Preoperative Continuous Positive Airway Pressure in Obstructive Sleep Apnea Patients Decreases Opioid Use and Pain during Post-Operative Inpatient Days

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Abstract

Over half of the patients with obstructive sleep apnea (OSA) who present for surgery are undiagnosed. Patients with OSA may be more vulnerable to adverse events during the preoperative period. Our aim was to determine whether diagnosing and treating preoperative patients with OSA for at least two days prior to surgery reduces pain and Opioid requirement during their postoperative two-day in-patient period.

We performed a retrospective chart review of 103 patients that underwent inpatient elective surgery, who had a STOPBANG score of 6 or greater. Fifty patients diagnosed with OSA and treated with continuous positive airway pressure (CPAP) were included in the treatment group and 53 patients not on CPAP therapy were included in the non-treatment group based on refusal of apnea evaluation. Combined postoperative days one and two revealed significantly lower pain scores (3.34, p-value=0.02) and morphine use (111.86 mg, p-value=0.02) in the treatment group compared to the non-treatment group (pain score 4.78; morphine use 360.08 mg), with the effect stronger on postoperative day two than postoperative day one. Preoperative diagnosis and treatment of OSA with CPAP for at least two preoperative days is important as it is associated with reduced Opioid use and reduced pain scores for two postoperative days.

INTRODUCTION

The prevalence of OSA in surgical patients is much higher than the general population, 70%, or greater in various reports [1-4] Previous studies on surgical populations have shown that patients with obstructive sleep apnea (OSA) have a higher incidence of postoperative complications [5-9] such as intensive care unit (ICU) admissions, longer hospital stays, longer ICU stays, postoperative encephalopathy, and postoperative infection [7,8]. Even patients who are suspected to have OSA based on screening questionnaires may have increased postoperative respiratory complications [6,7].

Previously, there has been little emphasis on screening and or diagnosing sleep-disordered breathing prior to surgery [10]. However, patients with OSA may be more vulnerable to adverse events during the preoperative period, especially if they receive general anesthesia and Opioid analgesia. The Society of Ambulatory Anesthesia task force suggested that patients with known OSA and optimized co-morbidities were suitable candidates for outpatient elective surgery if they are able to use a continuous positive pressure device in the postoperative period and if their pain can be managed with minimal Opioid [11]. Furthermore, they also recommended the use of the STOPBANG questionnaire as a preoperative screening tool [11]. This is a series of eight Yes-No questions about snoring, tiredness, fatigue, observed apneas, history of high blood pressure, body mass index greater than 35, age greater than 50 years, neck size greater than 40 centimeters, and male gender. It has been
All of the patients were greater than 18 years of age. Gordon et al., demonstrated that continuous positive airway pressure (CPAP) treatment enhanced sleep continuity in patients with severe OSA and reduced pain sensitivity across five radiant heat intensities as measured by time to withdraw one’s finger at the first experience of pain [14]. No other prior research has focused on the association of prophylactic and preoperative treatment with CPAP for OSA and its impact on surgical outcomes. Our aim was to explore in a retrospective chart review study whether diagnosing and treating preoperative patients with OSA for at least two days prior to surgery is associated with reduced pain and Opioid requirement during their postoperative two-day in-patient period compared to those declining OSA diagnosis and treatment.

**MATERIALS AND METHODS**

We performed a retrospective electronic medical record chart review of 103 patients that underwent inpatient elective surgery at Henry Ford Hospital, all of whom had a STOPBANG score of six or greater, between November 2014 and March 2015. All of the patients were greater than 18 years of age. Gordon et al., demonstrated that STOPBANG scores ≥ 6 are predictive of patient Opioid use and visual analog pain scores postoperatively [15]. This is a retrospective review of prophylactic treatment of apnea patients prior to surgery. To control for various diseases often co-morbid with OSA, patients with New York Heart Association (NYHA) class III-IV heart failure, severe chronic obstructive pulmonary disease (COPD) with forced expiratory volume in one second (FEV1) < 0.70 and post-bronchodilator FEV1 < 50% predicted [16], neuromuscular disease, and drug or alcohol abuse were excluded. Surgeries were classified as high risk (open aortic, vascular, cardiac), intermediate risk (orthopedic, open abdominal, thoracic, head and neck, neurosurgery, prostate, carotid endarterectomy), and low risk (ophthalmologic, breast, endoscopy, plastic surgery) [17]. The type of surgeries is classified in Table 1 for the two patient groups (Treated and Non-treated as described below). All surgeries, except one, were conducted under general anesthesia with muscle relaxation. The one exception was in the Non-treated group and it was done under central neuro axial blockade. Fifty patients diagnosed with OSA and treated with CPAP were included in the treatment group and 53 patients not on CPAP therapy were included in the non-treatment group based on preoperative patient refusal of sleep apnea evaluation. Patients were diagnosed with OSA with a RESMED Apnea Link Air portable home sleep test or a diagnostic in lab attended sleep study depending on medical insurance coverage, medical co morbidities, and above mentioned diagnostic criteria. If the portable sleep test results revealed OSA without significant oxygen desaturations, patients were set up with the Auto CPAP machine if appropriate. If there was very severe OSA and or accompanied significant oxygen desaturations (greater than 30 minutes with oxygen saturations less than 88%), patients returned for an in lab attended positive airway pressure (CPAP) titration study and were subsequently set up with a CPAP machine at the appropriate pressure (s). The patients qualifying for a CPAP machine received the machine and supplies two to 30 days before the scheduled surgery. Patients were instructed to use the CPAP machine before surgery and encouraged to continue to use the CPAP machine postoperatively. CPAP machine compliance data was obtained at one month outpatient office clinic visits via an internal processor located within standard

