A study of Autonomic functions in shift workers

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Abstract:
A person is considered as a shift worker if the work schedule is outside the routine 9am to 5pm. Shift work causes considerable disturbance of biological clock and alteration in sleep wake cycle. This alteration imposes a stress in the body causing significant disturbances in the autonomic functions. The study includes two study groups of age, sex and BMI matched 30 shift workers and 30 non-shift workers. All the 60 subjects undergo Heart Rate Variability and other autonomic function tests. The results showed significant increase in LF, LF HF, and Blood pressure raise in Isometric Hand Grip is more in shift workers suggestive of sympathetic over activity. The values of HF, 3015, EI and Valsalva ratio is reduced suggestive of parasympathetic withdrawal. Reduced mean RR interval suggests reduced Heart rate variability. Thus shift workers showed sympathetic over activity, parasympathetic withdrawal and reduced Heart Rate Variability. The changes in shift workers may due to altered circadian rhythm.

Keyword: Shift workers, Heart Rate Variability, Autonomic Function Tests, Circadian

Introduction:
A person is considered as shift worker if work schedule is outside routine 9Am to 5Pm. Though shift work does not create potential production productivity advantage, it is an excellent way to increase production without an increase in infrastructure. Shift work with deviant sleep schedule imposes a stress on the regular circadian rhythm and the exact margin between a normal response and pathological response to this circadian stress remains unclear. Shift work carries negative health effects like altered, shortened, disturbed sleep, cognitive decrements, decreased alertness, increased injuries and accidents, risk of cardiovascular and gastrointestinal diseases. Shift work alters the biological clock which controls the rhythmic function of sleep – wake cycle. This results in alteration in autonomic functions due to hypothalamic
dysfunction. Autonomic function tests are a battery of tests that are based on evaluation of cardiovascular reflexes triggered by performing specific provocative manoeuvres along with heart rate variability and evaluate the sympathovagal balance.

**Materials and Method:**
The study was conducted after approval of our Institutional Ethical Committee, during May 2014 – August 2014. The study includes two groups, a shift worker group and a non-shift worker group, who will act as the control group. Thirty subjects, equal number of men and women on rotational shift work with working hour other than 9 am to 5 pm with a duration of not less than 6 months. The control group includes randomly selected sex and age matched thirty workers within the normal working time (9am to 5pm). The subjects in both the groups do almost the same work in altered timings. The age of all subjects lies between 25- 40 years. The subjects should not suffer from hypertension, cardiovascular disease, endocrine disorder or any other chronic diseases. After an informed consent and explanation all the subjects underwent a general and systemic examination. All the subjects are subjected to a battery of autonomic function tests along with resting heart rate variability (HRV).

**AUTONOMIC FUNCTION TESTS:**

1. **Resting Heart Rate Variability** – After a period of rest HRV is measured using standard instrument for 5 minutes.

2. **Expiration / Inspiration ratio (E/I)** - Respiratory arrhythmia is the basic principle behind the tests. It is the ratio between the longest RR interval during expiration and the shortest RR interval during inspiration during deep breathing.

3. **The Valsalva ratio (VR):** The subjects were asked to sit comfortably. Their heart rates were recorded at rest with the ECG. They were instructed to exhale forcefully through the tube of the Mercury sphygmomanometer and to maintain pressure in the manometer upto 40 mm Hg for 15 seconds. ECG recording was taken during the manoeuvre and continued for about 30 seconds after the performance. The manoeuvre was repeated three times with few minutes time interval of rest.

4. **The 30:15 ratio (Ortho Static Test):** The subjects were asked to lie down comfortably over the couch and then they were asked to stand up. The heart rates were recorded at the 15th and 30th beats immediately after standing.

5. **Isometric Hand Grip (IHG):** When the subject is isometrically pressing a hand grip dynamometer using 1/3rd of maximal strength for 3-5 minutes, there is raise in diastolic pressure. The elevated diastolic pressure is due to cardiac acceleration without increase in peripheral vascular resistance. Then the subject is instructed to maintain 1/3rd of maximal capacity for three minutes and the raise in diastolic blood pressure is noted.

