Sleep disordered breathing and acute pain management

Richard Halliwell
What we found and wrote, & what’s new
Sleep disordered breathing

• A spectrum of breathing abnormalities during sleep
  • Snoring
  • Obstructive sleep apnoea
  • Obesity hypoventilation syndrome
  • Central apnoea
• OSA is the most extensively studied
What is Obstructive Sleep Apnoea?

• Recurrent airway obstruction during sleep
• Causes hypoxaemia
• Interferes with sleep efficiency
• up to 10% of the population
• Maybe more in surgical patients
• and 80% are not diagnosed - yet
• Causes cardiovascular and metabolic morbidity
• Actually multiple phenotypes with differing risk, opioid sensitivity
OSA is common, but unrecognised.
At least 25% of those presenting for elective surgery
Increased risk of pulmonary complications, and ICU admission
Presentation for surgery may be the first time of OSA diagnosis
A Dilemma - cancel or refer for workup, or proceed with interventions
Costs of complications, and cost of interventions
Interventions - may be beneficial, or not…
Data is from large databases - inherent problems.
The problem

- Obstructive sleep apnoea is common; made worse in the postoperative period for multiple reasons.
- Opioids, and the postoperative period make it worse.
- So does rebound REM sleep after surgery, residual general anaesthesia.
- Difficult to isolate the separate effects of each contribution.
The Two Issues

1. The type of analgesia?
2. Where to put the patient and how to monitor them?
Guiding Evidence

- Indirect clinical data
- Expert opinion
PATIENT SAFETY WATCH

EDITION 1/13: Sleep Apnoea

WHAT SHOULD YOU DO

Do you have local protocols for managing patients with Obstructive Sleep Apnoea (OSA)?

Do they address monitoring requirements, drug selection, pain management and Patient Controlled Analgesia for these patients?

Do staff complete training on OSA protocols, the operation of CPAP machines and supplemental oxygen?

Are oxygen connections for supplemental oxygen use available where OSA patients are cared for?

Do you have mechanisms in place for the pre-operative detection of sleep apnoea in surgical patients?

THE CASE

A 47 year old male was admitted to a tertiary care hospital for a laparoscopic nephrectomy. The patient's medical history included obstructive sleep apnoea (OSA) for which he had been using a continuous positive airway pressure (CPAP) machine at night for the past three years.

Officer (RMO) also recorded that the patient had sleep apnoea. He was also taking desvenlafaxine 100mg daily.

In the recovery unit, the patient required fentanyl IV for pain relief, and patient controlled analgesia (PCA) with fentanyl and morphine. PCA

NSW Clinical Excellence Commission 2013.
OSA and pain interact

• Sleep disruption promotes systemic inflammation
• Can cause hyperalgesia
• Treatment with CPAP may decrease this
• But, opioid sensitivity is increased by hypoxaemia*

The patient with sleep-disordered breathing including obstructive sleep apnoea

1. Patients with sleep-disordered breathing, including obstructive sleep apnoea, having surgery are at increased risk of adverse cardiac and respiratory effects (S) (Level III-2 SR), in particular cardiac arrest/shock, atrial fibrillation, aspiration pneumonia, acute respiratory distress syndrome and need for intubation, mechanical and noninvasive ventilation (N) (Level III-2).
Some of the worrying evidence
Perioperative Pulmonary Outcomes in Patients with Sleep Apnea After Noncardiac Surgery

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BACKGROUND: Although patients with sleep apnea (SA) are considered to be at increased risk for postoperative complications, evidence supporting increased risk of perioperative pulmonary morbidity is limited. The objective of this study, therefore, was to analyze perioperative demographics and pulmonary outcomes of patients with SA after orthopedic and general surgical procedures using a population-based sample. We hypothesized that SA is an independent risk factor for perioperative pulmonary complications, thus providing a basis for an increase in the utilization of resources, including intensive monitoring and development of strategies to prevent and treat these events.

