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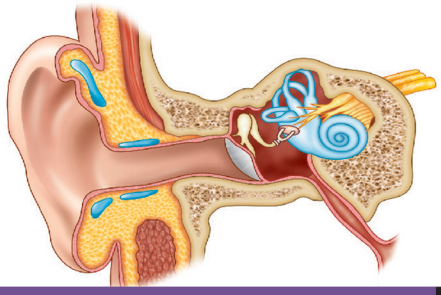
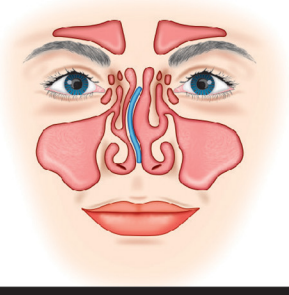
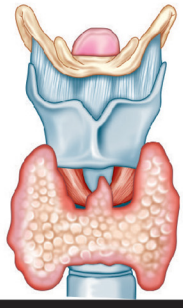
VOLUME 5

RECENT ADVANCES IN OTOLARYNGOLOGY

HEAD & NECK SURGERY







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MARKUS HF PFISTER

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Chapter 3

Anesthesia for Otolaryngology

Parwane P Pagano

ANESTHESIA FOR SLEEP ENDOSCOPY

Drug-induced sleep endoscopy (DISE) aims to reproduce upper airway obstruction that occurs during natural sleep to assist in planning surgical intervention for obstructive sleep apnea (OSA) patients. Anesthesia protocols for DISE can be compared based on provision of a clinically adequate level of sedation to allow endoscopic evaluation of obstruction, safety (particularly avoidance of excess oxygen desaturation), and efficiency. Like other anesthesia cases, DISE is performed in the operating room or out-of-operating room location by qualified personnel with appropriate intravenous access, supplemental oxygen and standard monitoring. The overlap between a diagnosis of OSA and difficult mask ventilation or difficult endotracheal intubation requires availability of various airway management devices.

The intravenous benzodiazepine midazolam is used frequently for DISE. For example, an initial dose of 0.03 mg/kg is followed by additional doses of 0.015 to 0.03 mg/kg.[1] The relatively short duration of action facilitates outpatient DISE; if necessary, the competitive antagonist flumazenil may be administered to reverse benzodiazepine effects. Propofol, a rapid-onset nonbarbiturate hypotic agent, is administered for DISE using target-controlled drug infusions, other quantitative infusion methods and manual titration. In patients with severe OSA investigators found a median nadir for oxygen saturation of 81% when propofol for DISE was administered via a probability ramp control infusion scheme.[2] The lowest observed oxygen saturation during the procedure was better than the lowest saturation measured for these patients during sleep studies, and upper airway obstruction was accomplished reasonably quickly with this technique within a median time of 3.8 minutes. A prospective study of standardized manual titration compared to a target-controlled infusion of propofol for DISE in patients with moderate sleep apnea noted a 10% incidence of severe desaturation in the manual titration group.[3] Also, while the

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study time was longer in the target-controlled infusion group, this technique allowed the endoscopist to capture apnea events more frequently than with the manual titration technique.

Several combinations of agents have been evaluated for DISE, achieving the level of sedation required with a lower total dose of each individual agent. Remifentanil is an ultrashort-acting opioid that does not depend on hepatic biotransformation. In a prospective randomized study, patients undergoing sleep endoscopy with target-controlled infusions of propofol in combination with remifentanil had successful sedation, but a high incidence of desaturation (17 of 22 patients). Patients who received infusions of the centrally acting α-2 agonist dexmedetomidine with remifentanil had fewer desaturation episodes; dexmedetomidine minimizes ventilatory depression, but within this group several patients did not achieve a clinically adequate level of sedation.[4] Dexmedetomidine has been applied alone for sleep endoscopy using a loading dose of 1 mcg/kg and an infusion rate of 1.0 mcg/kg/hour; in this single patient case the endoscopic evaluation was completed without desaturation or significant hypotension.[5]

