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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

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Methodology

A. Definition of Obstructive Sleep Apnea

Obstructive sleep apnea (OSA) is a syndrome characterized by periodic, partial, or complete obstruction of the upper airway during sleep. This, in turn, causes repetitive arousal from sleep to restore airway patency, which may result in daytime hypersomnolence or other daytime manifestations of disrupted sleep such as aggressive or distractible behavior in children. The airway obstruction may also cause episodic sleep-associated oxygen desaturation, episodic hypercarbia, and cardiovascular dysfunction. It is estimated that the adult prevalence of sleep disordered breathing, as measured in a sleep laboratory, is 9% in women and 24% in men, whereas the prevalence of overt OSA has been estimated to be 2% in women and 4% in men.[1] These figures are likely to increase as the population becomes older and more obese. In the perioperative period, both pediatric and adult patients with OSA, even if asymptomatic, present special challenges that must be systematically addressed to minimize the risk of perioperative morbidity or mortality. It is the opinion of the Task Force that the perioperative risk to patients increases in proportion to the severity of sleep apnea.

Because procedures differ among laboratories, it is not possible to use specific values of indices (such as the apnea-hypopnea index [AHI]) to define the severity of sleep apnea. Therefore, for the purposes of these Guidelines, patients will be stratified using the terms *mild*, *moderate*, and *severe* as defined by the laboratory where the sleep study was performed.

B. Purpose of the Guidelines

The purpose of these Guidelines is to improve the perioperative care and reduce the risk of adverse outcomes in patients with OSA who receive sedation, analgesia, or anesthesia for diagnostic or therapeutic procedures under the care of an anesthesiologist. The Task Force recognizes that it is not possible to determine with 100% accuracy whether a given patient will develop perioperative complications related to OSA. Therefore, these Guidelines should be implemented with the goal of reducing the likelihood of adverse outcomes in patients who are judged to be at the

greatest risk, with the understanding that it may be impractical to eliminate OSA-related perioperative morbidity and mortality completely. However, it is hoped that the implementation of these Guidelines will reduce the likelihood of adverse perioperative outcomes in patients with OSA.

C. Focus

These Guidelines focus on the perioperative management of patients with OSA who may be at increased risk for perioperative morbidity and mortality because of potential difficulty in maintaining a patent airway. This population includes but is not limited to patients who have sleep apnea resulting from obesity, pregnancy, and other skeletal, cartilaginous, or soft tissue abnormalities causing upper airway obstruction. Excluded from the focus of these Guidelines are patients with the following: (1) pure central sleep apnea, (2) abnormalities of the upper or lower airway not associated with sleep apnea (*e.g.*, deviated nasal septum), (3) daytime hypersomnolence from other causes, (4) patients younger than 1 yr, and (5) obesity in the absence of sleep apnea.

D. Application

These Guidelines apply to both inpatient and outpatient settings, and to procedures performed in an operating room, as well as in other locations where sedation or anesthesia is administered. They are directly applicable to care administered by anesthesiologists and individuals who deliver care under the medical direction or supervision of an anesthesiologist. They are also intended to serve as a resource for other physicians and patient care personnel who are involved in the care of these patients. In addition, these Guidelines may serve as a resource to provide an environment for safe patient care.

E. Task Force Members and Consultants

The American Society of Anesthesiologists appointed a Task Force of 12 members to (1) review the published evidence, (2) obtain the opinion of a panel of consultants including anesthesiologists and nonanesthesiologist physicians and researchers who regularly care for patients with OSA, and (3) build consensus within the community of practitioners likely to be affected by the Guidelines. The Task Force included anesthesiologists in both private and academic practices from various geographic areas of the United States, a bariatric surgeon, an otolaryngologist, and two methodologists from the American Society of Anesthesiologists Committee on Practice Parameters.

The Task Force developed the Guidelines by means of a six-step process. First, they reached consensus on the criteria for evidence of effective perioperative management of patients with OSA. Second, original published research studies from peer-reviewed journals relevant to the perioperative management of patients with OSA were evaluated. Third, the panel of expert consultants was asked to (1) participate in opinion surveys on the effectiveness of various perioperative management strategies for patients with OSA and (2) review and comment on a draft of the Guidelines developed by the Task Force. Fourth, the Task Force held open forums at two major national meetings to solicit input on its draft recommendations. National organizations representing most of the specialties whose members typically care for patients with OSA were invited to participate in the open forums. Fifth, the consultants were surveyed to assess their opinions on the feasibility and financial implications of implementing the Guidelines. Sixth, all available information was used to build consensus within the Task Force to finalize the Guidelines.

Tables 1 and 2 are meant to serve as examples of how patients with OSA might be identified and stratified with respect to their perioperative risk. While they were developed by the Task Force with input from the consultants and open forum participants, these tables are not evidence based and have not been clinically validated.

F. Availability and Strength of Evidence

Preparation of these Guidelines followed a rigorous methodologic process (appendix). To convey the findings in a concise fashion, these Guidelines use several descriptive terms that are easier to understand than the technical terms used in the actual analyses.

When sufficient numbers of studies are available for evaluation, the following terms describe the strength of the findings.

Supportive: Meta-analyses of a sufficient number of adequately designed studies indicate a statistically significant relationship ($P < 0.01$) between a clinical intervention and a clinical outcome.

Suggestive: Information from case reports and descriptive studies permits inference of a relationship between an intervention and an outcome. This type of qualitative information does not permit a statistical assessment of significance.

Equivocal: Qualitative data are not adequate to permit inference of a relationship between an intervention and an outcome and (1) there is insufficient quantitative information or (2) aggregated comparative studies have found no significant differences among groups or conditions.

The *lack* of scientific evidence in the literature is described by the following terms.

Silent: No identified studies address the specified relationship between an intervention and outcome.

Insufficient: There are too few published studies to investigate a relationship between an intervention and an outcome.