METHODS: National Inpatient Sample data for each year between 1998 and 2007 were accessed. Orthopedic and general surgical procedures were included and discharges with a diagnosis code for SA were identified. Patients with the diagnosis of SA were matched to those without the disease based on demographic variables using the propensity scoring method.
Methods

- Large database linkage study
- Orthopaedic and general surgery patients
- Used National Inpatient Sample; US database 1998 to 2007
- Patients
  - lower limb arthroplasty
  - open abdominal surgery
Methods

• Propensity score - multivariate regression model
• matched OSA with non-OSA control patients
Results

- General surgery patients: 3,400,000
  - 51,000 with OSA
- Orthopaedic: 2,600,000
  - 65,000 with OSA
Key findings

Figure 1. Incidence of respiratory complications for patients with and without sleep apnea (SA) undergoing orthopedic (A) and general surgical (B) procedures for patients utilizing the full and matched sample. ARDS = adult respiratory distress syndrome; PE = pulmonary embolism; AE = adverse event.
Possible reasons

- Aspiration: Pharyngeal muscle dysfunction
- PE in orthopaedic patients
- More coagulopathic
- RV dysfunction
- ARDS
- Higher pro-inflammatory changes in OSA
- Raised CRP in OSA
- Caused by repetitive hypoxia
Postoperative Complications in Patients With Obstructive Sleep Apnea

Roop Kow, MD; Vinay Pasupuleti, MD, PhD; Esteban Walker, PhD; Anuradha Ramaswamy, MD; Nancy Foldvary-Schaefer, DO

Background: Unrecognized obstructive sleep apnea (OSA) is associated with unfavorable perioperative outcomes among patients undergoing noncardiac surgery (NCS).

Methods: The study population was chosen from 39,771 patients who underwent internal medicine preoperative assessment between January 2002 and December 2006. Patients undergoing NCS within 3 years of polysomnography (PSG) were considered for the study, whereas those < 18 years of age, with a history of upper airway surgery, or who had had minor surgery under local or regional anesthesia were excluded. Patients with an apnea-hypopnea index (AHI) ≥ 5 were defined as OSA and those with an AHI < 5 as control subjects. For adjusting baseline differences in age, sex, race, BMI, type of anesthesia, American Society of Anesthesiology class, and medical comorbidities, the patients were classified into five quintiles according to a propensity score.

Results: Out of a total of 1,750 patients who underwent both PSG and NCS, 471 met the study criteria. Of these, 282 patients had OSA, and the remaining 189 served as control subjects. The presence of OSA was associated with a higher incidence of postoperative hypoxemia (OR, 7.9; P = .009), overall complications (OR, 6.9; P = .003), and ICU transfer (OR, 4.43; P = .069), and a longer hospital length of stay (LOS), (OR, 1.65; P = .049). Neither an AHI nor use of continuous positive airway pressure at home before surgery was associated with postoperative complications (P = .3 and P = .75, respectively) or LOS (P = .97 and P = .21, respectively).

Conclusions: Patients with OSA are at higher risk of postoperative hypoxemia, ICU transfers, and longer hospital stay.
Methods

• Cleveland clinic database linkage study
• Non-cardiac surgery
• Had sleep-study confirmed OSA
• 471 patients eligible
• Used matched controls
• Propensity score and logistic regression
• But, no data on opioid dose (!)


<table>
<thead>
<tr>
<th>Complications</th>
<th>AHI ≥ 5 (n = 282)</th>
<th>AHI &lt; 5 (n = 189)</th>
<th>Propensity-Adjusted OR</th>
<th>Propensity-Adjusted P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation</td>
<td>3 (1.1)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>2 (0.7)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delirium</td>
<td>9 (3.4)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>3 (1.1)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postoperative hypoxemia</td>
<td>35 (12.4)</td>
<td>4 (2.1)</td>
<td>7.9</td>
<td>.009</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>14 (4.9)</td>
<td>4 (2.1)</td>
<td>4.3</td>
<td>.271</td>
</tr>
<tr>
<td>Reintubation</td>
<td>4 (1.4)</td>
<td>1 (0.5)</td>
<td>9.2</td>
<td>.018</td>
</tr>
<tr>
<td>ICU transfer</td>
<td>19 (6.7)</td>
<td>3 (1.6)</td>
<td>5.7</td>
<td>.049</td>
</tr>
<tr>
<td>Any complication</td>
<td>40 (14.2)</td>
<td>5 (2.6)</td>
<td>6.9</td>
<td>.003</td>
</tr>
<tr>
<td>LOS &gt; 2 d</td>
<td>135 (48.2)</td>
<td>53 (28.0)</td>
<td>1.65</td>
<td>.049</td>
</tr>
<tr>
<td>Overall LOS, median</td>
<td>2 (0.4)</td>
<td>1 (0.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are presented as No. (% of AHI group) unless indicate otherwise. LOS = length of stay. See Table 1 legend for expansion of other abbreviation.

