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Syllabus

SASM 8TH ANNUAL MEETING

October 12, 2018 • W San Francisco • San Francisco, California

Perioperative Care and Sleep Medicine:
Controversies, Challenges and Special Populations

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ACCREDITATION INFORMATION

PROGRAM OBJECTIVE

The objective of this meeting is to provide a forum for discussions pertaining to the common grounds between sleep and anesthesia. The goal is to promote excellence in medical care, research and education in anesthesia, sleep medicine and perioperative medicine.

TARGET AUDIENCE

This conference is designed for anesthesiologists, critical care physicians, residents, fellows-in-training, general medicine physicians, pulmonary physicians, sleep medicine physicians, surgeons, scientists and allied health care professionals.

PRACTICE GAPS

The overall goal of SASM is to advance standards of care for clinical problems shared by anesthesiology and sleep medicine, including perioperative management of sleep disordered breathing (SDB),
and to promote interdisciplinary communication, education and research in matters common to anesthesia and sleep.

To identify and address present clinical practice gaps, we propose to explore the following gaps existing today in care of patients with sleep-disordered breathing:

- Utilization of point-of-care ultrasound to identify higher risk patients with SDB is still very low in clinical practice.
- Knowledge and familiarity with initiation and assessment of positive airway pressure therapy of patients with SDB remains low in clinical practice.
- Knowledge of research and evidence-based approaches in perioperative management of SDB is limited in clinical practice.
- Knowledge of cost and value of perioperative protocols such as ERAS that include management of patients with SDB is largely unknown.
- Programmatic needs for initiation of upper airway stimulation therapy are largely unknown.

LEARNING OBJECTIVES

- Discuss and understand the use of state-of-the-art diagnostic and therapeutic modalities for patients with sleep disordered breathing.
- Discuss and understand the modulation of upper airway function in the context of sleep and anesthesia.
- Discuss and understand the perioperative considerations for OSA subtypes including pharmacological mechanisms of respiratory failure.
- Discuss and understand the current evidence around cost and value with perioperative protocols for adult and pediatric patients with sleep disordered breathing.

ACCREDITATION STATEMENT

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In support of improving patient care, this activity has been planned and implemented by Amedco and the Society of Anesthesia and Sleep Medicine (SASM). Amedco is jointly accredited by the American Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

SATISFACTORY COMPLETION

Learners must complete an evaluation form to receive a certificate of completion. Your chosen sessions must be attended in their entirety. Partial credit of individual sessions is not available. If you are seeking continuing education credit for a specialty not listed above, it is your responsibility to contact your licensing/certification board to determine course eligibility for your licensing/certification requirement.

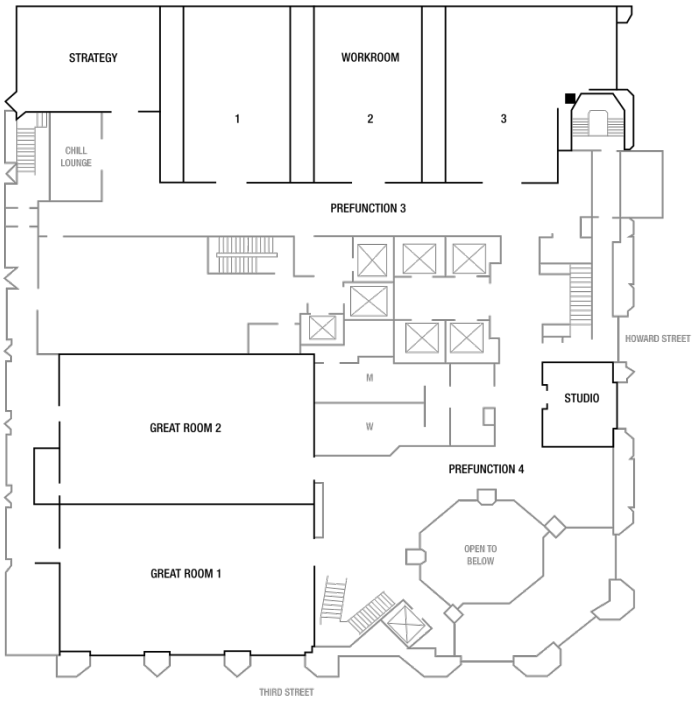
CREDIT DESIGNATION STATEMENT

Amedco designates this live activity for a maximum of ***10.25 AMA PRA Category 1 Credits™***. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FACULTY DISCLOSURES

For a full list of disclosures, please see registration desk.

MEETING SPACE LAYOUT



SCHEDULE OF EVENTS

FRIDAY, OCTOBER 12, 2018

6:00-6:15am *Workroom 2/3 Foyer & Prefunction 4*
Workshop Breakfast and Registration

6:15-8:15am *Workroom 2*
Positive Airway Pressure and Noninvasive Ventilation Hands-On Workshop – *additional fee applies*
Peter Gay, MD, MS, David Hillman, MBBS, FFARACS, FANZCA, Lisa Wolfe, MD & Bernardo Selim, MD, Dennis Auckley, MD
This is a hands-on workshop opportunity for clinician participants who will hear from expert users of current common non-invasive ventilatory devices. Multiple instructors and smaller groups will allow opportunities to become familiar with the actual indications for and operation of the equipment.

6:15-8:15am *Workroom 3*
Point of Care Cardiac Ultrasound Hands-On Workshop - *additional fee applies*
Stephen Haskins, MD, Jan Boublik, MD, PhD, Nibras Bughrara, MD, Sean Garvin, MD, Jemiel Nejim, MD & Oliver Panzer, MD
Assessing cardiac function and hemodynamic status.

7:30-8:25am *Prefunction 4*
Continental Breakfast and Registration

8:25-8:30am *Great Room 1*
Welcome - Overview
Tom Cloward, MD

8:30-10:00am *Great Room 1*
Session 1: OSA Subtypes and Perioperative Considerations
Moderator: Tom Cloward, MD

8:30-8:55am *Great Room 1*
Pulmonary Hypertension and Sleep-Disordered Breathing in the Perioperative Setting
Stavros Memtsoudis, MD, PhD

8:55-9:20am *Great Room 1*
Opioid-Induced Respiratory Failure - Are There Early Warning Signs?
Robert Farney, MD

9:20-9:45am *Great Room 1*
Choosing the Appropriate Mode of PAP Therapy in the Perioperative Setting
Lisa Wolfe, MD

9:45-10:00am *Great Room 1*
Panel Discussion

10:00-10:45am *Great Room 1*
KEYNOTE: Upper Airway Stimulation – Technology, Program Implementation and Outcomes
Patrick Strollo, MD

10:45-11:30am *Prefunction 4 & Workroom 1*
Break with Exhibitors & Abstract Poster Viewing

11:30-12:30pm *Great Room 2*
Luncheon & Annual General Meeting

Great Room 2
Annual General Meeting
Moderator: Babak Mokhlesi, MD, MSc

Great Room 2
Abstract Award Presentations
Moderator: Toby Weingarten, MD

12:30-1:30pm *Great Room 1*
Session 2: Upper Airway Function in the Context of Sleep and Anesthesia
Moderator: David Hillman, MBBS, FFARACS, FANZCA

12:30-12:55pm *Great Room 1*
Perioperative Upper Airway Considerations in Pediatric OSA
Kimmo Murto, MD, FRCPC

12:55-1:20pm *Great Room 1*
Upper Airway Dysfunction in Sleep Apnea
Clete Kushida, MD, PhD

1:20-1:30pm *Great Room 1*
Panel Discussion

1:30-2:00pm *Prefunction 4 & Workroom 1*
Break with Exhibitors & Abstract Poster Viewing

2:00-2:45pm *Great Room 1*
KEYNOTE: Pharmacological Mechanisms of Postoperative Respiratory Failure
Matthias Eikermann, MD, PhD

2:45-4:00pm *Great Room 1*
Session 3: Perioperative Protocols – Defining Cost and Value
Moderator: Frances Chung, MBBS, FRCPC

2:45-3:05pm *Great Room 1*
Pediatric Perioperative Pathways
Rajeev Subramanyam, MD, MS

3:05-3:25pm *Great Room 1*
ERAS Pathways – A Model for OSA Specific Pathway Implementation – European Experience
Karl Franklin, MD, PhD

SCHEDULE OF EVENTS

FRIDAY, OCTOBER 12, 2018 *(cont.)*

3:25-3:45pm *Great Room 1*
OSA Pathway Implementation: How to Measure Success – Mayo Clinic Experience
Bhargavi Gali, MD & Timothy Morgenthaler, MD

3:45-4:00pm *Great Room 1*
Panel Discussion

4:00-4:05pm *Great Room 1*
Closing Remarks & Giveaway
Satya Krishna Ramachandran, MD

4:05-6:00pm *Prefunction 4*
Closing Cocktail Reception
Open to all attendees.

Please note that the morning and afternoon sessions of each workshop will provide the same content. You are welcome to register for both the Positive Airway Pressure and Point of Care Cardiac Ultrasound workshops if you wish.

4:55-6:55pm *Workroom 2*
Positive Airway Pressure and Noninvasive Ventilation Hands-On Workshop – *additional fee applies*
Peter Gay, MD, MS, David Hillman, MBBS, FFARACS, FANZCA, Lisa Wolfe, MD & Bernardo Selim, MD, Dennis Auckley, MD
This is a hands-on workshop opportunity for clinician participants who will hear from expert users of current common non-invasive ventilatory devices. Multiple instructors and smaller groups will allow opportunities to become familiar with the actual indications for and operation of the equipment.

