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Message from the President

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It goes without saying that anesthesia and sleep medicine are two major disciplines that share significant common ground. Over the past seven years, the Society of Anesthesia and Sleep Medicine (SASM) has been successful in bringing together an outstanding group of clinicians and researchers in the field of anesthesia and sleep medicine to work together to achieve a common goal: improving the well-being of patients with sleep disorders during the perioperative period.

As a testament to our mission, SASM has developed comprehensive, evidence-based recommendations to guide anesthesia practitioners for preoperative screening and assessment of adult patients with obstructive sleep apnea. This clinical practice guideline was published in the August 2016 issue of the International Anesthesia Research Society (IARS) *Anesthesia & Analgesia (A&A)* journal. Most recently, a task force led by Drs. Stavros Memtsoudis, Frances Chung and Crispiana Cozowicz developed the first ever guidelines for the intraoperative management of patients with obstructive sleep apnea. I am pleased to announce that this new guideline has been accepted for publication in *A&A* journal.

Efforts on developing a guideline on perioperative management of patients with narcolepsy are ongoing. In order to increase our scientific footprint, SASM continues to work diligently with the IARS. For the past few years, Dr. David Hillman has been serving as the Executive Section Editor for Sleep and Respiration for *A&A*, the flagship journal of IARS and the official journal of SASM. Both IARS and SASM share the goal of increasing the amount of published literature related to respiration and sleep medicine. This relationship has been most critical in helping disseminate knowledge of sleep medicine in the field of anesthesiology. We are grateful to Dr. Hillman for serving in this position given his unique qualification as an anesthesiologist, sleep medicine specialist, and a prolific clinical investigator.

Our Clinical Committee, co-chaired by Drs. Bhargavi Gali and Dennis Auckley, completed the development of a comprehensive slide set titled "Opioids and Respiratory Depression". I am confident practitioners will find this document most useful. Dr. Susana Vacas continues to lead the Scientific Update Subcommittee which provides busy members of SASM with frequent and relevant literature updates. Dr. Jean Wong continues to chair our Newsletter Subcommittee with three newsletters annually. These newsletters are important to keep our membership informed about new developments in our Society and the field.

Lastly, I am excited to announce that the Conference Committee, led by Dr. Krish Ramachandran and Dr. Tom Cloward, has completed the program for the annual scientific meeting scheduled for Friday, October 12, 2018 at the W San Francisco hotel in San Francisco. This year, the theme of the meeting is "Perioperative Care and Sleep Medicine: Controversies, Challenges and Special Populations". The Conference Committee decided to introduce workshops during the scientific meeting. We plan to have

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Editor's File

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Welcome to the May edition of the SASM newsletter. This issue of the newsletter features updates and controversial topics relevant to clinicians caring for patients with sleep breathing disorders during the perioperative period. I would like to thank the contributors of this issue of the newsletter. They highlight recent research that is increasing our knowledge regarding the perioperative risks for patients with OSA, and potential areas for further research to improve management of these patients.

It is unclear whether patients with OSA undergoing cardiac surgery are at higher risk of adverse events. In this issue of the newsletter, Mahesh Nagappa, MD, and George Ho, BSc, summarize the results of their recently published systematic review and meta-analysis of eleven studies on postoperative outcomes in OSA patients undergoing cardiac surgery. Interestingly, they found that overall major adverse cardiac or cerebrovascular events and newly documented postoperative atrial fibrillation were higher in OSA compared to non-OSA patients. However, the majority of cardiac surgical patients were newly diagnosed and untreated prior to surgery – indicating there is a huge opportunity to improve management of these patients to optimize their clinical outcomes.

Previous studies on whether OSA is a risk factor for difficult airway have been inconsistent. In this issue, Siaw May Leong, MBBS, MMED, and David Wong, MD, provide a summary on studies investigating whether OSA is a risk factor for difficult airway management.

Vivian Asare, MD, reviews the use of home sleep testing, which has recently gained increasing acceptance for the diagnosis of OSA. She discusses the evidence showing that home sleep testing is an acceptable alternative to in-lab PSG in certain populations. She cautions that although these devices are cost effective, convenient, and may expedite treatment, there are important limitations of these devices.

Jim K. Wong, MD, MS, and Clete A. Kushida, MD, PhD, FAASM share their experience with initiating a quality improvement project to reintroduce PAP therapy in PAP non-adherent patients at the Palo Alto Veterans Affairs Health Care Systems facility. Although only a small number of the patients agreed to seek outpatient sleep medicine follow-up, their results were encouraging for further work with this challenging group of patients.

There is intense interest in identifying which patients with OSA are at risk of developing postoperative complications. Eric Deflandre, MD, FCCP reviews some of the previous studies that have shown inconsistent results with using different parameters.

Finally, Garrett Enten, BS, David Samuels, MD, and Enrico Camporesi, MD, challenge the use of short-acting opioids to avoid postoperative respiratory complications in patients with OSA. They argue that intraoperative remifentanil can induce postoperative wound hyperalgesia and propose avoiding opioids altogether – this would be a major shift in usual clinical care.