Inadequate: The available studies cannot be used to assess the relationship between an intervention and an outcome. These studies either do not meet the criteria for content as defined in the Focus of these Guide-

Table 1. Identification and Assessment of OSA: Example

A. Clinical signs and symptoms suggesting the possibility of OSA

1. Predisposing physical characteristics
   a. BMI 35 kg/m^2 [95th percentile for age and gender]*
   b. Neck circumference 17 inches (men) or 16 inches (women)
   c. Craniofacial abnormalities affecting the airway
   d. Anatomical nasal obstruction
   e. Tonsils nearly touching or touching in the midline
2. History of apparent airway obstruction during sleep (two or more of the following are present; if patient lives alone or sleep is not observed by another person, then only one of the following needs to be present)
   a. Snoring (loud enough to be heard through closed door)
   b. Frequent snoring
   c. Observed pauses in breathing during sleep
   d. Awakens from sleep with choking sensation
   e. Frequent arousals from sleep
   f. [Intermittent vocalization during sleep]*
   g. [Parental report of restless sleep, difficulty breathing, or struggling respiratory efforts during sleep]*
3. Somnolence (one or more of the following is present)
   a. Frequent somnolence or fatigue despite adequate "sleep"
   b. Falls asleep easily in a nonstimulating environment (*e.g.*, watching TV, reading, riding in or driving a car) despite adequate "sleep"
   c. [Parent or teacher comments that child appears sleepy during the day, is easily distracted, is overly aggressive, or has difficulty concentrating]*
   d. [Child often difficult to arouse at usual awakening time]*

If a patient has signs or symptoms in two or more of the above categories, there is a significant probability that he or she has OSA. The severity of OSA may be determined by sleep study (see below). If a sleep study is not available, such patients should be treated as though they have moderate sleep apnea unless one or more of the signs or symptoms above is severely abnormal (*e.g.*, markedly increased BMI or neck circumference, respiratory pauses that are frightening to the observer, patient regularly falls asleep within minutes after being left unstimulated), in which case they should be treated as though they have severe sleep apnea.

B. If a sleep study has been done, the results should be used to determine the perioperative anesthetic management of a patient. However, because sleep laboratories differ in their criteria for detecting episodes of apnea and hypopnea, the Task Force believes that the sleep laboratory's assessment (none, mild, moderate, or severe) should take precedence over the actual AHI (the number of episodes of sleep-disordered breathing per hour). If the overall severity is not indicated, it may be determined by using the table below:

Severity of OSA	Adult AHI	Pediatric AHI
None	0–5	0
Mild OSA	6–20	1–5
Moderate OSA	21–40	6–10
Severe OSA	> 40	> 10

* Items in brackets refer to pediatric patients.

AHI = apnea-hypopnea index; BMI = body mass index; OSA = obstructive sleep apnea; TV = television.

Table 2. OSA Scoring System: Example

	Points
A. Severity of sleep apnea based on sleep study (or clinical indicators if sleep study not available). Point score _____ (0–3)*†	
Severity of OSA (table 1)	
None	0
Mild	1
Moderate	2
Severe	3
B. Invasiveness of surgery and anesthesia. Point score _____ (0–3)	
Type of surgery and anesthesia	
Superficial surgery under local or peripheral nerve block anesthesia without sedation	0
Superficial surgery with moderate sedation or general anesthesia	1
Peripheral surgery with spinal or epidural anesthesia (with no more than moderate sedation)	1
Peripheral surgery with general anesthesia	2
Airway surgery with moderate sedation	2
Major surgery, general anesthesia	3
Airway surgery, general anesthesia	3
C. Requirement for postoperative opioids. Point score _____ (0–3)	
Opioid requirement	
None	0
Low-dose oral opioids	1
High-dose oral opioids, parenteral or neuraxial opioids	3
D. Estimation of perioperative risk. Overall score = the score for A plus the greater of the score for either B or C. Point score _____ (0–6)‡	

A scoring system similar to this table may be used to estimate whether a patient is at increased perioperative risk of complications from obstructive sleep apnea (OSA). This example, which has not been clinically validated, is meant only as a guide, and clinical judgment should be used to assess the risk of an individual patient.

* One point may be subtracted if a patient has been on continuous positive airway pressure (CPAP) or noninvasive positive-pressure ventilation (NIPPV) before surgery and will be using his or her appliance consistently during the postoperative period. † One point should be added if a patient with mild or moderate OSA also has a resting arterial carbon dioxide tension ($Paco_2$) greater than 50 mmHg. ‡ 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.

lines, or do not permit a clear causal interpretation of findings due to methodologic concerns.

The following terms describe survey responses from the consultants for any specified issue. Responses were solicited on a five-point scale; ranging from 1 (strongly disagree) to 5 (strongly agree), with a score of 3 being equivocal.

Strongly agree: Median score of 5.
Agree: Median score of 4.
Equivocal: Median score of 3.
Disagree: Median score of 2.
Strongly disagree: Median score of 1.

Guidelines

I. Preoperative Evaluation

Preoperative evaluation of a patient for potential identification of OSA includes (1) medical record review, (2)

patient or family interview, (3) physical examination, (4) sleep studies, and (5) preoperative x-rays for cephalometric measurement in selected cases. Although the comparative literature is insufficient to evaluate the impact of preprocedure identification of OSA status, it suggests that OSA is associated with airway characteristics that may predispose patients to difficulties in perioperative airway management.* The literature identified certain patient characteristics that are associated with OSA. These characteristics include such features as a higher body mass index, hypertension, and abnormal cephalometric measurements. Additional literature, although insufficient for statistical analysis, suggests that an association may exist between OSA and a larger neck circumference, a history of snoring or respiratory pauses, lower oxygen saturation values during sleep, clinical signs of difficult airway management, and certain congenital conditions (*e.g.*, Down syndrome, craniofacial abnormality, muscular dystrophy) or disease states (*e.g.*, diabetes mellitus, cerebral palsy).

The consultants agree that, in the absence of a sleep study, a presumptive diagnosis of OSA may be made based on consideration of the following criteria: increased body mass index, a weight or body mass index greater than 95th percentile for age (pediatric patients), increased neck circumference, snoring, congenital airway abnormalities, daytime hypersomnolence, inability to visualize the soft palate, and tonsillar hypertrophy. They strongly agree that observed apnea during sleep is an additional criterion. The consultants agree that preprocedure identification of a patient's OSA status improves perioperative outcomes, and they are equivocal regarding whether overall costs are decreased. The consultants agree that a patient's perioperative risk depends on both the severity of the OSA and the invasiveness of the surgical procedure.

Recommendations. Anesthesiologists should work with surgeons to develop a protocol whereby patients in whom the possibility of OSA is suspected on clinical grounds are evaluated long enough before the day of surgery to allow preparation of a perioperative management plan. This evaluation may be initiated in a preanesthesia clinic (if available) or by direct consultation from the operating surgeon to the anesthesiologist. A preoperative evaluation should include a comprehensive review of previous medical records (if available), an interview with the patient and/or family, and conducting a physical examination. Medical records review should include (but not be limited to) checking for a history of airway difficulty with previous anesthetics, hypertension or other cardiovascular problems, and other congenital or acquired medical conditions. Review of sleep studies is encouraged. The patient and family interview should include focused questions related to snoring, apneic episodes, frequent arousals during sleep (vocalization, shifting position, extremity movements), morning headaches, and daytime somnolence. A physical examination should include an evaluation of the airway, nasopharyngeal characteristics, neck circumference, tonsil size, and tongue volume. If any of these characteristics suggest that the patient has OSA, the anesthesiologist and surgeon should jointly decide whether to (1) manage the patient perioperatively based on clinical criteria alone or (2) obtain sleep studies, conduct a more extensive airway examination, and initiate indicated OSA treatment in advance of surgery. If this evaluation does not occur until the day of surgery, the surgeon and anesthesiologist together may elect for presumptive management based on clinical criteria or a last-minute delay of surgery. For safety, clinical criteria (table 1) should be designed to have a high degree of sensitivity (despite the resulting low specificity), meaning that some patients may be treated more aggressively than would be necessary if a sleep study were available.