4:55-6:55pm *Workroom 3*
Point of Care Cardiac Ultrasound Hands-On Workshop - *additional fee applies*
Stephen Haskins, MD, Jan Boublik, MD, PhD, Nibras Bughrara, MD, Sean Garvin, MD, Jemiel Nejim, MD & Oliver Panzer, MD
Assessing cardiac function and hemodynamic status.

ABSTRACT AWARD WINNERS

FIRST PLACE AWARD

Abstract: The Score for Prediction of Postoperative Respiratory Complications (SPORC) Revisited: A Score Development and External Validation Study

Co-Authors: Charlotte Lukannek, Cand Med, Massachusetts General Hospital, Shahzad Shaefi, MB, BS, Beth Israel Deaconess Medical Center, Paul Rostin, MD Candidate, Massachusetts General Hospital, Timothy Houle, PhD, Massachusetts General Hospital, Matthias Eikermann, MD, Beth Israel Deaconess Medical Center

SECOND PLACE AWARD

Abstract: Respiratory Chemosensitivity and Sleep as Risk Factors for Postop Opioid-Induced Respiratory Depression

Co-Authors: Tiffany Dong, BSE, David MacLeod, MD, Antoinette Santoro, Zach Augustine, Richard Moon, MD, Duke Anesthesiology, Duke University School of Medicine

THIRD PLACE AWARD

Abstract: Cost-Utility Analysis of Pre-operative Screening Strategies for Obstructive Sleep Apnea Among Patients Undergoing Major Elective Non-Cardiac Surgery

Co-Authors: Ashwin Sankar, MD, University of Toronto, Peter Dixon MD, University Health Network, University of Toronto, Stavros Memtsoudis PhD, Hospital for Special Surgery, John de Almeida, MD, MSc, University Health Network, University of Toronto, Mandeep Singh MD, MSc, University Health Network, University of Toronto

IMPORTANT

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ABSTRACT TABLE OF CONTENTS

ABSTRACT TABLE OF CONTENTS

Bicuculline and Picrotoxin Modulate Flumazenil-antagonism on Diazepam-induced Hypoglossal Nerve Inhibition

Presenting Author: Yoshiya Adachi, MD, Saitama Medical University
Co-Authors: Masaaki Nishida, MD, Kumagaya General Hospital, Saitama, Japan, Kimie Terayama, MD, Kumagaya General Hospital, Saitama, Japan, Atsuhiro Sekiguchi, MD, Saitama Medical University, Saitama, Japan, Shin-Chan Nakamura, MD, Kumagaya General Hospital, Saitama, Japan

Background: Sedation with Benzodiazepines (Bz) often causes upper airway obstruction. It comes from the fact that Bz inhibits the hypoglossal nerve activity (HGA) via the Bz-$GABA_A$ receptor complex systems. This study aimed to investigate how the pre-injection of bicuculline (BIC: a competitive $GABA_A$ antagonist) and/or picrotoxin (PIC: a non-competitive $GABA_A$ antagonist) modulate the effect of flumazenil (FLU: a competitive Bz antagonist) on the diazepam (Dz)-inhibited hypoglossal activity (Dz-I).

Methods: Studies were carried out in adult rabbits (n=24) which were vagotomized, paralyzed and ventilated with 50% N_2O, 50% O_2 and 0.5% sevoflurane. This experiment is composed of the following three steps. The first step was Dz-I. The second step was injections of antagonists. Based on the tested antagonists, we divided the rabbits into five groups: Group one, no antagonists for sham treatment; group two, FLU; group three, PIC; group four, BIC; and group five, BIC and PIC. The final step was the injection of FLU for all groups.
We measured the root mean square (RMS) in integrated hypoglossal neurogram for data analysis.

Results: Dz-I is characterized by a rough 40-50% decrease in RMS. FLU antagonized Dz-I promptly with a short duration of antagonism and induced neither cumulation, potentiation nor tachyphylaxis in the subsequent FLU induced responses (see Fig.5-1&2). PIC gradually reversed Dz-I with a longer duration of antagonism than FLU alone, and allowed the next FLU to cause a marked excitation in HGA going up to approximately 50% over the control (refer to Fig.5-3). After BIC injection (see Fig.5-4), there were no significant changes in Dz-I like the results show in the sham treatment (see Fig.5-1), except for a transient trivial excitation that appeared following FLU injection. Co-injection of PIC with BIC facilitated the process of Dz-I recovery compared with PIC alone and inhibited the next FLU induced excitation in HGA substantially (see Fig.5-5).

Conclusion: These results suggest that the FLU-induced HGA excitation in Dz-I, which is only triggered by pre-administrated PIC, seems to be mainly controlled via PIC-sensitive Bz-$GABA_A$ receptor complex system and the other BIC-modulated $GABA_A$ constituents may secondarily affect the excitation.

- Figures -

Differential Modulation of Pre-Administration of Bicuculline and/or Picrotoxin for Antagonistic Effects of Flumazenil on Diazepam-Induced Hypoglossal Nerve Inhibition

* =P<0.01 vs. Control Mean + S.D.

↑ : Excitation: beyond 10 % from control

Fig.5-1: Sham Treatment (Control)

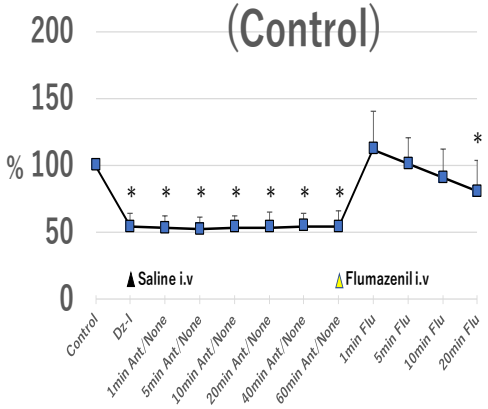


Fig.5-2: Flumazenil (FLU)

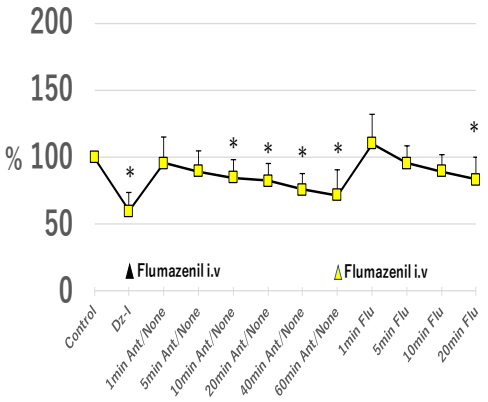


Fig.5-3: Picrotoxin (PIC)

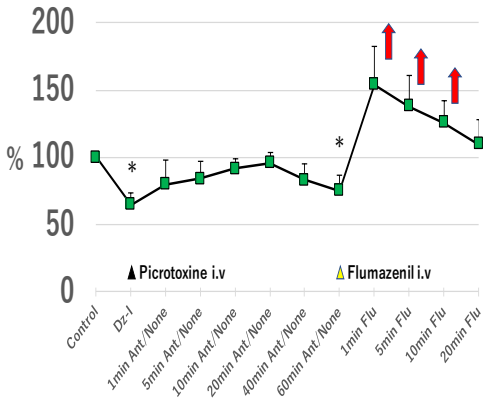


Fig.5-4: Bicuculline (BIC)

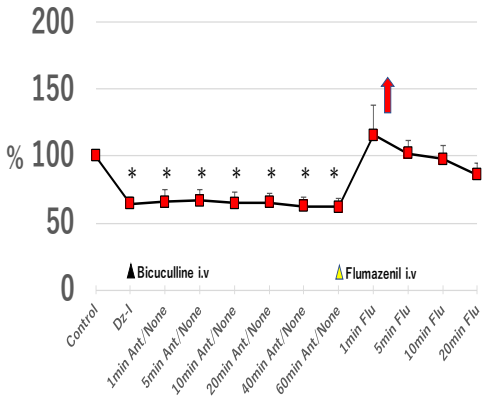
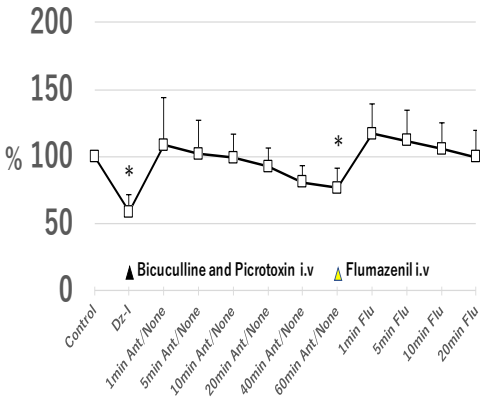


Fig.5-5: BIC and PIC



Postoperative Delirium After Hip Fracture Repair: Modifiable Perioperative Risk Factors and The Role of Age and Obstructive Sleep Apnea

Presenting Author: Janis Bekeris MD[1]
Co-Authors: Jashvant Poeran MD PhD[2], Crispiana Cozowicz MD[3], Nicole Zubizarreta MPH[4], Stavros G. Memtsoudis MD PhD[6]

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[2]Assistant Professor, Institute for Healthcare Delivery Science, Department of Population Health Science & Policy / Department of Orthopaedics / Department of Medicine, Icahn School of Medicine at Mount Sinai, New York, NY
[4]Data Analyst, Institute for Healthcare Delivery Science, Department of Population Health Science and Policy / Department of Orthopaedics, Icahn School of Medicine at Mount Sinai, New York, NY
[6]Clinical Professor of Anesthesiology & Public Health, Weill Cornell Medical College, New York, NY / Attending Anesthesiologist & Senior Scientist, Department of Anesthesiology, Hospital for Special Surgery, New York, NY / Department of Anesthesiology, Perioperative Medicine and Intensive Care Medicine, Paracelsus Medical University, Salzburg, Austria

Introduction: Postoperative delirium in hip fracture patients is common and associated with substantial morbidity and resource utilization. Using national data we aimed to identify potential modifiable perioperative risk factors for postoperative delirium. Furthermore, given the higher baseline risk for postoperative delirium due to higher age in this patient population, we investigated whether obstructive sleep apnea (OSA) would additionally increase risk.