We welcome articles from all members of SASM, please contact me at info@sasmhq.org if you are interested in contributing an article or joining the newsletter committee.

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two concurrent workshops: 1) Positive Airway Pressure and Noninvasive Ventilation Workshop led by Drs. Peter Gay and David Hillman, and 2) Point of Care Ultrasound Workshop focused on assessing cardiac function and hemodynamic status, led by Dr. Stephen Haskins. I am confident that these workshops will be well-received by attendees. I encourage all SASM members to consider submitting their scientific abstracts to the annual SASM meeting. I look forwarding to seeing you all in San Francisco!

Postoperative Outcomes in Obstructive Sleep Apnea Patients Undergoing Cardiac Surgery

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Obstructive sleep apnea (OSA) is a common sleep disordered breathing (SDB) characterized by upper airway collapse resulting in recurrent episodes of arousal from sleep and intermittent hypoxemia. In the cardiac surgical population, prevalence of mild OSA (apnea-hypopnea index [AHI] ≥ 5) and moderate-severe OSA (AHI ≥ 15) is 74% and 48% respectively.[1]

In cardiac surgery, it is unclear whether patients with OSA are at higher risk of adverse events compared to patients without OSA. Several new studies reported positive association between OSA and increased postoperative complications.[1–6] However, varying methodologies and limitations of data on the types of outcomes have impeded meaningful conclusions in cardiac surgical patients. For example, Foldvary-Schaefer et al. found no significant association between OSA and adverse postoperative outcomes but Kaw et al. reported that OSA was significantly associated with a higher incidence of encephalopathy, postoperative infection and increased length of stay (LOS) in the intensive care unit (ICU).[1,7]

We published a systematic review and meta-analysis of eleven studies with a total of 1801 patients (688 OSA vs. 1113 non-OSA) were included in the final analysis.[1,2,12,4–11] Of these, nine studies were prospective and two were retrospective in nature. Eight studies investigated patients undergoing coronary artery bypass grafting (CABG),[2,4,6,8–12] and three studies investigated patients undergoing cardiac procedures including CABG, valve replacements and/or repairs.[1,5,7] Most studies included newly diagnosed or suspected OSA patients by sleep studies or questionnaire. In total, 79% (607/771) were newly diagnosed and untreated OSA patients.

Overall, Major Adverse Cardiac or Cerebrovascular Events (MACCE) were 33.3% higher odds in the OSA patients when compared to the non-OSA patients (OSA vs. non-OSA: 31.1% vs. 10.6%; OR 2.4; 95% CI: 1.38-4.2, P =0.002; heterogeneity I^2 = 64%) (Figure 1). The newly documented postoperative atrial fibrillation (POAF) was 18.1% higher odds in the OSA patients versus the non-OSA patients (OSA vs. non-OSA: 31% vs. 21%; OR 1.94; 95% CI: 1.13-3.33, P = 0.02; Heterogeneity I^2 = 45%). The risk of postoperative tracheal intubation was significantly higher by 7.6% in the OSA patients versus the non-OSA patients (OSA vs. non-OSA: 13% vs. 5.4%; OR 2.67; 95% CI: 1.03-6.89, P = 0.04; Heterogeneity I^2 = 59%). There were no significant differences in the infection or sepsis and ICU re-admissions. The metaregression analysis based on the various characteristics like study type, study quality, medical comorbidities, loss of patients to follow-up and confirmation of OSA (PSG vs. Berlin Questionnaires) did not impact the odds ratio of postoperative complications for OSA versus non-OSA groups.

Recently, OSA was found to be independently associated with postoperative major adverse cardiac and cerebrovascular events following percutaneous coronary intervention.[13] There is a strong association between OSA and atrial fibrillation in patients undergoing various elective surgeries.[14] In prospectively collected outcomes of 190 patients with OSA (confirmed by PSG), after cardiac surgery, Post-Operative Atrial Fibrillation (POAF) was associated with AHI in univariate analysis but not after results were adjusted for obesity and other confounders.[15]

In the literature, there are inconsistencies in the results on the association between OSA and postoperative mortality. The study results may differ depending on whether patients at high-risk for OSA were recognized, and subsequent monitoring or CPAP therapy was implemented. OSA patients might have a longer intubation time than non-OSA patients, prolonging the ICU LOS.[1,2,9]

Prolonged ICU stay leads to higher healthcare costs and greater consumption of limited resources.[16] However, the length of hospital stay was not significantly prolonged in OSA patients compared to non-OSA patients. The variations in the length of hospital stay in the individual studies may be due to varying discharge criteria across different hospitals and changing practice principles with time as well as possible cohort bias.

The high prevalence but low recognition of OSA among patients presenting for cardiovascular surgery may put patients at increased risk of postoperative complications.[1,17,18] The Society of Anesthesia and Sleep Medicine has recommended the use of a screening tool to identify OSA in the surgical patients in the preoperative period.[19] The majority of OSA patients in our meta-analysis were untreated prior to surgery given that 79% (607/771) of the OSA patients were newly diagnosed or screened as high-risk "at the beginning of the studies". Only 7% (54/771) of the OSA patients were on preoperative CPAP.