6. **Cold Pressor Test (CPT):** Immersion of hand inside the cold water (40) for 60- 90 seconds cause activation of sympathetic system via afferent pain and temperature fibres of skin. There is a raise in diastolic blood pressure which is a measure of sympathetic activity. The blood pressure should be measured on the
opposite hand after 90s of immersion. The result is presented as difference between the procedure blood pressure and the resting blood pressure. The results of the above tests were evaluated statistically using Statistical Package for the Social Sciences (SPSS) software version 17.

Results:
The mean and standard deviation of the variable were determined for the two groups. Independent student’s t-test was employed as the Test of significance at 95% confidence interval and P value < 0.05 was considered as significant. The results of Autonomic Function Tests are tabulated.

Table – Comparison of variables and statistical results between the two study groups

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>CONTROLS</th>
<th>SHIFT WORKERS</th>
<th>p’ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>34.22 ± 6.2</td>
<td>32.42 ± 6.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>24.24 ± 2.17</td>
<td>23.18 ± 1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Resting Systolic BP</td>
<td>122.4 ± 4.16</td>
<td>126.46 ± 5.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Resting diastolic BP</td>
<td>80.12 ± 2.12</td>
<td>84.12 ± 4.16</td>
<td>0.6</td>
</tr>
<tr>
<td>Mean RR</td>
<td>0.71 ± 0.04</td>
<td>0.61 ± 0.02</td>
<td>0.01*</td>
</tr>
<tr>
<td>n LF</td>
<td>42.58 ± 7.70</td>
<td>49.18 ± 5.12</td>
<td>0.00*</td>
</tr>
<tr>
<td>n HF</td>
<td>57.42 ± 7.70</td>
<td>50.42 ± 5.12</td>
<td>0.00*</td>
</tr>
<tr>
<td>LF/HF</td>
<td>0.74 ± 0.34</td>
<td>0.67 ± 0.31</td>
<td>0.000*</td>
</tr>
<tr>
<td>E/I ratio</td>
<td>1.22 ± 0.08</td>
<td>1.16 ± 0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>VR</td>
<td>1.26 ± 0.05</td>
<td>1.21 ± 0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>30/15</td>
<td>1.14 ± 0.04</td>
<td>1.09 ± 0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>IHG</td>
<td>7.9 ± 2.13</td>
<td>10.2 ± 1.7</td>
<td>0.00</td>
</tr>
<tr>
<td>CPT</td>
<td>6.56 ± 2.11</td>
<td>7.62 ± 2.2</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Discussion:
The HRV measurements mean RR interval, nLF, n LF, and LF/HF ratio showed high statistical significance. All other ANS function test is also statistically significant. Suprachiasmatic nucleus (SCN) a part of hypothalamus is our biological clock, which provides rhythmic functions in a circadian rhythm. It organizes the body to different setting of activity or inactivity during a particular phases of day or night. Shift work alters the biological clock and alters its normal function. Shift work causes violation of biological clock and being active during night causes the over sympathetic activity accompanied by a parasympathetic withdrawal. The circadian pattern of HRV is related to sleep and wakefulness. This pattern is independent of day night cycle. The results of HRV shows significant increase of LF, which is a sympathetic activity indicator and decreased HF parasympathetic indicator and also decreased LF/HF ratio, which is a indicator of sympathovagal balance. Similarly the E/I, Valsalva manoeuvre, and orthostatic standing reflects the parasympathetic reflex activity of body is decreased in shift workers. The isometric hand grip test and cold pressor test reflects the sympathetic activity is increased in shift workers.

Conclusion:
Shift workers show significant increase in sympathetic activity along with parasympathetic withdrawal. The normal sympathovagal balance is lost and shows significant autonomic dysfunctions.
Reference:


