical students. Many studies have been conducted to assess the impact of stress on students prior to examinations. Stress leads to autonomic arousal and change in many of autonomic functions. In this study our aim to determine changes in parameters of autonomic functions in the first year medical students during pre-examination period. Methods: The study group consisted of 30 medical students (17 males and 13 females) who were students of first year M.B.B.S, medical college, Baroda. The data of parameters of autonomic functions (pulse rate, systolic and diastolic blood pressure, body temperature, galvanic skin resistance) was taken 5-7 days before examination and follow up data collection for the same parameters 5-7 days after examination. The data were analyzed using student's Paired T – test. Results: Participants had a mean±SD age of 17.80 ± 0.48 years, height of 164.97±4.86 cm and weight of 54.9±6.29kg. The pulse rate (/min) - before examination showed a value of 89.87±8.08 and after, it showed a value of 83.27±9.20. The systolic blood pressure (mm Hg) - before examination showed a value of 115.20 ±9.97 and after, it showed a value of 112.14 ±6.80. The diastolic blood pressure (mm Hg) - before examination showed a value of 78.67± 7.88 and after, it showed a value of 75.47 ±5.73. The body temperature - before examination (^0F) showed a value of 98.53±0.59 and after, it showed a value of 98.14±0.88. For all the parameters, a P value of <0.05 was considered as statistically significant. Conclusion: There was a statistically highly significant increase in pulse rate, body temperature, significant increase in systolic and diastolic blood pressure and highly significant decrease in galvanic skin resistance during pre-examination period. There does occur increase in sympathetic activity in students who were to appear in their examination consequent to the psychological stress faced by them._

Keywords: pre-examination stress, medical students, parameters of autonomic functions (pulse rate, systolic and diastolic blood pressure, body temperature, galvanic skin resistance)

1. Introduction

The modern age has been called the age of anxiety. All things, events, conditions or situations that demand a change or adjustment in the physical and emotional functions are termed as stressors. Examination that is a specific stressor. Medical students are usually under stress due to a variety of reasons like vast curriculum, academic competition, examinations etc. During these stressful situations there might be increase in anxiety level and sympathetic discharge. The study of Medicine is extensive, time-consuming and very stressful. In every five-years study period students are subjected to endless working hours, and exams add an extra stress quotient.

Studies indicate that medical students face unique academic challenges that make them more vulnerable to stress and anxiety than students in other faculties [1] (1997). The time of academic examinations is a known model of mental stress in students, as performance in examinations determines their future prospects. Several studies have reported changes in markers of stress in students during the time of examinations [2] (2008), [3] (1988), [4] (2002).

Physiological studies have shown that stress from any source can influence on the endocrine, haemopoietic and immune systems [5] (2001). Psychological stress increases the activity of hypothalamic-pituitary-adrenocortical (HPA) axis leading to increase circulating levels of glucocorticoids [6] (2003), [7] (2002). Hypothalamic-pituitary-adrenocortical (HPA) axis that includes sympathetic activation leading to changes in heart rate, blood pressure, rate and depth of respiration, body temperature, reaction time, galvanic skin resistance. The aim of the study was: to assess the effect of examination (situational) stress on some of the autonomic functions in medical students.

2. Material and Methods

The present study was carried out in the department of physiology, medical college, Baroda. A group of 39 medical students of first year M.B.B.S. was selected. Since age, height, weight affect autonomic functions following criteria were used for selection of subjects.

2.1 Inclusion criteria

- The students were chosen from the age group of 17 to 19 years.
- The height of all students ranged from 152-174 cms.
- The weight of all students ranged from 42-64 kg.

2.2 Exclusion Criteria

- The students who were hospitalized in the last 5 years due to any illness.
- The students who were having history of any other major illness viz: hypertension, diabetes mellitus, heart disease etc.
- The students who had history of Smoking, tobacco chewing. Systemic diseases were ruled out in the selected students by taking their detailed history and by their thorough clinical examination.

Depending on inclusion / exclusion criteria's, the numbers of subjects finally taken were reduced to 30.Out of 30 students 17 were males and 13 were females. The subjects were explained the purpose and importance of the study. They were motivated to participate in the present work only. Prior consent was taken for participation in research. Those who consented were registered for this study. The data of parameters of autonomic functions was taken 5-7 days before examination and follow up data collection for the same parameters 5-7 days after examination.