The high percentage of newly diagnosed OSA patients strengthens the evidence that OSA is highly prevalent in the cardiac surgical population but largely remains unrecognized. It raises the question whether the perioperative management of these newly diagnosed OSA patients is

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adequate in view of the increased risk of postoperative complications.

The benefits of CPAP therapy in surgical patients was supported by two recent publications.[20,21] In a retrospective matched cohort analysis of postoperative outcomes in diagnosed versus undiagnosed OSA undergoing various surgeries, surgical patients with diagnosed OSA and a CPAP prescription had more than a 50% decreased risk of cardiovascular complications (cardiac arrests and shock) versus patients with undiagnosed OSA.[20] In another cohort study of adult patients undergoing vascular and general surgeries, patients with untreated OSA were at an increased risk of cardiopulmonary complications versus OSA patients with CPAP therapy.[21] Further work is needed in this area.

There are some limitations to the findings of this meta-analysis due to the absence of randomized controlled trials. Variation also exists between studies on reporting of various comorbidities and definition of postoperative outcomes. Several of these comorbidities which are associated with post-operative complications after cardiac surgery were not fully controlled as confounders. Selection bias and treatment bias, inherent to the observational studies, may exist.

In conclusion, our meta-analysis demonstrates that following cardiac surgery, MACCE and newly documented POAF were 33.3% and 18.1% higher odds in OSA versus non-OSA patients respectively. Further research on the optimal perioperative management of cardiac surgical patients at high-risk for OSA is needed.

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Obstructive Sleep Apnea as a Risk Factor Associated with Difficult Airway Management

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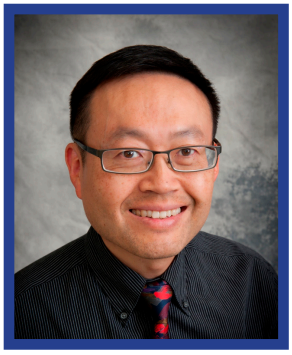
Obstructive sleep apnea (OSA) is a common sleep disorder characterized by repetitive opening and closure of the upper airway during sleep that affects alveolar gas exchange, yet it is often underdiagnosed in a vast majority of patients due to the lack of awareness and limited access to sleep centers. [1,2]

OSA is associated with a number of upper airway anatomical changes that are also common to the difficult airway including oropharyngeal crowding, macroglossia, retrognathia, and retro position of the maxilla. [3-5] The association between OSA and difficult airway had been studied in various clinical trials but the relationship between the two conditions has not been clearly established. [5-17] In view of this possible equipoise, a recent narrative review was performed to determine if OSA is a risk factor associated with the four major aspects of difficult airway, namely difficult intubation, difficult mask ventilation, failed supraglottic airway (SGA) use, and difficult creation of a surgical airway.

The definition of a difficult airway is not consistent in medical literature. The American Society of Anesthesiologists outlined definition points for difficulty facemask ventilation, laryngoscopy, tracheal intubation, SGA placement and ventilation. [18] The Canadian Airway Focus Group included difficulty with indirect (e.g. video) laryngoscopy and difficult creation of a surgical airway. [19] Other classically accepted definitions include failure to intubate by an experienced practitioner, three or more attempts at laryngoscopy or endotracheal tube passage and/or a poor view of the vocal cords on direct laryngoscopy. Therefore, depending on the definition that is used, the reported incidence of airway difficulty and subsequent airway problems can be extremely variable. [20]

OSA and Difficult Tracheal Intubation (Table 1)



Studies by Hiremath [5], Siyam [8] and Kim [9] recorded that OSA patients had a higher incidence of difficult intubation vs non-OSA patients, whereas studies by Brodsky [14], Sabers [15] and Shah [16] found the difference to be statistically not significant. Overall, from these six studies, the incidence of difficult intubation was higher in OSA compared to non-OSA patients (14.5% vs 7.7%, p=0.0002)

In addition to the studies above, Toshniwal did a prospective, questionnaire-based clinical assessment in three categories of

Table 1 – Incidence of difficult tracheal intubation in OSA patients

Paper	Study Design	OSA diagnosis	Setting/Population	Result		
				Difficult Tracheal Intubation		
				With OSA	Without OSA	P-value
Hiremath	Retrospective Case-Control	PSG, AHI≥10	Patients recorded as difficult to intubate	8/10 (80.0%)	7/20 (35.0%)	0.05
Siyam	Retrospective Case-Control	PSG	ENT and non-ENT surgeries	8/36 (21.9%)	2/77 (2.6%)	0.003
Kim	Retrospective Case-Control	PSG	UPPP surgeries	15/90 (16.7%)	3/90 (3.3%)	0.003
Brodsky	Prospective Cohort	History	Morbidly obese (BMI>40) patients for elective surgeries	6/56 (10.7%)	6/44 (13.6%)	0.89
Sabers	Retrospective Case-Control	PSG, RDI>10	Outpatient surgeries excluding ENT	18/187 (9.6%)	12/173 (6.9%)	0.46
Shah	Prospective Observational	History	Multidisciplinary surgeries	1/7 (14.3%)	39/493 (7.9%)	0.9203
			Overall	56/386 (14.5%)	69/897 (7.7%)	0.0002

OSA = obstructive sleep apnea; PSG = polysomnography; AHI = apnea-hypopnea index; ENT = ear nose & throat; UPPP = uvulopalatopharyngoplasty; GA = general anesthesia; BMI = body mass index; RDI = respiratory disturbance index

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patients with confirmed OSA, high and low STOP-Bang scores scheduled for elective bariatric surgery. [21] Their results suggests an association between patients with confirmed or high risk of OSA and difficult intubation.