The severity of the patient's OSA, the invasiveness of the diagnostic or therapeutic procedure, and the requirement for postoperative analgesics should be taken into account in determining whether a patient is at increased perioperative risk from OSA (table 2). The patient and his or her family as well as the surgeon should be informed of the potential implications of OSA on the patient's perioperative course.

II. Preoperative Preparation

Preoperative preparation is intended to improve or optimize an OSA patient's perioperative physical status and includes (1) preoperative continuous positive airway pressure (CPAP) or noninvasive positive-pressure ventilation (NIPPV) or bilevel positive airway pressure (BiPAP®; Respironics, Murrysville, PA), (2) preoperative use of mandibular advancement or oral appliances, (3) preoperative medications, or (4) preoperative weight loss.

There is insufficient literature to evaluate the impact of the preoperative use of CPAP, NIPPV, or mandibular advancement devices on perioperative outcomes. Similarly, there is insufficient literature to evaluate the efficacy of preoperative medications or weight loss. However, the literature supports the efficacy of CPAP in improving AHI, respiratory disturbance index scores, and oxygen saturation levels in nonperioperative settings. Similarly, the literature supports the efficacy of mandibular advancement devices in reducing AHI scores in nonperioperative settings.

The consultants agree that preoperative use of positive airway pressure (CPAP or NIPPV) may improve the preoperative condition of patients who they believe are at increased perioperative risk from OSA, and they are equivocal regarding the efficacy of mandibular advancement devices for these patients. The consultants agree that a

* Refer to the appendix for details of the literature review and data analyses.

preoperative determination should be made regarding whether surgery in patients at increased perioperative risk from OSA should be performed on an inpatient basis.

Recommendations. Preoperative initiation of CPAP should be considered, particularly if OSA is severe. For patients who do not respond adequately to CPAP, NIPPV should be considered. In addition, the preoperative use of mandibular advancement devices or oral appliances and preoperative weight loss should be considered when feasible. A patient who has had corrective airway surgery (*e.g.*, uvulopalatopharyngoplasty, surgical mandibular advancement) should be assumed to remain at risk for OSA complications unless a normal sleep study has been obtained[1] and symptoms have not returned. Patients with known or suspected OSA may have difficult airways and therefore should be managed according to the "Practice Guidelines for Management of the Difficult Airway."[2] In patients at risk for perioperative complications from OSA, a preoperative determination must be made regarding whether surgery should be performed on an inpatient or outpatient basis (see section V below).

III. Intraoperative Management

Intraoperative concerns in patients at increased perioperative risk from OSA include (1) choice of anesthetic technique, (2) airway management, and (3) patient monitoring. The literature is insufficient to evaluate the effects of various anesthetic techniques on patients with OSA. Similarly, the literature is insufficient to evaluate the impact of specific intraoperative airway management (*e.g.*, awake extubation) or patient monitoring techniques for patients with OSA.

The consultants agree that the use of local anesthesia or peripheral nerve blocks rather than general anesthesia improves outcomes in patients undergoing peripheral surgery. The consultants agree that the use of major conduction anesthesia (*i.e.*, spinal or epidural) rather than general anesthesia improves outcomes for peripheral surgery. The consultants are equivocal regarding the utility of major conduction anesthesia rather than general anesthesia for intraabdominal surgery. The consultants are equivocal regarding whether the use of combined regional and general anesthesia improves outcomes.

The consultants agree that patients at increased perioperative risk from OSA should be extubated when fully awake, and they strongly agree that full reversal of neuromuscular blockade should be verified before extubation. They agree that these patients should be placed in the semiupright position for extubation and recovery.

The consultants agree that respiratory carbon dioxide monitoring should be used during moderate or deep sedation in these patients.† The consultants agree that general anesthesia with a secured airway is preferable to deep sedation for superficial procedures, and they are equivocal regarding whether general anesthesia with a secured airway is preferable to moderate sedation for superficial procedures. The consultants agree that general anesthesia with a secured airway is preferable to moderate or deep sedation for patients with OSA undergoing procedures involving the upper airway (*e.g.*, upper endoscopy, bronchoscopy, uvulopalatopharyngoplasty).

Recommendations. Because of their propensity for airway collapse and sleep deprivation, patients at increased perioperative risk from OSA are especially susceptible to the respiratory depressant and airway effects of sedatives, opioids, and inhaled anesthetics; therefore, in selecting intraoperative medications, the potential for postoperative respiratory compromise should be considered. For superficial procedures, one should consider the use of local anesthesia or peripheral nerve blocks, with or without moderate sedation. If moderate sedation is used, ventilation should be continuously monitored by capnography or another automated method if feasible because of the increased risk of undetected airway obstruction in these patients. One should consider administering CPAP or using an oral appliance during sedation to patients previously treated with these modalities. General anesthesia with a secure airway is preferable to deep sedation without a secure airway, particularly for procedures that may mechanically compromise the airway. Major conduction anesthesia (spinal/epidural) should be considered for peripheral procedures. Unless there is a medical or surgical contraindication, patients at increased perioperative risk from OSA should be extubated while awake. Full reversal of neuromuscular block should be verified before extubation. When possible, extubation and recovery should be carried out in the lateral, semiupright, or other nonsupine position.

IV. Postoperative Management

Postoperative concerns in the management of patients with OSA include (1) analgesia, (2) oxygenation, (3) patient positioning, and (4) monitoring. Risk factors for respiratory depression include the systemic and neuraxial administration of opioids, administration of sedatives, site and invasiveness of surgical procedure, and the underlying severity of the sleep apnea. In addition, exacerbation of respiratory depression may occur on the third or fourth postoperative day as sleep patterns are reestablished and "REM rebound" occurs.

Postoperative Analgesia. The literature is insufficient to evaluate the effects of various postoperative analgesic techniques on patients with OSA. However, the literature is equivocal regarding the use of epidural opioids compared with intramuscular or intravenous opioids in reducing respiratory depression among unselected surgical patients. The literature is insufficient to

† Continuum of Depth of Sedation: Definition of General Anesthesia and Levels of Sedation/Analgesia. American Society of Anesthesiologists Standards, Guidelines, and Statements, October 27, 2004.

evaluate the effect of adding a basal infusion to systemic patient-controlled opioids on the oxygenation of patients with OSA. However, the literature supports the observation that adding a basal infusion results in an increased incidence of hypoxemia in unselected surgical patients.

