Academic Medical Center | Patient Safety Organization
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Patient Safety Alert: Obstructive Sleep Apnea - Management Considerations

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The Academic Medical Center Patient Safety Organization (AMC PSO) recently convened its member opinion leaders from multiple disciplines to share their expertise regarding patient safety issues relevant to postoperative management of sleep apnea. Participants analyzed a representative case and discussed existing guidelines, strategies, and emerging technologies that complement existing management protocols. The AMC PSO sponsored this meeting to propagate CRICO's established mission of helping health care providers turn credible patient safety data into effective action.

CASE REVIEW

Background

A young adult enters a regional hospital for a scheduled outpatient minor procedure. The patient's past medical history included sleep disordered breathing, snoring, adenotonsillar hypertrophy, and obesity. Preoperative vitals were within normal limits including room-air oxygen saturation of 100%. The patient tolerated the procedure well and was managed postoperatively with narcotic analgesics and discharged home on oral narcotic preparation with typical dose and frequency instructions.

Approximately 12 hours after discharge, the patient was rushed to a local hospital suffering a cardiac arrest. Upon successful resuscitation, the patient was transferred to a higher level of care where they arrested again approximately 2 hours later. Subsequent resuscitative measures were unsuccessful.

Patient Safety Review

An analysis of this case highlights the difficulties in treatment of patients at risk for postoperative complications from undiagnosed sleep apnea. In this case, a minimal amount of narcotics and anesthetic agents were administered during and after the patient's surgery. Additionally, the patient met all criteria for discharge from both the post-anesthesia care unit and the second stage recovery area. There were no early warning signs or indications that the patient would have difficulties postoperatively or have any difficulty concerning use of postoperative pain medication. It is unknown, however, how much pain medication the patient ingested after discharge.

OVERVIEW OF SLEEP APNEA

Obstructive sleep apnea (OSA) presents a significant risk factor in both adult and pediatric surgical patients as individuals with OSA may be more vulnerable to adverse events during the perioperative period. Complications can specifically arise when patients with OSA receive sedatives, such as opioid analgesia or general analgesia (Loadsman and Hillman, 2001; Chung, Yuan and Chung, 2008; Finkel, Searleman, Tymkew et al., 2009). Specifically, these medications can diminish the protective arousal reflex triggered by bouts of hypoxia, thereby increasing the risk for prolonged periods of apnea and respiratory arrest. In addition, narcotics and sedatives often decrease pharyngeal muscle tone which can worsen existing OSA by increasing upper airway resistance (Boushra, 1996).

Outcome studies on specific surgical populations have shown that patients with OSA have a higher incidence of postoperative adverse events, such as unplanned ICU admissions, longer ICU durations, longer hospital stay, postoperative encephalopathy, and infection. OSA is also associated with numerous comorbidities such as diabetes, hypertension, stroke, heart failure, and coronary artery disease.

All of these OSA-related adverse events appear more likely to occur when surgical teams are unaware of an OSA diagnosis, or the patient's OSA has never been diagnosed. Thus, the effective use of OSA screening tools would seem logical for decreasing morbidity, mortality, and healthcare costs in the surgical setting, but remains unproven.

Definition

Adult Obstructive Sleep Apnea (OSA) is a clinical sleep disorder characterized by repetitive, periodic, partial or complete obstruction of the upper airway during sleep with episodes of breathing cessation lasting for more than 10 seconds (Aloia, Arnedt, Davis et al., 2004; Gross, Bachenberg, Benumof et al., 2006; Chung, Yuan, and Chung, 2008). The Apnea-Hypopnea Index (AHI) is an hourly measure of apneic episodes of >10 seconds associated with hypoxia that occur during nightly sleep. The cessations of inhalation created by the upper airway narrowing during OSA frequently result in a state of hypoxemia, creating increased respiratory effort and arousals from sleep to resume breathing (Aloia, Arnedt, Davis et al., 2004). The hypoxemia associated with OSA may also produce episodic hypercarbia and cardiovascular dysfunction.

Pediatric Obstructive Sleep Apnea, which manifests many of the same characteristics as adult OSA, is properly diagnosed via polysomnography in conjunction with patient history and physical examination. Importantly, use of the AHI as criterion for the interpretation of polysomnography continues to vary widely. Other diagnostic tests, including nocturnal video recording, nocturnal oximetry, daytime nap polysomnography, or ambulatory polysomnography, should be employed when traditional polysomnography is not available (Marcus et al., 2012).