a Propensity model includes the first seven baseline characteristics and their interactions.

b JMP software will not compute a correct P value when numbers in the comparison group are small.
Does Obstructive Sleep Apnea Influence Perioperative Outcome? A Qualitative Systematic Review for the Society of Anesthesia and Sleep Medicine Task Force on Preoperative Preparation of Patients with Sleep-Disordered Breathing

Mathias Opparer, MD,*† Crispiana Czowicz, MD,*† Dario Bugada, MD,† Babak Mokhlesi, MD, MSc,§ Roop Kaur, MD,‖ Dennis Auckley, MD,‖ Frances Chung, MBBS, FRCP,∥ and Stavros G. Memtsoudis, MD, PhD, FCCP†

• Systematic review only. Unable to merge data for meta-analysis. 50 studies
• Limitations with nature of data: Varying OSA diagnosis, administrative databases, control groups may have OSA.
• OSA multiple inclusions for diagnosis: PSG, Chart diagnosis, questionnaire
• Most studies show increase in complications: pulmonary and others
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Mathias Opperer, MD,*† Crispiana Cozowicz, MD,*† Dario Bugada, MD,§ Babak Mokhlesi, MD, MSc,§ Roop Kaw, MD,‖ Dennis Auckley, MD,¶ Frances Chung, MBBS, FRCPC,# and Stavros G. Memtsoudis, MD, PhD, FCCP*†

Table 1. Included Studies for Procedures Under General or Neuraxial Anesthesia

<table>
<thead>
<tr>
<th>Impact of OSA on outcomes</th>
<th>Detrimental Impact</th>
<th>Beneficial Impact</th>
<th>Not significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary complications</td>
<td>9 studies[^6^,^7^,^10^,^12^-^17]</td>
<td>0 studies</td>
<td>6 studies[^9^,^18^-^22]</td>
</tr>
<tr>
<td>Desaturation</td>
<td>7 studies[^14^,^23^-^28]</td>
<td>0 studies</td>
<td>5 studies[^13^,^29^-^33]</td>
</tr>
<tr>
<td>Difficult intubation</td>
<td>4 studies[^34^-^37]</td>
<td>1 study[^38]</td>
<td>1 study[^39]</td>
</tr>
<tr>
<td>Cardiac complications</td>
<td>1 study[^7]</td>
<td>0 studies</td>
<td>9 studies[^12^-^18,^20^-^27]</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>5 studies[^9^,^10^,^40^-^42]</td>
<td>0 studies</td>
<td>1 study[^27]</td>
</tr>
<tr>
<td>Combined complications</td>
<td>8 studies[^7^,^8^,^13^-^15,^25,^43,^44]</td>
<td>0 studies</td>
<td>2 studies[^21,^45]</td>
</tr>
<tr>
<td>Other outcomes</td>
<td>1 study[^29]</td>
<td>2 studies[^52,^53]</td>
<td>1 study[^54]</td>
</tr>
<tr>
<td>Mortality</td>
<td>1 study[^12]</td>
<td>3 studies[^9^,^10,^55]</td>
<td>9 studies[^7^,^15,^18^-^21,^27,^49,^56]</td>
</tr>
</tbody>
</table>

OSA = obstructive sleep apnea.
How do we recognise OSA?