**Table 1:** Surgery type in the treatment versus non-treatment groups.

<table>
<thead>
<tr>
<th></th>
<th>Orthoped</th>
<th>Urology</th>
<th>General</th>
<th>Neuro/spine</th>
<th>Gyn</th>
<th>Vascular</th>
<th>Ophtho</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat (n=50)</td>
<td>5 (10%)</td>
<td>15 (30%)</td>
<td>9 (18%)</td>
<td>12 (24%)</td>
<td>3 (6%)</td>
<td>5 (10%)</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>No treat (n=39)</td>
<td>4 (10%)</td>
<td>7 (18%)</td>
<td>17 (44%)</td>
<td>7 (18%)</td>
<td>1 (2%)</td>
<td>2 (5%)</td>
<td>1 (2%)</td>
</tr>
</tbody>
</table>

**Table 2:** Comparison of treatment versus non-treatment groups.

<table>
<thead>
<tr>
<th></th>
<th>Mean SB score</th>
<th>Mean AGE</th>
<th>Mean ASA</th>
<th>Mean BMI</th>
<th># COPD</th>
<th># Heart failure</th>
<th>#CAD</th>
<th>#DM2</th>
<th>#HTN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat (n=50)</td>
<td>6.78</td>
<td>60.04</td>
<td>3.02</td>
<td>36.59</td>
<td>9</td>
<td>2</td>
<td>10</td>
<td>22</td>
<td>44</td>
</tr>
<tr>
<td>No treat (n=53)</td>
<td>6.53</td>
<td>61.94</td>
<td>3</td>
<td>36.81</td>
<td>10</td>
<td>3</td>
<td>12</td>
<td>27</td>
<td>46</td>
</tr>
</tbody>
</table>

**Abbreviations:** ASA: American Society of Anesthesiologist physical status score; BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; CAD: Coronary Artery Disease; DM2: Diabetes Mellitus Type 2; HTN: Hypertension; SB: STOPBANG score.

**Table 3:** Surgery Risk Classifications.

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Intermediate</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat (n=50)</td>
<td>4</td>
<td>41</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>No treat (n=53)</td>
<td>6</td>
<td>46</td>
<td>1</td>
<td>53</td>
</tr>
</tbody>
</table>
CPAP devices. The primary endpoints of the study were Opioid use (calculated in morphine mg equivalents) and visual analog scale (VAS) pain scores collected by the nursing staff during the first two post-operative days. Two-tailed t test statistical analyses were performed comparing treated and untreated patients. The Henry Ford Health System Institutional Review Board reviewed and granted approval for this retrospective electronic medical record chart review.

RESULTS AND DISCUSSION

The two groups were similar in regards to race, ethnicity, co-morbid conditions, STOP-BANG score, age, ASA score, surgery risk classification, and BMI (Tables 1-3). The STOP-BANG score of the treated group was 6.78+/-1.4 and the Apnea-Hypopnoea Index (AHI) pretreatment score was 37.1+/-23.1, which is considered moderate OSA. CPAP machine compliance data was obtained for 17 patients, all of whom were compliant (with at least four hours of CPAP machine usage per night, on 70% of the days). Post-treatment AHI scores ranged from 0.2-15.2, with a mean AHI score of 3.35. The untreated group had a similar STOP-BANG score of 6.53 +/-0.8, but had refused OSA diagnosis and treatment. They either refused a referral to the Sleep Center or did not follow through on the provided referral. The most common reason for refusal was a desire to postpone their having to deal with a possible second medical disorder. Combined postoperative days one and two assessment revealed significantly lower VAS pain scores (3.34, p-value=0.02) and morphine equivalent use (calculated in morphine mg equivalents) and visual analog scale (VAS) pain scores collected by the nursing staff during the first two post-operative days. Two-tailed t test statistical analyses were performed comparing treated and untreated patients. The Henry Ford Health System Institutional Review Board reviewed and granted approval for this retrospective electronic medical record chart review.

