Effect of head up tilt on heart rate variability in males

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ABSTRACT

AIMS: Orthostatic stress is commonly utilized to evaluate the cardiovascular autonomic function. This is done mainly by Head Up Tilt (HUT) testing. The parameters which represent the cardiovascular autonomic function involved the Heart Rate Variability (HRV). HRV indices provide non-invasive assessment of cardiovascular control mechanisms. Low Frequency (LF) is an indicator of sympathetic system. High Frequency (HF), an index of parasympathetic and the ratio LF/HF is the specific and quantitative index of sympathovagal balances. MATERIALS AND METHODS: Hundred apparently healthy males in the age group of 18-45 years were selected to evaluate the effect of HUT on cardiovascular autonomic responses. Parameters of HRV were recorded at supine and 300, 600 and 800 HUT. Niviquire software was used to measure the LF, HF and the LF/HF ratio. In each position the Heart Rate (HR) was determined by recording the ECG for 5 min in lead II. RESULTS: LF and the LF/HF ratio increased on HUT in males and HF decreased on HUT. CONCLUSION: Cardiovascular reflex effects can be assessed using various postural stress tests effectively for physiological and clinical investigations in the field, by the patient bedside, or in the laboratory using more elaborate equipment. HRV is one among them. With HUT the sympathetic activity increases and parasympathetic activity decreases.

1. Introduction

The significant increase in LH/HF ratio was observed by Badilini and his colleagues. Beat to beat R-R series were recorded during 900 passive tilt in 18 healthy subjects. He observed that on head up tilt LH/HF ratio increases significantly[1].

A study was conducted in 1999 in which the variation of HRV during graded HUT was demonstrated. The HRV was examined by general spectral analysis. The HF showed a decrease as the tilt angle increased. Compared with the values at the 0 degree position, these changes were statistically significant. The LH/HF ratio showed a significant difference between 0 degree and 90 degrees, and between 30 degrees and 90 degrees. These results confirmed that immediate responses to HUT reflect autonomic nerve activity. Hence, changes in the frequency components were found to be an index of autonomic nerve activity, and explained the individual differences in the ability to control BP during an upright posture[2].

The effects of mental task on the HRV during graded HUT was demonstrated by Ishibashi K. In his study, he used the spectral analysis of HRV to estimate the change in autonomic control in response to stimuli produced by graded HUT. He concluded that the LF/HF increased on graded HUT. LF component of HRV provided a quantitative index of sympathetic and parasympathetic activities of heart[3].

Differences in HRV between young and elderly normal men during graded HUT was studied. The HF was used as the parasympathetic indicator and HF decreased with tilt angle in both age groups. The result suggested that parasympathetic withdrawal have an important role in adaptation to an upright posture in both age group. However, mean HF amplitude at the 00 position in
elderly men was not significantly different from that of young men at 600 tilt. The increase in LF and the LF/HF ratio in elderly subjects from 00 to 150 seemed to be larger than that in young subjects. Sympathetic activities may be sensitive to lower levels of orthostatic stress in the elderly, and the elderly workers were easily affected by a change in workload[4].

The graded vascular autonomic control during graded HUT was demonstrated. The spectral power of LF and HF of R-R variability and the ratio LF/HF changed rather abruptly from either 300 or 450 depending on each individual. The ratio of HF to total spectral R-R variability decreased markedly from 100 to 300 and less, but more gradually from 300 to 600. The pattern of changes in systolic arterial pressure attested the discontinuous cardiac autonomic control rather than the gradual setting of arterial tone[5].

The cardiovascular autonomic responses to HUT was dependent on age. It was observed that during HUT there was decrease in HRV. These changes became attenuated with aging. Age correlated significantly with amplitude of HUT stimulated response of HF component and the ratio of LF to HF power of HRV. However the HUT induced increase in HR was more pronounced in the younger subjects, whereas the increase in peripheral resistance was predominantly observed in older subjects. It has been concluded that cardiac autonomic regulation decreases the vascular responses related to vasoactive mechanisms and vascular sympathetic regulation become augmented with increasing age[6].

MATERIALS AND METHODS

The study was approved by Ethical Committee.

Normal healthy 100 male subjects between the age group of 15-45 years were selected from general population randomly. The subjects were informed about the procedure which had to be followed by them. Consent was taken. The study was conducted before lunch between 12 noon to 2 pm. After the completion of procedure fruit juice was offered to all subjects.

Exclusion Criteria:

- Normal healthy males aged 15-45 years
- Obese
- Alcoholics
- Smokers
- Hypertensive
- Agebelow 15 and above 45 yrs
- Subjects taking any medication
- Subjects suffering from any medical illness.
- Diabetes mellitus

Preparation for Tilt Table Test (TTT):

Generally, there was no eating or drinking 4-6 hours prior to the test to limit symptoms of nausea/vomiting. Manually operated tilt table with foot plate support is used. Additional straps are applied at the level of knee, waist and shoulders. The metal arcs is attached to the table where holes are made at various angles. The table is locked at particular angles by the iron rod. The angles used were 300, 600 and 800 for HUT. ECG leads were fixed at right arm, left arm, left foot and right foot. ECG recordings were observed over the monitor. When normal lead II ECG was obtained, these recordings were saved for a duration of 5 minutes. The table is tilted to 300, 600 and 800 HUT position. Before the change in the tilt angle the subject was brought to the supine position for 5 mins rest. The subject was asked for any symptoms such as nausea, sweating, pallor, light headedness, palpitation and fainting. Frequency domain analysis was done by using Nivique software. Repeated measures ANOVA was used for analysis at different tilts. Followed by Tukeys post hoc test and paired ‘t’ test. Inter group comparisons will be done by unpaired ‘t’ test.

