Perioperative management of adult and pediatric sleep apnoea

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**Abstract**

Among the various diseases required to be screened preoperatively obstructive sleep apnoea (OSA) is one of the most underdiagnosed conditions. The various screening tools devised to prevent OSA related postoperative complications are: Berlin questionnaire, STOP-BANG questionnaire, American Society of Anesthesiologist checklist and Perioperative Sleep Apnea Prediction Score. Among these, the STOP-BANG questionnaire is validated, sensitive, specific and viable and can be self administered. Portable sleep study is the most practicable approach to confirm the diagnosis preoperatively in suspected cases. Continuous positive airway pressure (CPAP) administration is recommended for reducing the risk of complications related to OSA during post and or pre operative period although; the data describing the impact of CPAP therapy on adverse outcomes are limited. Also, close monitoring of patients postoperatively; avoiding use of sedatives and awake extubation are important components of postoperative care. Using CPAP in pre and or postoperative period can not only reduce the postoperative complication but also diagnose and sensitize the patients towards the long term management of OSA. The perioperative management of pediatric OSA is also similar to adult OSA, though clinically both are different.

**Keywords**: Excessive daytime sleepiness (EDS), obstructive sleep apnea (OSA), continuous positive airway pressure (CPAP), apnea hypopnea index (AHI)

**Introduction**

Obstructive sleep apnoea (OSA) needs to be recognized by anesthesiologist because it is not only more common in surgical patients than in the general population but also leads to increased perioperative morbidity and mortality. Guidelines have been developed for identifying and managing the patients of OSA prior to surgery however it needs to be followed and pulmonologist are required work in tandem and guide the anesthesiologist so that more and more snorers are identified and prevented from the risk of going under the knife.

**Prevalence of OSA in general population and preoperative patients**

It has been estimated that over 5% of middle aged adults and 24% adults above 65 years have OSA. Eighty percent cases of OSA remain undiagnosed. Prevalence of OSA in adult Indian population is reported to be approximately 3.5% i.e. 34 million people in India.
may be suffering from OSA. A recent study evaluating the prevalence of OSA in general surgical patients undergoing elective non-upper airway surgery has been estimated to be about 22%. The study has also noted that 70% of patients were undiagnosed before presentation for perioperative evaluation. Another study has demonstrated prevalence of OSA in surgical population to be 3.2%. This study however had excluded patients undergoing cardiac surgery, in whom the risk of OSA is higher. Prevalence of OSA among obese bariatric surgery patients is more than 70%. Thus, though various studies have reported different prevalence of OSA in surgical populations, it appears that patients undergoing surgery have a higher prevalence of OSA.

### Postoperative complications due to OSA

OSA has been shown to increase the need for intensive care intervention and prolongs the hospital stay. The complications usually occur during the first day after surgery, a small number may occur as late as postoperative days 4 and 5. The commonest complications are episodic hypoxemia and unplanned intensive care unit (ICU) transfer seen in about 33% of patients with OSA. Serious complications like cardiac ischemia, respiratory failure and even death have been shown to occur in up to 24% of patients. The patients may even suffer from delirium. The complications during postoperative period related to OSA are summarized in table 1.

### Pathophysiology of perioperative complications in OSA

Upper airway collapse during sleep in OSA is due to the interplay of upper airway narrowing, abnormal muscle tone and genetic predisposition. Upper airway narrowing, a key feature of OSA may lead to difficult intubation during intraoperative period. Consequences of OSA i.e. nocturnal hypoxemia, rapid eye movement (REM) sleep deprivation, and severe sleep fragmentation are believed to cause complications in the immediate and late postoperative period. (flow chart 1) Predictably, anesthetics abolish or blunt arousal from sleep, an important defense mechanism that occurs during natural sleep to overcome airway obstruction leading to prolonged hypoxemia. Anesthetic agents such as pentothal, propofol, opioids, benzodiazepines, and inhaled halogenated agents also reduce the tone of the pharyngeal musculature leading to increased propensity for upper airway collapse. These agents and opioids used for pain control also increase the risk of respiratory depression. In a study assessing the ventilator response to carbon dioxide, apneic episodes were increased by up to 50% after modest doses of fentanyl (0.5 µg/kg). REM rebound in the postoperative period due to OSA and disturbed sleep in hospital are known to compound respiratory and cardiovascular complications as most apneas and hypopneas occur in the REM stage. Neurological complication like delirium is also due to rebound of REM sleep.