OSA and Difficult Mask Ventilation

Kheterpal and colleagues carried out two large-scaled studies involving attempts at mask ventilation. In the earlier trial, the presence of sleep apnea was one of the independent predictors of grade 3 (difficult) or grade 4 (impossible) mask ventilation. [10] In the second study spanning 4-years, they also found that the incidence of impossible mask ventilation was increased in OSA vs non-OSA patients and OSA was identified as one of five independent predictors of impossible mask ventilation. [11] This result was further strengthened by Cattano's study, a retrospective analysis of a database of airway assessments, management plans and outcomes, which identified OSA as one of seven risk factors for difficult mask ventilation. [13]

On the contrary, in a trial by Shah et al., OSA patients were not at an increased risk of difficult mask ventilation. However, this statistically insignificant result may be due to a small sample size. [16] In summary, combined analysis of the four included studies, revealed a strong association between OSA and difficult mask ventilation. Overall, from these three studies, the incidence of difficult mask ventilation was higher in OSA compared to non-OSA patients (2.5% vs 0.7%, p<0.0001)

OSA and Combined Difficult Laryngoscopy and Difficult Mask Ventilation

Kheterpal showed the incidence of difficult mask ventilation combined with difficult laryngoscopy was 0.4%. [12] Twelve independent predictors of combined difficult mask ventilation and laryngoscopy were identified, including OSA with an odds ratio of 1.59 (CI 1.12-2.27, *P*=0.01). The incidence of this challenging combination was significantly increased in OSA vs non-OSA patients (1.04% vs 0.3%, *P*=0.0001).

OSA and Failed Usage of SGA Device

Analysis of two included studies found no statistical difference in failed laryngeal mask airway (LMA) use between OSA and non-OSA patients. Sabers' study reported only one out of 13 OSA patients who had failed LMA insertion requiring conversion to tracheal intubation. [15] Ramachandran performed a large-scaled study on the use of the LMA Unique™ with the primary aim of determining the predictors of LMA failure. [22] OSA was not an independent risk factor for failed LMA use as they reported no difference in the incidence of its failed usage in OSA vs non-OSA patients.

Discussion

Overall, the incidence of difficult tracheal intubation was higher in OSA vs non-OSA patients. OSA patients also have a higher incidence of difficult mask ventilation. OSA was not associated with difficulty in the use of a supraglottic airway device. There were no studies comparing difficult surgical airway in OSA and non-OSA patients.

Patients with difficult intubation may have a high probability of undiagnosed OSA. [23] Due to the elevated prevalence of OSA in patients who are difficult to intubate, these patients should be screened with the STOP-Bang tool [24] and those with a high score be referred for sleep studies. An alternative, the DES-OSA score, considering five morphological variables, may also be used to screen and increase the detection rate for OSA without having to utilize any questionnaire. [25]

OSA as one of the independent predictors of difficult mask ventilation combined with difficult laryngoscopy, [12] holds an important implication as this combined scenario may lead to a "cannot intubate, cannot oxygenate" (CICO) situation that is associated with significant morbidity and mortality. The presence of OSA and some of the other aforementioned risk factors should alert the clinician to a po

Table 2 – Incidence of difficult mask ventilation in OSA patients.

Paper	Study Design	OSA diagnosis	Setting/Population	Result		
				Difficult Mask Ventilation		
				With OSA	Without OSA	P-value
Kheterpal 2006	Prospective Observational Grade 3 MV Grade 4 MV	History	Adult patients undergoing GA	49/700 (7.0%) 7/700 (1.0%)	264/13670 (1.9%) 30/13669 (0.2%)	0.001 < 0.001
Kheterpal 2009	Prospective Observational	History	Adult patients undergoing GA	20/3680 (0.5%)	57/49361 (0.1%)	0.0001
Cattano	Retrospective Subgroup Analysis	History	Elective surgical patients	41/239 (17.2%)	83/1160 (7.2%)	<0.0001
Shah	Prospective Observational	History	Multidisciplinary surgeries	2/7 (28.6%)	37/493 (7.5%)	0.1761
			Overall	115/4626 (2.5%)	471/64684 (0.7%)	<0.0001

OSA = obstructive sleep apnea; PSG = polysomnography; MV = mask ventilation; GA = general anesthesia

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tential CICO situation and to prepare for its management accordingly. [26, 27]

