The Effect of Rose Water Inhalation on Cardiac Parasympathetic Activity

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ABSTRACT

Objectives: Olfactory stimulus can affect the autonomic balance via communicating neural pools of central nervous system. Rose water affects the autonomic balance and is used in traditional medicine.

Methods: This self-control clinical trial study was conducted in 32 volunteer male college students (all were free from cardiac, respiratory and olfactory diseases, nonsmoker and had no drug history). Using 1 kHz sampling rate, ECG was recorded. After five minute adaptation period, the heart rate variability (HRV) was calculated and was compared for two minute periods before and after the inhalation of rose water odor.

Results: The mean of four criteria including the high and low frequencies (HF, LF) in normalized units (nu), their ratio (LF/HF) and the heart velocity before and after the rose water exposure were as follow respectively: 35.74±2.68 and 56.42±3.12, 48.92±4.26 and 28.88±3.43, 1.362±0.32 and 0.516±0.14, 85.35±3.64 and 82.08±2.92.

Conclusion: In effect of 120 seconds rose water odor inhalation parasympathetic tone (HF) increased and heart rate (HR) and sympathetic tone (LF/HF) decreased. Differential and direct parasympathetic modulation may account for part of this effect.

KEYWORDS: Rose Odor, Parasympathetic, HRV

INTRODUCTION

Decrease in sympathetic tone and anxiolytic activities are two well-documented effects of rose odor inhalation [1-2]. The correlation between heart rate (HR) and pleasantness of olfactory stimulus is reported by some authors [3]. There are also some reports indicating the opposite effect of different pleasant odors on sympathetic activity in individuals which may be related to pharmacological components of odor [2].

The sympathovagal tone generally obeys a paradoxical control [4]. Therefore it is suggested that rose odor inhalation would increase the parasympathetic discharges as well. Heart rate variability (HRV) analysis can provide differential In Vivo assessment of sympathetic and
parasympathetic tone. The low frequency (LF) band is probably associated with both parasympathetic [5] and sympathetic activity [6-8], and represents a reflection of the baroreflex response. The high frequency (HF) band coincides with the respiratory frequency and reflects mainly respiration-linked variations of HR or the respiratory sinus arrhythmia which result from centrally mediated cardiac vagal control. The HF component of HRV spectrum is a specific indicator for parasympathetic activity [9]. Since the control of HR is dominated by parasympathetic over sympathetic effects, we focused on the possible direct effect of rose odor inhalation on parasympathetic activity.

MATERIALS AND METHODS:

Participants and Study design

Subjects were 32 healthy male students of our university, aged between 20 to 24 years old. All participants were healthy and free of cardiac, respiratory and olfactory diseases, did not smoke and had no history of dysautonomia or medication. Measurements were carried out between 9-11 AM in a period of 2 weeks. Subjects were tested in a comfortable sitting position with their feet flat on the floor and were instructed not to speak during the examination [10]. All subjects well informed and signed the consent form.

Pure rose water was purchased from Nader Agro industrial Co. (Iran) and prepared at a concentration of 0.12 mg/dl.

In order to study the short term HRV at least 2 to 5 minutes intervals were used for data selection. The Power spectral analysis of HRV was performed under resting conditions by means of Powerlab ML870 (ADInstruments, Australia). Power spectrum was calculated using a fast-Fourier transformation, whereby three frequency bands were automatically separated: very-low-frequency (VLF) band (0.003-0.04 Hz), LF band (0.04-0.15 Hz), and HF band (0.15-0.4 Hz). LF/HF ratios were calculated providing a measure of sympathetic/parasympathetic activity. The total spectral power (TP) was also calculated as a measure of both sympathetic and parasympathetic activities on HRV. Lead II was used as data source for HRV analysis.

Odor testing method

Measurements were done in a big room with adequate ventilation. Participants were seated in a comfortable chair. They were informed about the procedure and trained once by water as blank odor. They were unaware of the odor type before its exposure. All subjects were asked to close their eyes and to breathe regularly during the test. Data were recorded following 5 minutes for adaptation to experimental conditions. Using 1 kHz sampling rate analog electrocardiogram (ECG) signals were digitized and used for HRV analysis. Rose water inhalation was done by holding the bottle under the nostrils for 2 minutes while recording the ECG. Recording was done before, during and after inhalation of odor, each time for at least 120 seconds.

Statistical analysis

All data were expressed as mean ± S.E.M. and test for normality. Paired samples t-test was used to compare pre and post-exposure differences. For overcoming the effect of total power inequality on absolute value of LF and HF components, the normalized value of LF and HF were calculated according the following equation: LF or HF (ms²)/ [total power (ms²)-VLF (ms²)] and were used for statistical analysis [4,9].

RESULTS

Mean age of the participants were 22±1.8 years. The mean ± S.E.M for HR, HF and LF in normalized units (nu), their ratio (LF/HF) and total power (TP) before and after the rose water exposure are shown in Table 1.
Table 1: The effects of rose water odor inhalation on heart rate variability indexes

<table>
<thead>
<tr>
<th></th>
<th>Pre-exposure (n=32)</th>
<th>Post-exposure (n=32)</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>HR (bpm)</td>
<td>85.35±3.64</td>
<td>82.08±2.92</td>
<td>0.002</td>
</tr>
<tr>
<td>LF (nu**)</td>
<td>48.92±4.26</td>
<td>28.88±3.43</td>
<td>0.000</td>
</tr>
<tr>
<td>HF (nu)</td>
<td>35.74±2.68</td>
<td>56.42±3.12</td>
<td>0.000</td>
</tr>
<tr>
<td>LF/HF</td>
<td>1.362±0.32</td>
<td>0.516±0.14</td>
<td>0.000</td>
</tr>
<tr>
<td>TP</td>
<td>13384.525±7496.32</td>
<td>6884.335±9870.37</td>
<td>0.212</td>
</tr>
</tbody>
</table>

*bpm: beat per minute; **nu: normalized unit

DISCUSSION

These data showed that rose water odor inhalation may change the autonomic balance of heart rhythms in favor of the parasympathetic tone. The main outcomes were a significant increase in HF component and also a significant decrease in LF component. The amount of post-exposure increase in HF was greater than post-exposure LF decrease.

These effects were observed in recorded data immediately after exposure to stimulus and then continued for several minutes. The olfactory stimulation can change the respiratory rate and depth. However all subjects were well trained to breathe regularly during the experimental procedure. So, the respiratory sinus arrhythmia seems unlikely to bias the results.

The effect of metabolic, hormonal and other circadian cycles manifest in ultra- and very low-frequency components of HRV, which require longer ECG records for analysis [9]. So, variations of the HRV indexes following rose water odor inhalation may be primarily caused by central mechanisms. Factors such as pleasantness, mental and/or emotional state, memory and pharmacological properties of odor compounds have been reported to affect the autonomic activity following odor exposure [2, 11-12]. The rose water inhalation affected parasympathetic tone more than sympathetic tone quantitatively. The percentage of post-exposure change was greater for HF than LF. Since in normal condition, vagal control of heart rate is dominant and fast, it seems that the LF changes following rose water inhalation may partially be related to increased vagal activities [9]. The reciprocal interaction between two branches of autonomic system should be controlled by pharmacologic manipulation for further differential assessment of this observation.
CONCLUSION
In effect of 120 seconds rose water odor inhalation parasympathetic tone (HF) increased and HR and sympathetic tone (LF/HF) decreased. Differential and direct parasympathetic modulation may account for part of this effect.

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CONFLICT OF INTEREST
No conflict of interest declared.

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