RESULTS:

Low frequency (LF): The resting mean value of low frequency in males was 0.1 0.0. On head up tilt the mean values in males were 0.2 0.1 and 0.3 0.1 and 0.4 0.1 at 300, 600 and 800 respectively. There was an increase in low frequency value in males with head up tilt. Low frequency values showed a highly significant value in all position (p < 0.001).

High frequency (HF): The mean high frequency value in males supine position was 0.3 0.1. The mean high frequency value on head up tilt in males were 0.3 0.1, 0.2 0.1 and 0.1 0.1 at 300, 600 and 800 respectively. There was a decrease in high frequency with head up tilt in male. In comparison with supine and head up tilt position, high frequency values showed a statistically significant decrease only at 600 and 800 head up tilt (GRAPH 1, TABLE 1).

Low frequency to high frequency ratio (LF/HF): The mean value of low frequency to high frequency ratio at supine position in males was 0.3 0.1. On head up tilt the mean ratio value in males was 0.4 0.2, 1.5 1.4 and 2.2 2.0 at 300, 600 and 800 respectively. With head up tilt there was increase in the LF/HF ratio. In comparison with supine and 300, 600, 800 head up tilt, the ratio showed a statistically highly significant increase (p < 0.001) only at 600 and 800 head up tilt. (GRAPH 1, TABLE 1).
Table 1: CARDIOVASCULAR RESPONSES TO HUT IN MALES

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Supine</th>
<th>30 Deg</th>
<th>60 Deg</th>
<th>80 Deg</th>
</tr>
</thead>
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<tr>
<td>LF(Hz) Mean</td>
<td>0.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>SD</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>HF (Hz) Mean</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>SD</td>
<td>0.1</td>
<td>0.3</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>LF/HF Mean</td>
<td>0.3</td>
<td>0.4</td>
<td>0.2</td>
<td>1.5</td>
</tr>
<tr>
<td>SD</td>
<td>0.1</td>
<td>0.2</td>
<td>1.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Graph 1: Heart rate variability in Males

RESULTS:

Low frequency (LF): The resting mean value of low frequency in males was 0.1. On head up tilt the mean values in males were 0.2, 0.1 and 0.3, 0.1 and 0.4 at 300, 600 and 800 respectively. There was an increase in low frequency value in males with head up tilt. Low frequency values showed a highly significant value in all position (p < 0.001).

High frequency (HF): The mean high frequency value in supine position was 0.3. The mean high frequency value on head up tilt in males were 0.3, 0.1, 0.2, 0.1 and 0.1 at 300, 600 and 800 respectively. There was a decrease in high frequency with head up tilt in males. In comparison with supine and head up tilt position, high frequency values showed a statistically significant decrease only at 600 and 800 head up tilt (GRAPH 1, TABLE 1).

Low frequency to high frequency ratio (LF/HF): The mean value of low frequency to high frequency ratio at supine position in males was 0.3. On head up tilt the mean ratio value in males was 0.4, 0.2, 1.5, 1.4 and 2.2, 2.0 at 300, 600 and 800 respectively. With head up tilt there was an increase in the LF/HF ratio. In comparison with supine and 300, 600, 800 head up tilt, the ratio showed a statistically highly significant increase (p < 0.001) only at 600 and 800 head up tilt (GRAPH 1, TABLE 1).

DISCUSSION

Low frequency and posture: Low frequency component of the heart rate variability has been reported to be a marker of sympathetic system. In our study the low frequency increased with head up tilt in males. This value showed significant increase (p < 0.001). On standing, about 300 to 800 mL of blood is forced downward to the abdominal area and lower extremities. Within seconds of this sudden decrease in venous return, pressure receptors in the heart, lungs, carotid sinus and aortic arch are activated and mediate an increase in sympathetic outflow and increase in low frequency on head up tilt. Our findings are consistent with those of an earlier study by Mukai[7,8].

High frequency and posture: High frequency component of the heart rate variability indicates the vagal modulation of heart rate. In our study the high frequency decreased with head up tilt in males. This value showed significant decrease (p < 0.001). The decrease in the high frequency component on head up tilt was mainly due to decrease in the vagal tone. Similar findings were observed by Lt Col KK Tripathi and Jahan et al.[10].

Reference...

CONCLUSION

In conclusion, cardiovascular reflex effects can be assessed using various postural stress tests effectively for physiological and clinical investigations in the field, by the patient bed side, or in the laboratory using more elaborate equipment. Physiologists, clinicians and medical students can make use of these tests to assess or understand cardiovascular reflex response in man in health or disease.

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REFERENCES


