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Original Research Article

Evaluating the Effect of University Examination Stress on Heart Rate Variability in first year MBBS Students

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Abstract

Background: Medical curriculum is one of the toughest professional curricula. High prevalence of stress is seen among students of 1st MBBS mainly because they are coming from different backgrounds having different coping skills to new environment. This leads to high academic stress. Stress mainly when of prolonged duration causes autonomic imbalance which can be detected by changes in heart rate variability (HRV) parameters.

Methods: A follow up cohort study was conducted over 84 first year medical students. After taking informed consent from students lead II ECG was recorded during university examination and 2 months later when they were on holidays. Assessment of stress in students was done with the help of a validated self scoring medical students stress questionnaire.

Result: In our study we found 82.14% students had severe stress. We found a significant increase in Low frequency normalized unit (LF n.u.) and Low Frequency/High Frequency (LF/HF) ratio and a significant decrease in High frequency normalized unit (HF n.u.), Very Low Frequency (VLF) power, Low Frequency (LF) power, High Frequency (HF) power and Total Power (TP) of HRV in students who were under stress of university examination.

Conclusion: As severe stress has many undesirable effects on students it is important to teach students time management skills and various stress relieving measures to alleviate stress and adapt well to the different stressful situations that they may encounter throughout their professional curriculum.

Key words: HRV, Stress, 1styr MBBS students.

Introduction

Stress is defined as any change in environment that changes or threatens to change an existing optimal steady state. It is a response to increased demands or towards changes in environment.(1) It is manifested as a normal human reaction to these changes which results in physical, emotional and behavioral responses. These responses help us to adjust to new environment. Thus, stress can be positive, keeping us alert, motivated and ready to avoid danger. But it can sometimes become a problem when stressors continue without relief or period of relaxation.(2)

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Medical curriculum is one of the toughest professional curricula. A high prevalence of stress is seen among medical students, mainly during 1st year after entering medical institution.(2) This is a transition phase in their life when they enter professional institution from junior college level at a very young age. Students coming from different backgrounds have different coping skills. They find difficult to adapt to new syllabus in terms of vast topics to learn, frequent examinations, lack of time for learning results in academic stress. High degree stress can cause physical and mental health problems affecting academic scores, personal and professional development.(4) They also experience problem such as insufficient rest, lack of sleep and problems in adjusting to a new place and new friends. Some students even suffer from depression, anxiety, distress and burnout.(3)

Stress affects almost all systems of our body. Autonomic nervous system (ANS) is one major adaptor to stress response. Stress is found to affect autonomic balance and cardiovascular health of individual. Excessive stress results in autonomic imbalance with increased sympathetic and decreased parasympathetic activity. Chronic stress has been frequently found to be associated with distorted cardiovascular activity.(2)

Heart rate is mainly controlled by autonomic nerve activity to sinoatrial node. Sympathetic and parasympathetic drive can be non-invasively investigated using Heart Rate Variability (HRV) analysis. HRV detects both instantaneous heart rate and R-R intervals of the electrocardiogram. It is usually analyzed in time domain and frequency domain. The latter is also known as power spectral analysis (PSA). Time domain indices evaluate the dispersion of the cardiac R-R intervals around the mean and reflect overall autonomic modulation on the sinus node. PSA evaluates the variance of R-R intervals as a function of frequency and is calculated by mathematical algorithms. The PSA results exhibits three main components: very low frequency (VLF), low frequency (LF; mainly sympathetic modulation) and high frequency (HF, parasympathetic modulation). PSA of HRV has been considered to be a useful tool in assessing the autonomic nervous system function.

Stress can shift sympathovagal balance to sympathetic and that is reflected in HRV. Researchers have found that there is decrease in HRV in medical students during the time of examination due to mental stress.(5) Also during exam decrease in HRV was seen as opposed to the relaxation period after exam.(6) And an increase in sympathetic and decrease in parasympathetic activity is seen in students because of academic stress in first year medical students.(2)

Hence this study was undertaken to find out changes in HRV parameters in students during the time of university examination with those recorded during holidays in the same group of students.

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Material and Methods

The present study was carried out in department of physiology in our institution. The study was approved by institutional ethics committee. The study was conducted between March 2022 to July 2022. The study design is follow up cohort study.

84 students (40 females and 44 males) of 18-22 age group who volunteered to take part in study were included. All volunteers were healthy, non smokers and were not on any medications. A written informed consent was taken from students.

A validated self scoring medical students stress questionnaire [(7)] having 27 items was used. The scoring was based on options "Strongly disagree", "Disagree",
"Neutral", "Agree" and "Strongly agree". The student's response of "Strongly disagree" was given score of one and response "Strongly agree" was given highest score of five. Each item was scored and overall scoring for each student was calculated. A score of <54 means no stress perceived, a score 55-81 means mild to moderate stress perceived and a score between 82-108 means severe stress perceived. Depending on this score stress levels in students were assessed.

After obtaining written consent, anthropometric measurements were done and following 10 minutes of rest lead II ECG was recorded (by using physiopac machine Model:PL-2005 Medicaid systems, Punjab India) in students on 2 different days when they were under 2 different emotional states. First recording was done on the day of examination and second was taken a month later when students were on holidays. Repeat recordings were made at the same time of the day, at similar room temperatures. All recordings were made 4-5 hrs after consumption of light breakfast.