Methods: Data on 506,438 hip fracture repair surgeries was included in this analysis (Premier Healthcare Database, 2006-2016). The main outcome was postoperative delirium; risk factors of interest included the presence of OSA, anesthesia type (general, neuraxial, both), perioperative opioid utilization (high, medium or low; <25th, 25-75th or >75th percentile of oral morphine equivalents), use of benzodiazepines (long-acting, short-acting, both), use of meperidine, non-benzodiazepine hypnotics, ketamine, corticosteroids, and gabapentinoids. Multilevel models assessed associations between risk factors and postoperative delirium, in the full cohort, and separately in those <80 and ≥80 years of age. Odds ratios (OR) and Bonferroni adjusted 95% confidence intervals (CI) are reported.

Results: Overall, postoperative delirium incidence was 15.7% (n=79,566). After adjustment for relevant covariates, particularly the use of long-acting (OR 1.81 CI 1.74-1.89) and combined long- and short-acting benzodiazepines (OR 1.56 CI 1.48-1.63), as well as ketamine use (OR 1.09 CI 1.03-1.15) were associated with increased odds for postoperative delirium while neuraxial anesthesia (OR 0.91 CI 0.85-0.98) and opioid use (OR 0.95 CI 0.92-0.98 and OR 0.88 CI 0.84-0.92 for medium and high dose compared to low dose) were associated with lower odds; all P<0.05. When analyzing data separately by age group, OSA was associated with increased risk for

postoperative delirium in patients younger than 80 years (OR 1.13 CI 1.02-1.26), while in patients older than 80 years a risk increase was not observed (OR 0.97 CI 0.86-1.10), likely reflecting the already higher baseline risk in patients of higher age. Effects associated with the use of benzodiazepines persisted in age stratified analysis, while opioid use significantly decreased delirium odds in those aged <80 years.

Conclusion: In this cohort with a high baseline risk of postoperative delirium, we were able to identify modifiable risk factors associated with postoperative delirium incidence. These findings may inform clinical studies and interventions targeting the reduction of postoperative delirium in hip fracture patients.

A Capnography Profile of Bariatric Patients after an Opioid Sparing Protocol in the Post-Anesthesia Care Unit

Co-Authors: Jin Deng[1], Garrett Enten[2], David J. Samuels[3], Devanand Mangar[3], Enrico M. Camporesi[2,3]
[1]University of South Florida, Morsani College of Medicine Tampa, FL
[2]TEAMHealth Research Institute Tampa, FL
[3]TEAMHealth Anesthesia Tampa, FL

Introduction: Approximately 8% of bariatric surgery patients experienced perioperative respiratory complications [1]. Respiratory monitoring in the PACU is traditionally accomplished with pulse oximetry, which measures peripheral oxygen saturation (SPO_2) levels. However, the ability of pulse oximetry to detect hypoventilation is impaired when patients are provided supplemental oxygen, which can artificially inflate and mask low SPO_2 levels [2]. Alternatively, capnography continuously monitors the partial pressure of carbon dioxide at the end of an expired breath. These end-tidal CO_2 ($ETCO_2$) levels closely approximate the partial pressure of CO_2 in arterial blood throughout the respiratory cycle, allowing healthcare providers to track a number of respiratory factors in real time. This study is an evaluation of the benefits of capnography monitoring in an obese population post bariatric surgery.

Methods: IRB-approved consent was obtained from 34 Roux-en-Y gastric bypass surgery patients with a body mass index above 30 kg/m^2 and a STOP-BANG score from 5-8. Anesthesia was induced with an average of 200 mcg fentanyl (23 of 31), lidocaine, and propofol. Subsequently, patients were intubated with rocuronium. Anesthesia was maintained with sevoflurane gas (1/2 MAC) and a continuous infusion of magnesium sulfate, ketamine, and dexmedetomidine. Neuromuscular blockade was reversed with sugammadex. During recovery, capnography traces were continuously recorded using a Microstream Smart CapnoLine® Plus O_2 Sampling Line (Medtronic: Dublin, Ireland) and IntelliVue MX700 patient monitor (Philips: Amsterdam, Netherlands). Monitors were calibrated to display highest $ETCO_2$ value recorded over 10 seconds. Aggregate monitor displayed $ETCO_2$ values over a 30 second interval were calculated and recorded at 5 minutes, 30 minutes, and 1 hour after being admitted to the post-anesthesia care unit (PACU). Any hypercapnia events, respiratory arrhythmias, or respiratory complications were noted. Patients were monitored for a minimum of one hour post-operatively.

Results: Three patients were excluded from analysis as their surgery duration was two standard deviations less than the mean; the remaining sample (n =31) patient characteristics are listed in the table. PACU respiratory measures were within normal limits and no adverse respiratory events were observed, although a number of patients received supplemental oxygen (Table). Analysis of variance failed to detect significant differences in $ETCO_2$, SPO_2, RR, or pain across the duration of the PACU stay.

Discussion: Patients undergoing bariatric surgery present a unique risk of pulmonary complications such as apnea, hypoventilation, and hypercapnia. Two-thirds of study subjects carried an OSA diagnosis and the rest were marked high risk for developing postoperative apnea. Over the course of patients' PACU stay, $ETCO_2$ levels were expected to increase. However, none of the patients experienced any adverse respiratory events, which may be attributed to a number of factors, including the sparing use of opiate during anesthesia.

Capnography gives healthcare providers access to respiratory measures such as $ETCO_2$, tidal volume, breathing rhythm, apnea, and respiratory rate that are not otherwise available through pulse oximetry or tracheal acoustic monitoring. These measurements provide a more thorough assessment of the ventilation status of patients and allow providers to maintain patient safety. However, this requires additional equipment periodic calibration and provider education.

References:

[1] Pouwels S, Smeenk FW, Manschot L, Lascaris B, Nienhuijs S, Bouwman RA, Buise MP. Perioperative respiratory care in obese patients undergoing bariatric surgery: Implications for clinical practice. *Respir Med*. 2016;117:73-80.

[2] Fu ES, Downs JB, Schweiger JW, Miguel RV, Smith RA. Supplemental oxygen impairs detection of hypoventilation by pulse oximetry. *Chest J.* 2004;126:1552–1558.

TABLE

Patient Characteristics (n=31)	
Variable	Mean (± SD)
Age (years)	43.5 (±12.4)
Sex	77.4% female
Race (%White [%Black])	54.8% (41.9%)
Ethnicity (%Non-Hispanic)	90.3%
BMI (kg/m^2)	45.9 (±6.9)
Procedure Duration (min)	196.2 (±85.9)
Prior OSA Diagnosis (19 of 31)	61.3%
Apnea-Hypopnea Index (events/hr) (12 of 19)	28.5 (±40.5)

Capnography and Other Respiratory Data for 31 Patients (Mean ± SD) During PACU Admission					
	$ETCO_2$ (mmHg)	Respiratory Rate	SPO_2 (%)	Patients on Supplemental O_2 (2 L/min)	Pain VAS
5 min after PACU Admission	37.4 (±4.6)	18.1 (±3.1)	95.5 (±3.2)	5 of 31	1.3 (±2.6)
30 min	37.3 (±4.0)	18.7 (±5.3)	95.9 (±2.8)	7 of 31	2.7 (±3.4)
PACU DIscharge	37.1 (±3.6)	18.4 (±5.1)	96.0 (±2.4)	7 of 31	2.2 (±2.1)
p-value	N.S.	N.S.	N.S.	N.S.	N.S.

Obstructive Sleep Apnea and Postoperative Outcomes in Patients Undergoing Open Colectomies: A Population-Based Study

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Introduction: An increasing body of evidence demonstrates an association between obstructive sleep apnea (OSA) and adverse perioperative outcomes with national data existing on particularly orthopedic and bariatric surgery. However, large scale data is currently lacking on open colectomies: procedures associated with high opioid utilization and high complication rates. Moreover, the interaction between obesity and OSA in this setting remains undefined.

Methods: Patients undergoing open colectomies were identified using the national Premier Perspective claims-based database (2006-2014; n=275,064). Multilevel multivariable models measured the associations between an OSA*obesity interaction term and perioperative outcomes: length and cost of hospitalization, opioid utilization (in oral morphine equivalents), respiratory and cardiac complications, ICU admission, mechanical ventilation, and in-hospital mortality. Odds ratios (OR) and 95% confidence intervals (CI) are reported.