Previous guidelines on airway management, including the ASA Difficult Airway Guidelines, [18] the Canadian Airway Focus Group recommendations [19, 28] and Difficult Airway Society [29] did not mention OSA when assessing patients for difficult airway. Since OSA is an independent predictor of difficult tracheal intubation and difficult mask ventilation, its screening ought to be advocated and plans for difficult airway management should be implemented. For example, awake fiberoptic-guided intubation should be performed if there are increasing number of risk factors for difficult airway and rapid desaturation. Short-acting anesthetic agents should be administered and sugammadex should be available if a non-depolarizing muscle relaxant is used. [18, 19, 28] Care should be taken to ensure sufficient preoxygenation and the strategy of apneic oxygenation can be considered. Alternative airway equipment, for example intubating SGAs, trained personnel and a well-planned airway management strategy should be at hand to ensure optimal outcomes and prevention of critical events in those at risk.

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Home Sweet Home: Proper Usage of Home Sleep Testing

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Home sleep testing (HST) has been available since the 1980's, however, this technology did not become widely accepted until two decades later. With the growing epidemic of obesity and expanding knowledge of obstructive sleep apnea (OSA) and its associated health risks, the potential benefits of a readily available and cost-effective alternative to in-laboratory polysomnography (PSG) gained greater acceptance in the Sleep Medicine community. In 1994, practice parameters on HST for assessment of OSA were published by the American Sleep Disorders Association (1). By 2007, official clinical guidelines by the American Academy of Sleep Medicine (AASM) concluded that HST was appropriate for the diagnosis of OSA, but only in those with moderate to high risk and in the absence of comorbid conditions such as lung disease, neurological and neuromuscular disease, heart failure, or suspected or known underlying comorbid sleep disorders such as insomnia, narcolepsy, movement disorder, or central apnea (2). When the National Coverage Determination published that unattended HSTs would provide necessary qualification for Continuous Positive Airway Pressure (CPAP) reimbursement and described patient adherence criteria, acceptance became more widespread (3). Finally in 2009, the Center for Medicare and Medicaid Services (CMS) stated that HST was reasonable and necessary for OSA diagnosis, and hence reimbursable.

These changes toward HSTs were made possible by studies showing evidence of equivalent adherence practices and OSA symptom resolution in patients undergoing HST and subsequent Auto PAP treatment compared to patients undergoing in-lab PSG testing and titration studies (4). Non inferiority comparative outcomes expressed HST as an acceptable diagnostic option in certain patient populations (5), however limitations to unattended studies exist and must be weighed in clinical decision-making. Various studies showing evidence of similar diagnostic data, and ultimately clinical treatment outcomes have continued to move HSTs to the forefront (4-7). The limited availability of testing facilities, growing healthcare costs, and patient satisfaction with the ease and convenience of home testing have served to further boost demand for HSTs. In a prospective randomized study, Santos-Silva and colleagues in 2009 evaluated the accuracy of portable sleep testing in measuring the apnea-hypopnea index in patients with a suspicion of OSA, compared with in-lab PSG. This study was unique in that HST, PSG, and simultaneous PSG and HST data were collected and compared. Results revealed strong correlation between HST and PSG respiratory parameters in mild, moderate, and severe cases of OSA. The study, which excluded patients with suspected sleep disorders other than OSA, intrinsic lung disease, neurologic disorders, heart failure, as well as participants under the age of 21, found that accuracy of HSTs improved with severity of sleep disordered breathing (4).

In 2011, Kuna and colleagues went on to compare functional outcome and CPAP treatment adherence in veterans randomized to ambulatory HST compared to those receiving standard in-laboratory PSGs. Veterans suspected of having OSA in the HST groups underwent home testing followed by at least 3 days of auto-titrating PAP, and then based on data were initiated on CPAP and followed for 3 months. Similarly, veterans randomized to PSG underwent in-lab titrations and were then followed for 3 months. Functional outcome questionnaire scores and adherence measured in hours per day were compared for both groups. Both groups were found to have improvement of functional outcome scores without statistically significant differences, and mean hours per day of adherence were also similar between groups (5). Several other studies over the years have shown similar comparative effectiveness outcomes (4-7)

HSTs are now widely accepted, and indeed for some insurance carriers have become the preferred first line assessment for patients suspected of having OSA. However, there are important limitations of HSTs, and selection of appropriate patients is paramount. Per AASM guidelines, patients should first have a comprehensive sleep evaluation and those found to have a high pre-test probability for moderate or severe OSA without comorbid sleep disorders such as narcolepsy, insomnia, movement disorders, or central apnea, neurologic disorders, heart failure or intrinsic lung disease are potential candidates for HSTs. Portable monitoring devices as recommended by AASM guidelines should record at least airflow, respiratory effort, and blood oxygenation. The biosensors for airflow and oximetry should be the same as those used for conventional in-lab PSG testing, and an experienced sleep technologist must either apply the sensors or provide direct education to patients on proper application of sensors. Furthermore, if patients with symptoms of OSA have a negative HST or have technically inadequate data, further evaluation with an in-laboratory PSG is recommended (2). It is also important to realize that because HSTs are not measuring sleep, the respiratory disturbance indices are calculated using total recording time instead of total sleep time, as used for apnea hypopnea index calculations in PSG. This may in some cases underestimate sleep disordered breathing severity, especially if a patient has a prolonged period of wakefulness during the test or if most breathing abnormalities are found to be associated with arousals instead of oxygen desaturations. HSTs have

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their clinical limitations, and although the cost–effectiveness, accessibility, and ability to help expedite initiation of treatment may be appealing, accuracy of the diagnosis of OSA is contingent on appropriate pre-test clinical decision-making.

