Society of Anesthesia & Sleep Medicine

SASM newsletter

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Message from the President

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It is with gratitude and a sense of profound responsibility that I have accepted the presidency of SASM for the coming year. For the trust the Board of Directors and you as members have put in me, I would like to thank you and in return make the promise that I will work tirelessly on your behalf to continue and expand SASM's path as the leader in the field of anesthesia and sleep medicine. But before we take on the work ahead I would like to reflect on the state of our society and contemplate what we need to do to secure our future.

Over the years, we have not only grown in numbers, but also in purpose and impact. I can confidently say that we have worked hard to become the trusted leaders in education and research in all things related to the perioperative practice of sleep medicine. Our website and newsletter serve as major resource to our members and the public, our annual meeting attracts a multidisciplinary, international audience and our publications inform the field in the practice of perioperative sleep medicine with original research and guideline development. Given all our achievements the only thing we should fear is complacency.

As with any organization that seeks to remain successful I would propose that we frequently assess our strengths, identify our weaknesses and look for ways to be better in the future than we are today. SASM is without a doubt a society for its members by its members. In my view this notion is paramount to our success. Therefore, those who have been entrusted with leading the society on an administrative level need to constantly hear from you. We need you and invite you to be both involved and engaged, need to hear your ideas and create opportunities for participation. Only a few years ago I was invited by our founder Frances Chung to get involved, not knowing that this young, vibrant society would make it so easy for its members to chart to participate and chart its course. The SASM I joined in 2013 has not changed in this respect and welcomes anyone who dares to get involved.

In this context, I would like to invite every member to ask the following questions: Have I taken full advantage of what SASM has to offer? Are there things that SASM is not doing that we should be doing? Is there anything that I can do to strengthen the society? If the answer is yes, please let me, any of the members of the Board or administrative staff know and join our active committees, lead initiatives and expand our boundaries. We want to hear from you how we can improve our educational and research activities. We want to know about any initiatives that you believe are important and most importantly: We want you to be engaged and become the leaders of tomorrow. This is your society.

Finally, I would encourage you to spread the word amongst your colleagues and peers about the value our society adds to our practices. With sleep medicine being a board certifiable subspecialty of Anesthesiology, residents need to know about this widening of their horizon in their professional and career development opportunities. Research opportunities are endless as many of the questions regarding

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Editor's File

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I would like to take this opportunity to wish everyone a healthy, happy and prosperous new year! Our Past President, Babak Mokhlesi, MD, MSc, has provided outstanding leadership and vision over the past year. Our incoming President, Stavros G. Memtsoudis, MD, PhD, MBA, FCCP will ensure that our society continues to promote the goals of encouraging collaboration amongst anesthesiologists, sleep medicine specialists, surgeons, and other health care providers to promote education and research to improve perioperative management of patients with sleep-disordered breathing.

Recently, members of our society, under the leadership of Stavros G. Memtsoudis, MD, PhD, MBA, FCCP and Frances Chung, MBBS, published the intraoperative guideline for OSA patients in the October edition of the Anesthesia Analgesia: "Society of Anesthesia and Sleep Medicine Guideline on Intraoperative Management of Adult Patients With Obstructive Sleep Apnea. Anesth Analg. 2018;127: 967–987". This is the second guideline paper from SASM, the first one was on the preoperative screening and assessment of adult patients with OSA. This was published in the August edition of the Anesthesia & Analgesia 2016. These guidelines are important additions to the literature of sleep medicine and in the practice of anesthesia, critical care and pain medicine.

In addition to this success, members of our society are currently actively working on many other fronts, including educational resources, and developing guidelines/consensus statement that will be valuable tools for clinicians caring for pregnant women and surgical patients with sleep disordered breathing.

I would like to thank Mahesh Nagappa, MD, for serving as the Co-Chair of the Newsletter Committee for the year 2018 and we continue to bring readers 3 annual newsletters for the year 2019.

In this issue, Dr. Kimmo Murto MD, FRCPC, from University of Ottawa presents perioperative airway management challenges in pediatric OSA population. He highlights, parents need to be better prepared when caring for these children in an ambulatory setting, a point that will be addressed in the updated 2019 American Academy of Otolaryngology-Head and Neck Surgery tonsillectomy guideline.

Dr. Kapil Gupta, MD, examines recent evidence suggesting that sleep apnea may be a risk factor for postoperative opioid induced respiratory depression. He describes prevalence, timing, and various patient and clinical conditions as the possible risk factors for postoperative opioid induced respiratory depression.

This issue also features the Mayo Clinic experience of the implementation of the OSA clinical pathway for the surgical patients by Dr. Bhargavi Gali, MD. This clinical protocol had been implemented at Mayo Clinic in Rochester and they are currently determining the economic benefits of this perioperative protocol.

Susana Vacas, MD, provides a summary of the featured article for this newsletter - Colin Suen et al.'s study "Sleep Study and Oximetry Parameters for Predicting Postoperative Complications in Patients With OSA" that was published in Chest this year.

This issue of the newsletter features a summary of the 2018 SASM Annual Meeting held in San Francisco, California. This meeting was another success, with great presentations, and discussions of challenging and controversial topics in perioperative and sleep medicine. This summary highlights important topics presented by the eminent speakers on many areas of particular interest to members of the society and point to areas of future research. For the first time member were provided the opportunity to attend the noninvasive positive airway pressure ventilation and point of care cardiac ultrasound workshop at 2018 SASM Annual Meeting.

The articles in this issue highlight some of the exciting areas of previous and ongoing research in perioperative management of patients with sleep disordered breathing. We encourage and welcome submissions for newsletter articles from all members of the society on all areas of perioperative management of patients with sleep disordered breathing. Please contact me (jean.wong@uhn.ca) if you are interested in contributing an article or joining the Newsletter Committee.

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the care of patients suffering from sleep disordered breathing in the perioperative arena remain unanswered. Our society represents a unique multidisciplinary opportunity to teach each other what we need to know to better serve our patients.

If we all do our part, become more engaged, bring others into our circle and keep our eye on the ball –which is to better serve our patients - I have no doubt that SASM will remain and expand its role as the trusted leader in education and research for anything related to anesthesia and sleep medicine.

