TITLE: Post-Operative Monitoring Equipment in Patients with Sleep Apnea: A Review of Clinical Effectiveness and Guidelines

DATE: 14 May 2015

CONTEXT AND POLICY ISSUES

Sleep apnea is a prevalent breathing disorder, and obstructive sleep apnea (OSA) is the most common form of sleep apnea. OSA is characterized by recurrent partial or complete blockage of the upper airway during sleep, resulting in apneas (cessation of breathing for at least 10 seconds) and hypopneas (a greater than 50% reduction in airflow for at least 10 seconds). Untreated OSA is associated with oxygen desaturation, hypercapnia and cardiac complications, any of which may lead to cardiac arrest and death. In the general adult population, the prevalence of OSA was estimated at approximately 20%, while a higher rate was reported in surgical patients undergoing elective surgery (24% to 41%). According to the findings from a Canada-wide survey in 2009, approximately 3% of Canadians adults (18 years and older) had a diagnosis of sleep apnea, while 26% of Canadian adults were considered at high risk for having OSA. In children, a 1% to 4% prevalence rate for OSA was reported in previous research. The vast majority of OSA patients are undiagnosed prior to surgery (over 80% was reported in the literature). It, therefore, is recognized as a significant perioperative problem for these patients. Previous studies have indicated that patients with OSA have higher incidences of postoperative complications (e.g. pulmonary, cardiac and neurological) following most surgical procedures and corresponding higher risk of unplanned intensive care unit (ICU) admissions, longer ICU durations or longer hospital stay. In addition, these patients are sensitive to the respiratory depressant effects of anesthetic drugs, especially opioid analgesic agents. Severe respiratory depression and even death were reported after the use of morphine in case reports.

Postoperative monitoring, such as continuous cardiopulmonary and oxygen saturation monitoring for patients with OSA, is an essential component of the perioperative management strategy. For patients with severe OSA who have undergone major surgical procedures where parenteral narcotics are required after the surgery, continuous monitoring of the respiratory status, such as continuous pulse oximetry and continuous capnography, should be provided.
This report will review the evidence of clinical effectiveness of postoperative monitoring equipment in patients with sleep apnea, and the guidance on postoperative monitoring in the study population from the clinical practice guidelines.

**RESEARCH QUESTIONS**

1. What is the clinical effectiveness of post-operative monitoring equipment in patients with sleep apnea?
2. What are the evidence-based guidelines associated with post-operative monitoring equipment in patients with sleep apnea?

**KEY FINDINGS**

There was no evidence identified to assess the clinical effectiveness of post-operative monitoring equipment in patients with sleep apnea. Two evidence-based guidelines recommended post-operative monitoring in patients with sleep apnea: one recommended post-operative monitoring with continuous pulse oximetry in adult and pediatric patients with increased risk of respiratory compromise from obstructive sleep apnea; a second guideline that focused on pediatric patients recommended that after the surgery, high-risk patients should be hospitalized overnight for close monitoring, but it did not provide any explicit guidance on the use of postoperative monitoring.

**METHODS**

**Literature Search Methods**

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the results by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2010 and April 15, 2015.

Rapid Response reports are organized so that the evidence for each research question is presented separately.

**Selection Criteria and Methods**

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Selection Criteria</th>
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<tbody>
<tr>
<td><strong>Population</strong></td>
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<td><strong>Intervention</strong></td>
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<td><strong>Comparator</strong></td>
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## Outcomes

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Question 1: clinical effectiveness (benefits and harms)</th>
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<tr>
<td></td>
<td>Question 2: guidelines for monitoring postoperative patients</td>
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## Study Designs

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<tr>
<td>Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials (RCTs), observational studies, and evidence-based clinical practice guidelines.</td>
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## Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, were duplicate publications, or were published prior to 2010. Review articles that did not use a systematic review approach were excluded from the report. Clinical trials investigating the overall effect of a postoperative monitoring protocol instead of individual effect of specific monitoring equipment were excluded. Guidance documents or consensus statements were excluded if a description of the methodology used in formulating the recommendations were not reported or were not clearly evidence-based.