The consultants agree that regional analgesic techniques rather than systemic opioids reduce the likelihood of adverse outcomes in patients at increased perioperative risk from OSA. The consultants agree that the exclusion of opioids from neuraxial postoperative analgesia reduces risks as compared with neuraxial techniques which include opioids. The consultants agree that the use of nonsteroidal antiinflammatory agents, when acceptable, reduces adverse outcomes through their opioid-sparing effect. The consultants are equivocal regarding whether patient-controlled analgesia with systemic opioids reduces risks as compared with nurse-administered intramuscular or intravenous opioids. In addition, the consultants are equivocal regarding whether avoiding a basal infusion of opioids in patients at increased perioperative risk from OSA reduces the likelihood of adverse outcomes.

Oxygenation. Although the literature is insufficient to evaluate the effects of postoperative supplemental oxygen administration in patients with OSA, it supports the use of postextubation supplemental oxygen to improve the oxygen saturation levels of unselected surgical patients. There is insufficient literature to evaluate the effect of CPAP or NIPPV on the postoperative respiratory status of patients with OSA. However, the literature supports the efficacy of CPAP in nonperioperative settings.

The consultants agree that supplemental oxygen should be administered as needed to maintain acceptable arterial oxygen saturation and that supplemental oxygen may be discontinued when patients are able to maintain their baseline oxygen saturation while breathing room air. The consultants strongly agree that CPAP or NIPPV should be administered as soon as feasible after surgery to patients with OSA who were receiving it preoperatively, but they are equivocal regarding the utility of instituting CPAP or NIPPV in patients who were not previously treated with these modalities. The consultants are equivocal regarding whether patients receiving postoperative CPAP or NIPPV should have the appliance in place whenever the patients are not ambulating.

Patient Positioning. The literature supports an improvement in AHI scores when adult patients with OSA sleep in the lateral, prone, or sitting positions rather than the supine position in nonperioperative settings, but the literature is insufficient to provide guidance for the postoperative setting. The literature is insufficient to provide guidance for optimal positioning of pediatric patients with OSA. The consultants agree that the supine position should be avoided when possible during the recovery of adult and pediatric patients who they believe are at increased perioperative risk from OSA.

Monitoring. The literature is insufficient to evaluate the efficacy of telemetry monitoring systems (*e.g.*, for pulse oximetry, electrocardiogram, or ventilation) in minimizing the risk of adverse perioperative events in patients with OSA. Similarly, the literature is insufficient to examine the impact of monitored postoperative settings (*e.g.*, stepdown or intensive care unit) *versus* routine hospital wards for patients with known or suspected OSA. The literature is insufficient to offer guidance regarding the appropriate duration of postoperative respiratory monitoring in patients with OSA.

The consultants agree that continuous oximetry in a stepdown unit or by telemetry reduces the likelihood of perioperative complications among patients who they believe are at increased perioperative risk from OSA. They are equivocal regarding the efficacy of full monitoring in an intensive care unit or continuous oximetry monitored by a dedicated observer in a patient's room. The consultants disagree that intermittently monitored bedside oximetry reduces patient risks. The consultants agree that pulse oximetry should be continuously monitored while these patients are in bed. They are equivocal regarding whether pulse oximetry should be continuously monitored until these patients are no longer receiving parenteral narcotics. They agree that pulse oximetry should be applied until room air oxygen saturation remains above 90% during sleep.

Recommendations. Regional analgesic techniques should be considered to reduce or eliminate the requirement for systemic opioids in patients at increased perioperative risk from OSA. If neuraxial analgesia is planned, weigh the benefits (improved analgesia, decreased need for systemic opioids) and risks (respiratory depression from rostral spread) of using an opioid or opioid–local anesthetic mixture as compared with a local anesthetic alone. If patient-controlled systemic opioids are used, continuous background infusions should be used with extreme caution or avoided entirely. Nonsteroidal antiinflammatory agents and other modalities (*e.g.*, ice, transcutaneous electrical nerve stimulation) should be considered if appropriate to reduce opioid requirements. Clinicians are cautioned that the concurrent administration of sedative agents (*e.g.*, benzodiazepines, barbiturates) increases the risk of respiratory depression and airway obstruction.

Supplemental oxygen should be administered continuously to all patients who are at increased perioperative risk from OSA until they are able to maintain their baseline oxygen saturation while breathing room air. The Task Force cautions that supplemental oxygen may increase the duration of apneic episodes and may hinder detection of atelectasis, transient apnea, and hypoventilation by pulse oximetry. CPAP or NIPPV, with or without supplemental oxygen, should be continuously ad-

Table 3. Consultant Opinions Regarding Procedures That May Be Performed Safely on an Outpatient Basis for Patients at Increased Perioperative Risk from OSA

Type of Surgery/Anesthesia	Consultant Opinion
Superficial surgery/local or regional anesthesia	Agree
Superficial surgery/general anesthesia	Equivocal
Airway surgery (adult, *e.g.*, UPPP)	Disagree
Tonsillectomy in children less than 3 years old	Disagree
Tonsillectomy in children greater than 3 years old	Equivocal
Minor orthopedic surgery/local or regional anesthesia	Agree
Minor orthopedic surgery/general anesthesia	Equivocal
Gynecologic laparoscopy	Equivocal
Laparoscopic surgery, upper abdomen	Disagree
Lithotripsy	Agree

OSA = obstructive sleep apnea; UPPP = uvulopalatopharyngoplasty.

ministered when feasible (*e.g.*, when patients are not ambulating) to patients who were using these modalities preoperatively, unless contraindicated by the surgical procedure. Compliance with CPAP or NIPPV may be improved if patients bring their own equipment to the hospital.

If possible, patients at increased perioperative risk from OSA should be placed in nonsupine positions throughout the recovery process. Hospitalized patients who are at increased risk of respiratory compromise from OSA should have continuous pulse oximetry monitoring after discharge from the recovery room. 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. Continuous monitoring should be maintained as long as patients remain at increased risk. Intermittent pulse oximetry or continuous bedside oximetry without continuous observation does not provide the same level of safety. If frequent or severe airway obstruction or hypoxemia occurs during postoperative monitoring, initiation of nasal CPAP or NIPPV should be considered.

V. Inpatient versus *Outpatient Surgery and Criteria for Discharge to Unmonitored Settings*

The literature is insufficient to offer guidance regarding which patients with OSA can be safely managed on an outpatient as opposed to an inpatient basis, and the appropriate time for discharge of these patients from the surgical facility.