- Pulse rate
- Systolic blood pressure
- Diastolic blood pressure
- Body temperature
- Galvanic skin resistance

All the above parameters were taken at the same time of the day i.e. between 8 to 10 a.m. to avoid diurnal variation. The parameters were taken in a quiet room in order to alleviate the emotional and psychological stresses. The results of these above parameters of autonomic functions before & after examination were compared & statistically analyzed using student's Paired T – test.

2.3 Method

2.3.1 Pulse Rate

By palpating pulse of the right radial artery of the subjects in lying down position, Pulse was counted for two minutes and result was expressed in one minute.

2.3.2 Arterial Blood Pressure

Arterial blood pressure was recorded over the right brachial artery, applying a cuff just above cubital fossa, using a mercury sphygmomanometer kept at level of subjects' heart in supine position. Systolic blood pressure was recorded by palpatory method and then systolic and diastolic blood pressure was recorded by auscultatory method.

2.3.3 Body Temperature

Oral temperature was recorded in degree Fahrenheit by using a digital thermometer.

2.3.4 Galvanic Skin Resistance

It was recorded with the help of computerized biofeedback instrument (Micro Electronics, Hyderabad, India).All the subjects were explained the procedure. The palmer G.S.R. was recorded by applying the two silver electrodes of one cm^2 on index and middle finger. Mild electric current was passed and the instrument recorded resistance offered by the skin. The subjects were asked to remain relaxed during recording.

Total time for recording was 10 minutes. The first five minutes were for getting the subject accustomed to the instrument and the procedure. Last five minutes to record and to find out the mean of G.S.R. of the subject.

3. Result

Study started with 39 students but 9 of them failed to complete the course. Depending on inclusion / exclusion criteria's, the number of subjects finally taken was reduced to 30.Out of 30 students 17 were males and 13 were females. Statistical analysis using student's Paired T – test revealed that there was a significant increase in parameters of autonomic functions like Pulse rate, Arterial blood pressure, Body temperature and significant reduction in galvanic skin resistance during pre- examination period.

Table 1: sex-wise distribution, mean and standard deviation of age, height and weight

Parameters	Male (n=17)	Female (n=13)	Total (n=30)
Age (years)	17.76 +0.56	17.85+0.37	17.80+0.48
Height (Cms.)	167.71+4.16	161.38+3.04	164.97+4.86
Weight (Kg.)	56.21+7.14	53.19+4.71	54.9+6.29

Table 2: Showing mean & standard deviation of observations 5-7 days before & after examination

Parameters	Before Examination		After Examination	
	Mean	±SD	Mean	±SD
PR(/min)	89.87	8.08	83.27	9.20
SBP(mm Hg)	115.20	9.97	112.14	6.80
DBP(mm Hg)	78.67	7.88	75.47	5.73
BT(^{0}F)	98.53	0.59	98.14	0.88
GSR(K Ohms)	179.18	80.44	274.26	184.82

PR-Pulse Rate,
SBP-Systolic Blood Pressure,
DBP-Diastolic Blood Pressure,
GSR-Galvanic Skin Resistance

Table 3: Showing results of paired 't' test

Parameters	Pre and Post Examination		Significance
	't' value	'p' value	
PR(/min)	5.5	<0.001	Very Highly Significant
SBP(mm Hg)	2.52	<0.05	Significant
DBP(mm Hg)	2.62	<0.05	Significant
BT(^{0}F)	3.09	<0.01	Highly Significant
GSR (K Ohms)	3.73	<0.001	Very Highly Significant

4. Discussion

Stress is a condition that puts mind in a state of fear or anxiety. Stressors can be physical conditions such as heat or inflammation, exercise, etc. or psychological like examination, interview, etc [8] (2006). Pre-examination stress is one of the most widely suffered problems in medical students throughout the world.

MBBS students are at more stress as they are exposed to professional course first time in their life with a lot of expectations [9] (2012). The students of 1st year M.B.B.S. probably face a major stress especially during the 1st term credit examination [10] (1992).