Perioperative Upper Airway Considerations in Pediatric Obstructive Sleep Apnea

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Anesthesiologists should be aware that airway management of children with obstructive sleep apnea (OSA) have unique challenges. Specifically, underlying pathophysiology and comorbid conditions associated with OSA are responsible for an increased risk of perioperative respiratory adverse events (PRAEs)[1,2] that can result in cerebral anoxia and death,[3,4] particularly in children with severe OSA.[5,6] As such, anesthesiologists should adjust their airway management technique.[7,8,9]

Treatment of children with OSA is indicated to arrest or reverse the associated multiple end-organ dysfunction including cardiopulmonary disease, metabolic dysfunction and neurocognitive/behavioral impairment.[10] These adverse effects are secondary to underlying systemic inflammation as a result of increased respiratory effort and recurrent hypoxemia caused by upper airway resistance and pharyngeal collapsibility.[11] OSA has an estimated prevalence of 1-5% and is associated with low socioeconomic status.[12,13] If left untreated it can change life-time health trajectory and cause premature death.[14,15]

Adenotonsillectomy (AT) is the first-line treatment for OSA which is the most common indication for AT. Unfortunately, few children have a definitive OSA diagnosis before surgery. As such, the perioperative management and postoperative disposition planning of children with suspected OSA are usually based on a variable patchwork of hospital policy, published guidelines and clinical judgment. Beyond AT, OSA prevalence in pediatric non-otolaryngologic surgeries is estimated to be 10-15%.[16] An appreciation of the characteristic of children with OSA that make them susceptible to PRAEs is therefore warranted. The purpose of this update is to review how OSA associated pathophysiology and related upper airway structure and dysfunction impacts perioperative anesthetic airway management in children and to highlight limitations of current published pediatric OSA related guidelines.

Influence of OSA pathophysiology and end-organ dysfunction

Systemic inflammation caused by repeated nocturnal hypoxemia appear central to airway management challenges in the perioperative setting in children with OSA.[10] Environmental stressors related to low socioeconomic status, exposure to second/third hand smoke and recurrent viral respiratory infections are associated with OSA.[13] In the genetically predisposed child, the oxidative stress from recurrent hypoxemia results in elevated endorphin levels and reactive oxygen species leading to up-regulation of brainstem opioid mu receptors and systemic-inflammation-prone epigenetic alterations, respectively.[17,18] The former may explain opioid respiratory sensitivity[7], but recent reports of increased pain perception in these patients and African-American compared with Caucasian children having an increased morphine clearance complicates proper opioid dosing.[19,20,21] The interaction between obesity and OSA-related systemic inflammation is not completely understood,[22] but obese patients have a 2-5 fold increased risk for OSA.[23] Similarly, neurocognitive/behavior disorders (e.g. hyperactivity) are prevalent. Morbid obesity is associated with difficult perioperative airway management, increased risk of PRAEs and unexpected admissions,[24,25] while hyperactivity may compel a perceived need for sedation. Careful selection and dosing of preoperative sedative medications needs to be considered, as the obese or hyperactive child may have an exaggerated response.[26] Parental presence at induction may be a safe alternative.[27] Inflammation manifesting as asthma and upper respiratory tract infections are typically encountered in these children and the reader is referred to reviews of their perioperative management.[28,29,30] Finally, recent evidence for GABAA receptor augmentation by general anesthetics in the presence of systemic inflammation[31] supports a role for anti-inflammatory therapy to reduce the incidence of PRAEs.[32,33]

Influence of OSA associated co-morbidities

Age can predict the type of airway structural anatomy and management challenges encountered by anesthesiologists treating children with OSA. Adenotonsillar hyperplasia is the most common OSA endotype in children 2-8 years old while craniofacial syndromes and obesity are more prominent in infant and adolescent age group phenotypes, respectively (Table 1).[34] Still other neuromuscular and genetic syndrome-related airway endotypes can span all ages or multiple endotypes can co-exist, such as in trisomy 21. In addition, children with brainstem crowding are known to experience OSA. Structurally, children with OSA have a smaller upper airway volume. Airway narrowing secondary to adenotonsillar hypertrophy and excess extra-lumen soft tissue/craniofacial syndromes is most prominent at the level of the soft palate and retroglossal areas, respectively. Children compared with adults have a smaller airway diameter, which is compensated for by an increased resting muscle tone. As such, obstructive apneas in children are unusual and reflected by lower defined apnea-hypopnea-index severity threshold values and evidence for airway collapse occurring at lower (more negative) critical closing pressures.[35] Difficult airway management can be anticipated in those children with craniofacial and soft tissue airway endotypes due to an imbalance between soft tissue and its boney enclosure making

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Table 1 – Prevalence of pediatric OSA airway endotypes according to age-defined phenotypes

Pediatric OSA Airway Endotype	Age-defined Airway Phenotype		
	Infant (0-<2 yrs)	Child (2-8 yrs)	Pre-teen/Teen (9-21 yrs)
Lymphoid hyperplasia (adenoids +/- tonsils)	+/-	+++	+
Soft tissue			
Obesity	+/-	++	+++
"Genetic" (e.g. Hurler's, Prader-Willi, Beckwith-Wiedemann)	++	+++	+
Craniofacial Syndromes			
Vault & Mandible (e.g. Craniosynostosis & P Robin)	+++	++	+/-
Foramen Magnum (e.g. Arnold-Chiarii)	++	++	+/-
Neuromuscular (e.g. C palsy & Trisomy 21)	+	+++	++
Prematurity (< 32 wks)	+++	+	-
Inflammatory (e.g. Asthma & Sickle Cell Dis.)	+/-	+++	++

tissue displacement during airway manipulation challenging. Managing the airway in a semi-sitting position or reverse Trendelenburg can utilize the advantage of tracheal tethering to "stiffen" the airway. Nasopharyngeal airway placement is useful in the OSA patient including those with lymphoid hyperplasia or immediately after AT.

Influence OSA upper airway neuro-motor dysfunction

Upper airway neuro-motor dysfunction in children with OSA should be considered in the perioperative anesthetic plan. Evidence for upper airway neuro-motor dysfunction includes an absence of airway obstruction during the day and the presence of residual airway obstruction after AT.[36] Further, children with OSA demonstrate reduced ventilatory drive in response to hypoxemia and/or hypercarbia. However, this is due to a heightened propensity for airway collapse, a blunted "airway self-rescue" arousal threshold and increased ventilatory control instability ("High Loop Gain") rather than a reduced sensitivity to oxygen and carbon dioxide levels.[35,37] For these reasons, the choice of medication in children with OSA should minimize the impact on airway collapsibility and ventilatory drive. Opioids, as well as anesthetic induction agents, sedatives, neuromuscular blockers and their reversal agents should be administered with caution.[7,8,9,38,39] Oxygen administration reduces ventilatory instability and can mask a propensity for upper airway obstruction.[40] In this respect, medications such as dexmedetomidine (alpha-2 receptor agonist) and ketamine (N-methyl-D-asparate receptor antagonist) are attractive alternatives and optimal airway assessment should occur when the child is breathing room air while asleep.