Prevalence

In Adults

Published reports assessing the occurrence of sleep apnea in the general adult population vary widely. This is most likely due to the use of different sampling methods, diagnostic criteria for OSA, and statistical techniques, as well as variances in sample sizes, and the selection of targeted populations among these reports. Prevalence estimates from studies with probability samples in adults range from (Young, Peppard and Gottlieb, 2002):

- OSA of at least mild severity (defined by an apnea–hypopnea index [AHI] >5) from 3 to 28%
- OSA of at least moderate severity (defined by AHI > 15) from 1 to 14%
- Estimates that up to 5% of adults in Western countries are likely to have undiagnosed OSA
- Up to 90% of adults with OSA remain undiagnosed

In Pediatric Populations

Published studies on the prevalence of sleep related obstructed breathing in children are very limited and vary greatly. The range most likely reflects differences in the populations studied, age ranges observed, the use of parent-completed questionnaires to observe apnea, and in cultural factors influencing the perception of "snoring" or noisy breathing. Based on this, it is not possible to accurately estimate the prevalence of OSA in children. The most currently available evidence does suggest that (Young, Peppard and Gottlieb, 2002):

- Apneas witnessed by parents ranged from 0.5 to 9.0% of children with most estimates around 5.0%
- Sleep-related obstructive breathing recorded by polysomnography in children ages 2 to 7 are 24%
- Approximately 33.3% of children ≤ 6 years of age were reported to snore occasionally
- Between 10 to 14% of children ≤ 6 years of age were reported to snore frequently
- Overall the literature suggests a minimum occurrence of OSA in children of 2 to 4% with a possible rate of 10 to 20% in habitually snoring children

RISK FACTORS

In Adults

Several risk factors for OSA have now been identified though their predictive values vary. Adult surgical patients who present the following most prevalent risk factors may be at risk for OSA and prompt prescreening:

- Obesity (BMI > 35)
- Congestive heart failure
- Atrial fibrillation
- Treatment refractory hypertension
- Type 2 diabetes
- Nocturnal dysrhythmias
- Stroke
- Pulmonary hypertension
- High-risk driving populations
- Preoperative for bariatric surgery
- Smoking
- High alcohol consumption
- Long term nasal congestion
- Menopausal hormone changes

In Pediatric Populations

The assessment of OSA risk factors in children is mostly inferred from case series because of the limited epidemiological data. The available data support the concepts that:

- Peak incidence of childhood OSA occurs between 2 and 5 years of age, consistent with the available epidemiological data on snoring prevalence
- There is a similar prevalence of snoring and OSA in boys and girls
- Rates of OSA are two to three times more common in obese than in non-obese children
- Apnea appears to be most severe in the prone sleep position for children

TREATMENT

There are currently several treatments available that reduce the number of apnea episodes in individuals diagnosed with OSA (Veasey, Guilleminault and Strohl, 2006).

- Positive airway pressure (PAP) therapy is the most uniformly effective intervention for OSA
- Successful outcomes in OSA individuals from either upper airway surgeries or use of an oral appliance have also been reported
- Weight loss should be routinely recommended to overweight OSA patients
- Presently, there are no widely effective pharmacotherapies for OSA (with the exceptions of individuals whose OSA is related to hypothyroidism or acromegaly)
- Treating underlying OSA comorbidities can have pronounced positive effects on the Apnea-Hypopnea Index
- Stimulant therapy leads to a small but statistically significant improvement in objective sleepiness
- Supplemental oxygen and positional therapy may benefit subsets of patients

PREOPERATIVE EVALUATION

As previously mentioned, surgical patients with OSA present a unique series of challenges for surgical care teams, particularly during the perioperative period. Currently, most preoperative assessment focuses on the diagnosis and management of heart and lung diseases with little emphasis on screening for, or diagnosing, sleep-disordered breathing (Loadsman and Hillman, 2001; Finkel, Searleman, Tymkew et al., 2009). Such screening and identification is exceptionally important as it is estimated that 90% of individuals with OSA remain undiagnosed (Young, Evans, Finn et al., 1996). At present, while there are no validated guidelines for the specific screening and identification of patients who are most at risk for OSA-related surgery complications, several techniques are available to identify these individuals. Even patients who are suspected to have OSA based on screening questionnaires may have increased postoperative respiratory complications (Blake, Chia, Donnan et al., 2008; Chung, Yegneswaran, and Liao, 2008).

While polysomnography is an effective technology in diagnosing OSA, the limited access to and expense of overnight polysomnography, combined with a lack of specific OSA knowledge among clinicians and frequent payer denial has created a need for simpler, less expensive OSA-screening detection methods. The Epworth Sleepiness Scale (ESS), the STOP-BANG questionnaire and the Apnea Risk Evaluation System (ARES) are three alternative OSA evaluation techniques

that have been clinically validated and are potential low cost alternatives to polysomnography (Epstein, Kristo, Strollo et al., 2009).