The bispectral index (BIS) is a dimensionless parameter derived from the electroencephalogram (EEG) signal that ranges from 0 for an isoelectric EEG to 100 in the awake state. To investigate the similarity of conditions achieved in DISE with natural sleep,6 BIS values of patients undergoing polysomnography were monitored, ascertaining average BIS levels for stages of non-REM sleep N1 (79.55), N2 (73.14), and N3 (53.21). In patients with OSA considered for surgical intervention, DISE with midazolam reproduced BIS levels seen in N1 and N2 sleep stages, offering ample opportunity to observe airway obstruction. During DISE with dexmedetomidine, the lowest BIS value observed was 75. With a combination of dexmedetomidine and remifentanil, the average BIS was 73, similar to that with propofol and remifentanil. Studies reporting BIS levels for propofol alone demonstrate average levels of 63–69 depending on the infusion technique. Based on the results of these studies, the BIS may be considered in addition to standard physiologic monitoring during DISE.

CARDIAC EVALUATION FOR PATIENTS UNDERGOING OTOLARYNGOLOGY PROCEDURES

Rationale and Outcomes

Cardiac evaluation aims to identify surgical patients at risk for perioperative major adverse cardiac events and institute interventions to lower this risk. Invasive tests and institution of cardiovascular medications should be critically examined for evidence of actual benefit in

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relation to the risks incurred. Well-organized perioperative cardiac management is an individualized process taking into account each patient's unique clinical situation.[7] A general approach to this problem is outlined in the American Heart Association/American College of Cardiology clinical practice guideline on perioperative cardiac evaluation for patients undergoing noncardiac surgery, in which evidence supporting various tests and interventions is reviewed.[8]

The incidence of adverse cardiac events accompanying otolaryngology procedures has been surveyed. Postoperative complications after major head and neck cancer surgery from 2006 to 2011 in England were identified from Hospital Episodes Statistics data. Adverse cardiovascular events occurred in 4.6% of patients, comprising myocardial infarction (MI), stroke or transient ischemic attack, and peripheral vascular complications.[9] A retrospective analysis of major head and neck surgery in a United States tertiary care institution over 5 years found 15% of patients developed elevated postoperative troponin I levels, and 2.6% were diagnosed with myocardial infarction postoperatively.[10] Patients with elevated postoperative troponin I levels had an increased risk of mortality at 30 days, 60 days, and 1 year after the surgical procedure.

Risk Assessment and Preoperative Testing

Perioperative cardiac evaluation takes into account the patient history and physical examination, surgical procedure-related risk, and the patient's functional status. High risk surgery, specifically intrathoracic, intraabdominal or suprainguinal vascular surgery was identified as one of the six predictors of major perioperative cardiac complications in the Revised Cardiac Risk Index (RCRI).[11] More generally, procedures associated with increases in heart rate and afterload, or significant decreases in preload and/or afterload can predispose a patient to cardiac events and various otolaryngology procedures have such features. In terms of hemodynamics, a retrospective study of over 30,000 patients having all types of noncardiac surgeries in a single institution found that intraoperative mean arterial pressure below 55 mm Hg was associated with myocardial injury and cardiac complications[12] probably due to ischemia-reperfusion injury.

A detailed history and physical examination will focus on the following: angina, previous MI, surgical or percutaneous interventions, smoking, diabetes mellitus, hyperlipidemia, hypertension, peripheral or cerebrovascular disease, chronic kidney disease, congestive heart failure, carotid bruit, and ventricular gallop.[13] Using a risk prediction index, the clinician may estimate whether the patient is low or high

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risk for perioperative adverse cardiac events. For example, the RCRI comprises six independent predictors of perioperative major cardiac complications: history of congestive heart failure, cerebrovascular disease, ischemic heart disease, preoperative treatment with insulin, preoperative creatinine >2.0 mg/dL, and high risk surgery (as listed previously). In the RCRI validation cohort, patients with zero risk factors had a 0.4% rate of adverse cardiac events, while the rate was 0.7% in the group with one risk factor.[11] In contrast, two risk factors resulted in a cardiac complication rate of 7% and the presence of three or greater risk factors was associated with an 11% rate. Major cardiac complications in the RCRI dataset included MI, pulmonary edema, ventricular fibrillation or cardiac arrest, and complete heart block.