Limitations of published guidelines related to the perioperative care of the child with OSA

Current guidelines for the management of children with OSA are variable.[41,42,43,44,45] However, most guidelines advocate for pre-procedure risk-stratification as follows: 1. Perform a subjective or objective OSA assessment and identify associated at-risk conditions; 2. If suspicious of OSA, attempt to differentiate between" severe" vs "mild-moderate" OSA and assess for end-organ dysfunction and "co-morbid conditions" 3. Admission is reserved for assumed or diagnosed "severe" OSA or those with "mild-moderate" disease who are < 3 years of age and/or have a "significant" comorbidity.[34] Unfortunately, an OSA diagnosis based on a history and clinical exam alone is known to be unreliable,[46] but questionnaires are being developed to predict both OSA and PRAE risk.[47,48] Also, endo-types of co-morbid conditions at risk for PRAEs, for example asthma, need to be better defined as they represent a spectrum of disease.

Polysomnography (PSG) is the preferred tool for OSA diagnosis, but given limited access PSG is ideally reserved for medically complex patients, the diagnosis is unclear or with discordant history and physical exams.[44] Further, there is no consensus regarding whether PSG parameters used to diagnose "severe" OSA (e.g. AHI>10) are equivalent to those that predict an increased risk for PRAEs. There is general agreement, however, that PSG gas exchange abnormalities, specifically oxygen desaturation nadir <80%, as well as age <3 years predict risk for PRAEs. However, risk of PRAEs may vary by procedure. In the absence of PSG, overnight pulse-oximetry, home-based sleep-studies (e.g. polygraphy), and biological markers hold promise as tools to diagnose OSA.[41,49] Finally, little is said in current guidelines about the postoperative monitoring of children with OSA. Given the risk of critical respiratory PRAEs, invasiveness of surgery and anesthesia, intra/postoperative respiratory adverse events, opioid administration and skill of the attending provider need to be incorporated into future risk-stratification prediction tools .[50]

Conclusion

The OSA syndrome in children presents perioperative airway management challenges. Although there is no one "best" anesthetic technique, an anesthetic approach that is "opioid and pharyngeal muscle

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sparing" and anticipates a challenging airway prone to PRAEs is recommended. Controversy remains whether the pediatric PSG parameters and thresholds to define "severe" OSA are equivalent to those predictive of increased risk for PRAEs. There is no consensus for acceptable alternatives to PSG for both OSA diagnosis and preoperative risk stratification. The type, location and duration of postoperative monitoring is variable, and depends on local practice. As such, parents need to be better prepared when caring for these children in an ambulatory setting, a point that will be addressed in the updated 2019 American Academy of Otolaryngology-Head and Neck Surgery tonsillectomy guideline.

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Risk Factors for Opioid Induced Respiratory Depression in Surgical Patients: A Systematic Review

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Opioids are used for management of post-operative pain but are associated with a high mortality and morbidity. Recently, there have been many studies reporting post-operative opioid induced respiratory depression (OIRD).[1-12] Knowledge of the risk factors of OIRD will help the health care providers to take appropriate measures to prevent postoperative OIRD. We performed a systematic review of all risk factors leading to postoperative OIRD.

We performed literature search for post-operative OIRD in adult patients according to Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. This systematic review included adult surgical patients (≥18 years), who were prescribed opioids during their hospital stay after surgery and had postoperative OIRD, which was defined as respiratory rate < 10/min and/or oxygen saturation < 90%, and/or naloxone administration, and /or presence of other respiratory events like apnea, hypopnea, respiratory failure, excessive sedation, and upper airway obstruction.

Twelve studies are were included in this review, in which 841,424 patients underwent surgery, and 4194 patients (0.5%) developed OIRD in the postoperative period. The prevalence of OIRD in postoperative period was 4.9 per 1000 anesthetics (95% CI: 4.83 – 5.14). Of the OIRD events, 3,333 (79.5%) patients developed OIRD within 12 hrs and 3567 (85.1%) patients within 24 hrs postoperatively. The mean age of patients developing OIRD was 57.6 ± 6 yrs. The mean body mass index (BMI) of patients developing OIRD was 28.8 ± 3 kg/m2.

OIRD was mostly reported in orthopedic (84%) and general surgery (30%), followed by cardio-thoracic/vascular surgery (19.3%) and gynecology/urology surgery (15.5%). The route of administration of opioids associated with OIRD was higher with IV patient-controlled analgesia (PCA) 57.5%, followed by I.V/oral / nurse administered opioids 32.5% and epidural opioids 18.9%. In OIRD associated with IV PCA, continuous background infusion of opioids accounted for 39.5%. There was a concomitant administration of sedatives in 56.8% patients with OIRD. Multiple co-morbidities are associated with a higher risk of postoperative OIRD. Obstructive sleep apnea (OSA) was present in 18% of OIRD; cardiac disease 45.6%, hypertension 40.9%; diabetes mellitus (DM) 23%, renal disease 17.3%; respiratory disease 16.9%; and neurologic disease (stroke, dementia) 16.4%.

This systematic review highlights a higher risk of OIRD with the following factors: first 12 hours postoperatively, elderly patients (greater than 55 years), orthopedic surgery or general surgery and presence of co-morbidities like cardiac disease, pulmonary disease, OSA, hypertension, renal disease and DM. There was a higher association of OIRD with concomitant administration of sedatives or administration of opioids by IV PCA (especially with continuous background infusion) or epidurally. Cavalcante highlighted that administration of preoperative gabapentin in patients undergoing laparoscopic surgery increased the incidence of OIRD post-operatively.[13]

We suggest minimizing the use of sedative drugs like benzodiazepines and gabapentin along with opioids to prevent OIRD. We also advocate the consideration of weight, age, sex and co-morbidities, while administering the opioids; and avoiding continuous background infusion of opioids while using PCA, especially in opioid naïve patients. Opioid sparing strategy (like use of non-opioid analgesics post-operatively) will decrease the risk of OIRD.[14] Increased monitoring of ventilation (respiratory rate, pulse oximetry and capnography) and sedation levels in the postoperative period, especially in patients with high risk of OIRD will help us to detect OIRD and intervene earlier.[14, 15]

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OSA Pathway Implementation: Mayo Clinic Experience

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Development of a perioperative protocol for management of patients at high risk of undiagnosed obstructive sleep apnea (OSA) and known OSA at our institution was a multi-specialty endeavor involving many groups of providers. Our ability to implement this protocol in a stepwise fashion required collaboration of physicians, nurses, respiratory therapists, pharmacists, and respiratory technicians.