Epworth Sleepiness Scale

The ESS is recommended to be included in comprehensive sleep evaluations (Johns 1993; Epstein et al., 2009) and may facilitate OSA diagnosis by identifying persons with excessive daytime sleepiness. While it was not originally designed to screen for OSA, validity trials have shown its effectiveness in identifying individuals with OSA. Characteristics of the ESS:

- Questionnaire based
- Measures the propensity of falling asleep in different situations
- Based on a four process model of sleep and wakefulness
- Depends on accurate patient recall
- ESS scores significantly distinguish primary snoring and OSA
- ESS scores increase with OSA severity
- ESS scores are more closely related to the frequency of apneas than to the degree of hypoxemia
- ESS scores give a useful measure of average sleep propensity, comparable to the results of all-day tests such as the multiple sleep latency tests.

Apnea Risk Evaluation System

The ARES OSA screening questionnaire is a screening tool (Westbrook PR, Levendowski DJ, Cvetinovic et al., 2006) that combines in-home acquired physiological data with elements of three established OSA screens: the Berlin questionnaire, Flemons' Index, and the ESS. Attributes of ARES include:

- Combined physiological monitoring data with questionnaire
- Physiological monitoring done in home
- Equipment that is small and portable
- Physiological data: oxygen saturation, pulse rate, snoring level (microphone), and head position/movement (accelerometers)
- Questionnaire portion to assess preexisting risk factors for OSA, including age, gender, body mass index, neck circumference, daytime drowsiness, frequency of snoring, observed apneas, and history of hypertension
- Combined physiological and questionnaire data to provide an overall risk level for OSA
- Clinical trials demonstrated consistently high sensitivity and specificity for both in-laboratory and in-home recordings

STOP-BANG

The STOP-BANG instrument is a four-question survey that has specifically been validated in perioperative patients as identifying those at risk for OSA (Chung, Yegneswaran, Liao et al., 2008). Features of the STOP-Bang incorporate:

- Four questions related to ***S***noring, **T**iredness during the daytime, **O**bserved apnea, and high blood **P**ressure (STOP)
- Concise and easy to use
- Specifically developed and validated in surgical clinics
- STOP scores are combined with **B**ody mass index, **A**ge, **N**eck size, and **G**ender (BANG)
- STOP has a high sensitivity particularly for patients with moderate to severe OSA

GUIDELINES FOR THE USE OF ANESTHESIA

Pediatric Patients

In 2006, the American Academy of Pediatrics (AAP) published revised guidelines for managing and monitoring sedation in pediatric patients (Cote and Wilson, 2006). While these guidelines are ***not*** specific to OSA pediatric patients, children with OSA are at higher risk for adverse events related to sedating medications. This work group on sedation emphasized that the safe sedation of children requires a systematic approach following the guidelines summarized in Table 1:

Table 1: American Academy of Pediatrics (AAP) revised guidelines for managing and monitoring sedation

• No use of sedating medication without a safety net of medical supervision with sufficient numbers of people to carry out the procedure and monitor the patient
• Thorough and careful prescreening for underlying medical or surgical conditions, including OSA, that would place the child at increased risk of adverse events related to sedating medications
• Appropriate fasting for elective procedures and, for those who are unable to fast, a balance between depth of sedation and risk
• A focused airway examination for large tonsils and/or anatomic airway abnormalities
• Knowledge and training in the pharmacokinetic and pharmacodynamic effects and interactions of sedating agents on pediatric patients
• Appropriate preparation and skills in patient rescue including age- and size-appropriate equipment for airway management and venous access and appropriate medications and reversal agents
• Appropriate physiologic after the procedure in a properly equipped and staffed recovery area
• Recovery to pre-sedation level of consciousness before discharge with appropriate discharge instructions

Adult Patients

In 2006, the American Society of Anesthesiologists' Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea published a series of guidelines specifically regarding patients diagnosed with OSA or high in OSA risk factors. A summary of these guidelines is presented in Table 2 (Gross JB, Bachenberg KL, Benumof JL et al., 2006.):

Table 2: Summary of ASA Perioperative Guidelines for Patients With Obstructive Sleep Apnea
• Extubate only after patient is fully conscious and upper airway obstruction seems unlikely
• Supplemental oxygen use if desaturation occurs, but only for as long as necessary to maintain appropriate arterial oxygen levels
• Continuous monitoring of oxygen saturation is necessary only in ICU or step down unit as long as patients remain at increased risk o Intermittent pulse oximetry or continuous bedside oximetry without continuous observation does not provide the same level of safety
• There is no consensus agreement on whether CPAP should be administered if there is evidence of apneas and desaturation or if hypoxia persists with supplemental oxygen o This is especially controversial for patients who were not previously treated with CPAP
• However, if frequent or severe airway obstruction or hypoxemia occurs during postoperative monitoring, initiation of nasal CPAP or NIPPV should be considered
• Consider use of nonopioid medications (such as NSAIDS) instead of or in conjunction with opioids to decrease the need for analgesia o Use of regional analgesic techniques rather than systemic opioids can reduce the likelihood of adverse respiratory events
• Avoid supine position for postoperative recovery o Consider placing at-risk patients in a sitting position to reduce OSA episodes and improve oxygen saturation
• OSA patients without significant comorbid factors can be monitored in an ambulatory care postoperative unit with proper nursing support and oxygen desaturation monitoring, but only if surgery is superficial or minor, and involves local or regional anesthesia.