In the right patient, and performed in the right way with the right equipment, HSTs are a convenient, cost-effective way of diagnosing OSA in patients with high pre-test probability. If patients are provided the recommended education and instruction on how to properly apply the portable monitor with at least 3 respiratory parameters (oxyhemoglobin saturation, respiratory effort, and airflow) in the right patient population, functional outcomes and adherence to CPAP therapy have been found to be non-inferior to standard PSG testing. So when clinical diagnosis in a high risk patient is everything, especially in pre-operative testing, HSTs may be an advantageous option in helping to expedite clinical diagnosis and initiation of treatment in the pathway to medically optimizing patients.

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Is There a Role for Perioperative Medicine to Initiate PAP Therapy in PAP Non-adherent Patients?

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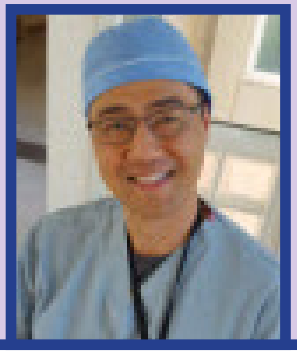

Adherence to positive airway pressure (PAP) therapy for the treatment of obstructive sleep apnea (OSA) remains low despite a vast amount of research into barriers to PAP acceptance. Technical challenges, side effects, insufficient education, and psycho-social barriers thwarts patient acceptance of PAP; importantly, patients often identify multiple reasons for PAP non-adherence. Combined with evidence that patient acceptance of PAP is likely established within a week of PAP initiation, the multifactorial nature of PAP non-adherence often presents an insurmountable challenge for overburdened outpatient sleep medicine clinics.

As the practice of anesthesiology continue to extend beyond the operating room, anesthesiologists will have opportunities to impact patients' health and well-being beyond the perioperative period. For PAP adherence in patients with OSA, the inpatient postoperative period may be a propitious time to re-introduce PAP therapy for the following reasons: 1) time for patient education; 2) readily available respiratory therapists—many of whom may have worked with OSA patients in the outpatient setting—for nightly troubleshooting; 3) objective feedback via PAP machine Subscriber Identity Module (SIM) card data available for daily review; 4) expedite a sleep medicine consult in facilities with an inpatient sleep medicine service; and 5) the operative period may be the sentinel event motivating patients to address behavior impacting health and well-being.

The Department of Anesthesiology at the Palo Alto Veterans Affairs Health Care Systems facility recently initiated a quality improvement project to reintroduce PAP non-adherent veterans to PAP therapy with the goal of encouraging the veterans to repatriate with their outpatient sleep medicine health care providers. Elective orthopedic and cardiac surgery patients who were previously prescribed a PAP device for the treatment of OSA and who reported to be non-adherent, were offered the opportunity to work with the respiratory therapy staff on nocturnal PAP therapy. For the first 16 patients, no alterations to the current re-

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spiratory therapy PAP initiation protocol were made. The initial PAP setting was APAP mode through nasal pillow interface. Respiratory therapists initiated treatment and performed bedside checks twice or more during the night. We review some of the unpublished data.

How many reasons did patients cite for PAP non-adherence? Twelve of the 16 patients cited multiple reasons for PAP non-adherence. A quarter reported four or more reasons for non-adherence.

Can non-adherent PAP patients tolerate PAP for more than 4 hours? Of the 16 patients, 8 achieved more than 4 hours of PAP use during their inpatient stay. Five used PAP for more than 7 hours on at least one night. Four patients either refused to try PAP despite expressing initial interest or could not tolerate PAP for more than 1 hour despite multiple interventions by respiratory therapists.

*How effective was PA*P? Half of the patients had a lowest median leak night of 10 L/min with a 95th percentile leak less than 20 L/min and who also used PAP for more than 4 hours that night. Of the 8, five had a measured apnea-hypopnea index (AHI) less than 5; the highest AHI among this group was 14.

Did the inpatient PAP experience result in patients seeking outpatient sleep medicine follow-up? Only two patients sought follow-up with outpatient sleep medicine within a month of hospital discharge. Both eventually underwent sleep studies that reported AHI's of 58 and 71.