Results: Overall, 4.9% (n=13,383) of patients had a diagnosis code for OSA of which 46.5% (n=6,460) was classified as obese. When adjusted for relevant covariates, OSA (with and without obesity, respectively) was associated with 17.6% (CI 15.2-20.0%) and 5.4% (CI 3.4-7.4%) increased cost of hospitalization; this was 9.4% (CI 8.3-10.6%) for obesity without OSA (all

P<0.0001). Interestingly, other perioperative outcomes followed this same pattern: highest risks for OSA/obesity combined, with obesity more important in this risk than OSA. The strongest effects were seen for respiratory complications: OR 2.51 (CI 2.35-2.68), OR 1.43 (CI 1.33-1.54), OR 1.52 (CI 1.45-1.58), for OSA with obesity, OSA without obesity, and obesity without OSA, respectively (all P<0.0001).

Conclusion: OSA is associated with adverse perioperative outcomes in patients undergoing open colectomies. However, obesity without OSA appears to exert a stronger risk than OSA without obesity, with a synergistic effect if both OSA and obesity are present. Given the high volume of open colectomies, and the large proportion of undetected OSA further research is warranted into not only risk stratification but also effectiveness of tailored interventions.

Table 1. Study variables by yes/no OSA

	Diagnosis of Sleep Apnea				
	Yes (n=13,383)		No (n=261,681)		
	n	%	n	%	P-value**
PATIENT DEMOGRAPHICS					
Mean Age *	63.5	12.4	63.3	16.4	<0.0001
Gender					
Female	5914	42.6	143268	54.7	<0.0001
Male	7969	57.4	118413	45.3	
Race					
White	10565	76.1	184451	70.5	<0.0001
Black	1268	9.1	27360	10.5	
Hispanic	209	1.5	7040	2.7	
Other	1841	13.3	42830	16.4	
HEALTHCARE RELATED					
Insurance Type					
Commercial	4864	35.0	91121	34.8	<0.0001
Medicaid	728	5.2	16866	6.4	
Medicare	7653	55.1	135867	51.9	
Uninsured	318	2.3	11667	4.5	
Unknown	320	2.3	6160	2.4	
Hospital Location					
Rural	1482	10.7	29679	11.3	0.0156
Urban	12401	89.3	232002	88.7	
Hospital Size					
<300 beds	4359	31.4	84925	32.5	<0.0001
300-499 beds	5460	39.3	96383	36.8	
≥500 beds	4064	29.3	80373	30.7	
Hospital Teaching Status					
Non-Teaching	8154	58.7	153615	58.7	0.94321
Teaching	5729	41.3	108066	41.3	
Mean # of Annual Colectomies*	128	68.8	124.5	70.8	<0.0001
PROCEDURE RELATED					
Admission Type					
Elective	7309	52.6	125026	47.8	<0.0001
Urgent	6574	47.4	136655	52.2	
Indication for Colectomy***					
Neoplasm	3378	24.3	71465	27.3	<0.0001
Diverticular Disease	3891	28.0	63099	24.1	<0.0001
Inflammatory Bowel Disease	4108	29.6	70552	27.0	<0.0001
Other	6480	46.7	121500	46.4	0.5724

Type of Procedure***					
Right Hemicolectomy	4633	33.4	91265	34.9	0.0003
Left Hemicolectomy	1880	13.5	33168	12.7	0.0028
Resection of Transverse Colon	997	7.2	16105	6.2	<0.0001
Sigmoidectomy	4767	34.3	87490	33.4	0.0280
Other	2088	15.0	41932	16.0	<0.0001
Year of Procedure					
2006-2008	3529	25.4	98140	37.5	<0.0001
2009-2011	4466	32.2	80980	30.9	
2012-2014	5888	42.4	82561	31.6	
ANESTHESIA/ANALGESIA					
Anesthesia Type					
General	11515	82.9	214920	82.1	0.0929
General + Neuraxial	467	3.4	9462	3.6	
Neuraxial	73	0.5	1494	0.6	
Unknown/Missing	1828	13.2	35805	13.7	
Use of Patient Controlled Analgesia	4253	30.6	82726	31.6	0.0156
Use of non-opioid analgesics					
IV Acetaminophen	1601	12.0	22386	8.6	<0.0001
NSAID	4277	30.8	87453	33.4	<0.0001
Cox-2 Inhibitor	157	1.1	2390	0.9	0.0091
Ketamine	400	2.9	5843	2.2	<0.0001
Pregabalin/Gabapentin	1078	7.8	9642	3.7	<0.0001
COMORBIDITIES					
Mean Charlson Comorbidity Index*	2.4	2.8	2.3	3.0	<0.0001
History of Substance Use/Abuse	2205	15.9	44099	16.9	0.0029
Pain Conditions	5992	43.2	114057	43.6	0.3244
Psychiatric Comorbidities	3508	25.3	43387	16.6	<0.0001
Obesity	6460	46.5	26860	10.3	<0.0001

*Continuous variable mean and standard deviation reported, instead of N and %, respectively
**Chi-square test for categorical variables, t-test for continuous variables
***Overlap between categories

Table 1. Outcomes by yes/no OSA

	Diagnosis of Sleep Apnea				
	Yes (n=13,383)		No (n=261,681)		
	n	%	n	%	P-value**
Oral Morphine Equivalents*	630	310-1310	537	255-1110	<0.0001
Length of Hospital Stay*	9	6-15	8	5-14	<0.0001
Cost of Hospitalization*	20479	13268-35814	17626	11700-29990	<0.0001
Respiratory Complications	2555	18.4	28573	10.9	<0.0001
ICU Utilization	1159	8.3	12788	4.9	<0.0001
Mechanical Ventilation Utilization	2845	20.5	37622	14.4	<0.0001
Cardiac Complications	1434	10.3	22667	8.7	<0.0001
Mortality	741	5.3	14186	5.4	0.6714

*Continuous variable mean and interquartile range reported, instead of N and %, respectively
**Chi-square test for categorical variables, Kruskal-Wallis test for continuous variables

Table 3. Results from multilevel multivariable models

	Diagnosis of Sleep Apnea * Obesity			
	OSA-Yes, Obesity-Yes	OSA-Yes, Obesity-No	OSA-No, Obesity-Yes	OSA-No, Obesity-No
Oral Morphine Equivalents	14.8% (11.9; 17.7%)*	5.1% (2.6; 7.6%)*	9.9% (8.5; 11.3%)*	Reference
Length of Hospital Stay	16.8% (15.0; 18.6%)*	1.6% (0.2; 3.1%)*	9.0% (8.2; 9.9%)*	Reference
Cost of Hospitalization	17.6% (15.2; 20.0%)*	5.4% (3.4; 7.4%)*	9.4% (8.3; 10.6%)*	Reference
Respiratory Complications	2.51 (2.35; 2.68)*	1.43 (1.33; 1.54)*	1.52 (1.45; 1.58)*	Reference
ICU admission	2.25 (2.03; 2.49)*	1.36 (1.22; 1.52)*	1.31 (1.22; 1.39)*	Reference
Mechanical Ventilation	1.57 (1.46; 1.68)*	1.09 (1.01; 1.17)*	1.19 (1.14; 1.24)*	Reference
Cardiac Complications	1.56 (1.43; 1.70)*	1.21 (1.12; 1.32)*	1.24 (1.18; 1.30)*	Reference
Mortality	1.15 (1.03; 1.29)*	0.88 (0.78; 0.99)*	1.00 (0.94; 1.07)	Reference

*P<0.05

** Continuous outcomes; exponentiated coefficients from the log model which provides % change comparing OSA/obesity categories

Models adjusted for: age, gender, race, insurance type, hospital location, hospital size, hospital teaching status, hospital annual colectomy volume, elective/emergent procedure, indication for colectomy, type of procedure, year of procedure, anesthesia type, use of patient controlled analgesia, use of non-opioid analgesics, mean Charlson comorbidity index, history of substance use/abuse, pain conditions, and psychiatric comorbidities

Influence of Tobacco Smoking on the Development of Obstructive Sleep Apnea

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Background: Tobacco smoking can induce epithelial lesions of the upper airway. These lesions could contribute to an alteration of the upper airway reflex, and thus promote the development of Obstructive Sleep Apnea (OSA). Nevertheless, the influence of tobacco smoking on the development of OSA appears unclear[1].

General Aim: This study aimed to analyze the influence of tobacco smoking on the development of OSA in a preoperative surgical population.

Materials and Methods: We retrospectively include patients who undergo their preoperative screening in the Cabinet Medical ASTES (Jambes, Belgium) between 01/01/2014 and 31/12/2017, and for whom results of polysomnography (PSG) were available. As it was a retrospective study, we do not request Ethical Committee Approval. We correlated the tobacco smoking habits of patients with the Apnea-Hypopnea Index (AHI) derived from the PSG. Comparisons were made using Probit analysis and Prediction Probability (PK). Analyses were performed: 1) on the entire population, 2) for patients with age < 40 years, 3) for patients with age > 45 years, 4) for patients with BMI < 30 kg/m^2, 5) for patients with BMI > 35 kg/m^2, and 6) for patients with age > 45 years and BMI > 35 kg/m^2. For these six categories, we performed analyses for: A) an AHI > 5, B) an AHI > 15, and C) an AHI > 30 events/hour. Values of P less than 0.05 were considered statistically significant.