The consultants agree that procedures typically performed on an outpatient basis in non-OSA patients may also be safely performed on an outpatient basis in patients who they believe are at increased perioperative risk from OSA when local or regional anesthesia is administered (table 3). The consultants are equivocal regarding whether superficial procedures may be safely performed during general anesthesia in outpatients at increased perioperative risk from OSA, but they disagree that airway surgery (*e.g.*, uvulopalatopharyngoplasty) should be performed on an outpatient basis in adults with OSA. They also disagree that tonsillectomy in children younger than 3 yr with OSA should be performed on an outpatient basis, and they are equivocal regarding outpatient tonsillectomy in older children. The consultants strongly agree that when patients at increased perioperative risk from OSA are anesthetized as outpatients, the facility should have emergency difficult airway equipment, and they agree on the availability of respiratory care equipment (nebulizers, CPAP equipment, ventilators), radiology facilities (for portable chest x-ray), clinical laboratory facilities (blood gases, electrolytes). They strongly agree that a transfer arrangement with an inpatient facility should be in place. The Task Force believes that patients who are at significantly increased risk of perioperative complications (score of 5 or greater on table 2) are generally not good candidates for surgery in a freestanding outpatient facility.

In addition to standard outpatient discharge criteria, the consultants agree that room air oxygen saturation should return to its baseline, and they strongly agree that patients should not become hypoxemic or have development of clinical airway obstruction when left undisturbed in the recovery area. The consultants indicated that patients with OSA should be monitored for a median of 3 h longer than their non-OSA counterparts before discharge from the facility. They also indicated that monitoring of patients with OSA should continue for a median of 7 h after the last episode of airway obstruction or hypoxemia while breathing room air in an unstimulating environment.

Recommendations. Before patients at increased perioperative risk from OSA are scheduled to undergo surgery, a determination should be made regarding whether a given surgical procedure is most appropriately performed on a given patient on an inpatient or outpatient basis. Factors to be considered in determining whether outpatient care is appropriate include (1) sleep apnea status, (2) anatomical and physiologic abnormalities, (3) status of coexisting diseases, (4) nature of surgery, (5) type of anesthesia, (6) need for postoperative opioids, (7) patient age, (8) adequacy of postdischarge observation, and (9) capabilities of the outpatient facility. The availability of emergency difficult airway equipment, respiratory care equipment, radiology facilities, clinical laboratory facilities, and a transfer agreement with an inpatient facility should be considered in making this determination.

These patients should not be discharged from the recovery area to an unmonitored setting (*i.e.*, home or unmonitored hospital bed) until they are no longer at risk for postoperative respiratory depression. Because of their propensity to develop airway obstruction or central respiratory depression, this may require a longer stay as compared

with non-OSA patients undergoing similar procedures. Adequacy of postoperative respiratory function may be documented by observing patients in an unstimulated environment, preferably while they seem to be asleep, to establish that they are able to maintain their baseline oxygen saturation while breathing room air.

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Appendix: Methods and Analyses

The scientific assessment of these Guidelines was based on evidence linkages or statements regarding potential relationships between clinical interventions and outcomes. The interventions listed below were examined to assess their relationship to a variety of outcomes related to the management of patients with OSA in the perioperative setting.

1. Preoperative evaluation
   a. Medical records review
   b. Patient and family interview
   c. Screening questionnaire
   d. Focused physical examination
   e. Sleep study
2. Preoperative preparation
   a. Preoperative treatment/optimization for OSA (*e.g.*, CPAP, NIPPV, mandibular appliances, medical treatment)
   b. Consult the American Society of Anesthesiologists "Practice Guidelines for Management of the Difficult Airway"
   c. Limit procedures to facilities with full hospital services
3. Intraoperative management
   a. Anesthetic technique
      (i) Local or regional anesthesia *versus* general anesthesia
      (ii) Combined regional and general anesthesia *versus* general anesthesia
      (iii) Sedation *versus* general anesthesia
   b. Monitoring
      (i) Continuously monitor the respiratory depressant effects of sedatives and/or opioids (*e.g.*, level of consciousness, pulmonary ventilation, oxygenation, automated apnea monitoring)
      (ii) Special intraoperative monitoring techniques (arterial line, pulmonary artery catheter)
   c. Extubation
      (i) Verify the full reversal of neuromuscular block before extubation
      (ii) Extubate patients after they are fully awake (*vs.* asleep or partially awake)
      (iii) Extubate patients in the semiupright, lateral, or prone positions (*vs.* supine)
4. Postoperative management
   a. Analgesic use
      (i) Regional analgesic techniques without neuraxial opioids *versus* systemic opioids
      (ii) Neuraxial opioids *versus* systemic opioids
      (iii) Oral analgesics *versus* parenteral opioids
      (iv) PCA without a background infusion *versus* PCA with a background infusion
      (v) Titration or lower dosage levels of systemic opioids
   b. Oxygenation
      (i) Supplemental oxygen *versus* no supplemental oxygen
      (ii) CPAP *versus* no CPAP (oxygen or room air)
      (iii) CPAP for patients who had previously been on CPAP *versus* CPAP for patients not previously on CPAP
      (iv) NIPPV *versus* no NIPPV (CPAP, oxygen, or room air)
   c. Positioning patients in the lateral, prone, or tonsil position *versus* the supine position
   d. Monitoring
      (i) Telemetry monitoring systems *versus* no telemetry monitoring systems
      (ii) Monitored settings *versus* routine hospital wards
   e. Duration of stay
      (i) Extended stay in PACU *versus* no extended stay in PACU
      (ii) Hospital admission *versus* discharge home

Scientific evidence was derived from aggregated research literature, and opinion-based evidence was obtained from surveys, open presentations, and other consensus-oriented activities (*e.g.*, Internet posting). For purposes of literature aggregation, potentially relevant clinical studies were identified *via* electronic and manual searches of the literature. The electronic and manual searches covered a 53-yr period from 1953 through 2005. More than 2000 citations were initially identified, yielding a total of 622 nonoverlapping articles that addressed topics related to the evidence linkages. After review of the articles, 332 studies did not provide direct evidence and were subsequently eliminated. A total of 290 articles contained direct linkage-related evidence.

