Effect of Noise Reduction Methods in the ICU on Sleep Quality

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Introduction

- Sleep deprivation is a common problem in the critical care unit- in part due to frequent interruptions.

- It causes decreased attentiveness, fatigue, poor cognitive function (Weinhouse et al., 2009), increased risk of delirium (Rompaey, Elseviers, Drom, Fromont, & Jorens, 2012).

- Studies have been conducted that test the effect of various interventions on sleep quality. Some of these interventions are use of earplugs, eye masks, and melatonin.
Methods

- Key words used to search included “earplugs,” ”melatonin,” “sleep deprivation,” “delirium prevention,” “intensive care unit,” and “critical care.”

- The databases used for the review were PubMed, CINAHL, The Cochrane Library, and Google scholar.

- Results were limited by “English language only,” adults, and full text. Further limits were based on relevance, and the existence of clinical implications for nursing practice.
Figure 1: Study design.

- **Night 1**: Adaptation
  - Interval 1 day
- **Night 2**: Baseline
  - Quiet and light off
  - Interval 1 day
- **Randomization (n=14)**
  - n=7
  - Interval 1 day
  - n=7
- **Night 3**: ICU noise and light, no earplugs and eye masks
  - Interval 1 day
- **Night 4**: ICU noise and light, earplugs and eye masks
  - Interval 1 day
  - ICU noise and light, no earplugs and eye masks
Results

- **Improved sleep quality with the use of earplugs and eye-masks**
  - Hu et al., (2010) and Huang et al., (2015) both found that subjects had significantly worsened sleep quality ($p<0.05$) when exposed to noise and light (NL).
  - Subjects who used earplugs and eye masks (NLEE) had longer REM, less arousal, and elevated melatonin.

- NL had 9.3% REM sleep, compared to NLEE which was 12.9%, $p=0.005$. Sleep onset latency for NL was 23.4, as opposed to NLEE which was 15.4, with $p=0.055$. NL subjects had on average 15.1 arousals, in comparison to NLEE’s 12.2 arousals, $p=0.04$ (Hu, Jiang, Chen, & Zhang, 2010).

- Huang et al., (2015) conducted a similar study in which a simulated ICU noise and light environment caused worsened sleep quality. NLEE subjects had a slightly longer total sleep time (385 minutes compared to NL 369 minutes). NLEE had a significantly ($p=0.01$) higher sleep onset latency of 46.6 minutes in comparison to NL 71.4 minutes. NLEE had significantly ($p=0.001$) fewer awakenings, averaging 5 times less than those in NL. Those under NL had sleep anxiety level of 46, where as NLEE had sleep anxiety level of 33 ($p=0.000$). NL had sleep quality 6.1, in comparison to NLEE’s sleep quality 3.4 ($p=0.000$) (Huang et al., 2015).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th>NL</th>
<th>NLEE</th>
<th>ANOVA P</th>
<th>Contrast P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in bed (min)</td>
<td>539.7 ± 1.7</td>
<td>536.0 ± 15.9</td>
<td>536.0 ± 13.7</td>
<td>0.48</td>
<td>—</td>
</tr>
<tr>
<td>Total sleep time (min)</td>
<td>456.0 ± 39.9</td>
<td>454.7 ± 41.8</td>
<td>475.1 ± 33.4</td>
<td>0.20</td>
<td>0.06</td>
</tr>
<tr>
<td>Sleep efficiency Index</td>
<td>0.8 ± 0.1</td>
<td>0.8 ± 0.1</td>
<td>0.9 ± 0.0</td>
<td>0.12</td>
<td>0.09</td>
</tr>
<tr>
<td>REM%</td>
<td>10.9 ± 5.9</td>
<td>9.3 ± 4.3</td>
<td>12.9 ± 4.3</td>
<td>0.03</td>
<td>0.005</td>
</tr>
<tr>
<td>S1%</td>
<td>21.8 ± 10.4</td>
<td>23.4 ± 11.9</td>
<td>22.5 ± 9.7</td>
<td>0.80</td>
<td>0.67</td>
</tr>
<tr>
<td>S2%</td>
<td>43.9 ± 10.2</td>
<td>45.6 ± 10.3</td>
<td>43.5 ± 6.9</td>
<td>0.57</td>
<td>0.20</td>
</tr>
<tr>
<td>S3%</td>
<td>14.0 ± 6.8</td>
<td>11.6 ± 6.5</td>
<td>13.9 ± 5.6</td>
<td>0.30</td>
<td>0.11</td>
</tr>
<tr>
<td>Sleep onset latency (min)</td>
<td>22.3 ± 13.1</td>
<td>23.4 ± 16.6</td>
<td>15.4 ± 16.4</td>
<td>0.46</td>
<td>0.055</td>
</tr>
<tr>
<td>REM latency (min)</td>
<td>121.8 ± 47.0</td>
<td>146.9 ± 56.2</td>
<td>105.7 ± 47.0</td>
<td>0.02</td>
<td>0.013</td>
</tr>
<tr>
<td>Arousal index</td>
<td>13.0 ± 4.7</td>
<td>15.1 ± 6.2</td>
<td>12.2 ± 6.5</td>
<td>0.03</td>
<td>0.04</td>
</tr>
</tbody>
</table>

ANOVA, repeated measures analysis of variance; Contrast, paired student’s test or wilcoxon’s rank sum test of simulated ICU environment with and without earplugs and eye masks; NL, recorded ICU noise and light exposure; NLEE, recorded ICU noise and light, subjects wore earplugs and eye masks; REM, rapid eye movement.
Results

- Decreased incidence of delirium

- Those who used earplugs developed delirium at a 43% lesser rate than those who did not, and reported better sleep quality (Rompaey, Elseviers, Drom, Fromont, & Jorens, 2012)
<table>
<thead>
<tr>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased incidence of delirium with earplugs</td>
<td>Longer REM, less arousal, and elevated melatonin levels with earplugs and eye masks</td>
<td>Longer REM, less arousal, and elevated melatonin levels with earplugs and eye masks</td>
</tr>
<tr>
<td>Improved self-ratings on sleep quality</td>
<td>Fewer arousals</td>
<td>Fewer arousals</td>
</tr>
<tr>
<td>Decreased sleep anxiety</td>
<td>Longer REM</td>
<td>Longer REM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longer total sleep time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower sleep anxiety level</td>
</tr>
</tbody>
</table>
Discussion

All three studies:
- Observed sleep quality, but measured it in different ways.
  - Van Rompaey et al., (2012) focused on rates of delirium
  - Hu et al., (2010) and Huang et al., (2015) used very specific measurements that helped quantify sleep quality, such total sleep time, sleep-onset latency, REM latency, amount of light sleep, amount of REM sleep, and number of arousals or awakenings.
  - They also measured urine excretion, serum melatonin, and serum cortisol.

The three studies were all randomized controlled trials

The three studies were all double blinded
Implications

- Evidence suggests that noise remains an obstacle that prevents patients from receiving adequate and restful sleep.
- Healthcare providers should be proactive in promoting a quiet environment in order to foster restful and restorative sleep.
- Earplugs are cost effective and easy to implement. Earplugs and eye masks should be in stock at the hospital and offered to patients.
References