Results: We enrolled 1298 patients in this retrospective study. Table 1 and Figure 1 show complete results of the study. Two Probit models [95% CI] were significant: 1) entire population and AHI > 5 (0.991 [0.982-0.999]), 2) age > 45 years and AHI > 5 (0.989 [0.978-0.999]). These two models present a PK of 0.466 and 0.462, respectively. These two PK values represent the lowest PK values in the study (accordingly with Probit models). The subgroup combining age > 45 years, a BMI > 35 kg/m^2, and an AHI > 15 exhibits the highest PK value (0.538). This subgroup reveals a Probit model of 1.025 [0.989-1.029, non-significant].

Discussion: On the one hand, tobacco smoking represents a risk reduction for developing OSA in the entire population and for an AHI > 5 (protective effect). This protective effect is found again for the subgroup of patients with age > 45 years and an AHI > 5. On the other hand, tobacco smoking tends to be a risk factor for developing moderate to severe OSA (AHI > 15) in the subgroup of patients characterized by age > 45 years and a BMI > 35 kg/m^2.

Conclusion: To the best of our knowledge, it is the first time that such statistical analyses were performed to understand the link between tobacco smoking and OSA. Our results exhibit a wide variation between subgroups of patients. This variation could partially explain the divergent results of previous studies. Larger scale studies must confirm our conclusion.

References:

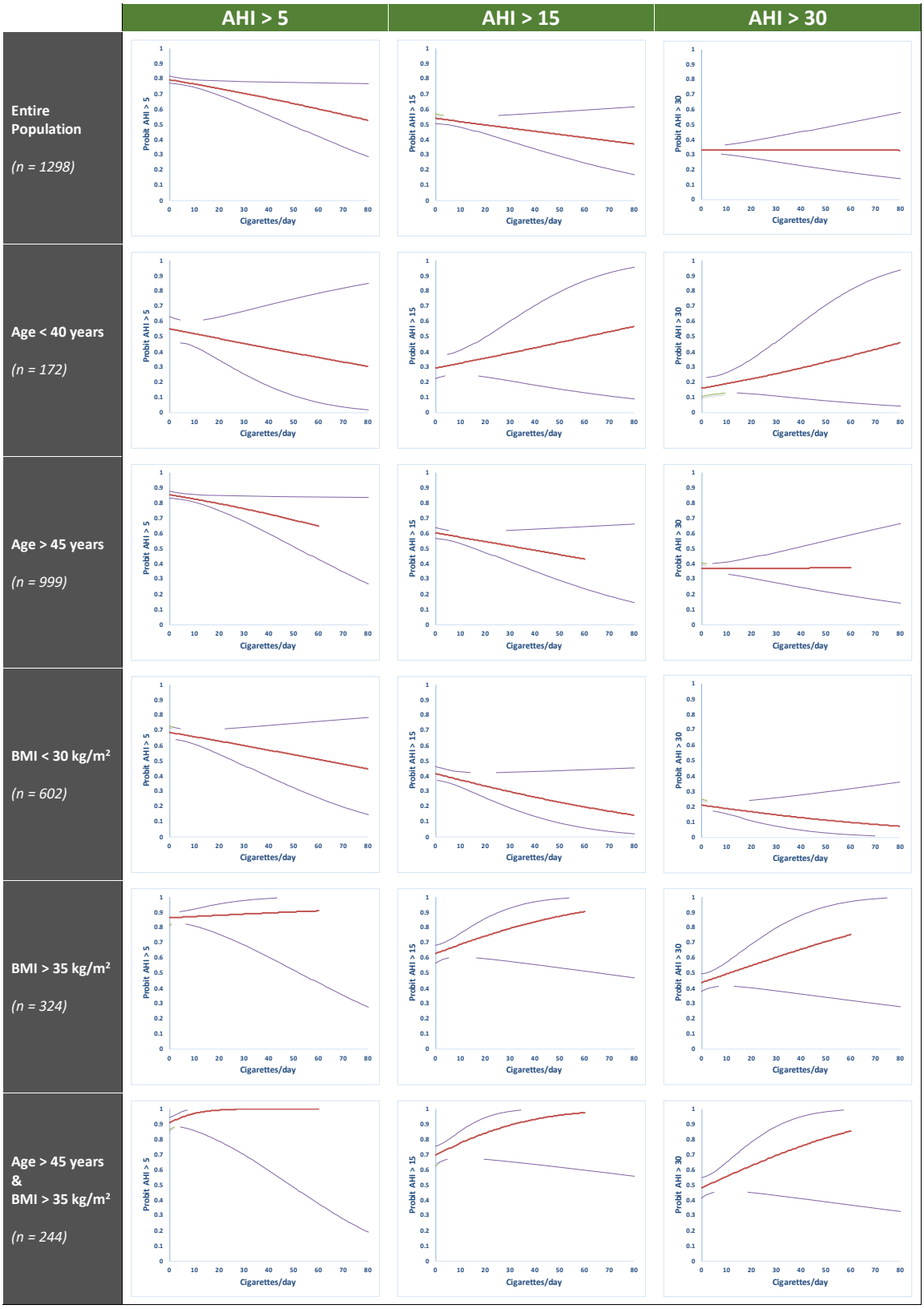
1. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. *American journal of epidemiology.* 2013;177(9):1006-1014.

TABLE 1

		AHI > 5	AHI > 15	AHI > 30
Entire population *(n = 1298)*	PK	0.466	0.486	0.499
	Probit Model (95% CI)	0.991 * (0.982 – 0.999)	0.995 (0.987 – 1.003)	1 (0.992 – 1.008)
Age < 40 years *(n = 172)*	PK	0.474	0.534	0.548
	Probit Model (95% CI)	0.992 (0.972 – 1.012)	1.009 (0.989 – 1.029)	1.011 (0.990 – 1.033)
Age > 45 years *(n = 999)*	PK	0.462	0.489	0.504
	Probit Model (95% CI)	0.989 * (0.978 – 0.999)	0.993 (0.983 – 1.002)	1 (0.990 – 1.010)
BMI < 30 kg/m^2 *(n = 602)*	PK	0.469	0.467	0.479
	Probit Model (95% CI)	0.992 (0.980 – 1.004)	0.989 (0.977 – 1.002)	0.992 (0.978 – 1.006)
BMI > 35 kg/m^2 *(n = 324)*	PK	0.486	0.516	0.517
	Probit Model (95% CI)	1.004 (0.978 – 1.030)	1.016 (0.994 – 1.039)	1.014 (0.994 – 1.034)
Age > 45 years & BMI > 35 kg/m^2 *(n = 244)*	PK	0.536	0.538	0.530
	Probit Model (95% CI)	1.056 (0.972 – 1.148)	1.025 (0.995 – 1.055)	1.018 (0.994 – 1.043)

*: Statistically significant Probit models

FIGURE 1


AHI > 5
AHI > 15
AHI > 30
Entire Population
(n = 1298)
Age < 40 years
(n = 172)
Age > 45 years
(n = 999)
BMI < 30 kg/m²
(n = 602)
BMI > 35 kg/m²
(n = 324)
Age > 45 years & BMI > 35 kg/m²
(n = 244)
Probit AHI > 5
Probit AHI > 15
Probit AHI > 30
Cigarettes/day

Respiratory Chemosensitivity and Sleep as Risk Factors for Postop Opioid-Induced Respiratory Depression

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Background: Postoperative opioid-induced respiratory depression (OIRD) remains a problem, can be fatal, and unfortunately is poorly predicted by traditional risk factors (e.g. advanced age, OSA). While opioids blunt respiratory chemosensitivity (hypercapnic and hypoxic ventilatory responses, HCVR, HVR), [1] there are few observations of its relationship to OIRD. We hypothesize that low respiratory chemosensitivity is a risk factor for OIRD in patients undergoing major surgery.

General Aims: We present a method and pilot study to explore respiratory chemosensitivity as a predictor for postop OIRD, and to determine whether respiratory depression is more likely during specific phases of sleep.

Materials and Methods: Following IRB approval and informed consent, each patient prior to surgery undergoes a home sleep study (WatchPAT™, Itamar Medical, Franklin, MA) and measurements of HCVR during hyperoxia and mild hypoxia using Duffin's procedure, [2] with and without an infusion of remifentanil (effect site concentration 0.7 or 2.0 ng/mL).
Post-surgery, respiratory minute volume and respiratory rate (RR) (ExSpiron™, Respiratory Motion, Waltham, MA), sleep data (WatchPAT™), and transcutaneous P_{CO2} (P_{TCCO2}) (SenTec, Fenton, MO) are collected from PACU admission until the first postop morning. SpO_2 (WristOx™, Nonin Medical, Plymouth, MN) is collected from PACU admission to hospital discharge. Opioid consumption and timing, as well as other analgesic and/or sedating medications, are recorded. End points are 1) hypoventilation (RR <80% of baseline), 2) hypoventilation (MV <80% of expected MV, calculated based on weight and height), 3) desaturation (SpO_2 < 90% or 92% while on room air or supplemental O_2, respectively,) and 4) hypercapnia (P_{TCCO2} >50 mmHg). Events lasting ≥1 minute are considered.