In our study there was highly significant increase in pulse rate and significant increase in systolic and diastolic blood pressure in medical students during pre-examination period when compared with these parameters during post – examination period.

These results were consistent with those of other studies. The relationship between task difficulty and increase in heart rate and blood pressure was observed by Carroll et al[11] (1986), Kahneman et al[12] (1969).Elizabeth Tharion et al found that The decreased mean RR interval indicates an overall increase in heart rate and the mean arterial pressure was significantly higher at the time of examinations[13] (2009).Similar results were obtained by Zeller A et al, when they used heart rate as an indicator of exam stress. As in the present study, they found the peak of heart rate at the beginning of the exam, followed by its decline during the rest of the exam[14] (2004).Heart rate also proved to be a good indicator of students' stress in classroom and laboratory activities, such as oral reports, exams, and laboratory exercises[15] (2005). Pre-menstrual stress also a condition where increase in systolic and diastolic blood pressure was reported by Mehta V. et al [16] (1993).

Human body responds to stress by alterations in different biological functions especially autonomic functions like heart rate and blood pressure [17] (1998). Increase in pulse rate and blood pressure is important sympatho-adrenal responses to physiological stressful experience when outcome is unpredictable or in condition of fear, there is an increase in adrenaline secretion[18] (1984).Increased level of plasma epinephrine and nor-epinephrine during stress by their action on beta receptors of heart increases heart rate[19] (1988) and systolic blood pressure[20] (1986),[21] (1998),[22] (2007).

Stress act directly or indirectly upon brain stem, a great sympathetic discharge is induced at the spinal cord and terminal endings of the sympathetic nervous system. The release of norepinephrine is the cause of arteriolar vasoconstriction raising peripheral resistance and that increases diastolic blood pressure [23] (1997).

In our study we also found highly significant increase in body temperature and decrease in galvanic skin resistance in medical students during pre-examination period when compared with these parameters during post –examination period.

Casper et al explained that increase in body temperature and sweating was produced as a result of increased sympathetic activity caused by stress [24] (1979).

The body temperature is generated and maintained by heat production which is a principal byproduct of metabolism in various parts of body. An exceeded metabolism caused by effects of epinephrine, nor-epinephrine and sympathetic stimulation due to stress increases heat production. Activation of sympathetic nervous system is known to increase core body temperature by increasing thermogenesis, including non-shivering thermogenesis in brown adipose tissue and by decreasing heat loss with peripheral vasoconstriction and increases body temperature [25] (2001), [26] (2012) .During emotional excitement the body temperature slightly increases due to involuntary increase tension in muscles[27] (1993).

Saha et al reported a significant decrease in galvanic skin resistance due to noise stress in workers of thermal power station [28] (1996). Prabhakaran et al also found the similar type of decrease in galvanic skin resistance during stress [29] (1988).

Changes in activities of sweat glands are related to one's level of stress and relaxation. Changes in skin resistance are a measure of sweat gland activities because normally sweat offers a low resistance to the current. Stress stimulates the sympathetic nervous system and increases activities of sweat glands and decreases galvanic skin resistance[30] (1987), [31] (1985).

5. Conclusion

We can summaries and conclude that there does occur increase in sympathetic activity in students who were to appear in their examination consequent to the psychological stress faced by them. Students can be recommended relaxation techniques like meditation, yoga, breathing exercises, appropriate diet and physical exercises. Counseling sessions could be provided to overcome stress.

6. Future Scope of Study

We hereby did non-invasive methods for assessing activity of autonomic nervous system in times of examination stress. These methods are less time consuming so convenient and comfortable for students in times of examination as well as for us. The study has certain limitations. Our data was restricted to cardio-vascular autonomic activity; we did not evaluate stress scores by non invasive tests in the form of questionnaires and anxiety scales hence the status of mental health of students prior to their examination could have influenced the levels of stress. Other sources of stress such as familial or interpersonal problems were not examined. Biochemical parameters of stress such plasma or salivary cortisol was not measured. Another limitation that needs to be acknowledged is the sample size of the present study, but it was a preliminary study. In future we need to work on a broader platform which would allow a more extensive study in order to have the option of comparing the results and obtaining a more generalized and accurate conclusion.

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