The use of HRV and Skin Conductance to value the effect of CV4 and Rib Raising Techniques on the autonomic balance

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Introduction

• The osteopathic profession has long recognized a relationship between osteopathic manipulative treatment (OMT) and the autonomic nervous System (SNA).

• Direct methods have been developed to provide non-invasive markers of autonomic balance and among these, the simplest and least invasive techniques are:

  ➢ Electrical Skin Conductance

  ➢ Heart Rate Variability (HRV)


CV4

- This technique influences body physiological functions, changing the rate of CRI\(^1\) and the activity of the Autonomic Nervous System ANS.

- Studies of Sergueef and Nelson\(^4\) have shown that cranial manipulation changes the activity of the ANS.

- Cutler\(^5\) showed that the CV4 induced Still Point is associated with a reduction of the muscle sympathetic nerve activity (MSNA).

- Magoun\(^6\) using as a parameter measuring the electrical skin resistance, observed a reduction in sympathetic nerve activity during CV4 technique.

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Rib Raising

- Raising the rib heads modulates the activity of the ANS activating the thoracic sympathetic chain ganglia.

- Studies of Henderson\(^9\), that used salivary alfa-amylase activity and salivary cortisol levels, showed that this osteopathic technique:
  
  - initially stimulates the sympathetic efferent activity;
  
  - subsequently leads to a reduction of sympathetic outflow in those regions;
  
  - It is indicated in conditions associated with sympathetic hypertonia.

Goal

To verify if the CV4 and Rib Raising Techniques influence the autonomic system activity using OSD (to measure electrical skin conductance) and HRV
Material and Methods

- **Setting:** Department of Psychology, University of Palermo, Italy, Head Professor Oliveri Massimiliano and Clinic of Osteophaty, ASP n° 9, Mazara del Vallo, Trapani, Italy, department manager D.O. Fasulo Luigi, Medical Director De Simone Vittoriano, since June 2010 to January 2011.

- **Patients:** Were recruited 37 healthy adult volunteers.

- **Exclusion criteria:** obese subjects, subjects under pharmacologic therapies and/or effected by skin and cardiovascular disease, any psychiatric disorder or with an history positive for a traumatic cranial event.
Study Design:

- **Gr. CV4**
- **Gr. Rib Raising**
- **Gr. Placebo**

**Timelines:**
- **T0: 0-300 sec**
- **T1: 300-end Still Point**
- **T2: end Still Point-1200 sec**
- **T0: 0-300 sec**
- **T1: 300-500 sec**
- **T2: 500-1200 sec**
- **T0: 0-300 sec**
- **T1: 300-500 sec**
- **T2: 500-1200 sec**

Time (sec):
- 0
- 300
- 500
- 1200
Tools

- OSD (electromagnetic pump) Microscale Model and specific software: to assess electrical skin conductance (µS)
Tools

- Tachogram obtained from the RR intervals (between consecutive heart beats)

- Heart Rate Monitor Polar S810 and specific software HRV ANALYSIS to value HRV

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Peak (Hz)</th>
<th>Power (m²)</th>
<th>Power (%)</th>
<th>Power (n.u.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLF</td>
<td>0.0000</td>
<td>445616</td>
<td>99.3</td>
<td></td>
</tr>
<tr>
<td>LF</td>
<td>0.1113</td>
<td>786</td>
<td>0.2</td>
<td>26.2</td>
</tr>
<tr>
<td>HF</td>
<td>0.1934</td>
<td>2220</td>
<td>0.5</td>
<td>73.8</td>
</tr>
<tr>
<td>LF:HF</td>
<td></td>
<td></td>
<td>0.354</td>
<td></td>
</tr>
</tbody>
</table>
Statistical Analysis

• To assess the **homogeneity** between the groups (CV4, RR, PL) at T0;
• To compare the sympathetic activity in **every time for each group**;
• To assess which group was significantly different from the others using **ANOVA**.

**P<0.05** was considered statistically significant;
**P<0.001** was considered high statistically significant.
### Tab.1 Anamnestic Table

<table>
<thead>
<tr>
<th></th>
<th>Gr. CV4 (Tot:18)</th>
<th>Gr. RR (Tot:11)</th>
<th>Gr. PL (Tot:8)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE (year)</td>
<td>33.77±14.90</td>
<td>33.90±12.66</td>
<td>34.12±16.05</td>
<td>0.95</td>
</tr>
<tr>
<td>SEX (F :M)</td>
<td>13:5</td>
<td>10:1</td>
<td>6:2</td>
<td></td>
</tr>
<tr>
<td>WEIGHT (Kg)</td>
<td>63.66±11.78</td>
<td>58.90±10.33</td>
<td>58.00±7.32</td>
<td>0.41</td>
</tr>
<tr>
<td>HIGH(cm)</td>
<td>167.77±10.59</td>
<td>165.09±6.54</td>
<td>164.62±9.11</td>
<td>0.58</td>
</tr>
<tr>
<td>SURGICAL OPERATIONS</td>
<td>55.5%</td>
<td>45.4%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>MEDCINE</td>
<td>16.6%</td>
<td>18.2%</td>
<td>37.5%</td>
<td></td>
</tr>
<tr>
<td>SMOKE</td>
<td>16.6%</td>
<td>9.1%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>ANSIETY</td>
<td>3%</td>
<td>27.3%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>SPORT</td>
<td>22.2%</td>
<td>36.4%</td>
<td>12.5%</td>
<td></td>
</tr>
</tbody>
</table>
Results 2/4