Results: Seven patients have been studied thus far (age 65 ± 8.6 years; AHI 24.0 ± 8.8). (See data example in Fig. 1.) Remifentanil depressed HCVR both at 2.0 and 0.7 ng/ml. Respiratory events tended to occur during light sleep. Event frequencies were positively correlated with total opioid dose and were higher during epidural opioid infusions. While there was not a consistent relationship seen between HCVR values and event frequencies, patients whose HCVR was more significantly depressed by remifentanil generally had higher event frequency and event duration, even when accounting for varying observation times and opioid dosages.

Discussion and Conclusion: We have established a practical method for assessing baseline chemosensitivity and sleep, and appropriate monitoring to detect respiratory events in patients after surgery. A remifentanil site concentration of 0.7 ng/ml is adequate when assessing HCVR and may be more useful than 2.0 ng/ml, given that 2.0 ng/ml frequently abolished HCVR.

Preliminary data suggest that respiratory events occur mostly during light sleep, and ΔHCVR ($HCVR_{+remi}$ – $HCVR_{-remi}$) may correlate with a higher frequency and duration of respiratory events.

References:

1. Gross, J. and D. Cerza, Ventilatory effects of medications used for moderate and deep sedation. Lung Biology in Health and Disease, 2005. 202: p. 513.
2. Duffin, J., Measuring the respiratory chemoreflexes in humans. Respir Physiol Neurobiol, 2011. 177(2): p. 71-9.

Figures

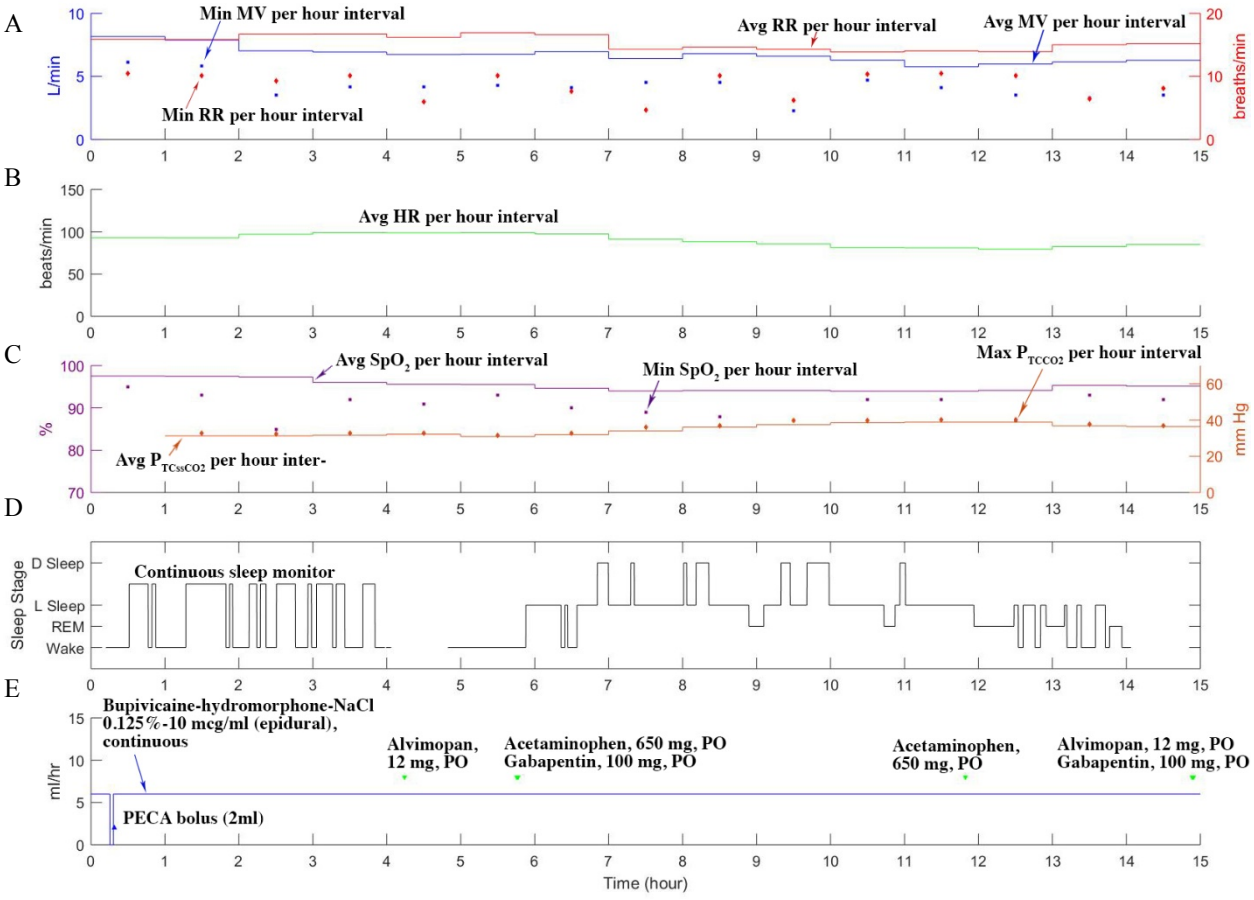

Figure 1. Data for one patient (PACU to postop morning 1). A-C: data per hour interval. D-E: continuous data.

Non-Steady State Modeling of the Ventilatory Depressant Effect of Remifentanil in Awake Patients Suffering From Moderate-To-Severe Obstructive Sleep Apnea

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Background: Evidence suggests that obstructive sleep apnea (OSA) promotes postoperative respiratory complications by enhancing vulnerability to opioid-induced ventilatory depression. We hypothesized that patients with moderate-to-severe OSA are more sensitive to remifentanil-induced ventilatory depression than controls.

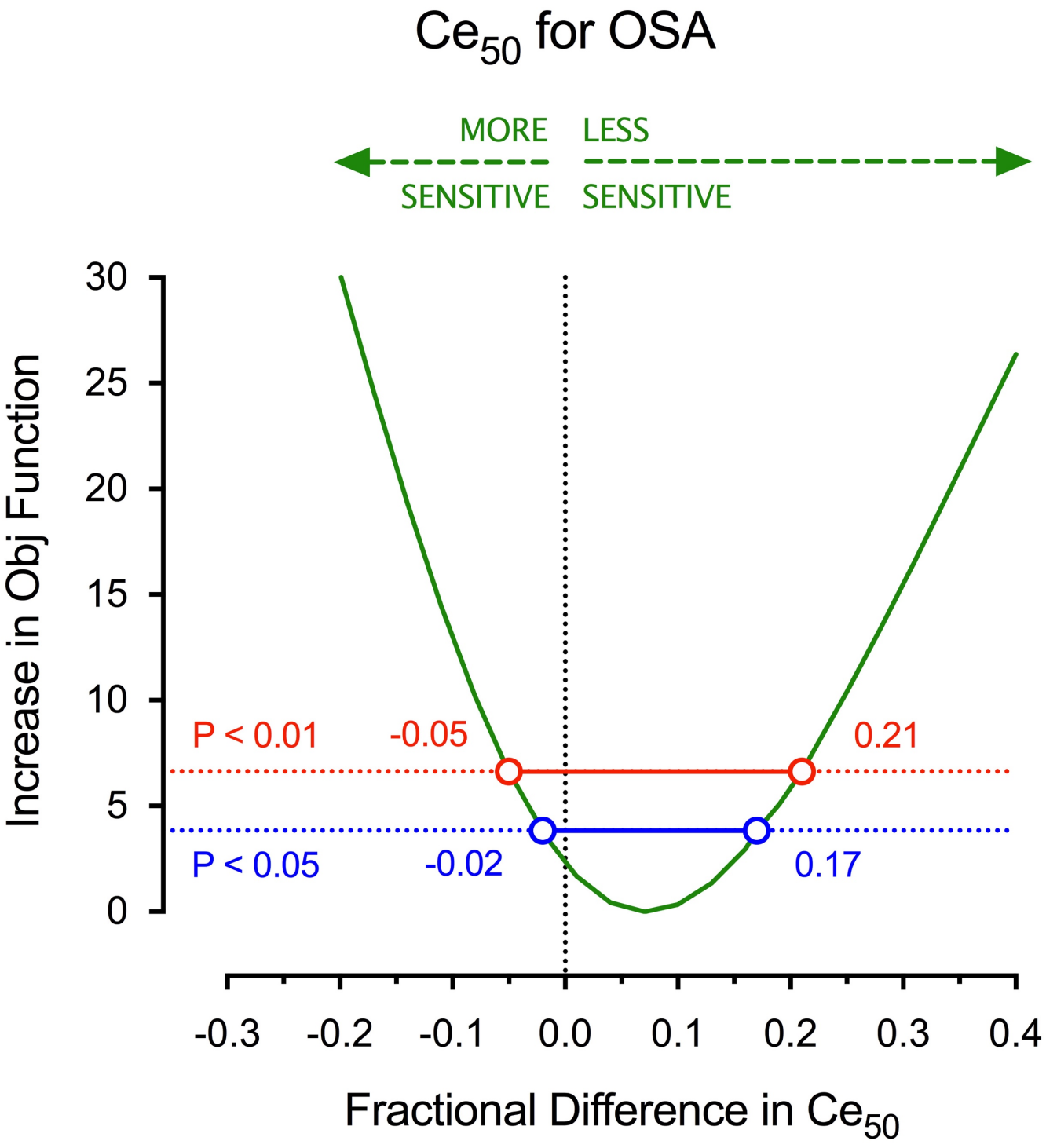
Methods: After Institutional approval and written informed consent, patients received a brief remifentanil infusion during continuous monitoring of ventilation. We compared minute ventilation in 30 patients with moderate-to-severe OSA diagnosed by polysomnography and 20 controls with none to mild OSA per polysomnography. Effect site concentrations (Ce) were estimated by a published pharmacologic model. We modeled minute ventilation as a function of Ce and the estimated CO_2. OSA status, body mass index, sex, age, use of continuous positive airway pressure, apnea /hypopnea events per hour of sleep, and minimum nocturnal SpO_2 in polysomnography, were tested as covariates for remifentanil Ce_{50}, and included in the model if a threshold of 6.63 ($P < 0.01$) in the reduction of objective function was reached and improved model fit.