Despite our observation that a respiratory therapist driven protocol for PAP re-introduction in PAP non-adherent postoperative patients can result in an acceptable duration of PAP tolerance and effectiveness in about half of the patients in this small cohort, the conversion rate to outpatient sleep medicine follow-up was low. The observation that a significant number of PAP non-adherent patients can overcome the technical barriers of PAP therapy with intensive assistance from respiratory therapists is encouraging; the small percentage of those inspired enough to seek outpatient sleep medicine follow-up suggest that PAP acceptance requires more than overcoming technical barriers. Disruptions in sleep architecture in the inpatient environment during the immediate postoperative period reported by Chung et al.[1] may limit patients' perceived benefit of PAP treatment for OSA. Patients may be unaware of the comorbid conditions associated with OSA. Because of its geographic reach, the Palo Alto Veterans Affairs facility may not be the home facility for many veterans. The Veterans Affairs facility that provide primary care for many of our veterans may not have a sleep medicine department, presenting a logistical challenge for veterans interested in establishing continuity with sleep medicine providers.

Although it is encouraging that some PAP non-adherent patients can physically tolerate PAP, much work needs to be done to affect the long-term commitment to OSA treatment for these patients. As we progress with this quality improvement project, the lessons learned from this first cohort of patients will help us target areas that will help bridge a positive inpatient PAP experience to long-term PAP adherence. The complexity of re-introducing PAP therapy to OSA patients in hopes of inspiring long-term PAP adherence in patients with a prior negative PAP experience will require a multidisciplinary, prolonged, individualized approach—an approach that anesthesiologists and sleep medicine providers are positioned to lead. Interest in impacting patients' health and well-being beyond the perioperative period is a burgeoning aspect of anesthesiology practice as exemplified by anesthesiologists led implementation of the Perioperative Surgical Home; in health care organizations that habitually practice this patient-centric, team-based model of care, the inpatient perioperative period may be an opportunity to address PAP adherence.

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Who's the Big Bad Wolf?

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Complications related to anesthesia are less frequent than in the past. Most current studies aim to identify patients at risk of developing postoperative complications. OSA represents a significant risk factor for postoperative complications. At the same time, the budget allocated to postoperative monitoring of OSA patients continues to increase. There is, therefore, a need for precision in the criteria for selecting high-risk patients.

Numerous studies have been conducted to determine the perioperative influence of OSA. These studies sometimes give contradictory results. Several methodological differences may exist. Firstly, are the patient selection criteria specific? Some authors have relied on polysomnography (PSG). It remains the gold standard for OSA diagnosis. Other authors have included patients based on portable devices, or even on clinical OSA predictive scores. These selection methods are interesting but approximate to the PSG. Secondly, at what AHI threshold value should the cutoff be placed? Some authors have separated groups into apneic/non-apneic by an AHI greater or less than five events per hour. Other authors divided patients into four groups: 1) non-apneic patients (AHI < 5); 2) mild, moderate and severe apneic patients (AHI > 5); 3) moderate and severe apneic patients (AHI > 15); 4) severe apneic patients (AHI > 30). Both selections are methodologically valid, but the populations observed are not at all the same.

In our opinion, an important study was carried out by *Thomas Mutter* and colleagues in 2014.The authors classified patients according to the results of a PSG, and they subdivided apneic patients by the AHI into mild, moderate and severe OSA. This study showed that only severe apneic patients (and mainly those not diagnosed before surgery) reached statistical significance.[1]

Other research has focused on the notion of nocturnal hypoxemia. *Frances Chung* and colleagues demonstrated that patients with preoperative nocturnal hypoxemia were at higher risk of complications.[2] At the same time, we have shown that less than 50% of severe apneic patients present nocturnal hypoxemia.[3] We also showed that obesity and especially the daily intake of benzodiazepines were risk factors for developing the association of severe OSA and nocturnal hypoxemia.[4] Our current hypothesis is that patients with this association are the highest postoperative risk patients. This hypothesis is not currently confirmed. This notion of nocturnal hypoxemia is close to the Obesity Hypoventilation Syndrome.[5]

To optimize perioperative management, two other concepts still need to be clarified. Namely, what is the real impact on postoperative complications of Overlap Syndrome and Complex Sleep Apnea Syndrome? The overlap syndrome associates OAS with COPD (Chronic Obstructive Pulmonary Disease). [6] The Complex Sleep Apnea Syndrome combines OSA with the coexistence of central apneas.[7] Patients exhibiting one of these two syndromes may represent an increased risk factor for postoperative complications.

OSA is a risk factor for postoperative complications. But it is not economically justifiable to watch over all OSA patients in intensive care. In the years to come must be used to clarify which patients are at the highest risk, patients who need increased care.