- Sleep study is the gold standard
  - Limited access, time consuming

- Screening tools
  - STOP-Bang verified
High STOP-Bang score indicates a high probability of obstructive sleep apnoea

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Editor's key points

- The authors investigated the value of STOP-Bang score in predicting obstructive sleep apnoea (OSA) in surgical patients.
- Results from 746 patients were analysed.
- The odds ratio of moderate-to-severe OSA increased with the increase in the score.
- Importantly, the study shows the usefulness of STOP-Bang score in predicting OSA.

Background. The STOP-Bang questionnaire is used to screen patients for obstructive sleep apnoea (OSA). We evaluated the association between STOP-Bang scores and the probability of OSA.

Methods. After Institutional Review Board approval, patients who visited the preoperative clinics for a scheduled inpatient surgery were approached for informed consent. Patients answered STOP questionnaire and underwent either laboratory or portable polysomnography (PSG). PSG recordings were scored manually. The BMI, age, neck circumference, and gender (Bang) were documented. Over 4 yr, 6369 patients were approached and 1312 (20.6%) consented. Of them, 930 completed PSG, and 746 patients with complete data on PSG and STOP-Bang questionnaire were included for data analysis.

Results. The median age of 746 patients was 60 yr, 49% males, BMI 30 kg m⁻², and neck circumference 39 cm. OSA was present in 68.4% with 29.9% mild, 20.5% moderate, and 18.0% severe OSA. For a STOP-Bang score of 5, the odds ratio (OR) for moderate/severe and severe OSA was 4.8 and 10.4, respectively. For STOP-Bang 6, the OR for moderate/severe and severe OSA was 6.3 and 11.6, respectively. For STOP-Bang 7 and 8, the OR for moderate/severe and severe OSA was 6.9 and 14.9, respectively. The predicted probabilities for moderate/severe OSA increased from 0.36 to 0.60 as the STOP-Bang score increased from 3 to 7 and 8.

STOP-Bang questionnaire

1. Snoring: Do you snore loudly (loud enough to be heard through closed doors)?
   Yes □ No □
2. Tired: Do you often feel tired, fatigued, or sleepy during daytime?
   Yes □ No □
3. Observed: Has anyone observed you stop breathing during your sleep?
   Yes □ No □
4. Blood pressure: Do you have or are you being treated for high blood pressure?
   Yes □ No □
5. BMI: BMI more than 35 kg m\(^{-2}\)?
   Yes □ No □
6. Age: Age over 50 yr old?
   Yes □ No □
7. Neck circumference: Neck circumference > 40 cm?
   Yes □ No □
8. Gender: Male?
   Yes □ No □

High risk of OSA: Yes to $\geq 3$ questions.
Low risk of OSA: Yes to $< 3$ questions.
Questionnaire reproduced from Chung et al.\(^{11}\) with permission from Wolters Kluwer Health.
Higher STOP-Bang predicts more severe OSA


Extra screening in PACU
Screening in PACU improves sensitivity

- Giving supplemental oxygen negates sensitivity of pulse oximetry to detect hypercapnia respiratory depression.

- Screening during 3 consecutive, 30 minute periods, from PACU arrival:
  - bradypnea, apnoea, hypoxaemia, Pain-sedation mismatch.

- If High preop OSA risk and respiratory events in PACU, then do CPAP, and/or ICU/HDU admission.

Gali B. Identification of patients at risk for postoperative respiratory complications using a
Gali B. Identification of patients at risk for postoperative respiratory complications using a preoperative obstructive sleep screening in PACU improves sensitivity.

## Appendix 2: Postanesthesia Care Unit Evaluation for Recurrent Respiratory Events

<table>
<thead>
<tr>
<th>Evaluation Period</th>
<th>Bradypnea: &lt; 8 respirations/min (3 episodes needed for yes)</th>
<th>Apnea: ≥ 10 s (only 1 episode needed for yes)</th>
<th>Desaturation: pulse oximetry &lt; 90% with nasal cannula (3 episodes needed for yes)</th>
<th>Pain–sedation mismatch: RASS score –3 through –5 and pain scale score &gt; 5 (only 1 episode needed for yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial 30 min after Extubation or PACU Admit (Whichever Occurs Later)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second 30 min after Initial Evaluation (60 min after Extubation or PACU Admit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third 30 min after Second Evaluation (90 min after Extubation or PACU Admit)</td>
<td></td>
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</tbody>
</table>

Recurrent events if any event occurs at more than one evaluation period (not necessary to be same event).