Based on this information, stable patients at low risk generally do not need further cardiac testing before proceeding to surgery. Patients who have two or more predictors of adverse cardiac events may be stratified based on their functional capacity. Individuals who cannot perform activity expending at least four metabolic equivalents have poor functional capacity and can undergo preoperative stress testing to assess for myocardial ischemia. A low level of self-reported exercise tolerance (inability to walk four blocks or climb two flights of stairs) was associated with a greater incidence of perioperative myocardial ischemia and neurologic complications in a study of patients undergoing major noncardiac surgery.[14]

Limited functional capacity is a common sign of numerous diseases, including myocardial ischemia, heart failure, lung diseases (severe chronic obstructive pulmonary disease, pulmonary fibrosis, pulmonary hypertension), anemia, and deconditioning.[15] Heart failure and decreased left ventricular systolic function present significant perioperative risks. In a cohort of 174 patients previously diagnosed with heart failure requiring noncardiac surgery, severely reduced left ventricular ejection fraction (<30%) was an independent risk factor for perioperative MI, heart failure exacerbation, and 30-day mortality.[16] Echocardiography to assess left ventricular function yields useful information in patients with dyspnea associated with heart failure or without another obvious cause, and may be applied to reevaluate patients with reduced left ventricular function.[8]

Coronary Stents

An increasing number of patients scheduled for surgery have had coronary stents placed. Second-generation drug-eluting coronary stents release immunosuppressive agents (everolimus or zotarolimus) to block proliferation of vascular smooth muscle cells after stent placement.[17] In comparison with bare-metal stents, drug-eluting stents

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reduce the risk of repeat revascularization. To minimize the risk of stent thrombosis, current guidelines advocate treating drug-eluting stent patients with dual antiplatelet therapy, comprising aspirin and a P2Y12 inhibitor such as clopidogrel for at least 12 months.[18] Ongoing clinical trials aim to address the optimal duration of dual antiplatelet therapy to balance protection from stent thrombosis with the risk of hemorrhagic events.[19]

Occasionally, a patient presents for a surgical procedure that cannot be delayed while on dual antiplatelet therapy after recent drug-eluting stent implantation. Discontinuation of clopidogrel within the first 6 months after stent placement is significantly associated with stent thrombosis[20] often leading to MI. If the planned surgical procedure has low or moderate bleeding risk, it is optimal to continue both aspirin and clopidogrel through the perioperative period. For procedures with high bleeding risk for which clopidogrel is interrupted, aspirin should be continued through the perioperative period with intensive postoperative monitoring of the patient until the dual antiplatelet therapy is reinstituted.[21] In patients who must stop clopidogrel for surgery and present a very high ischemic risk due to clinical or angiographic factors, a short acting intravenous antiplatelet agent such as tirofiban or eptifibatide may be considered.[22]

Perioperative Biomarkers

Biomarkers associated with cardiac ischemic injury or volume overload such as natriuretic peptide and troponin are being explored for application in the perioperative period. In a large trial of noncardiac surgical patients, peak postoperative troponin levels correlated with 30-day mortality rates.[23] However, many of the events seen in studies of postoperative troponin elevation do not meet clinical criteria for MI and include mortality from a variety of causes. Accordingly, postoperative troponin measurement is supported if the patient presents a clinical picture consistent with myocardial ischemia or MI rather than as a general surveillance tool.[8] Higher postoperative natriuretic peptide levels were associated with an elevated risk of 30-day mortality or major cardiac events (MI or heart failure) in a meta-analysis of 18 studies of noncardiac surgical patients.[24] A well-defined clinical role for this biomarker in the perioperative period awaits further investigation.