## Critical Appraisal of Individual Studies

Guidelines were assessed using the AGREE II instrument. Numeric scores from these tools were not calculated for the included studies; rather, the strengths and limitations of each included study were described.

## SUMMARY OF EVIDENCE

### Quantity of Research Available

A total of 183 citations were identified in the literature search. Following screening of titles and abstracts, 168 citations were excluded and 15 potentially relevant reports from the electronic search were retrieved for full-text review. No potentially relevant publications were retrieved from the grey literature search. Of these potentially relevant articles, 13 publications were excluded for various reasons, while two evidence-based clinical practice guidelines met the selection criteria and were included in this report. No relevant health technology assessments, systematic reviews or meta-analyses, randomized controlled trials or non-randomized studies were identified. Appendix 1 describes the PRISMA flowchart of the study selection.

Additional references of potential interest are provided in appendix 4.

## Summary of Study Characteristics

The details of the study characteristics are located in Appendix 2.

Two evidence-based guidelines from the United States provided recommendations on the postoperative monitoring of patients with OSA.

In 2014, the American Society of Anesthesiologists (ASA) Task Force updated its previous guideline published in 2006 and provided recommendations for both pediatric and adult patients with OSA. A systematic review literature search was performed to identify new scientific evidence since the completion of the original guideline. In addition, a survey was conducted in
expert consultants and ASA members on the effectiveness of various perioperative management strategies. The identified literature and survey responses were graded and recommendations were developed based upon consensus.

Another guideline published in 2012 was developed by the American Academy of Pediatrics (AAP) and focused on children and adolescents with uncomplicated childhood OSA, which was defined as OSA associated with adenotonsillar hypertrophy and/or obesity in an otherwise healthy child. The AAP guideline was an update of its previous guideline published in 2002. Recommendations from this guideline were based on the evidence from a systematic literature search.

**Summary of Critical Appraisal**

The details of the critical appraisal of the included guidelines are summarized in Appendix 3.

The ASA guideline had a well-defined scope and purpose, involved national organizations representing most specialties that provide care for patients with OSA, was rigorous in its methodology for development, but did not describe a procedure for future update on the current guideline. The recommendations were explicit and identifiable. The guideline did, however, have some limitations with respect to its applicability as it did not describe barriers or facilitators to implementation or application. The recommendations in the ASA guideline were developed based on evidence from observational studies and case reports.

The AAP guideline explicitly defined its scope, target population and purpose. A description of the evidence grading was reported and a link to the recommendations was provided. The benefits-harms balance was considered when formulating the recommendations. The target population excluded infants younger than one year of age, patients with OSA associated with other medical disorders, such as Down syndrome, neuromuscular disease and chronic lung disease. Uncomplicated OSA was the focus of this guideline. It did not provide detailed guidance on how to monitor children with OSA after the surgery. Evidence used for formulating recommendations was graded as B (RCTs with minor limitations, or overwhelmingly consistent evidence from observational studies).

**Summary of Findings**

1. **What is the clinical effectiveness of post-operative monitoring equipment in patients with sleep apnea?**

No studies on the clinical evidence regarding the benefits and harms of postoperative monitoring equipment in adult and pediatric patients with sleep apnea were identified.

2. **What are the evidence-based guidelines associated with post-operative monitoring equipment in patients with sleep apnea?**

With respect to post-surgical monitoring, the ASA guideline recommends the following:

   "Hospitalized patients who are at increased risk of respiratory compromise from OSA should have continuous pulse oximetry monitoring after discharge from the recovery room. [Category B3-B]"
Continuous monitoring may be provided in a critical care or stepdown unit, by telemetry on a hospital ward, or by a dedicated, appropriately trained professional observer in the patient’s room. (p.274)

Continuous monitoring should be maintained as long as patients remain at increased risk. If frequent or severe airway obstruction or hypoxemia occurs during postoperative monitoring, initiation of nasal CPAP or NIPPV should be considered.” (p.274 and p.276) A footnote in this guideline indicated that “intermittent pulse oximetry or continuous bedside oximetry without continuous observation does not provide the same level of safety”. (p.274 and p.276)

In the AAP guideline, the following recommendations are provided:

“High-risk patients should undergo surgery in a center capable of treating complex pediatric patients. They should be hospitalized overnight for close monitoring post-operatively.