POSTOPERATIVE CONSIDERATIONS

General Considerations

- After sedation, the resulting hypoventilation or hypoxia may produce central instability in respiratory control, resulting in low levels of oxygen saturation
- Airway obstruction is also a major contributor to oxygen desaturation
- Arrhythmias and hypertension are commonly reported in association with OSA and may have implications for postoperative outcome

- A preoperative diagnosis of OSA has been shown to be an independent predictor of atrial fibrillation after coronary bypass surgery
- In OSA patients who received opioids post-surgery, there are numerous case reports of adverse perioperative outcomes including respiratory and cardiac arrest leading to death

Use of Opioids

There remains a lack of published evidence regarding the effect of opioids on respiration in OSA patients. However, the general recommendation is that opioids and other drugs with central respiratory and sedating effects should be minimized or avoided, if possible. What evidence is available does suggest that (reviewed by Chung, Yaun and Chung, 2008):

Opioids in OSA Pediatric Patients

- In pediatric patients, the total analgesic opiate dose in children with OSA and recurrent hypoxemia was one-half of that required in children without such a history
- Recurrent hypoxemia in OSA children is associated with a greater analgesic sensitivity to morphine administration
- As noted in a 2012 FDA Blackbox Warning, codeine preparations are not to be used due to an increased risk of respiratory compromise in hyper-metabolizers of codeine

Opioids in Adult Patients

- In healthy adults with no history of OSA, oral hydromorphone did not significantly alter the number of apneic or hypopnea episodes
- In patients with a larger baseline number of obstructive events, higher doses of hydromorphone produced more obstructive events
- Reviews of adult OSA case reports receiving sustained release opioids treatment for chronic pain demonstrated these patients have longer apnea duration, more severe hypoxia, irregular respiratory pauses and gasping, and periods of obstructive hypoventilation > 5 min

CONCLUSIONS

Undiagnosed OSA is prevalent in adult and pediatric surgical patients. Both clinicians and healthcare organizations that provide surgical services need to be aware of techniques for identification of those at risk for OSA, the unique guidelines and care required for such patients, and the risk of adverse events in OSA individuals related to surgery. It is unclear, though, what measures should be employed to minimize perioperative complications in patients with OSA.

Implementing universal screening is feasible and can identify undiagnosed OSA in many surgical patients. However, our group of experts could not reach consensus on pre-operative screening and postoperative discharge criteria, other than noting that these patients should be monitored closely and for longer periods. Postoperative hypoxia should lead to consideration for hospitalization.

Further investigation is needed into perioperative complications and their prevention for patients with undiagnosed OSA. Implementing OSA screening and supporting research into surgical care challenges surrounding OSA patients can greatly reduce perioperative morbidity and mortality with this population.

RECOMMENDED SOURCES FOR INSTRUMENTS AND GUIDELINES

American Academy of Pediatrics Guidelines for Sedative Use:

Cote CJ and Wilson S. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: An Update. *Pediatrics*. 2006; 118(6):2587-2602.

American Academy of Otolaryngology – Head and Neck Pediatric Guidelines for Polysomnography Prior to Tonsillectomy:

Roland PS, et al. Clinical Practice Guidelines: Polysomnography for Sleep-Disordered Breathing Prior

to Tonsillectomy in Children. Otolaryngology -- Head and Neck Surgery. 2011; 145: S1.

Considerations for Anesthesiologist and Surgical Teams with OSA Patients:

Chung SA, Yuan H, Chung F. A Systemic Review of Obstructive Sleep Apnea and Its Implications for Anesthesiologists. Ambula Anesthesiol. 2008; 5:1543-63.

American Society of Anesthiologists Guidelines for OSA:

Gross JB, Bachenberg KL, Benumof JL, et al. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. *Anesthesiology*. 2006; 104(5):1081-93.

STOP-BANG Questionnaire:

Chung F, Yegneswaran B, Liao P, Chung SA, Vairavana S, Islam S, Khajehdehi A, Shapiro CM. STOP Questionnaire: A Tool to Screen Patients for Obstructive Sleep Apnea. Anesthesiology 2008; 108:812-13.

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