### Table 1: Postoperative Complications Related to OSA

**Respiratory**
- Difficult intubation
- Reintubation
- Acute hypercapnia
- Episodic hypoxemia
- Atelectasis
- Pulmonary oedema
- Bronchospasm
- Laryngospasm

**Cardiovascular**
- Intraoperative hypertension
- Myocardial infarction
- Myocardial ischemia
- Arrhythmia
- Hypotension

**Neurological**
- Delirium

**Miscellaneous**
- GI bleeding
- Unanticipated admission to the ICU
- Sudden unexpected death
- Longer posanaesthesia recovery

Flow chart 1: Consequences of OSA
Screening of OSA

The various screening tools devised to detect the OSA cases at risk for post operative complications are: Berlin questionnaire, STOP-BANG questionnaire, American Society of Anesthesiologist (ASA) checklist and Perioperative Sleep Apnea Prediction Score (PSAP). The screening tools combine the risk factors, symptoms, signs and consequences of OSA. Since the screening is usually performed by the anesthesiologist the screening tool should be simple and non-time consuming keeping in mind the sensitivity and specificity. The comparison of the available tools is given in table 2. The best screening tool is sensitive and specific yet easy to execute. The STOP-BANG questionnaire is validated, sensitive, specific and feasible and can be even be self administered. The scheme of perioperative evaluation and management if the questionnaire is positive is given in chart 2.

Diagnosis of OSA

High pretest probability on screening tools preoperatively is an indication for diagnostic evaluation. The diagnostic evaluation confirms OSA and helps in categorizing the severity of OSA for determining OSA scoring system (described in the next paragraph). The diagnosis of OSA and its severity is facilitated by the guidelines given in box 1. American Academy of Sleep Medicine has

### Table 2: Comparison of various questionnaires

<table>
<thead>
<tr>
<th>Development of screening tool</th>
<th>Berlin questionnaire</th>
<th>STOP-BANG Questionnaire</th>
<th>American society of anesthesiologist (ASA) checklist</th>
<th>Perioperative apnoea prediction score (PAPS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td>3 categories of questions and category 1 and 2 questions are answered in 2-5 options. Category 1- Snoring and its detail, Category 2- excessive day time sleepiness, Category 3- BP &amp; BMI.</td>
<td>The following questions are given to the patients, the answers of which are in yes and no S- Snoring T- Tiredness O- Observed apnoea P- Blood pressure B- BMI &gt; 35 Kg/m² A- &gt;50 years N- &gt;40 cm G- gender, male</td>
<td>3 categories of questions and there are multiple questions in each category Category 1- Predisposing factors like BMI, neck circumference, Category 2- history suggestive of upper airway obstruction like snoring, observed apnoea. Category 3- history suggestive of excessive day time somnolence</td>
<td>3 demographic variables: age &gt; 43 years, male gender, and obesity; 3 history variables: history of snoring, type 2 diabetes mellitus, and hypertension; 3 airway measures: thick neck, modified Mallampati class 3 or 4, and reduced thyromental distance</td>
</tr>
<tr>
<td>Score indicating high probability</td>
<td>Two of the categories should be positive</td>
<td>≥3 yes</td>
<td>Two of the categories should be positive</td>
<td>The exact score not yet being decided</td>
</tr>
<tr>
<td>Feasibility</td>
<td>Many variables included with complexity of permutation combination</td>
<td>Easy to remember and execute</td>
<td>Not many variables included but complex in its execution because of permutation combination</td>
<td>Easy to remember and execute</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>&gt;85 % for severe OSA</td>
<td>&gt;90 %</td>
<td>&gt;76 % for severe OSA</td>
<td>Score ≥2 93 %, ≥6 23 %</td>
</tr>
<tr>
<td>Specificity</td>
<td>46%</td>
<td>63 %</td>
<td>36%</td>
<td>Score ≥2 32 %, ≥6 91 %</td>
</tr>
</tbody>
</table>
The portable monitoring task force of the American Academy of Sleep Medicine has recommended that portable monitoring i.e. type 2 or 3 study (unattended) may be used as an alternative to PSG for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA. Though, type 4 devices have not been indicated for the diagnosis of OSA, a prospective randomized clinical trial by Drummond and colleagues have found symptomatic improvement of daytime sleepiness and sleep-related quality of life with the initiation of empiric Auto-adjusting continuous positive airway pressure (Auto-PAP) therapy in patients with a high likelihood of having OSA while they were awaiting diagnostic laboratory-based PSG. Thus, depending on the availability of the diagnostic test and probability of OSA based on initial assessment the type of sleep study performed varies. Similarly, the diagnostic evaluation of OSA in preoperative cases may also vary. The likelihood of delay in the surgery, the inconvenience, and the high cost of laboratory test makes home-based unattended portable screening devices with cardiorespiratory monitor (type 2 or 3) a preferred choice over type 1 study.