"*To know that we know what we know, and that we do not know what we do not know, that is true knowledge*"
-Henri David Thoreau, 1817-1862

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The Folly of Using Short-Acting Opioids to Avoid Postoperative Respiratory Complications in Patients with Obstructive Sleep Apnea

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Over the past decade, obstructive sleep apnea has become a great concern when administering anesthesia. Currently, it is estimated that prevalence of obstructive sleep apnea in the general surgery population is 22% [1]. This prevalence varies when looking at surgical subpopulations and can reach as much as 70% in those undergoing bariatric surgery [2]. With the aging population within the United States and obesity rates on the rise, the prevalence of obstructive sleep apnea is likely to increase in the coming years [2]. Obstructive sleep apnea preoperative screening and assessment guidelines put forth in 2016 by the Society of Anesthesia and Sleep Medicine (SASM) define obstructive sleep apnea as a perioperative risk factor. The literature supports that obstructive sleep apnea patients have increased risk for adverse postoperative respiratory and cardiovascular events [2]. In light of reported respiratory outcomes, SASM ambulatory surgery guidelines recommend the minimization of perioperative opioids and the use of short-acting opioids such as remifentanil when opioid use is unavoidable [3]. This endorsement of short- acting opioids persists as evidenced by its continued recommendation and use as part of intraoperative anesthesia regimens within obstructive sleep apnea literature as recent as 2018 [1,4-5].

It is our opinion that the recommendation of using short-acting opioids is misguided. The context sensitive half-time of less than four minutes for remifentanil makes it seemingly a safe drug for the ambulatory setting in obstructive sleep apnea patients, but these same properties may negatively affect postoperative pain and result in respiratory depression and related deaths after patient discharge [6-7]. The short-acting nature of remifentanil results in acute tolerance and/or opioid induced hyperalgesia. The pro-nociceptive activity acts via the N-methyl-D-aspartate (NMDA) glutamate receptor activation. The tolerance to analgesia is independent of any tolerance to side effects such as respiratory depression [8]. An early example of this phenomenon was provided in a study by Derrode et al [9]. Postoperative pain and time to first analgesic administration were evaluated in 30 colorectal surgery patients randomized to receive remifentanil or sufentanil as the opioid component of their anesthesia; estimated times for a 50% reduction in plasma concentration were 3 minutes and 30 minutes respectively. Patients received intravenous morphine during post anesthesia recovery when citing a visual analogue pain score of ≥4 cm (0-10 cm). Those who were administered remifentanil on average reported a visual analogue pain score double of those receiving sufentanil within the first 3 hours of recovery. Further, patients receiving intraoperative remifentanil required rescue analgesia significantly sooner than patients receiving sufentanil.

Current literature also indicates administration of intraoperative remifentanil can induce postoperative wound hyperalgesia. The cumulative intraoperative dose of remifentanil was positively correlated with the extent of postoperative wound hyperalgesia and incidence of persistent pain 3, 6, and 9 months after surgery [10]. Patients receiving 12 mcg/kg/h of remifentanil suffered from a 3-fold increase in the incidence of persistent pain 3, 6, and 9 months after surgery when compared to those receiving 4 mcg/kg/h. For those experiencing persistent pain, patients who received 12 mcg/kg/h of remifentanil were likely to experience significantly higher pain maximums at 1-3 months. These results were reported despite increased postoperative opioid consumption in the 12 mcg/kg/h group.

A neuroadaptive model explaining the mechanisms of developing and recovering from opioid induced hyperalgesia has been suggested by Célèrier et al [11]. Before the introduction of opioids, antinociceptive and pronociceptive systems are in equilibrium in an unexcited state. Pronociceptive systems are then up regulated in an attempt to maintain this equilibrium during opioid exposure. As this equilibrium is maintained in an excited state the balance becomes prone to instability as some elements are more prone to fatigue. This can then become the basis for long-term opioid dependence and chronic pain, which are very undesirable outcomes for patients with obstructive sleep apnea.

We have recently published regarding the use of opioids in an ambulatory setting. This study consisted of retrospective review of a sequential series of patients undergoing a variety of procedures (breast

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reductions/reconstructions, cochlear implants, stapedectomies, tympanoplasties, mastoidectomies) as the anesthesia provider transitioned from opioid anesthesia (OA) n = 36 to opioid sparing anesthesia (OS) n = 143 to opioid free anesthesia (OFA) n = 177 from 2013 to 2015. All patients received general anesthesia utilizing varying concentrations of the inhalational agent, Sevoflurane. The OA cases were done with a typical dosing of intraoperative opioids (average 170 ug fentanyl). The OS cases were performed with sparing use of fentanyl (average of 17ug fentanyl). The OFA cases were performed with no opioids at all. Groups were not significantly different in terms of age, gender distribution, BMI, and surgery duration and distribution, and post-surgical pain. The opioid requirement in milligram morphine equivalents for the OA and OS groups during post anesthesia recovery was twice that of the OFA group. Further, a significantly higher proportion of patients in the OFA (73%) group required no postoperative opioids compared to OA (52%) and OSA groups (34%) [12].

We have now performed over 2500 cases of outpatient ENT surgery using a non-opioid general anesthetic technique. More than 20% of these cases have known or suspected obstructive sleep apnea. Our non-opioid technique utilizes NMDA blocking agents (magnesium and subanesthetic ketamine), as well as NSAIDs, acetaminophen, lidocaine and dexamethasone. By avoiding opioids we not only avoid the devastating respiratory depression effects of opioids, we also block the pathway responsible for their pronociceptive side effects. We believe this to be a safe approach for the outpatient obstructive sleep apnea patient population.

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