Children with an acute respiratory infection on the day of surgery, as documented by fever, cough, and/or wheezing, are at increased risk of postoperative complications and, therefore, should be rescheduled or monitored closely postoperatively.” [Grade B evidence, “Recommendation”] (p.581)

Higher risk patients was defined as “younger than 3 years of age, severe OSA on polysomnography, cardiac complications of OSA, failure to thrive, obesity, craniofacial anomalies, neuromuscular disorders and current respiratory infection”. (p.581)

Limitations

The literature search did not identify health technology assessments, systematic reviews, RCTs or observational studies regarding the clinical effectiveness of postoperative monitoring equipment in patients with sleep apnea.

The two included evidence-based guidelines were methodologically rigorous. Methods for formulating recommendations were provided and the links between levels of evidence and recommendations were explicit. The recommendations of one guideline, however, were not sufficient in guiding the postoperative monitoring in the target population.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

The evidence of the clinical effectiveness of postoperative monitoring equipment in patients with sleep apnea was not identified.

One guideline provided recommendations on adult and pediatric patients with obstructive sleep apnea. Continuous pulse oximetry monitoring is recommended for patients with increased risk of respiratory compromise from the condition; and the monitoring should be maintained as long as patients remained at increased risk. A second guideline that focused on pediatric patients recommended that after the surgery, high-risk patients should be hospitalized overnight for close monitoring, but it did not provide any explicit guidance on the use of postoperative monitoring. Both guidelines were conducted in the United States, possibly limiting the generalizability to the Canadian healthcare setting.
REFERENCES

1. Hensley M, Ray C. BMJ Clinical Evidence [Internet]. Sleep apnoea; 2008 [cited 2015 May 7].


APPENDIX 1: Selection of Included Studies

183 citations identified from electronic literature search and screened

168 citations excluded

15 potentially relevant articles retrieved for scrutiny (full text, if available)

0 potentially relevant reports retrieved from other sources (grey literature, hand search)

15 potentially relevant reports

13 reports excluded:
- irrelevant intervention (4)
- irrelevant outcomes (2)
- irrelevant study designs (7)

2 reports included in review
### APPENDIX 2: Characteristics of Included Evidence-Based Guidelines

<table>
<thead>
<tr>
<th>Target Population</th>
<th>Scope, Purpose, Country of Origin</th>
<th>Evidence Collection, Selection and Synthesis</th>
<th>Evidence Quality and Strength of Recommendation</th>
<th>Formulation of Recommendations</th>
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<tr>
<td><strong>American Society of Anesthesiologists 2014</strong></td>
<td>Inpatients and outpatients, both pediatric and adult patients receiving sedation, analgesia or anesthesia for diagnostic or therapeutic procedures.</td>
<td>Scientific evidence-based: review of literature published after the previous guideline; Opinion-based: survey to the expert consultants and ASA members. Categorization and grading of evidence.</td>
<td><strong>Scientific evidence-based</strong>&lt;br&gt;Category A – RCT with comparative findings&lt;br&gt;Category B – Observational studies or RCTs without pertinent controls&lt;br&gt;&lt;br&gt;<strong>Opinion-based</strong>&lt;br&gt;Category A – Expert opinion&lt;br&gt;Category B – Membership opinion&lt;br&gt;Category C – Informal opinion</td>
<td>The task force included anesthesiologists, surgeon, otolaryngologist and methodologists. Developed via a multistep process that included consensus on literature selection and summary, expert consultation, input on draft recommendations, and survey and consensus building for finalization of the Guidelines.</td>
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<td><strong>American Academy of Pediatrics 2012</strong></td>
<td>Children and adolescents with uncomplicated childhood OSA.</td>
<td>Systematic literature search, selection of evidence and grading of evidence.</td>
<td><strong>Levels of evidence and related recommendations</strong>&lt;br&gt;Grade A – well designed RCTs or diagnostic studies on relevant population&lt;br&gt;Grade B – RCTs or diagnostic studies with minor limitations; overwhelmingly consistent evidence from observational studies&lt;br&gt;Grade C – observational studies(case-control or cohort)&lt;br&gt;Grade D – expert opinion, case reports, reasoning from first principles&lt;br&gt;Grade X – exceptional situations</td>
<td>Developed by multidiscipline team comprised of pediatricians, other experts in sleep medicine, pulmonology and otolaryngology, and epidemiologists.&lt;br&gt;Guideline was developed after evidence was identified, appraised and summarized. An explicit link between evidence and recommendations was defined.</td>
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<tr>
<td>excluded. United States</td>
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<td>where validating studies cannot be performed and there is a clear preponderance of benefit or harm</td>
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<td>“Strong recommendation” when A or B presented; sometimes X presented;</td>
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<td>“Recommendation” when B or C presented; sometimes when D presented;</td>
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<td>“Option” when D presented;</td>
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OSA=obstructive sleep apnea; RCT=randomized controlled trial
### APPENDIX 3: Critical Appraisal of Included Evidence-Based Guidelines