**Box 1:** Diagnostic Criteria and severity grading for OSA

**Diagnostic criteria**

A. EDS* not better explained
   - Choking or gasping during sleep
   - Recurrent awakenings from sleep
   - Unrefreshing sleep
   - Daytime fatigue
   - Impaired concentration

B. 2 or > of the following not better explained
   - Choking or gasping during sleep
   - Recurrent awakenings from sleep
   - Unrefreshing sleep
   - Daytime fatigue
   - Impaired concentration

C. PSG** showing AHI*** > 5 in adults and >1 in children

OSA must fulfill A or B, plus criterion C

**Severity Grading of OSA**

<table>
<thead>
<tr>
<th>AHI /hour</th>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>5–15</td>
<td>2-4</td>
</tr>
<tr>
<td>Moderate</td>
<td>15–30</td>
<td>5-9</td>
</tr>
</tbody>
</table>

*EDS: Excessive daytime sleepiness
**PSG: Polysomnography
***AHI: Apnoea hypopnoea index

**Flow Chart 2:** Preoperative Assessment For Suspected OSA

**Box 2:** Type of sleep study

- **Neurological**
  - EEG
  - EOG
  - EMG

- **Cardio-Respiratory**
  - ECG/heart rate
  - Snoring
  - Thoraco-abdominal movements
  - Airflow
  - Oximetry

- **Type 1** - Standard polysomnography (PSG) with a minimum of 7 parameters measured i.e. EEG, EOG, chin EMG, and ECG, airflow, respiratory effort, and oxygen saturation.

- **Type 2** - Comprehensive portable PSG (unattended) essentially same as type 1, except that a heart rate monitor can replace the ECG.

- **Type 3** - Modified portable sleep apnea, (unattended) minimum of 4 parameters, including ventilation (at least two channels of respiratory movement, or respiratory movement and airflow), heart rate or ECG, and oxygen saturation.

- **Type 4** - Continuous (single or dual) bioparameter recording, measures a minimum of one parameter, usually oxygen saturation.

*Note:* A technician is in constant attendance in type 1 study; the other types i.e. type 2, 3 and 4 are unattended.