Reports of increased perioperative morbidity in patients with known or suspected obstructive sleep apnea (OSA) led to practice guidelines from the American Academy of Sleep Medicine in 2003 and the American Society of Anesthesiologists in 2006.[1] [2] We developed and studied a perioperative protocol at our tertiary care center in order to optimize safety in the perioperative period. Patients were assessed preoperatively for risk of undiagnosed OSA with the Sleep Apnea Clinical Score, a screening tool utilizing questions about symptoms, hypertension, and neck circumference.[3] With these factors, a likelihood ratio were calculated to identify patients as high or low risk of OSA. As our sleep physicians were utilizing this tool and our respiratory therapists were familiar with it, this was chosen as our preoperative screening tool. This was combined with a postoperative assessment in the post anesthesia care unit (PACU) for recurrent respiratory events. These events included desaturations, apneas, bradypnea, and pain sedation mismatch.

A prospective cohort study was performed with all patients assessed with the sleep apnea clinical score, and all patients were assessed in the PACU for recurrent respiratory events. All patients underwent recording pulse oximetry (with calculation of oxygen desaturation index) and documentation of postoperative complications. This study included 693 patients, with the findings of the two-phase process identified patients at higher risk of oxygen desaturation index>10 and postoperative respiratory complications.[4]

We utilized the results of this study to implement guidelines at our institution to improve screening and monitoring of patients with OSA or at high risk of undiagnosed OSA. A stepwise implementation occurred in order to optimize translation to clinical practice. Multiple stakeholders were involved in the process, and education of multiple care providers was necessary as we began. Education of anesthesiologists, surgeons and PACU nursing about the purpose of the protocols began with the first step-utilization of assessment for recurrent respiratory events (desaturations, apneas, bradypnea, and pain sedation mismatch) of all patients in the PACU. As this first step was implemented, how best to monitor high risk patients postoperatively in our institution became a priority. As our surgical volumes are high, sending all high-risk patients to monitored settings was not possible. As we looked at automated continuous oximetry with continuous observation was chosen, based on available literature.[5, 6] Capability for remotely monitored pulse oximetry for postoperative use was greatly expanded, with respiratory technicians trained to monitor for concerning patterns (figure 1). Concerns are conveyed to nurses caring for patients with events on oximetry by portable phones to reassess patients.

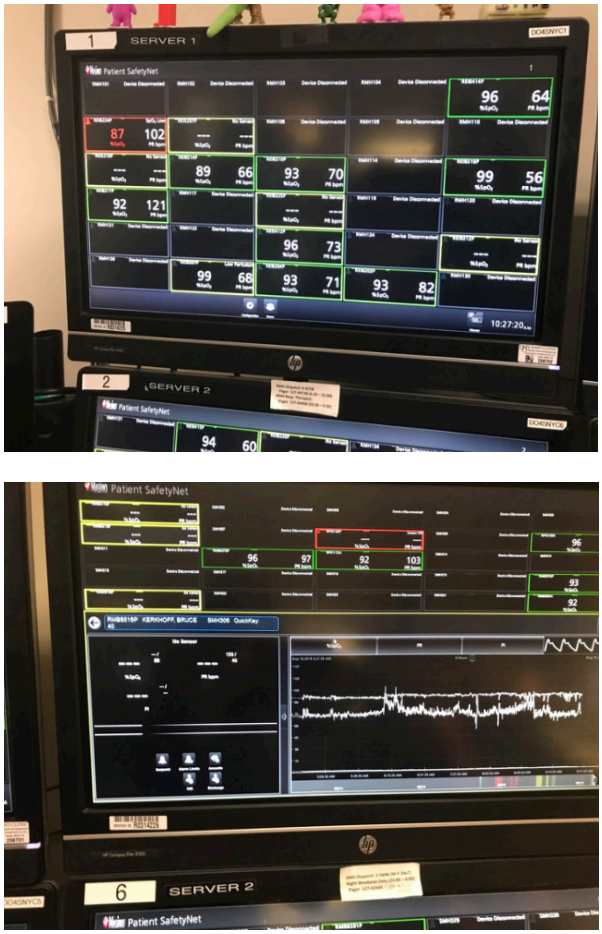

Figure 1: Screens of remotely monitored oximetry patients. Lower screen with an individual patient plethysmography under review

The next step was to implement our preoperative screening for all elective cases. This led to the unanticipated concern of increased workload for the group chosen to perform the screening with the sleep apnea clinical score. In order to avoid delays in the preoperative process, the preoperative nurses were asked to complete the screening as part of their intake. Multiple discussions occurred, as the added work was of great concern.