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<tr>
<th>First Author, Publication Year</th>
<th>Strengths</th>
<th>Limitations</th>
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<tr>
<td>American Society of Anesthesiologists, 2014&lt;sup&gt;14&lt;/sup&gt;</td>
<td>• Overall objective is explicit&lt;br&gt;• Population to whom the guideline is meant to apply is specifically described&lt;br&gt;• Relevant professional groups included in guideline development&lt;br&gt;• Target users of the guideline defined&lt;br&gt;• Systematic methods used for literature search&lt;br&gt;• Selection criteria for the evidence is described&lt;br&gt;• Strengths and limitations of the body of evidence is described&lt;br&gt;• Method for formulating recommendations clearly described.&lt;br&gt;• Health benefits, side effects, risks considered in formulating recommendations&lt;br&gt;• Explicit link between recommendations and supporting literature&lt;br&gt;• External review of guideline by experts&lt;br&gt;• Specific and unambiguous recommendations&lt;br&gt;• Recommendations easily identifiable&lt;br&gt;• Competing interests of develop group members stated (none)</td>
<td>• Unclear if views and preferences of the target population were sought&lt;br&gt;• Did not provide procedure for updating guidelines in the future&lt;br&gt;• Did not describe facilitators and barriers to application of guideline&lt;br&gt;• Did not provide tools and advice for implementation&lt;br&gt;• Did not consider resource implications of applying recommendations&lt;br&gt;• Unclear if views of the funding body would influence the content of guideline</td>
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<td>American Academy of Pediatrics, 2012&lt;sup&gt;16&lt;/sup&gt;</td>
<td>• Overall objective is described&lt;br&gt;• Health questions covered by guideline specifically described&lt;br&gt;• Population to whom the guideline is meant to apply is specifically described&lt;br&gt;• Relevant professional groups included in guideline development&lt;br&gt;• Views and preferences of the target population were sought&lt;br&gt;• Target users of the guideline is defined&lt;br&gt;• Systematic methods used for literature search&lt;br&gt;• Selection criteria for the evidence is described&lt;br&gt;• Strengths and limitations of the body of evidence is described&lt;br&gt;• Method for formulating recommendations is described.&lt;br&gt;• Health benefits and harms were considered in formulating recommendations&lt;br&gt;• Explicit link between recommendations and supporting literature&lt;br&gt;• Recommendations easily identifiable</td>
<td>• The target population is uncomplicated OSA only&lt;br&gt;• Non-English language literature was excluded from the evidence base&lt;br&gt;• Did not provide procedure for updating guidelines in the future&lt;br&gt;• Limited guidance on postoperative monitoring was provided – unclear what should be done and how&lt;br&gt;• Unclear if the guideline was externally review</td>
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<tr>
<td>First Author, Publication Year</td>
<td>Strengths</td>
<td>Limitations</td>
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<td></td>
<td>• Description of facilitators and barriers to application of guideline</td>
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<td>• Resource implications of applying recommendations considered</td>
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<td></td>
<td>• Competing interests of develop group members stated (none)</td>
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</table>
APPENDIX 4: Additional References of Potential Interest


- Guidelines for the perioperative care of adult obstructive sleep apnea patients. Kingston (ON): Queen's University Department of Anesthesiology and Perioperative Medicine; 2013.