Effect of romantic video clips on autonomic nervous system explored through Heart rate variability

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Abstract— The Heart rate variability (HRV) is an indicator of the cardiac autonomic control that may be related to mental or psychological stress. Two spectral components are usually recorded, viz., high frequency (0.15 to 0.50 Hz) which is due to vagal efferent activity and a low frequency component (0.05 to 0.15Hz), due to sympathetic activity [1]. The purpose of this study is to investigate the effect of audio-visual emotional stimulus on autonomic nervous system by analyzing HRV. 29 healthy female volunteers (age 22.10 ± 2.72 years) were assessed by showing the audio-visual stimulus and ECG recording was taken before (pre-stimulus) and while showing the stimulus. RR intervals of ECG were calculated and these were analyzed using auto-regression method to quantify the frequency domain properties of HRV. The result showed a significant increase in low frequency (LF) component and decrease in high frequency (HF) component during ECG recording in stimulus phase. The result suggests that romantic audio-visual stimulus modifies the autonomic status by increasing the sympathetic activity with reduced vagal tone.

Keywords- Heart rate variability (HRV); autonomic nervous system (ANS); sympathetic nervous system (SNS); vagal tone (PNS); pre-stimulus; romantic video clips.

I. INTRODUCTION

Visual videos have noticeable effect on people of all ages, a human watching visual videos change his physiological and psychological condition according to the contents of the visual videos. It is obviously that obscenity and violence visual video has strong effect on students and teenagers, so analyzing the HRV changes in this condition are expected to be useful to quantify how deeply the viewer was affected or interested in the videos. This technique is applicable to study adverse influences of visual stimulation on humans [2]. In modern times a number of people (especially young) who spend much time in front of television or computer are easy to suffer from negative visual stimulus which effects our body often detrimentally. So we have chosen romantic video clips as a stimulus as the young people are quite often exposed to such kinds of videos and have tried to study their effect on HRV [3].

HRV is the variation in the time interval between heartbeats, from beat to beat. It is controlled by ANS including the SNS and the PNS. Generally, the SNS activity increases the heart rate and the PNS activity decreases the heart rate [4]. Frequency domain analysis of HRV can obtain the HRV spectrum which is noninvasive tool for the evaluation of autonomic regulation of the heart. HRV spectrum can be categorized into high frequency (HF 0.15 to 0.50Hz) and low frequency (LF 0.05 to 0.15Hz) components.

II. METHOD AND MATERIAL

A. Subjects

The subjects, 29 in number, were young female volunteers resident of Kolkata. Their mean age was 22.10 ± 2.72 years. Each subject participated in 40 min session. All subjects signed informed consent forms. Facilitation of emotional states was accomplished utilizing the audio-visual stimulus.

B. Design of the study

Recordings were made on separate days for subjects, maintaining the same time of recording of the day for each subject. Subjects were seated in chair in such a position so as to avoid postural changes to minimize artifacts. Initially data was recorded for 5mins prior to stimulus (pre-stimulus) i.e. baseline period and for 5mins during showing the romantic clips of movies. We compared certain measures of HRV between a 5-minute baseline period and a 5-minute emotional stimulus.

C. Description of the custom made ECG Device

- ECG Electrodes: A bio-potential electrode is a transducer which provides an electrical contact with human body and converts bio-potential signals (having an ionic origin) into electronic signals to be processed by subsequent circuitry.
- HRV-DAQ: HRV-DAQ is the interface between ECG signal and data acquisition system. This is a custom made device consisting of pre-amplifier, opto-coupler, post amplifier, USB based ADC, DC to DC converter and USB of computer.

D. Data analysis:

Before data analysis the data was acquired using a PC and Windows XP Platform. The frequency domain analysis was performed using auto Regression (AR) method via Kubios HRV software which was used after calculating RR intervals by MATLAB. AR method was applied on these RR intervals calculated by MATLAB codes. This whole process was done in offline mode. After which we got a plot consisting of the energy in HRV series of the following specific frequency bands, viz., low frequency component (0.05 to 0.15Hz), and
high frequency component (0.15 to 0.50Hz). The low frequency and high frequency values were expressed as normalized units.

III. RESULT

After stimulus, there was significant increase in low frequency component and reduction in high frequency component expressed in normalized units compared to pre-stimulus value (p<0.05 paired t test in both cases).

Table 1: Observation table

<table>
<thead>
<tr>
<th>Stimulus (n=29)</th>
<th>Low frequency power (n.u)</th>
<th>High frequency power (n.u)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE</td>
<td>47.1345 ±18.3598</td>
<td>52.8655 ±18.3598</td>
</tr>
<tr>
<td>POST</td>
<td>52.4552 ±17.3843</td>
<td>47.5448 ±17.384</td>
</tr>
</tbody>
</table>

Table1: Heart rate variability spectral components measured prior to stimulus and during audio-visual stimulus. Values are group mean ± standard deviation. t-test for paired data. p<0.005 (n.u.=normalized units)

Fig 1: Sample records of HRV spectrum made before (upper record) and during (lower record) emotional audio visual stimulus in a single subject. The vertical axis gives the power values. The three frequency components, viz., very low frequency (VLF), low frequency (LF) and high frequency (HF) are represented by pink, blue and yellow color respectively. The present record shows an increase in low frequency power and a decrease in high frequency power following emotional audio visual stimulus.

IV. DISCUSSION

In the present study, effect of romantic audio-visual stimulus on HRV is seen, there is an increase in the low frequency power, decrease in the high frequency power.

The low frequency band (0.05 to 0.15Hz) of the HRV is thought to correspond to sympathetic modulation, especially when expressed as normalized as opposed to absolute units (5). The representation of low frequency and high frequency energy values in normalized units express the degree of control exerted and the relative balance of the two branches of the ANS. The efferent vagal activity is a major contributor to the high frequency band (0.15 to 0.50Hz).

Hence the present result suggests that the romantic videos shift the sympa-tho-vagal balance towards sympathetic activation.

It has been shown in a number of studies that during mental or emotional stress there is an increase in sympathetic activity and a decrease in parasympathetic activity. This results in increased strain on the heart as well as on the immune and hormonal systems. Increased sympathetic activity is associated with a lower ventricular fibrillation threshold and an increased risk of fibrillation, in contrast to increased parasympathetic activity, which protects the heart [6].

V. CONCLUSION

Our studies reveal that the romantic video clips taken from movies created a negative impact on the subjects, although videos that we chose comes under the category of entertainment. Therefore we may conclude that it is important not to consider all kinds of entertainment videos to produce a positive effect, rather it is important to investigate effect of different types of entertainment videos on human body and mind and identify videos with could have positive effect on humans. Further researches are required in this field to investigate the effect of different types of visual stimuli on HRV on mass population.

REFERENCES