Portable Monitoring Task Force of the American Academy of Sleep Medicine has recommended that portable monitoring i.e. type 2 or 3 study (unattended) may be used as an alternative to PSG for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA. Though, type 4 devices have not been indicated for the diagnosis of OSA, a prospective randomized clinical trial by Drummond and colleagues have found symptomatic improvement of daytime sleepiness and sleep-related quality of life with the initiation of empiric Auto-adjusting continuous positive airway pressure (Auto-PAP) therapy in patients with a high likelihood of having OSA while they were awaiting diagnostic laboratory-based PSG. Thus, depending of the availability of the diagnostic test and probability of OSA based on initial assessment the type of sleep study performed varies. Similarly, the diagnostic evaluation of OSA in preoperative cases may also vary. The likelihood of delay in the surgery, the inconvenience, and the high cost of laboratory test makes home-based unattended portable screening devices with cardiorespiratory monitor (type 2 or 3) a preferred choice over type 1 study.
**OSA Scoring system (box 3)**

Preoperatively diagnosed OSA should then be subjected to American Society of Anesthesiologists (ASA) scoring checklist for OSA. The scoring estimates the overall perioperative risk by combining (A) severity of OSA and (B) invasiveness of the surgery or (C) requirement of opioids. The severity of OSA is scored 1, 2 and 3 if OSA is mild, moderate and severe respectively. Major surgery or upper airway surgery under general anesthesia and high dose of opioid requirement are scored 3. The overall score is the score for A plus the greater of the score for either B or C i.e. the maximum score is 6. Patients with score of 4 may be at increased perioperative risk from OSA; patients with a score of 5 or 6 may be at significantly increased perioperative risk from OSA. One point may be subtracted if a patient has been on continuous positive airway pressure (CPAP) before surgery. One point is added if a patient with has a resting arterial carbon dioxide tension (PaCO2) greater than 50 mmHg.

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**Perioperative management in cases of OSA to reduce the postoperative complication**

The perioperative management can be divided into preoperative, intraoperative and postoperative management.

**Preoperative management**

Preoperative evaluation consists of airway examination and identifying comorbidities such as hypertension, diabetes mellitus, and congestive heart failure. Patients who are diagnosed with OSA after PSG testing should be treated with preoperative CPAP, especially if OSA is severe. Although limited data support the routine preoperative use of CPAP, preoperative familiarization and adjustment to CPAP may be beneficial by increasing the likelihood of successful postoperative use. Patients who are already on CPAP therapy should continue to use the same settings.

**Intraoperative management**

Intraoperative concerns in patients at increased perioperative risk from OSA include (1) choice of anesthetic technique, (2) patient monitoring, and (3) airway management.

Regional, spinal and epidural anesthesia is preferred over general anesthesia. General anesthesia is preferred over deep sedation. If general anesthetic is given, shorter-acting agents that allow for a more rapid restoration of consciousness and a more rapid return to baseline respiratory function should be used. If sedation is essential ultra short acting opioids i.e. remifentanil is preferred drug of choice. Deep sedation is avoided at all cost while for moderate sedation, continuous monitoring preferably by capnography is recommended. CPAP should be used during sedation if the patient is previously treated with the same.

Invasive arterial BP monitoring may be necessary if noninvasive BP monitoring is inaccurate or impossible because of associated morbid obesity. Preoxygenation with 100% oxygen and CPAP at 10 cm H₂O for 3 to 5 min in 25° head-up position prior to general anesthesia has been shown to be beneficial in predisposed individuals.
OSA may also predispose to difficult tracheal intubation due to upper airway abnormalities especially in patients with greater Mallampati score, anterior mandibular depth, and smaller mandibular and cervical angles.47, 48, 49, 50 Awake fiberoptic intubation may be required in such cases, one must however use topical anesthesia with caution during awake intubation as it further impairs upper airway protective reflexes.51, 52 Difficult airway management guidelines should be followed whenever needed.53 The extubation should be carried out only when the patient is awake, after verifying reversal of neuromuscular block in non supine position.16