Initially, each pertinent outcome reported in a study was classified as supporting an evidence linkage, refuting a linkage, or equivocal. The results were then summarized to obtain a directional assessment for each evidence linkage before conducting a formal meta-analysis. Literature pertaining to six evidence linkages contained enough studies with well-defined experimental designs and statistical information sufficient for meta-analyses. These linkages were (1) medical records review (OSA and body mass index; OSA and hypertension); (2) focused physical examination (OSA associated with neck circumference and various cephalometric measurements); (3) preoperative treatment/optimization for OSA (CPAP [nonperioperative patients] and AHI scores, respiratory depression index scores, and oxygen saturation levels; nonperioperative mandibular appliance and AHI scores); (4) postoperative analgesic use (neuraxial opioids *vs.* systemic opioids [in non-OSA patients] and oxygen saturation levels), postoperative analgesic use (neuraxial opioids *vs.* systemic opioids [in non-OSA patients] and respiratory depression), and postoperative PCA opioids (background infusion *vs.* no background infusion [in non-OSA patients] and hypoxemia); (5) postoperative oxygenation (supplemental oxygen *vs.* no supplemental oxygen [in non-OSA patients] and hypoxemia); and (6) postoperative positioning of patients (lateral, prone, or tonsil *versus* supine [nonperioperative patients] and AHI scores).

General variance-based effect-size estimates or combined probability tests were obtained for continuous outcome measures, and Mantel-Haenszel odds ratios were obtained for dichotomous outcome measures. Two combined probability tests were used as follows: (1) The Fisher combined test, producing chi-square values based on logarithmic transformations of the reported P values from the independent studies, and (2) the Stouffer combined test, providing weighted representation of the studies by weighting each of the standard normal deviates by the size of the sample. An odds ratio procedure based on the Mantel-Haenszel method for combining study results using 2×2 tables was used with outcome frequency information. An acceptable significance level was set at $P < 0.01$ (one tailed). Tests for heterogeneity of the independent studies were conducted to assure consistency among the study results. DerSimonian-Laird random effects odds ratios

Table 4. Meta-analysis Summary

Linkages	n	Fisher Chi-square	*P* Value	Weighted Stouffer Zc	*P* Value	Effect Size	Mantel-Haenszel OR	CI	Heterogeneity Significance	Heterogeneity Effect Size
Preoperative evaluation										
Focused history from medical records										
OSA *vs.* no OSA*										
BMI	10	116.41	0.001	15.93	0.001	0.56			0.001	0.001
Blood pressure	6	82.05	0.001	17.50	0.001	0.85			0.001	0.001
Hypertension	5						2.67	2.05–3.49		0.050
Focused physical examination–cephalometric measurement										
OSA *vs.* no OSA*										
Ba-SN	15	83.45	0.001	4.06	0.001	0.13			0.030	0.030
SNA	9	53.36	0.001	2.60	0.004	0.09			0.010	0.001
SNB	9	68.16	0.001	4.12	0.001	0.15			0.001	0.001
MP-H	8	109.09	0.001	10.90	0.001	0.50			0.001	0.001
PAS	8	80.56	0.001	6.99	0.001	0.27			0.001	0.001
OPA	5	22.59	0.020	1.39	0.080	0.06			0.210	0.250
PNS-P	12	139.54	0.001	13.28	0.001	0.56			0.001	0.001
SPT	5	65.49	0.001	7.34	0.001	0.41			0.600	0.700
TA	8	75.81	0.001	6.38	0.001	0.24			0.010	0.110
Preoperative preparation										
Preoperative treatment for OSA										
Pre–post CPAP*										
AHI	10	152.02	0.001	17.84	0.001	0.98			0.005	0.001
RDI	5	76.01	0.001	17.20	0.001	0.99			0.030	0.001
Oxygen saturation	6	91.21	0.001	7.85	0.001	0.46			0.750	0.040
Pre–post mandibular appliance*										
AHI	8	97.12	0.001	9.04	0.001	0.73			0.400	0.001
Postoperative management										
Analgesic use										
Neuraxial *vs.* systemic opioids†										
Respiratory depression	7						1.44	0.61–3.39		0.030
PCA without *vs.* with background infusion†										
Hypoxemia	5	42.39	0.001	3.02	0.001	0.68			0.900	0.800
Oxygenation										
Supplemental *vs.* no supplemental oxygen‡										
Hypoxemia	5						5.98	3.16–11.31		0.750
Positioning										
Patients in nonsupine *vs.* supine position*										
AHI	7	88.59	0.001	10.70	0.001	0.78			0.001	0.001

* Nonrandomized comparative studies; nonperioperative setting. † Data obtained from Practice Guidelines for Acute Pain Management in the Perioperative Setting[3]: not exclusively patients with obstructive sleep apnea (OSA). ‡ Data obtained from Practice Guidelines for Management of the Difficult Airway[2]: not exclusively patients with OSA.

AHI = apnea-hypopnea index; Ba-SN = cranial base flexure angle; BMI = body mass index; CI = confidence interval; CPAP = continuous positive airway pressure; MP-H = mandibular plane to hyoid bone; OPA = oropharyngeal area; OR = odds ratio; PAS = posterior airway space; PCA = patient-controlled analgesia; PNS-P = soft palate length, posterior nasal spine to palate; SNA = angle from sella to nasion to supramental point; SNB = angle from sella to nasion to submental point; SPT = soft palate thickness; TA = tongue volume/size.

were considered when significant heterogeneity was found ($P < 0.01$). To control for potential publishing bias, a "fail-safe n" value was calculated. No search for unpublished studies was conducted, and no reliability tests for locating research results were done.

Meta-analytic results are reported in table 4. To be accepted as significant findings, Mantel-Haenszel odds ratios must agree with combined test results whenever both types of data are assessed. In the absence of Mantel-Haenszel odds ratios, findings from both the Fisher and weighted Stouffer combined tests must agree with each other to be acceptable as significant.

Interobserver agreement among Task Force members and two methodologists was established by interrater reliability testing. Agreement levels using a kappa (κ) statistic for two-rater agreement pairs were as follows: (1) type of study design, $\kappa = 0.50-0.69$; (2) type of analysis, $\kappa = 0.43-0.60$; (3) evidence linkage assignment, $\kappa = 0.88-1.00$; and (4) literature inclusion for database, $\kappa = 0.44-0.87$. Three-rater chance-corrected agreement values were (1) study design, Sav = 0.56, Var (Sav) = 0.009; (2) type of analysis, Sav = 0.54, Var (Sav) = 0.011; (3) linkage assignment, Sav = 0.87, Var (Sav) = 0.003; and (4) literature database inclusion, Sav = 0.58, Var (Sav) = 0.030. These values represent moderate to high levels of agreement.

Consensus was obtained from multiple sources, including (1) survey opinion from consultants who were selected based on their knowledge or expertise in perioperative management of patients with OSA, (2) testimony from attendees of two publicly held open forums at two national anesthesia meetings,‡ and (3) Task Force opinion and interpretation. An initial survey obtained consultant opinions regarding the management of patients with known or suspected OSA. The survey rate of return was 65% (n = 69 of 106). Results of this survey are reported in table 5 and in the text of the Guidelines.

‡ 58th Annual Meeting of the Postgraduate Assembly in Anesthesiology, December 11, 2004, New York, New York, and 20th Annual Meeting of the Society of Ambulatory Anesthesia, May 12, 2005, Scottsdale, Arizona.