Results: Our model described the observed minute ventilation with reasonable accuracy (22% median absolute error). We estimated a remifentanil Ce_{50} of 2.20 ng· mL^{-1} (95% CI: 2.09 - 2.33). None of the tested covariates demonstrated a significant effect on Ce_{50}. Likelihood profiling with the model including OSA, suggested that the effect of OSA on remifentanil Ce_{50} was less than 5% (Fig. 1).

Conclusion: Neither OSA status, apnea /hypopnea events per hour of sleep, or minimum nocturnal SpO_2, influenced the sensitivity to remifentanil-induced ventilatory depression in awake patients in awake patients receiving a remifentanil infusion of 0.2 mcg·kg^{-1} of ideal body weight per minute.

Funding: Support was provided solely from departmental sources.

Figure 1.


Ce50 for OSA
MORE SENSITIVE
LESS SENSITIVE
Increase in Obj Function
30
25
20
15
10
5
0
P < 0.01
-0.05
0.21
P < 0.05
-0.02
0.17
-0.3
-0.2
-0.1
0.0
0.1
0.2
0.3
0.4
Fractional Difference in Ce50

Predicted Obstructive Sleep Apnea is Associated with Postoperative Supplemental Oxygen Use

Co-Authors: Vidya T. Raman, MD; Mohammed Hakim, MBBS; Emily D. Geyer, BS; Dmitry Tumin, PhD; Joseph D. Tobias, MD.

Background: Few children undergo definitive testing for obstructive sleep apnea (OSA) using polysomnography (PSG) prior to surgery. Undiagnosed OSA may lead to postoperative complications or the need for a prolonged postoperative hospital stay. Using a caregiver questionnaire designed to predict OSA (apnea-hypopnea index >5) on PSG, we prospectively evaluated whether predicted OSA on the questionnaire could identify the risk of adverse outcomes in the post-anesthesia care unit (PACU) in a large cohort of children presenting for surgery.

Materials and Methods: Following Institutional Review board approval (IRB).Patients, ages 3-18 years, American Society of Anesthesiologists status 1-3, were enrolled on the day of surgery. Caregivers completed a 6-item questionnaire on OSA-related symptoms (e.g, snoring), and scores ≥ 2 of 6 were classified as "predicted OSA." PACU outcomes were obtained from the electronic medical record. Prolonged oxygen requirement in the PACU was the primary outcome and prolonged length of stay (LOS, >1 hour) as a secondary outcome. Outcomes were compared according to predicted OSA using tests of independent proportions.

Results: To date, we have enrolled 319 boys and 295 girls of a planned total enrollment of 1,000 patients. Patients in the study were of mean age 12 ± 4 years, and 172 (28%) had scored ≥2 of 6 points on the OSA screening questionnaire. Patient characteristics and study outcomes are compared to our retrospective study in the **Table**. Children with predicted OSA were more likely than children without predicted OSA to require supplemental oxygen in the PACU (26% vs. 18%; 95% confidence interval [CI] of difference: 0.04%, 15%; p=0.038). However, this difference was significantly smaller than the difference of 16% found in a previous retrospective study limited to children undergoing preoperative PSG. Prolonged PACU LOS was not significantly more likely among children with predicted OSA (43%) compared to those without predicted OSA (41%; 95% CI of difference: -7%, 11%; p=0.640).

Discussion: OSA is known to be associated with postoperative adverse events in children, but preoperative testing for OSA using PSG is resource-intensive. It is unclear whether questionnaire-based tools predicting OSA on PSG can successfully predict adverse events considered related to OSA, such as need for supplemental O2 or requirement for prolonged PACU stay. In a prospectively-enrolled cohort of children undergoing a wide range of procedures under general anesthesia, we found that questionnaire screening for OSA predicted supplemental O2 requirement in PACU, although this association was much weaker than in a previous retrospective study limited to children referred for preoperative PSG. Nevertheless, the presence of this association in a cohort where most children did not have suspected OSA and were not undergoing procedures associated with OSA (e.g., adenotonsillectomy) suggests

that undiagnosed OSA may pose a risk of respiratory complications in PACU after procedures unrelated to OSA symptoms.

References:

1. Tait AR et al. Paediatr Anaesth 2013;23:510-6.
2. Raman VT et al. Paediatr Anaesth 2016;26:655-664.
3. Kako H et al. Int J Pediatr Otorhinolaryngol 2017;102:71-5.

Table. Patient characteristics and PACU outcomes, by predicted OSA status, in prior retrospective study and present prospective study.

	Procedures in patients with preoperative PSG[a]		All procedures[b]	
	No predicted OSA (N=63)	Predicted OSA (N=122)	No predicted OSA (N=442)	Predicted OSA (N=172)
Age (yr)[c]	8 (4)	8 (4)	12 (4)	11 (4)
Gender (M/F)	41/22	59/63	223/219	96/76
BMI (kg/m2)[c]	19 (7)	22 (9)	22 (7)	24 (9)
ASA status				
1	1 (2%)	12 (10%)	138 (31%)	24 (14%)
2	41 (65%)	64 (53%)	240 (54%)	105 (61%)
3	21 (33%)	44 (37%)	64 (14%)	43 (25%)
Adenotonsillectomy	27 (43%)	82 (67%)	2 (0.05%)	12 (7%)
PACU outcomes				
LOS >60 min	16 (25%)	39 (33%)	181 (41%)	74 (43%)
Supplemental O2	3 (5%)	26 (21%)	80 (18%)	44 (26%)

[a] Previous retrospective study. Kako et al. Int J Pediatr Otorhinolaryngol 2017;102:71-5.
[b] Current prospective study.
[c] Mean (SD) shown.

BMI, body mass index; LOS, length of stay; OSA, obstructive sleep apnea; PACU, post-anesthesia care unit; PSG, polysomnography; SD, standard deviation

Secondhand Smoke and Risk of Obstructive Sleep Apnea in Children

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Co-Authors: Robert Schnoll, Ignacio Tapia, Bingqing Zhang, Rajeev Subramanyam

Background: Obstructive sleep apnea (OSA) is the most prevalent pediatric sleep disorder causing increased morbidity and mortality.1 Although tonsillar enlargement is thought to be commonest cause,2 the role of environmental factors is not studied. We explored the role of exposure to secondhand smoke (SHS) in increasing OSA severity. There are only two studies to date with conflicting results.

General Aim: To study the association of SHS exposure assessed by questionnaire to the severity of OSA measured by overnight sleep study in children 3 years to 18 years of age.

Materials and Methods: IRB approval was obtained. Electronic Medical Record (EMR) was queried in this retrospective single center study to obtain data on exposure to smoking related variables, demographic data, and data on OSA from polysomnography. Smoking related variables were collected with standard questionnaire established in the EMR. Data was analyzed as descriptive variables. Smoking was analyzed as a categorical variable and apnea hypopnea index (AHI) as a continuous variable. A multivariate regression model using backward elimination was developed with all levels of AHI and another model for patients with severe OSA (defined as an AHI of more than or equal to 10). A p value of <0.05 was considered statistically significant. The statistical analysis was done with SAS.

Results: There were 71 patients with established smoking data and AHI from PSG. A multivariate regression model was developed using logarithm of AHI as the outcome. OSA diagnosis included none, mild, moderate, and severe. Out of 71 observations read, all were used. In multivariate analysis, SHS (OR:1.35; 95%CI:0.92-1.99; $p = 0.03$) remained associated with increased OSA severity (Table 1). Overall, there was a significant difference in the scores for SHS exposure ($M = 0.30$, $SD = 1.15$), and non-SHS exposure ($M = 2.79$, $SD = 1.94$) conditions; $t(1) = 2.22$, $p = 0.03$. Our study suggests that exposure to SHS causes an increase in OSA severity.

Discussion: Although secondhand smoke is presumed to be associated with sleep disordered breathing, most studies have focused on habitual snoring which has a higher prevalence of 10% as opposed to OSA which has a prevalence of 4%. These two studies have shown contradicting results.3,4

Conclusion: Based on questionnaire assessment measuring SHS exposure and AHI from overnight sleep study, children exposed to SHS had 35% increase in the severity of OSA.