Once both the preoperative screening, PACU assessments, and ability to utilize

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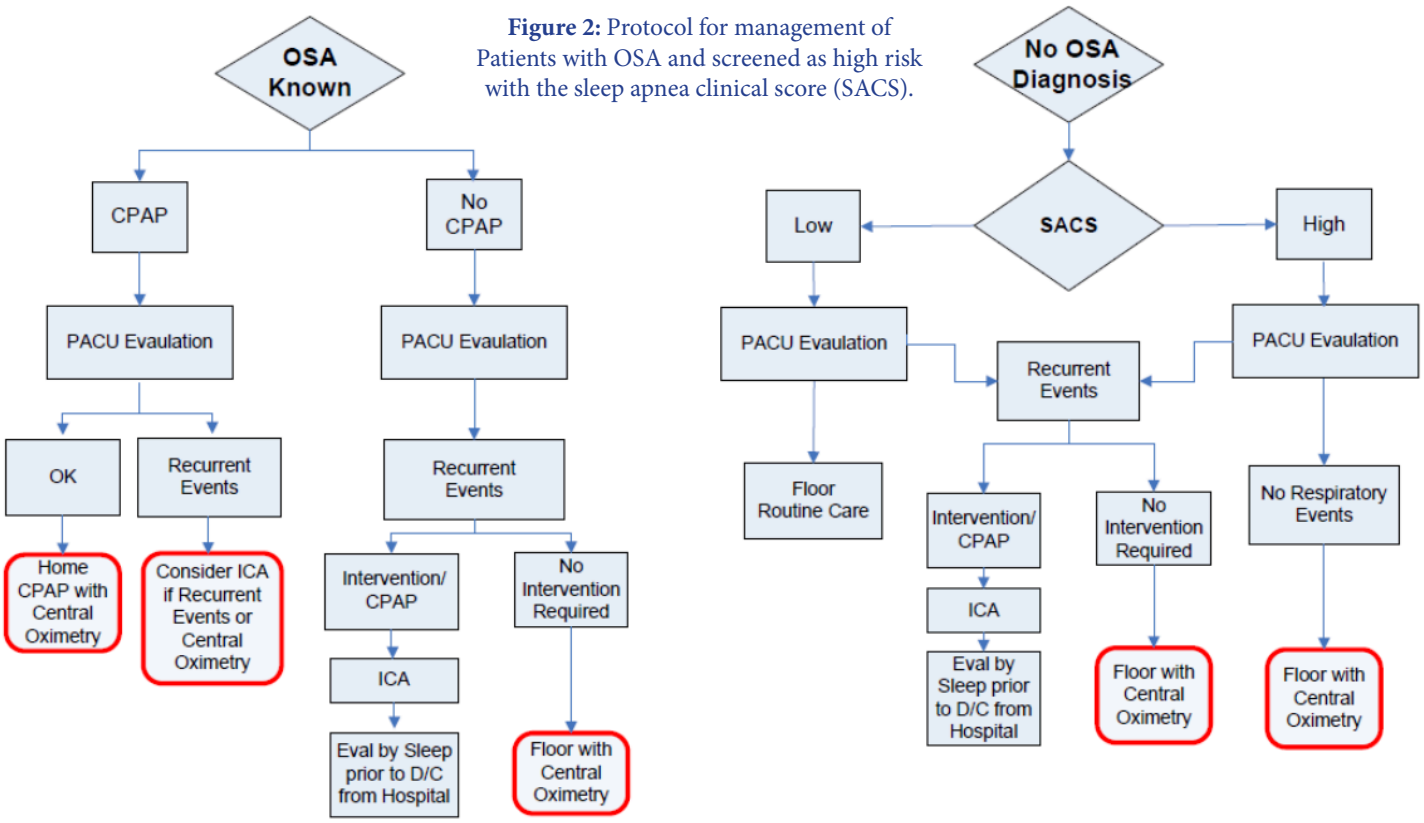

Figure 2: Protocol for management of Patients with OSA and screened as high risk with the sleep apnea clinical score (SACS).

remotely monitored oximetry were available for all high-risk patients, review of the process was undertaken. As an order by the anesthesiologist (or other provider) was required for remotely monitored oximetry on the floors, patients without the order presented a new challenge. A practice change allowed the PACU nurses to order remotely monitored oximetry per the protocol.

As more high-risk patients were identified during this process, other questions arose, leading to development of other efforts to limit risk of postoperative complications and coordinate ongoing care.

One effort was development of positive airway pressure (PAP) protocols for patients with diagnosed OSA, which involved respiratory therapists checking home PAP devices, mask fit, and following up on patients every evening. A second involved improving our postoperative opioid and sedation order sets, involving our pharmacists in optimizing patient safety. A third effort involved having sleep physicians available for consultation, including weekends, when patients who needed ongoing management and assessment were being prepared for discharge.

With this our protocol had been implemented at Mayo Clinic in Rochester (Figure 2). This led to the the Pre-Anesthetic Screening for Undiagnosed Obstructive Sleep Apnea Diffusion Project to facilitate the implementation of this protocol to all Mayo Clinic sites. Current efforts at our institution include review of postoperative course of high risk patients to determine utilization of rapid response resources and intensive care resources to determine ongoing optimization of our perioperative protocols.

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Is Obstructive Sleep Apnea Associated with Difficult Airway? Evidence from a Systematic Review and Meta-Analysis of Prospective and Retrospective Cohort Studies

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Obstructive sleep apnea (OSA) is characterized by intermittent episodes of either complete or partial upper airway obstruction resulting in desaturation and recurrent arousal episodes from sleep. Despite the strong association between OSA and adverse perioperative complications,[1–3] the majority of OSA cases remain undiagnosed and untreated at the time of surgery,[4] The difficult airway in OSA patients is considered to be a main contributing factor to the higher rate of adverse respiratory events.[5] Difficult airway can come in the form of either difficult intubation, or mask ventilation, or a combination of both. Although the incidence of a difficult intubation (1-6%) and failed intubation (0.1-0.3%) are very low,[6,7] it can contribute to increased risk of airway trauma, rapid desaturation, laryngeal injuries, unexpected intensive care unit admission and death.[8,9] OSA is considered to be an important risk factor for difficult airway management.[10,11,20–25,12–19] Studies have shown that OSA patients are at increased risk of either difficult intubation[10,11,24,25,12–15,17–19,21] or difficult mask ventilation[14,16,17,22,24,25] or both.[14,23]

American Society of Anesthesiologists Task Force recommended that patients with known or suspected OSA may have difficult airways and therefore should be managed according to difficult airway management guidelines.[26,27] The different abnormalities in the upper airway anatomies like a large tongue, overcrowding of the oropharyngeal structures, decreased upper airway diameter and greater neck circumference may contribute to the difficult airway in OSA patients during the perioperative period.[28–30] Lateral cephalometric studies of the upper airway confirmed cranio-cervical and mandibulo-hyoid deformities in both OSA and difficult airway patients.[31–33] These shared upper airway abnormalities may contribute to the increased risk of a difficult airway being encountered in OSA patients and vice versa.[10,15]

We published a systematic review and meta-analysis[34] involving sixteen studies with a total of 266,603 patients (32,052 OSA vs. 234,551 non-OSA) and a variety of surgical procedures: head and neck, thoracic, abdominal, vascular, genitourinary and orthopedic surgeries were incorporated into the meta-analysis.[10,11,20–25,12–19] No study showed data on OSA and surgical airway. Eleven studies were prospective[12,14,25,15–20,23,24] and five retrospective in nature.[10,11,13,21,22]

Difficult Intubation (DI): Of the sixteen studies, twelve studies provided data on DI (total 19,581: 1,775 OSA vs. 17,806 non-OSA). [10,11,24,25,12–15,17–19,21] Overall in patients with OSA the odds for DI were increased by a 3.46-fold compared to patients without OSA (OSA vs. non-OSA: 13.5% vs. 2.5%; pooled OR 3.46; 95% CI: 2.32 to 5.16, P <0.00001, I^2=47%) (Figure).