A second survey obtained consultant opinions regarding the feasibility of implementing the Guidelines in relation to their clinical practices. Results of this survey are reported below and in table 6. The rate of return was 42% (n = 45 of 106). Responses by specialty were as follows: anesthesiology, 46.7%; otolaryngology, 20.0%; sleep medicine, 20.0%; pediatrics, 6.7%; general or bariatric surgery, 4.4%; and pulmonology, 2.2%. The median percentage of the respondents' patients who have OSA is 20%, and they manage a median of 150 patients with OSA per year. They obtain a sleep study for a median number of 25 patients per year. They would need to obtain a sleep study for a median of an additional 10 patients per year to adhere to these Guideline recommendations. The median cost of a sleep study conducted at their facilities is $1,500. They initiate CPAP or NIPPV in preparation for surgery a median of five times a year, and they indicate that an additional median of 10 patients per year would require CPAP or NIPPV to adhere to these Guidelines. They report that a median of 30 additional patients would require postoperative respiratory monitoring at their hospital if the Guidelines were implemented, and they indicate that the median number of days for which such monitoring would be necessary is 1.5. A median of 10% of the consultants' outpatients with OSA would need to be reclassified as inpatients if the Guidelines were implemented. They report a median of 3 additional hours of recovery room stay that would be required for a typical OSA patient before discharge from their outpatient facility if the Guidelines were implemented. Seventy-three percent of the consultants indicate that the sensitivity of the criteria in section A of table 1 to detect patients with previously undiagnosed OSA is "about right," whereas 13% indicate that they are not sensitive enough, and 11% indicate that they are too sensitive. Eighty-two percent of the consultants indicated that the scoring system for assessment of perioperative risk described in table 2 is "about right," whereas 11% indicate that it is not stringent enough, and 4% indicate that it is too stringent.

Table 5. Consultant Survey Responses

		Percent Responding to Each Item				
	n	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. Preoperative evaluation						
Presumptive diagnosis of OSA:						
Elevated body mass index	66	30.3	50.0*	10.6	9.1	0.0
Weight > 95th percentile (pediatric)	65	20.0	46.2*	21.5	10.8	1.5
Increased neck circumference	69	30.4	46.4*	14.5	7.2	1.4
Observed apnea	69	66.7*	29.0	1.4	2.9	0.0
Snoring	68	26.5	50.0*	13.2	7.4	2.9
Congenital airway abnormalities	66	21.2	47.0*	28.8	3.0	0.0
Daytime hypersomnolence	69	30.4	53.6*	8.9	7.2	0.0
Inability to visualize soft palate	69	11.6	55.1*	23.2	7.2	2.9
Tonsillar hypertrophy	67	10.4	56.7*	23.9	6.0	3.0
Tests if OSA is suspected:						
Overnight oximetry (no polysomnography)	66	10.6	42.2*	12.1	19.7	15.2
Polysomnography	68	69.1*	25.0	2.9	2.9	0.0
Indirect laryngoscopy	66	10.6	15.2	27.3*	27.3	19.7
Radiographic cephalography	66	1.5	15.2	30.3	33.3*	19.7
Resting pulse oximetry	65	7.7	21.5	12.3	36.9*	21.5
Arterial blood gases	66	3.0	18.2	16.7	37.9*	24.2
2. Preprocedure evaluation						
Sleep study (improves outcomes)	68	26.5	47.1*	20.6	4.4	1.5
Sleep study (reduces costs)	68	11.8	29.4	42.6*	14.7	1.5
Risk depends on *both* the severity of OSA and invasiveness of procedure	68	44.1	51.5*	2.9	1.5	0.0
Delay surgery with incomplete preprocedure evaluation of OSA status if planned procedure is:						
Superficial surgery	67	3.0	13.4	20.9	55.2*	7.5
Airway surgery	68	52.9*	23.5	8.8	11.8	2.9
Minor laparoscopic surgery	68	4.4	26.5	33.8*	30.9	4.4
Major laparoscopic surgery	69	20.6	41.2*	19.1	16.2	2.9
Open abdominal surgery	68	33.8	44.1*	10.3	10.3	1.5
Peripheral orthopedic surgery	68	4.4	20.6	33.8*	39.7	1.5
Major orthopedic surgery	68	25.0	48.5*	13.2	11.8	1.5
3. Preoperative preparation						
Preoperative interventions:						
CPAP or NIPPV	68	39.7	39.7*	16.2	4.4	0.0
Mandibular appliance	68	1.5	19.1	58.8*	17.6	2.9
Weight loss	67	24.8	58.2*	7.5	6.0	0.0
Limit procedure to facility with outpatient capability	68	41.2	36.8*	17.6	4.4	0.0
Determine whether procedure should be performed on an inpatient basis	68	26.5	58.8*	13.2	1.5	0.0

(*continued*)

Table 5. Continued

	n	Percent Responding to Each Item				
		Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
4. Intraoperative management						
Intraoperative interventions to improve outcomes:						
ASA difficult airway algorithm	68	30.9	57.4*	8.8	2.9	0.0
Nerve blocks rather than GA for peripheral surgery	68	30.9	45.6*	19.1	4.4	0.0
Major conduction anesthesia rather than GA for peripheral surgery	68	23.5	42.6*	27.9	5.9	0.0
Major conduction anesthesia rather than GA for abdominal surgery	68	7.4	25.0	45.6*	17.6	4.4
Combined regional and GA (regardless of surgical site)	68	1.5	32.4	45.6*	19.1	1.5
GA with secured airway rather than moderate or conscious sedation for superficial procedures	68	7.4	33.8	35.3*	23.5	0.0
GA with secured airway rather than deep sedation for superficial procedures	68	32.4	47.1*	13.2	7.4	0.0
GA with secured airway rather than moderate or deep sedation for procedures involving the upper airway	68	48.5	38.2*	8.8	4.4	0.0
CO_2 respiratory monitoring during moderate or deep sedation	68	36.8	32.4*	27.9	2.9	0.0
5. Extubation						
Intraoperative interventions to improve outcomes during extubations:						
Verify full reversal of neuromuscular block before extubation	68	70.6*	25.9	2.9	0.0	1.5
Extubate patients when they are fully awake	68	48.5	41.2*	7.5	1.5	1.5
Extubate patients in the semiupright position rather than supine	68	36.8	44.1*	16.2	2.9	0.0
6. Postoperative analgesia						
Regional techniques rather than systemic opioids	68	30.9	58.8*	7.4	2.9	0.0
Regional techniques with local anesthetics rather than regional techniques with opioids	68	19.1	50.0*	17.6	13.2	0.0
Nonsteroidal antiinflammatory agents rather than systemic opioids	68	26.5	58.8*	7.4	7.4	0.0
Systemic patient-controlled analgesia with opioids rather than nurse-administered i.m. or i.v. opioids	68	8.8	35.3	33.8*	13.2	8.8
Systemic patient-controlled analgesia *without* a background infusion rather than patient-controlled analgesia *with* a background infusion	67	7.5	35.8	40.3*	7.5	9.0
7. Postoperative oxygenation						
Supplemental oxygen to maintain acceptable arterial oxygen saturation	68	32.4	55.9*	5.9	5.9	0.0
Supplemental oxygen may be discontinued when patients can maintain their baseline oxygen saturation level on room air	68	10.3	67.6*	13.2	8.8	0.0
Resume treatment as soon as feasible for patients previously treated with CPAP or NIPPV	68	79.4*	17.6	1.5	1.5	0.0
Initiate CPAP or NIPPV after surgery to patients not previously treated with CPAP or NIPPV	65	7.7	32.3	40.0*	16.9	3.1
When patient is not ambulating, the CPAP or NIPPV appliance should be in place at all times	68	7.4	25.0	26.5*	36.8	4.4
8. Postoperative positioning						
Avoid supine position (adult patients)	67	19.4	67.2*	11.9	0.0	1.5
Avoid supine position (pediatric patients)	66	15.2	43.9*	36.4	3.0	1.5
9. Postoperative inpatient monitoring						
Full monitoring in intensive care unit	67	14.9	22.4	26.9*	26.9	9.0
Oximetry in a stepdown unit	67	17.9	58.2*	10.4	11.9	1.5

