Identification of Apnea Events Using a Chest-worn Physical Activity Monitor

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Study Aim

Use the Zephyr BioHarness 3 (BH3) to identify apnea events in patients suspected of obstructive sleep apnea (OSA)

Methods

- Patients recruited from Sleep Disorders Center at Mayo Clinic in Phoenix, AZ
- Patients undergoing single-night PSG were fitted with BH3 after being fitted for PSG
- BH3 and PSG data were collected concurrently
- PSG scored by licensed, registered sleep technician

Measures

- Apnea events identified on PSG as scored by sleep technician according to American Academy of Sleep Medicine Scoring Manual
- HR, RR, ECG, movement recorded by BH3

Analysis

BH3 data was analyzed in 10-second windows using 3 methods:
1. Support vector machine (SVM), logistic regression, and neural networks (Table 1)
2. Differences in mean, median, and variance between 10-second windows (Table 2)
3. 5-dimensional phase-space transformation using window size = 5 seconds and τ = 70 (Table 3)

Study Sample

<table>
<thead>
<tr>
<th>Gender</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Average Age</td>
<td>58.0 ± 7.3 years</td>
<td></td>
</tr>
<tr>
<td>Average BMI</td>
<td>29.6 ± 3.0 kg/m²</td>
<td></td>
</tr>
<tr>
<td>Average neck circumference</td>
<td>38.4 ± 3 cm</td>
<td></td>
</tr>
<tr>
<td>Treated for HTN</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Average STOP-Bang</td>
<td>4.6 ± 1.9</td>
<td></td>
</tr>
<tr>
<td>Average ESS</td>
<td>8.0 ± 5.4</td>
<td></td>
</tr>
</tbody>
</table>

BMI = body mass index. HTN = hypertension. ESS = Epworth sleepiness scale. STOP-Bang = STOP-Bang questionnaire for OSA

Eligibility Criteria

- Age 35-60 years
- BMI 27-35 kg/m²
- No previous continuous positive airway pressure therapy
- No comorbid neurologic or sleep disorder

Introduction

- OSA is an underdiagnosed risk factor for cardiovascular morbidity and mortality
- Current gold standard for OSA diagnosis is laboratory-based PSG
- Many patients lack access to PSG
- The BH3 is a chest-worn physical activity monitor that records movement, heart rate (HR), electrocardiogram (ECG), and respiratory rate (RR) data in real-time
- Due to physiologic monitoring capabilities, the BH3 may be a useful portable sleep monitor for patients suspected of OSA

Discussion

- OSA will continually become a larger public health concern as obesity prevalence increases
- Access to PSG does not currently meet patient demand or public health needs
- Portable sleep monitoring may become a valuable tool, especially for patients who lack adequate access to timely PSG
- Portable sleep monitoring allows for multiple nights of data collection in a patient’s typical sleeping environment outside of the PSG lab
- Despite small study sample, the BH3 and PSG collect large amounts of data pertaining to the night of sleep being studied
- The most accurate and clinically useful method used in this study was 5-dimensional phase-space transformation of BH3 data

Conclusions

- The BH3 shows promise as a portable sleep monitor for patients suspected of OSA
- Future studies using larger sample sizes of patients and multiple nights of BH3 data may clarify the BH3’s clinical utility in patients suspected of OSA

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