Difficult Mask Ventilation (DMV): Six studies including 72,888 patients (OSA vs. non-OSA: 5,129 vs. 67,759) provided the data on the DMV (Figure).[14,16,17,22,24,25] Overall, DMV was 3.39-fold higher in the OSA than non-OSA patients (OSA vs. non-OSA: 4.48% vs. 1.11%: pooled OR 3.39; 95% CI: 2.74 to 4.18, P <0.00001, I^2=26%).

Combined difficult intubation and mask ventilation: Two studies provided the data on combined DI and DMV (total 191,049: 26,361 OSA vs. 164,688 non-OSA),[14,23] Combined DI and DMV is 4.12-fold higher in OSA than non-OSA patients. The absolute risk increase for OSA was 0.81% compared to non-OSA. (OSA vs. non OSA: 1.11% vs. 0.3%: pooled OR 4.12; 95% CI: 2.93 to 5.79, P <0.00001, I^2=48%) (Figure).[14,23]

Failed supraglottic airway device: Two studies reported the data on failed supraglottic airway insertion (total: 15,832; OSA vs. non-OSA: 662 vs. 15,170). One prospective controlled study[20] reported on LMA UniqueTM and the other retrospective study[13] reported on the use of a laryngeal mask airway. No significant difference in the supraglottic airway failure rates exists between the OSA and non-OSA patients (OSA vs. non-OSA: 1.5% vs. 1.0%; pooled OR: 1.34; 95% CI: 0.70 – 2.59; p = 0.38). Metaregression and sensitivity analysis on various confounding factors and subgroups did not impact the final inference or results

Prevalence of OSA in patients with difficult intubation: The shared upper airway abnormalities in both difficult airway and OSA patients explain the increased prevalence of OSA in patients with difficult intubation. Of the 48 patients with difficult tracheal intubation pooled from two studies,[10,15] 30 were later diagnosed with OSA (Prevalence 62%). Among these 48 pooled patients with difficulty associated with tracheal intubation, 39% had mild to moderate and 23% had severe OSA.

Relation between severity of OSA and difficult intubation: One retrospective study found that AHI was significantly higher in the difficult intubation group than in the control group (28.4±31.7 vs. 5.9±8.9 events/hr; P<0.02).[10] In another retrospective study, OSA patients with difficult intubation had a higher AHI than OSA patients without difficult intubation (67.4±22.5 vs. 49.9±28.0 events/hr). [21] For OSA patients with an AHI ≤40, AHI 40-70 and AHI ≥70 events/hr, the incidence of difficult intubation was 3.3%, 19.3% and 27.6% respectively.[21] This study

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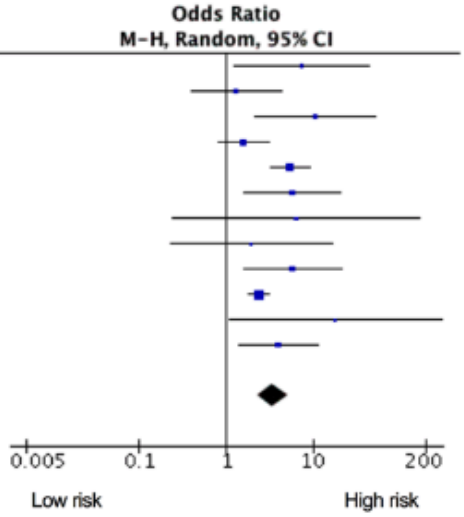
Figure: Meta-analysis of difficult airway between OSA and non OSA patients undergoing surgery. The odds ratio of each included study is plotted. A pooled estimate of overall odds ratio (diamonds) and 95% confidence intervals (width of diamonds) summarizes the effect size using the random effects model. CI = confidence interval; M-H: Mantel-Haenszel; OR = Odds ratio; OSA = obstructive sleep apnea.[34]

2A. Difficult Intubation

Study or Subgroup	OSA Events	OSA Total	No OSA Events	No OSA Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Hiremath et al. 1998	8	10	7	20	4.1%	7.43 [1.23, 45.01]	1998
Brodsky et al. 2002	6	44	6	56	7.6%	1.32 [0.39, 4.40]	2002
Siyam et al. 2002	8	36	2	77	4.9%	10.71 [2.14, 53.56]	2002
Sabers et al. 2003	26	187	16	173	14.7%	1.58 [0.82, 3.07]	2003
Kheterpal et al. 2006	18	700	66	13670	17.3%	5.44 [3.21, 9.21]	2006
Kim et al. 2006	15	90	3	90	7.0%	5.80 [1.62, 20.81]	2006
Chung et al. 2008	22	22	10	11	1.4%	6.43 [0.24, 171.42]	2008
Shah et al. 2012	1	7	39	493	3.0%	1.94 [0.23, 16.53]	2012
Acar et al. 2014	11	83	3	117	6.7%	5.81 [1.57, 21.52]	2014
Corso et al. 2014	91	455	284	2997	22.4%	2.39 [1.84, 3.10]	2014
Toshniwal et al. 2014	25	93	0	24	1.8%	18.24 [1.07, 311.15]	2014
Gokay et al. 2016	12	48	6	78	9.0%	4.00 [1.39, 11.53]	2016
Total (95% CI)		**1775**		**17806**	**100.0%**	**3.46 [2.32, 5.16]**	
Total events	243		442				

Heterogeneity: $Tau^2 = 0.17$; $Chi^2 = 20.58$, df = 11 (P = 0.04); $I^2 = 47\%$
Test for overall effect: Z = 6.09 (P < 0.00001)

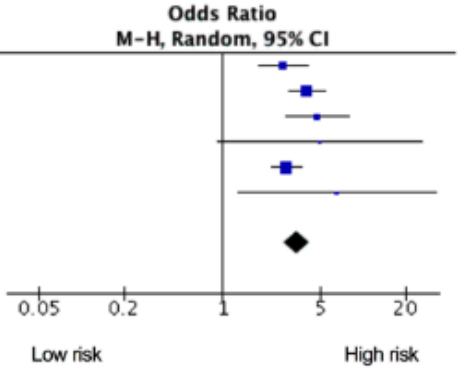


Bayesian Random effect with MCMC; 95% Credible Intreval: 4.24 (2.37 - 7.89)
Absolute risk increase: OSA - non OSA = 13.7% - 2.5% = 11.2%
Predictive Interval: 1.2 - 9.8