(*continued*)

Table 5. Continued

	n	Percent Responding to Each Item				
		Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Oximetry with telemetry on a standard hospital ward	67	6.0	56.7*	17.9	17.9	1.5
Oximetry with a dedicated observer in patient's room or hospital ward	67	4.5	40.3	23.9*	28.4	3.0
Oximetry at patient bedside with intermittent monitoring by staff	67	3.0	19.4	20.9	41.8*	14.9
Continuous ventilatory monitoring following discharge from the PACU	67	28.4	47.8*	16.4	7.5	0.0
Continuous pulse oximetry may be discontinued once patients are no longer receiving parenteral opioid analgesics	67	3.0	38.8	20.9*	29.9	7.5
Continuous pulse oximetry may be discontinued if oxygen saturations during sleep remain above 90% while breathing room air	67	10.4	50.7*	16.4	17.9	4.5
10. Outpatient *vs.* inpatient management						
Operations that may be safely performed on an outpatient basis:						
Superficial surgery (local/regional anesthesia)	67	19.4	74.5*	6.0	0.0	0.0
Superficial surgery (GA)	65	7.7	35.4	21.5*	32.3	3.1
Airway surgery (adult)	67	0.0	7.5	11.9	41.8*	38.8
Tonsillectomy in children less than 3 years of age	66	0.0	9.1	16.7	36.4*	37.9
Tonsillectomy in children greater than 3 years of age	66	0.0	25.8	27.3*	30.3	16.7
Minor orthopedic surgery (local/regional anesthesia)	67	7.5	79.1*	9.0	3.0	1.5
Minor orthopedic surgery (GA)	67	4.5	32.8	25.4*	31.3	6.0
Gynecologic laparoscopy	67	1.5	35.8	40.3*	20.9	1.5
Laparoscopic surgery, upper abdomen	67	1.5	10.4	19.4	53.7*	14.9
Lithotripsy	67	4.5	47.8*	34.3	11.9	1.5
Equipment that should be available in an outpatient facility:						
Difficult airway equipment	67	80.6*	17.9	1.5	0.0	0.0
Radiology facilities (chest x-ray)	67	17.9	49.3*	22.4	10.4	0.0
Respiratory therapy	67	20.9	53.7*	13.4	11.9	0.0
Clinical laboratory (blood gases, electrolytes)	67	28.4	52.2*	10.4	9.0	0.0
Transfer arrangement with inpatient facility	67	73.1*	23.9	3.0	0.0	0.0
Criteria that should be met before patients are discharged from an outpatient facility:						
Return of room air oxygen saturation to baseline value	67	46.3	44.8*	6.0	1.5	1.5
Documentation that patient does not become hypoxemic when left undisturbed in PACU or observation unit while breathing room air	67	55.2*	35.8	4.5	3.0	1.5
Documentation that patient does not develop clinical airway obstruction when left undisturbed in PACU or observation unit	66	65.2*	31.8	1.5	0.0	1.5

* Median.

ASA = American Society of Anesthesiologists; CO_2 = carbon dioxide; CPAP = continuous positive airway pressure; GA = general anesthesia; i.m. = intramuscular; i.v. = intravenous; n = number of consultants who responded to each item; NIPPV = nasal intermittent positive-pressure ventilation; OSA = obstructive sleep apnea; PACU = postanesthesia care unit.

Table 6. Feasibility Survey Responses

	Percent "Yes"
Preoperative evaluation	
Which of the following would you need to initiate or upgrade in order to comply with the recommendations?	
Preoperative protocol for management of OSA patients	64.4
Improved communication between surgeons and anesthesiologists	68.9
More careful questioning of patients and family	46.7
Increased ordering of preoperative sleep studies	46.7
For a patient who does not have a previous sleep study, based on these Guidelines, would you:	
(1) order a sleep study, or	37.8
(2) treat the patient as if he or she has OSA	60.0
Intraoperative management	
Would implementation of the Guidelines require the purchase of additional equipment?	15.6
Postoperative management	
Which of the following would you need to initiate or upgrade in order to comply with the recommendations regarding postoperative care of OSA patients?	
Caring for patients in nonsupine positions	35.6
Administration of supplemental oxygen	11.1
Use of CPAP or NIPPV by patients who were using it preoperatively	31.1
Continuously monitored pulse oximetry (or other respiratory monitoring) until patients are no longer at risk for postoperative airway obstruction	40.0

Cost estimates for consultants' hospitals or surgicenters	Median
Total annual cost of implementing the Preoperative Evaluation recommendations	$30,000
Total annual cost of implementing the Preoperative Preparation recommendations	$15,000
Cost of obtaining the necessary equipment for implementing the Intraoperative Management recommendations	$0
Total annual cost of implementing the Postoperative Management recommendations including personnel and equipment for postoperative respiratory monitoring	$25,000
Cost to outfit an outpatient facility to safely care for OSA patients in accordance with the Guidelines	$0
Annual increase in cost for an outpatient facility to implement the Outpatient Surgery/Discharge recommendations	$50,000

CPAP = continuous positive airway pressure; NIPPV = nasal intermittent positive-pressure ventilation; OSA = obstructive sleep apnea.