Table 4: VAS Pain Scores (0-10).

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>No treatment</th>
<th>p-value</th>
<th>effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postop Day 1</td>
<td>3.58±0.47</td>
<td>4.68±0.58</td>
<td>0.14</td>
<td>0.30</td>
</tr>
<tr>
<td>Postop Day 2</td>
<td>3.10±0.55</td>
<td>4.87±0.64</td>
<td>0.04</td>
<td>0.55</td>
</tr>
<tr>
<td>Postop Days 1+2</td>
<td>7.27±0.98</td>
<td>9.9±1.09</td>
<td>0.02</td>
<td>0.46</td>
</tr>
</tbody>
</table>
Data are Mean±SEM

Table 5: Morphine Opioid Use (in milligrams).

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>No treatment</th>
<th>p-value</th>
<th>effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postop Day 1</td>
<td>105.8±70.09</td>
<td>333.8±187.21</td>
<td>0.22</td>
<td>0.27</td>
</tr>
<tr>
<td>Postop Day 2</td>
<td>7.49±1.78</td>
<td>26.55±10.67</td>
<td>0.02</td>
<td>0.67</td>
</tr>
<tr>
<td>Postop Days 1+2</td>
<td>111.86±70.35</td>
<td>360.08±144.01</td>
<td>0.02</td>
<td>0.32</td>
</tr>
</tbody>
</table>
Data are Mean±SEM
an enhanced Opioid potency [22].

These contradictory results point to the complexity of the sleep-pain relation in OSA. Important variables are likely the severity of the OSA and hypoxia, the total sleep time, the measure used to quantify sleep fragmentation, which is defined by American Academy of Sleep Medicine criteria as the number of brief EEG arousals, and the nature of the pain induction, experimental pain such as radiant heat or cold presser stimulation vs. elective surgery with various levels of risk for pain. The role of sleepiness in the sleep-pain nexus also must be considered. Tiredness alone, as reported on a STOPBANG completed pre-surgery, was associated with greater post-surgery Opioid use and pain ratings in a similar elective surgery sample [15]. It is therefore possible that using the tiredness, rather than nocturnal hypoxemia, as a marker would serve as a better determinant of the perception of pain. Eradicating tiredness, by using CPAP to enhance sleep consolidation, would help minimize pain [14]. As the study gathers more patients, this will likely strengthen the significance of the effects seen on postoperative day one, in regards to pain scores and Opioid use. One limitation with this study involves the incomplete CPAP machine compliance data, including postoperative AHI. This is likely due to patients not following up for their return outpatient clinic visit or visiting their respective durable medical equipment companies, despite numerous phone calls, letters, and emails to do so. We discussed the benefits of CPAP therapy with all patients and also advised about the respective insurance companies’ parameters of machine usage as to permit continued usage of the machine.

Medicare health insurance requires use of CPAP devices for four or more hours per night on 70% of nights during a consecutive 30-day period anytime during the first three months of initial use. This study did not consider various patient factors that could be possible confounds. An important personality trait known to be associated with elevated pain levels is catastrophizing. Likelihood of refusing CPAP treatment and/or failure of CPAP compliance may relate to catastrophizing and consequently greater pain. Also of importance is the type of surgery and surgeon’s technique which may result in greater pain. We attempted to control for surgical risk in this study using the ACC/AHA 2007 rating guidelines. It is recognized this study is limited in that it is a retrospective chart review and the comparison group, patients that refused treatment, may be different than the treated patients on a number of other variables. But, importantly these data justify the need for a controlled study with patients randomized to therapeutic versus non-therapeutic CPAP. Studies with larger patient numbers, more accurate CPAP machine compliance data (including AHI while on therapy), and length of hospital stay, nocturnal hypoxemia, and cost effectiveness calculations are necessary. As the machines advance, it becomes easier to track patient compliance as well as obtain their postoperative AHI scores. A recent study revealed no significant differences in postoperative adverse complications with or without post-operative CPAP, but did reveal significantly lower postoperative AHI scores and a trend toward shorter hospital stays [23]. While important, this study did not look at preoperative treatment with CPAP nor focus on pain and Opioid use as post-operative outcome measures. Our research suggests that pain and Opioid use may be important outcome measures.

CONCLUSION

The data in the present study suggest improving sleep continuity in patients with moderate OSA before elective surgery is associated with improvement in post-surgery measures of Opioid use and pain scores. These retrospective data justify the conduct of a controlled randomized trial.

REFERENCES