2B. Difficult Mask Ventilation

Study or Subgroup	OSA Events	OSA Total	No OSA Events	No OSA Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Cattano et al. 2014	41	239	83	1160	19.5%	2.69 [1.79, 4.02]	
Kheterpal et al. 2006	56	700	294	13670	29.0%	3.96 [2.94, 5.32]	2006
Kheterpal et al. 2009	20	3680	57	49361	13.7%	4.73 [2.84, 7.88]	2009
Shah et al. 2012	2	7	37	493	1.6%	4.93 [0.92, 26.28]	2012
Corso et al. 2014	104	455	284	2997	34.6%	2.83 [2.20, 3.64]	2014
Gokay et al. 2016	7	48	2	78	1.7%	6.49 [1.29, 32.68]	2016
Total (95% CI)		**5129**		**67759**	**100.0%**	**3.39 [2.74, 4.18]**	
Total events	230		757				

Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 6.75$, df = 5 (P = 0.24); $I^2 = 26\%$
Test for overall effect: Z = 11.32 (P < 0.00001)

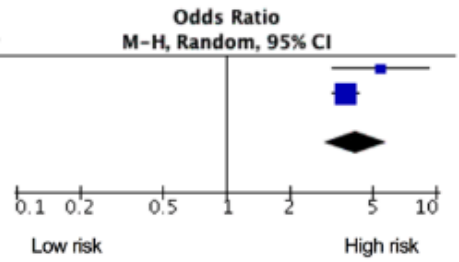


Bayesian Random effect with MCMC; 95% Credible Intreval: 4.02 (1.96 - 8.74)
Absolute risk increase: OSA - non OSA = 4.4% - 1.1% = 3.3%
Predictive Interval: 2.0 - 5.5

2C. Combined Difficult Intubation & Mask Ventilation

Study or Subgroup	OSA Events	OSA Total	No OSA Events	No OSA Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Kheterpal et al. 2006	18	700	66	13670	28.0%	5.44 [3.21, 9.21]	2006
Kheterpal 2013	268	25661	430	151018	72.0%	3.70 [3.17, 4.31]	2013
Total (95% CI)		**26361**		**164688**	**100.0%**	**4.12 [2.93, 5.79]**	
Total events	286		496				

Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 1.92$, df = 1 (P = 0.17); $I^2 = 48\%$
Test for overall effect: Z = 8.14 (P < 0.00001)



Bayesian Random effect with MCMC; 95% Credible Intreval: 4.39 (1.37 - 15.39)
Absolute risk increase: OSA - non OSA = 1.1% - 0.3% = 0.8%

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identified AHI as an important predictor of difficult intubation in OSA patients.[21]

Clinical Impact: The association of OSA with difficult airway is an important clinical information to perioperative physicians as it can contribute to increased perioperative morbidity and mortality.[1] Despite advancements in airway equipment, perioperative airway complications are still problematic in OSA surgical patients.[1] Many of the adverse respiratory events reported in OSA patients are mild, transient and reversible like oxygen desaturation; however some are catastrophic events.[2,5,35] This can be either death or anoxic brain injury, having direct association with difficult airway, usually in the form of failed reintubation in the postoperative period.[5,36]

Limitation: Some limitations of our systematic review and meta-analysis exist. First, the studies are mostly prospective or retrospective observational cohorts with no randomized controlled trial. Second, the studies included both diagnosed and suspected OSA patients with the possibility of incorporating false positive or false negative cases in both groups. Despite these limitations, our meta-analysis offers an up-to-date analysis of the current literature on the bidirectional relationship between difficult airway and OSA in patients undergoing surgery.

Conclusion: Our systematic review and meta-analysis analysis suggests that patients with OSA had a three to four-fold higher risk of difficult intubation or mask ventilation or both when compared to non-OSA patients. No significant difference in supraglottic airway failure rates between the OSA and non-OSA patients was found.

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Featured Article: Sleep Study and Oximetry Parameters for Predicting Postoperative Complications in Patients With OSA

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Suen C, Ryan CM, Mubashir T, Ayas NT, Abrahamyan L, Wong J, Mokhlesi B, Chung F

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Recently, Suen and colleagues published an interesting study looking into predictive factors for postoperative complications in Obstructive Sleep Apnea patients. This extensive narrative review included 21 studies and highlighted several parameters, such as, hypopnea index (AHI), oxygen desaturation index (ODI), cumulative sleep time percentage with oxyhemoglobin saturation (SpO2) < 90% (CT90), minimum SpO2, mean SpO2, and longest apnea duration, extracted from in-laboratory or portable PSG or overnight oximetry that may be of importance to forewarn of postoperative complications. AHI and measurements of nocturnal hypoxemia (ODI, CT90, minimum and mean SpO2) are indexes of OSA that provide an imperfect assessment of the risk of postoperative complications. A significant association between the AHI and postoperative adverse events exists. Complications may be more likely to occur in the category of moderate to severe OSA (AHI ≥ 15). Other parameters from PSG or overnight oximetry such as ODI, CT90, mean and lowest SpO2, and longest apnea duration can be associated with postoperative complications and may provide additional value in risk stratification and minimization. These parameters can be incorporated into clinical decision tools for risk minimization.

Summary of SASM Meeting

Jean Wong, MD, FRCPC
Associate Professor, Department of Anesthesia, University of Toronto
Staff Anesthesiologist, Toronto Western Hospital
University Health Network

The SASM Annual Meeting - Perioperative Care and Sleep Medicine: Controversies, Challenges and Special Populations was held on October 12, 2018, in beautiful San Francisco, California. The meeting was well attended and featured interesting talks and workshops.

The program began with SASM President, Stavros Metsmoudis, MD, PhD from Hospital for Special Surgery, New York, who discussed pulmonary hypertension in patients with obstructive sleep apnea (OSA) and obesity. These conditions are common, and often undiagnosed. He discussed the high risk for adverse outcomes and discussed the controversy regarding regional vs. general anesthesia and postoperative outcomes.

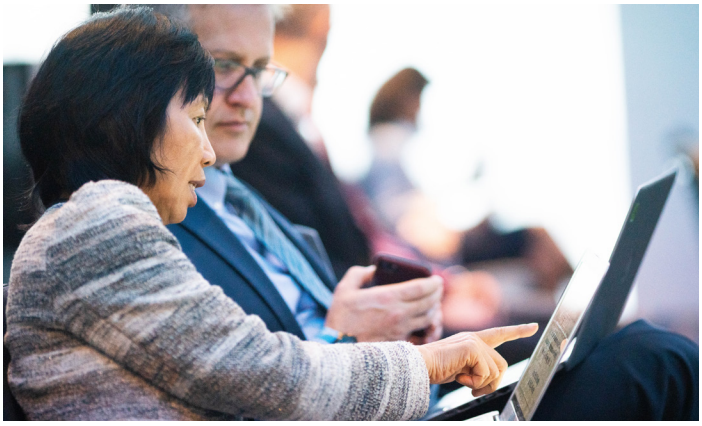
Robert Farney, MD, University of Utah School of Medicine discussed opioid induced respiratory depression – and the challenge of identifying this in asleep patients with supplemental oxygen. He discussed controversies with how to monitor patients including the unreliability of just monitoring respiratory rate, difficulty of monitoring tidal volumes, measuring ataxic breathing and patterns of erratic breathing that may predict postoperative cardiorespiratory events.