RESPIRATORY COMPLICATIONS IN PATIENTS WITH OSA UNDERGOING SLEEP SURGERY

Patients with OSA undergoing noncardiac surgery have a higher incidence of postoperative cardiac complications, respiratory failure,

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oxygen desaturation, and postoperative intensive care unit (ICU) utilization, based on a meta-analysis of 13 studies comprising almost 4,000 patients.[25] A retrospective study of over 1 million records using the Nationwide Inpatient Sample database examined differences in postoperative cardiorespiratory outcomes between patients with sleep disordered breathing and those without after elective abdominal, cardiovascular, orthopedic, and prostatic surgery.[26] The investigators found a significant independent association between sleep disordered breathing and a greater odds ratio for application of continuous positive airway pressure (CPAP)/noninvasive ventilation, emergent intubation and mechanical ventilation, as well as atrial fibrillation. Among all patients who required emergent intubation, a higher percentage of sleep disordered breathing patients had this intervention early in their hospital course on postoperative day 0 or 1.

Obstructive sleep apnea patients undergoing sleep surgery present several concerns. The potential for upper airway obstruction in the postoperative period is significant as a result of postsurgical edema. Opioids, while effective in postoperative pain management, cause central respiratory depression and decreased tonic activity to the upper airway.[27] A review by the Cochrane Airways Group of randomized trials in adult OSA patients described lower oxygen saturation levels with short-acting opioids and specific benzodiazepines.[28] Postoperative disposition is a key decision as admission to a stepdown unit or ICU after sleep surgery provides close monitoring to rapidly detect cardiorespiratory complications but utilizes limited and costly intensive care resources.

Several studies have investigated the respiratory complication rate after sleep surgeries. Among 50 patients undergoing multilevel OSA surgery excluding major tongue-base surgery with an average apnea-hypopnea index (AHI) of 24.4, 22% were admitted to the hospital overnight based on a set of criteria applied in the postanesthesia care unit (desaturation, upper airway obstruction, witnessed apnea, opioid analgesic requirements) while the remainder were discharged.[29] No respiratory complications occurred in the group discharged home and only one hospitalized patient required a respiratory intervention in which CPAP was applied. A series of patients with an average AHI of 42 undergoing uvulopalatopharyngoplasty with or without septoplasty had no significant postoperative respiratory complications such as emergent reintubation.[30]

A retrospective study of 166 patients who had transoral robotic surgery for OSA included a single case of pulmonary embolism requiring anticoagulation.[31] Individuals in this study group had lingual

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tonsillectomy in conjunction with one or more additional procedures and all patients were admitted to the surgical ICU postoperatively. In a series of over 400 patients undergoing surgery for OSA, individuals who had nasal and palate procedures only and were stable after 6 hours observation in the PACU were discharged, while others were admitted to a step-down unit for 1 day.[32] One hospitalized patient developed upper airway obstruction requiring emergent awake intubation due to a floor of mouth hematoma. Overall few serious respiratory complications were reported with the level of postoperative care selected for these patients.

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Markus HF Pfister MD is an Otolaryngologist with subspecialization in Otology and Neurotology. He has been trained at the University of Tuebingen, Germany, University of California, San Francisco and Stanford University, USA, and he is academically affiliated with the University of Tuebingen, Germany. He has been responsible for the molecular genetics unit of hereditary hearing impairment at the Department of Otolaryngology, University of Tuebingen, Germany, and has been a member of the European Work Group on Genetics of Hearing Impairment. Dr Pfister's interests include innovative approaches in the diagnosis and therapy of disorders in otolaryngology and head and neck surgery, particularly in otology and neurotology. He is considered a leading expert on hereditary hearing loss and has contributed to several international studies on hereditary hearing impairment. He is author of more than 80 peer-reviewed articles and numerous book chapters.

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