**Postoperative management**

Use of supplemental oxygen may increase the duration of apneic episodes and may hinder detection of atelectasis, transient apnea, and hypoventilation, thus providing only oxygen therapy during hypoxic event should be avoided.4 CPAP remains the most preferred therapy for OSA as it causes pneumatic splint and prevents upper airway collapse.4 CPAP or noninvasive positive-pressure ventilation (NIPPV), with or without supplemental oxygen, should be continuously administered when feasible to patients who were using these modalities preoperatively, unless contraindicated by the surgical procedure.4 In other patients with high risk of developing postoperative complication it is preferable to use CPAP postoperatively, however there are inadequate trials to confirm its use routinely.4 One small study however has shown a reduction in postoperative complications in patients who used CPAP therapy preoperatively, on extubation, and nearly continuously for 24 to 48 h after surgery.54 If CPAP is not feasible, close pulse oximetry monitoring and a standby CPAP are obligatory.14 Auto-PAP devices present an attractive alternative in the perioperative setting when optimal CPAP settings may not be available or are difficult to determine.56 Alternatively CPAP pressure may be given based on body mass index (BMI) at 8, 10, 12 cm H2O for BMI<30/Kg m2, 30-35/Kg m2 and BMI>35/Kg m2 respectively.57 It has been observed that the postoperative complications are low in patients with OSA on established home CPAP but are not put on CPAP postoperatively, possibly because of decreased inflammation or edema of the upper airway, decrease tongue size, as well as increased upper airway volume and stability.58

It is preferable to keep the patient in non supine position postoperatively to reduce the risk of upper airway collapse.59 Continuous monitoring should be maintained as long as patients remain at increased risk. Use of opioid analgesic is avoided for postoperative analgesia. Instead non steroid anti inflammatory drugs and analgesic adjuncts such as ketamine and dexmedetomidine which keep the respiratory drive intact with sedative and analgesic properties are preferred.60 Nonopioid analgesics, local anaesthetics or when feasible, continuous regional anaesthesia using a catheter are useful alternative to opioids.61

It is recommended that during postoperative period the high risk patients should be observed for longer duration than those without OSA. Also, in addition to standard outpatient discharge criteria, room air oxygen saturation should return to its baseline and remain normal for a median of 7 h after the last episode of airway obstruction or hypoxemia while breathing room air in an unstimulating environment.6

**Preoperative evaluation of pediatric OSA**

Children with OSA are also at higher anesthetic risk in the perioperative period than those with normal upper airways. The rate of complications in children range from 6.4% to 27% depending on age, severity of OSA, uniformity of diagnosis, and comorbidities.61, 62, 63, 64, 65 Children <3 year of age are at twice the risk than 3-6 yr old children.65 Complications include oxygen desaturation <90%, increased work of breathing and changes on a chest radiograph (edema, atelectasis, infiltrate, pneumothorax, pneumomediastinum, or pleural effusion).66, 67, 68 Snoring as a screening tool is sensitive in 91% and specific in 75% of pediatric OSA.69 OSA otherwise presents differently in young children than it does in teenagers and adults. Adults and teenagers with OSA are often obese and have daytime somnolence; younger children may have normal weight or failure to thrive and behavior disorders such as hyperactivity, attention problems, and enuresis.70, 71 Unlike adults the common predisposing factors for OSA in children are adenotonsillar hypertrophy and craniofacial abnormalities. Diagnostic criteria for polysomnography are also different as cutoff for apnea hypopnea index in children is 1/ hr.72 The perioperative management strategies in children are however similar to adults. Children with very severe
OSA who are at risk for persistent OSA and those with cardiovascular complications from OSA should be considered for preoperative CPAP/BiPAP therapy. The other management strategies which apply to adult OSA are also important for managing pediatric OSA i.e. judicious use of opioids, close monitoring in the postoperative period and awake extubation.

To conclude, it is important to increase the awareness about postoperative complications due to OSA as it is one of the most underrecognized conditions. Easy screening with a self administered questionnaire, evaluation by portable sleep study and optimal screening with a self administered questionnaire, one of the most underecognized conditions. Easy about postoperative complications due to OSA as it is postoperative period and awake extubation.

i.e. judicious use of opioids, close monitoring in the postoperative period and awake extubation. OSA are also important for managing pediatric OSA and in normal subjects. 

References