Lisa Wolfe, MD, Northwestern University, presented the challenges of choosing the appropriate mode of positive airway pressure (PAP) therapy in the perioperative setting. She discussed issues with PAP compliance, the use of APAP in new users or those who are not compliant with PAP in the postoperative period, factors leading to failure of CPAP, need for non-invasive ventilation, and alternate modes of PAP therapy such as adaptive servo-ventilation for opioid induced central apnea in the perioperative period.

Patrick J Strollo, Jr, MD, University of Pittsburgh, presented the first keynote address on the use of upper airway stimulation (UAS) for OSA. He discussed the Stimulation Therapy for Apnea Reduction (STAR) Trial and Adherence and Outcomes of UAS in OSA (ADHERE) Registry – a long-term follow of patients with implanted UAS systems.

Kimmo Murto, MD, University of Ottawa, presented perioperative upper airway considerations in pediatric obstructive sleep apnea. He reviewed some of the limitations of published pediatric OSA associated management guidelines.

Clete A. Kushida, MD, PhD, Stanford University Medical Center reviewed upper airway dysfunction in sleep apnea. He discussed some of the predisposing factors including genetic factors and different endotypes of OSA.



Abstract Co-Chair Toby Weingarten, MD and SASM Past President Frances Chung, MBBS, FRCPC, compare notes during a session.

The second keynote address was presented by Matthias Eikermann, MD, PhD, Harvard Medical Center, on pharmacological mechanisms of postoperative respiratory failure. He discussed perioperative screening, optimizing patients' ventilatory drive and use of oxygen, carbon dioxide, and anesthetic drugs.

Rajeev Subramanyam, MD, MS, The Children's Hospital of Philadelphia presented the current lack of pediatric perioperative pathways, and emphasized that this is an area for future research.

Karl A. Franklin, MD, PhD, from University Hospital, Umea, Sweden shared the European experience with enhanced recovery after surgery (ERAS) pathways as a model for OSA specific pathway implementation.

Timothy Morgenthaler, MD and Bhargavi Gali, MD from Mayo Clinic, Rochester, MD, shared their experience at Mayo Clinic with successful implementation of an OSA pathway.

At the Annual General Meeting and Luncheon, outgoing SASM President Babak Mokhlesi, MD was thanked for his leadership and Stavros Memstmoudis, MD, PhD was welcomed as the incoming President.

The first place Annual Meeting Abstract award winner was Charlotte Lukannek, Cand Med from Massachusetts General Hospital for her abstract entitled 'The score for prediction of postoperative respiratory complications (SPORC) revisited: a score development and external validation study. The second place award went to Tiffany Dong, BSE from Duke University School of Medicine for the abstract " Respiratory chemosensitivity and sleep as risk factors for postop opioid-induced respiratory depression. The third place

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award winner was Mandeep Singh, MD, MSc from University of Toronto for the abstract entitled "Cost-utility analysis of pre-operative screening strategies for obstructive sleep apnea among patients undergoing major non-cardiac surgery."

The next SASM meeting will be held on October 17-18, 2019 in Orlando, Florida.

SASM Past President Babak Mokhlesi, MD, MSc (left) and SASM Secretary Anthony Doufas, MD, PhD held at attention during educational sessions.

Abstract Co-Chair Toby Weingarten, MD, presents the First Place Abstract Award to Charlotte Lukannek, Cand. Med.

Abstract Co-Chair Toby Weingarten, MD, presents the Second Place Abstract Award to Tiffany Dong, BSE.

Mandeep Singh, MBBS, MD, MSc, FRCPC, presents the Third Place Abstract, "Cost-Utility Analysis of Pre-operative Screening Strategies for Obstructive Sleep Apnea Among Patients Undergoing Major Elective Non-Cardiac Surgery."

SASM Pediatric Subcommittee members meet at the 2018 Annual Meeting.

SASM 2019 Board of Directors (left to right): Babak Mokhlesi, MD, MSc, Toby Weingarten, MD, Satya Krishna Ramachandran, MD, MBBS, Stavros Memtsoudis, MD, PhD, Christine Won, MD, MSc, Dennis Auckley, MD, Anthony Doufas, MD, PhD, Jean Wong, MD, and David Hillman, MBBS, FFARACS, FANZCA.

SASM Membership Benefits at a Glance...

The mission of SASM is to advance standards of care for clinical challenges shared by anesthesiology and sleep medicine, including perioperative management of sleep disordered breathing, as well as to promote interdisciplinary communication, education and research in matters common to anesthesia and sleep.

Benefits of SASM Membership include:

- Significantly Reduced Registration Fees at SASM Sponsored Scientific Meetings
- SASM Newsletter
- *Full Voting Rights in Electing SASM Board of Directors and SASM Officers (*Dependent on membership category)
- Regular Receipt of "Literature Updates" and "Featured Articles," Allowing All Members to Stay Current on New Developments in the Area
- Enhances Your Network of Regional, National and International Colleagues
- Learn of Collaborative Research Projects
- Educational Material Posted on SASM Website for Members
- Access to a "Discussion Forum" to Evaluate and Discuss the Latest Research, Education and Clinical Practices Pertaining to OSA and Patients with Other Sleep-Disordered Breathing
- Get Advice and Counsel from Other Members Regarding Various Practice Paradigms

SASM Classes of Membership:

- **Gold Patron Member - $250**
  - Showing special support for SASM. This donation is inclusive of annual membership and available for all classes of membership.
- **Active Member - $115**
  - Physician and scientist members with the ability to vote, hold office and serve as Directors on the Board.
- **International Active Members - $40**
  - Physician and scientist members, who practice outside of the United States or Canada, with the ability to vote, hold office and serve as Directors on the Board.
- **Associate Member - $65**
  - Non-physicians and non-scientists, without voting rights.
- **Educational Member - $65**
  - Fellows, residents, medical students and other undergraduates, without voting rights.

To become a member of SASM, please visit our website and click on the membership tab: www.SASMhq.org

SASM is a 501(C)(3) non-profit organization. Membership dues may be deductible as a business expense. **SASM Tax ID number is 27–4613034**