ECG was analyzed using qubois HRV analysis software and time domain and frequency domain indices of HRV were obtained. Time domain measures included the mean of all RR interval (mean RR) in millisec (ms), standard deviation of NN intervals (SDNN) in millisec, root mean square of successive differences between adjacent RR differences (RMSSD) in ms and percentage of number of RR intervals with differences >50ms (pNN50). The frequency domain measures were measured by power spectral analysis by fast fourier transformation. It included the VLF band, LF band and HF band and total power in all the bands together. Powers LF and HF powers are expressed in absolute values (ms^2) and in normalized units (nu) and LF/HF ratio was also obtained.

Statistical analysis was done by using Microsoft Excel 2007 and Open Epi version 2.3. Paired t-test was used to assess the association between the variables with P-value < 0.05 considered to be statistically significant.

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Results

Table 1: Distribution of students based on stress level.

Group	Number of students	Percentage
Mild to moderate stress	5	17.86
Severe stress	79	82.14
Total	84	100

Table 2: Comparison of HRV parameters in students during university examination and during holidays.

HRV Parameters	During examination (Mean ± S.D.)	During holidays (Mean ± S.D.)	P value
Mean RR	550.39 ± 187.13	579.05 ± 174.17	0.5
SDNN	0.20 ± 0.18	0.27 ± 0.16	0.2
RMSSD	238.75 ± 262.61	326.20 ± 223.07	0.14
Pnn50	49.40 ± 20.48	55.44 ± 19.77	0.7
LF(n.u.)	62.13 ± 13.83	61.51 ± 10.20	0.006*
HF(n.u.)	37.69 ± 14.23	38.57 ± 10.16	o.002*
LF/HF	2.01 ± 1.21	1.76 ± 0.81	0.0003*
VLF power	10180.17 ± 4080.08	12054 ± 8274.4	P<0.01*
LF power	2329.02 ± 2814.3	3444.88 ± 5075.53	P<0.01*
HF power	1881.7 ± 2879.35	2658.38 ± 4357.89	P<0.01*
Total Power	14387.38 ± 7883.96	18157.83 ± 17298.26	P<0.01*

Table 1 shows distribution of students based on stress level, in our study we observed 79 students out of 84 were severely stressed.

Table 2 shows comparison of HRV parameters during university examination and during holidays. In our study we found a significant increase in LF(n.u.) and LF/HF ratio and a significant decrease in HF(n.u.), VLF power, LF power, HF power and total power of HRV in students when they were under stress of examination as compared to during holidays.

Discussion

In our study, we assessed stress levels in first year medical students and also compared HRV parameters during university examination and during holidays. We found out that 17.85 % of students had mild to moderate stress and 82.14% of students had severe stress.

Similar results showing a high prevalence of stress among 1st year medical students was also reported by several researchers over India.[2,8,9]

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We observed that with increased level of stress related to examination there was significant increase in LF(n.u.) and LF/HF ratio. This shows increase in sympathetic activity during stress.

We also observed a significant decrease in HF(n.u.) during examination as compared to during holidays showing a decrease in parasympathetic activity during stress.

Also a significant decrease in frequency domain parameters VLF, LF, HF and total power of HRV was observed. Reduced HRV indicates diminished responsiveness of cardiac autonomic system to normal physiological stimuli.

HRV is a non invasive marker of cardiac autonomic activity and cardiovascular health, also a biological marker of stress. A decreased HRV occures due to autonomic dysfunction. Also reduced HRV is known to be associated with early onset of prehypertension and other cardiovascular diseases. Hence chronic stress has the potency to become a significant psychological and cardiovascular risk factor in long run.[10]
Although appropriate stress is beneficial in stimulating learning and memory in students, but response of each person towards stress is not same. When students are not stressed students do not pay much attention, but as stress increases they focus on their work and improve their academic performance. Thus, stress in the form of a little tension becomes a person's driving force and increases one's efficiency and productivity. This degree of stress can be beneficial both physically and mentally.[3]

When the stress lasts for a certain length of time, the mind and body can be kept in a balanced state by the principle of homeostasis; however if stress is sustained it can have a negative effect on academic achievement. When people are less able to cope with stressors or repeated stress, the ANS activity is reduced and unbalanced, resulting in emotional anxiety and depression and constant tension of the ANS. As a result, mental or physical dysfunctions or illnesses appear making it essential to recognize and manage stress for good health. In addition, stress experienced by medical students during their education greatly influences their psychological attitudes as students and as physicians in the future. This can seriously affect the formation of doctor-patient relationships and the quality of medical care.[3]

Studies have proved that stress can be reduced by engaging students in relaxation methods like listening to music, as autonomic balance shifts towards an increase in parasympathetic tone shown by increase in HF(n.u.) and a decrease in LF(n.u.) and LF/HF ratio.[11] Also some studies have shown that parasympathetic activity is greater in young adults practicing yoga followed by those doing regular aerobic exercise when compared to those who do not practice yoga or any type of exercise.[12]

Teaching students time management skills so that they can make use of their time judiciously and reduce academic workload will reduce final exam related stress. Further advising them to adopt various stress relieving measures like listening music, meditation, yoga, exercise,

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outdoor sports and games during their leisure time will alleviate stress and restore autonomic balance and maintain cardiovascular health of students.

Conclusion

In our study, weobserved that 82% students were experiencing severe stress and examination related stress has many undesirable effects on the students which may affect their performance in examination. Our results showed that stress related to exam influences heart rate variability and changes the autonomic balance. Therefore it will be necessary to guide and support each student to adapt a coping stress reliving method considering individual and cultural characteristics so that they can adapt well to different stressful situations and develop positive attitude towards life.

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