<table>
<thead>
<tr>
<th>µS</th>
<th>RR (mean SD)</th>
<th>CV4 (mean SD)</th>
<th>PL (mean SD)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>0.23 0.11</td>
<td>0.23 0.11</td>
<td>0.25 0.13</td>
<td>0.32</td>
</tr>
<tr>
<td>T₁</td>
<td>0.15 0.12</td>
<td>0.23 0.13</td>
<td>0.25 0.12</td>
<td></td>
</tr>
<tr>
<td>T₂</td>
<td>0.20 0.17</td>
<td>0.31 0.17</td>
<td>0.27 0.14</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 3 Table of Mean ± Standard Deviation values in µS for each group

Fig. 1 Electrical Skin Conductance Mean µS values in for each group
## Results 3/4

<table>
<thead>
<tr>
<th></th>
<th>LF/HF</th>
<th>CV4 (mean ± SD)</th>
<th>RR (mean ± SD)</th>
<th>PL (mean ±SD)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>2.93±1.21</td>
<td>3.22±0.83</td>
<td>3.31±1.06</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>3.91±0.54</td>
<td>3.67±0.71</td>
<td>3.81±0.58</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>T₂</td>
<td>1.09±0.60</td>
<td>1.51±1.08</td>
<td>2.16±1.37</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

*Tab.2 Mean ± Standard Deviation Table of LF/HF values for each group.*

*Fig.2 LF/HF mean values of for each group.*
Results 4/4

<table>
<thead>
<tr>
<th>T2 (p)</th>
<th>CV4</th>
<th>RR</th>
<th>PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV4</td>
<td>-</td>
<td>.23</td>
<td>0.027</td>
</tr>
<tr>
<td>RR</td>
<td>.23</td>
<td>-</td>
<td>.34</td>
</tr>
<tr>
<td>PL</td>
<td>0.027</td>
<td>.34</td>
<td>-</td>
</tr>
</tbody>
</table>

Fig. 3 LF/HF Mean values of for each time in every group
Discussion 1/3:

- CV4 technique:
  1. During the procedure increases sympathetic activity
  2. After the technique skin conductance increases ratio LF/HF decreases significantly

parasympathetic activity increases

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Cranial Manipulation Can Alter Sleep Latency and Sympathetic Nerve Activity in Humans: A Pilot Study


Results: Sleep latency during the CV4 trial was decreased when compared to both the CV4 sham or control trials ($p < 0.05$). MSNA during the CV4-induced temporary halt of the cranial rhythmic impulse (stillpoint) was decreased when compared to prestillpoint MSNA ($p < 0.01$). During the CV4 sham and control trials MSNA was not different between CV4 time-matched measurements ($p > 0.05$). Moreover, the change in MSNA
Discussion 2/3:

*Volume 10, Issue 1*, Pages 8-17 (March 2007)

**Physiological effects of a CV4 cranial osteopathic technique on autonomic nervous system function: A preliminary investigation**

Kate Milnes, Robert W. Moran

Received 11 September 2006; received in revised form 19 December 2006; accepted 17 January 2007.

**Results** The results of this study demonstrated that the application of the CV4 technique when compared to simple touch in asymptomatic individuals had minimal physiological effect in any of the autonomic variables recorded. No significant differences were observed in any variable across the five phases. On examination of heart rate variability, it became apparent that three subjects may have responded in a manner that was consistent with an increase in parasympathetic activity during the treatment phase. This identification leads to the notion that there may be both ‘responders’ and ‘non-

**Conclusions** This pilot study fails to support the theorised effects of the CV4 technique that are commonly described. In response to application of the technique there were minimal physiological changes observed in the autonomic measures investigated. Additional research is required if the hypothesised physiological effects of techniques used in the field of cranial manipulation are to be
Discussion 3/3:

- Rib Raising technique has the same effect on SNA:
  1. During the procedure increases ratio LF/HF increases sympathetic tone
  2. After technique ratio LF/HF decreases significantly
     \( \downarrow \text{LF} \) orthosympathetic activity decreases \( \uparrow \text{HF} \) parasympathetic activity increases

Effects of Rib Raising on the Autonomic Nervous System: A Pilot Study Using Noninvasive Biomarkers

...to initially stimulate sympathetic efferent activity but results in a prolonged reduction in sympathetic outflow from the treated region. However, there is a limited amount

Conclusions: The results of the present pilot study suggest that SNS activity may decrease immediately after rib raising, but the hypothalamic-pituitary-adrenal axis and parasympathetic activity are not altered by this technique. Salivary \( \alpha \)-amylase may be a useful biomarker for
Differences with studies

- Differences of measures observed

- Differences of experimental paradigms (e.g. timing of measurement)
Conclusion

Future Improvements:
- Introduction of a control group

Explanation hypothesis:

Could the decrease of sympathetic activity after technique at peripheral level (electrical skin conductance) require more time, by comparison with cardiac level?

Is the increase of parasympathetic activity, after the technique, a direct effect or a rebound effect to balance the orthosympathetic increase shown during the technique?
Thanks

- Prof. Oliveri Massimiliano
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- Dott. Daccò Silvia
- Patients Volunteer