PACU = postanesthesia care unit; pain scale score = visual analog score; RASS = Richmond Agitation–Sedation Scale.
Very high risk: if both preop risk and PACU respiratory events

Fig. 1. The frequency of postoperative respiratory events is displayed according to the four patient groups defined by the combination of sleep apnea clinical score (SACS) (low/high) and recurrent postanesthesia care unit (PACU) events (no/yes). From a multiple logistic regression analysis, which included SACS group and recurrent PACU events as explanatory variables, the likelihood of postoperative respiratory events was found to be significantly associated with high SACS (odds ratio = 3.5, $P = 0.001$) and recurrent PACU events (odds ratio = 21.0, $P < 0.001$).
How common is postoperative hypoxaemia?

- Hypoxaemia is a surrogate for respiratory depression.
- Intermittent pulse oximetry, esp if supplemental oxygen shows only 1% prevalence.
- **Continuous** pulse oximetry is much more sensitive
- 21% patients have < 90% sat for ≥ 10 minutes per hour.
- 8% < 90% for ≥ 20 minutes per hour.
- Doing intermittent readings arouses patients and are
When is the high risk time period?

- 88% within 24h post PACU discharge
- 58% within 12h post PACU discharge
- When to focus on close monitoring
Suggested approach

• Risk depends on extent of surgery and severity of OSA
CPAP will fix everything?
• Tried to allocate at risk patients to having CPAP postop (n=177)
• Effective, but very poorly tolerated
• Only 45% compliance, used less than 4h per night
• AHI reduced from 30/h to 3/h
• Acute perioperative initiation of CPAP not helpful
• Used linkage of healthcare databases in Canada
• Compared postop outcome in patients with OSA, compared usual with specific care (testing, CPAP use periop, and postop high level monitoring).
• All patients with OSA had sleep study diagnostic test.
• Found:
  • OSA patients not treated with CPAP and monitoring postop, had more than double the risk of cardiac arrest and shock (OR 2.2)
  • Respiratory complications were double in both OSA groups (treated v untreated) compared with on OSA.
  • Severity of OSA increased risk
What **recommendations** are there??

- Preoperative screening for obstructive sleep apnoea combined with treatment (ideally instituted preoperatively) and increased postoperative observation may decrease postoperative morbidity and mortality; the STOP-Bang questionnaire can be used to identify patients at risk of significant obstructive sleep apnoea (N).

- Management strategies that may increase the efficacy and safety of pain relief in patients with obstructive sleep apnoea include multimodal non-sedating opioid-sparing analgesia including regional techniques, continuous positive airway pressure, monitoring and supervision (in a high-dependency area if necessary) and supplemental oxygen (S).

- Perioperative commencement of continuous positive airway pressure may be beneficial in patients with obstructive sleep apnoea but requires high levels of supervision and poor patient acceptance and postoperative adherence are significant problems (N).
Suggested Approach: Analgesia

- Analgesia
  - Avoid or minimise opioids

- Opioids
  - No long acting forms
  - Probably not morphine, or codeine
  - Dose sparing strategies (Regional analgesia, NSAIDs etc)
  - Intermittent opioids can also be dangerous
Suggested Approach: Environment

- Screen patients to have higher level monitoring.
- Appropriate nursing skill and ratio
- Education in CPAP/BiPAP
- Continuous pulse oximetry with alarms set
- Head-up position in bed. Avoid the supine position
- Patient brings their CPAP machine if used
- Controlled supplemental oxygen
The OSA challenge…

- Lack of good guiding evidence
- An important issue
- Be aware
- Make a plan: pre, intra and postop
- Minimise opioids, sedatives
- Maximise non-opioids