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Table 1: Multivariate regression model for logarithm of Apnea Hypopnea Index from Polysomnography			
Variable	**Parameter Estimate**	**Standard Error**	**P Value**
Intercept	2.78675	0.23069	<.0001
Secondhand smoke exposed vs. not exposed	0.30333	0.13667	0.0300
Body Mass Index	0.01908	0.01199	0.1164
Gender Male vs. Female	0.05630	0.13831	0.6853
Age in years	-0.01865	0.03353	0.5800
African Americans vs. other races	0.03619	0.14280	0.8007

Use of a Novel Modified Pediatric Face Mask to Deliver Nasal CPAP to Maintain Spontaneous Ventilation and Oxygenation in a Morbidly Obese Adult Patient with OSA and Difficult Airway during Colonoscopy under MAC

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Background: Patients under monitored anesthesia care (MAC) often receive intravenous sedation and O_2 via nasal cannula. Over-sedation and/or airway obstruction may cause oxygen desaturation, especially in obese patients with obstructive sleep apnea (OSA). In severe cases, the procedures have to be interrupted in order to resuscitate the patient. A simple nasal PAP mask assembly using a pediatric mask and existing anesthesia equipment and machine has been shown to maintain spontaneous ventilation and improve oxygenation in sedated obese patients with OSA.[1-5] Furthermore, it is often difficult to achieve a tight face-mask seal in an obese patient with a full beard during rescue assisted ventilation or after induction of general anesthesia. This nasal mask has been shown to provide a tight nose-mask seal for assisted ventilation in patients with full beards or patients with dysmorphic facial features.[1,6-8]

We used a modified infant mask to maintain spontaneous ventilation in a morbidly obese patient with OSA, difficult airway, and full beard during colonoscopy.

Case Description: A 56 year-old male, 5'10", 288 lb, (BMI 39.3 kg/m^2) with OSA on nocturnal CPAP, NIDDM, hypertension, aortic stenosis s/p aortic valve replacement, atrial fibrillation, pacemaker placement, peripheral vascular disease, COPD with 40 pack-year history, GERD, and diabetic neuropathy presented for outpatient screening colonoscopy.

The patient had a full beard, small mouth opening (3 cm), Mallampati Class III airway, and short neck.

He received pre-treatment with metoclopramide 10 mg and albuterol inhalation (4 puffs) thirty-five minutes prior to the procedure. After a modified infant mask (Fig. 1) with fully inflated air cushion was secured over his nose with elastic head straps and connected to an anesthesia breathing circuit and machine, he was placed in left lateral decubitus position. The APL valve was adjusted to deliver 8-10 cm H_2O CPAP with 4 L/min O_2 flow.

Following nasal CPAP pre-oxygenation, his SpO_2 increased from 96% to 100%. Deep sedation was then titrated with lidocaine 100 mg and propofol 70 mg, followed by propofol infusion (75-100 mcg/kg/min). The patient maintained stable hemodynamics and spontaneous ventilation with 100% SpO_2 throughout the difficult colonoscopy that lasted 50 minutes. He tolerated the procedure well and was discharged home without delay.

Discussion: This simple modified nasal mask assembly maintained spontaneous ventilation and improved oxygenation in a morbidly obese patient with OSA, difficult airway, and full beard. It

takes less than two minutes to modify a tear-drop shaped pediatric face mask to a rounded triangular shaped nasal mask that would fit an adult nose (Fig. 1). This nasal mask can provide a better mask seal than a face mask in a patient with a full beard. With APL valve adjustment, only low O_2 flow (4 L/min) is needed to provide optimum CPAP. It can also be used to deliver immediate assisted nasal ventilation in case of apnea and may improve patient safety at a low cost.

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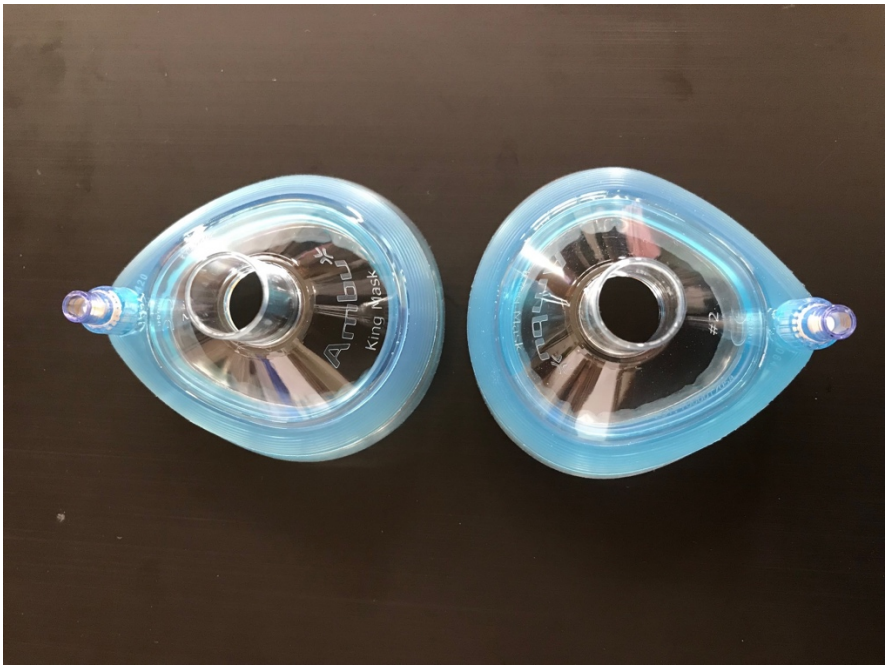

Fig. 1. Infant mask (size #2) (left) and the modified infant mask (right).

The Score for Prediction of Postoperative Respiratory Complications (SPORC) Revisited: A Score Development and External Validation Study

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Background: Pulmonary complications, including postoperative respiratory failure, occur in 2-7 percent of patients recovering from surgery and predict mortality and increased health care utilization. [1,2]
We previously developed a prediction score for postoperative respiratory complications (SPORC) [3], which is frequently used but limited to preoperatively available variables. We recently have identified additional intraoperative factors that increase the risk of postoperative respiratory complications.

General Aim: To test whether the addition of intraoperative predictors improves the predictive value in a clinically meaningful fashion.

Materials and Methods: This was a hospital registry study on adult inpatients who underwent non-cardiac surgery with endotracheal intubation and postprocedural extubation within the operating room between 2005 and 2017. Cohorts of 122,522 and 153,957 patients from two competing healthcare networks were considered strictly separately for score development and external validation. The primary outcome was unplanned reintubation with mechanical ventilation in either OR, PACU or ICU within the first three postoperative days. We used multivariable stepwise backwards regression to select predictors for postoperative reintubation from an a priori defined set. P-values of 0.05 and below were considered statistically significant. Utilizing net reclassification improvement and c-statistics, we compared the new prediction model to the previously developed SPORC. Predictive ability and generalizability were assessed through external validation. The study has been board approved and patient consent has been waived. (Partners IRB (protocol no. 2017P002541; BIDMC IRB (protocol no.2018P000136)).

Results: In the score development cohort 709 (0.8%) cases and in the external validation cohort 714 (1.2%) were reintubated within 3 days after surgery. In addition to four preoperative variables of SPORC (ASA score ≥3, congestive heart failure, chronic pulmonary disease and emergency surgery) we identified 8 independent intraoperative predictors of reintubation: Desaturation (≤ 90% SpO_2) within 5 minutes after intubation, long duration of surgery, high FiO_2, high vasopressor dose, intraoperative administration of packed red blood cells, no application of volatile anesthetics, no protective ventilation patterns (driving pressure >15mmHG) and high Procedure Severity Index [4]. Applying Youden`s Index, the empirically determined optimal cut point of the score to determine high risk was 14.5. The final model yielded an area under the receiver operating characteristic curve (AUC) of 0.84 (95% CI 0.82-0.85). The Hosmer-Lemeshow test was not significant (p= 0.2), indicating good calibration of

our model. External validation in a cohort of 57,137 patients proved excellent discriminative ability (AUC of 0.80 (95%CI 0.78-0.81)). Adding the intraoperative predictors to SPORC, significantly improved the risk categorization in net reclassification (NRI: 0.27, p-value <0.001): 227 patients were adequately reclassified in a higher and 9702 patients in a lower category) and in roc comparison analysis (compare at AUC 0.76 (95% CI 0.74-0.78)).

Conclusion: We developed and successfully validated an improved score for the prediction of postoperative respiratory complications. By incorporating intraoperative data, we were able to significantly enhance an existing prediction instrument.

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Figure 1. Prediction Model for postoperative Reintubation. The independent predictors for postoperative reintubation were identified through stepwise backwards regression and point values were assigned in proportion of the lowest ß- Coefficient.

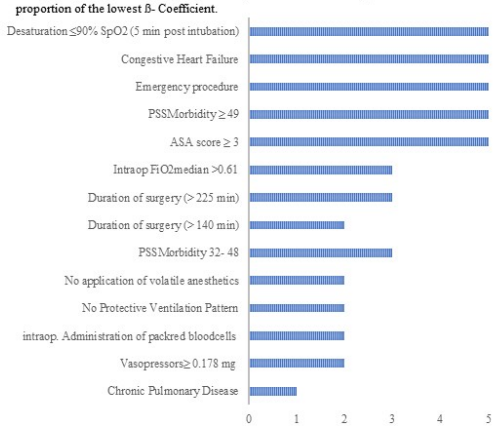
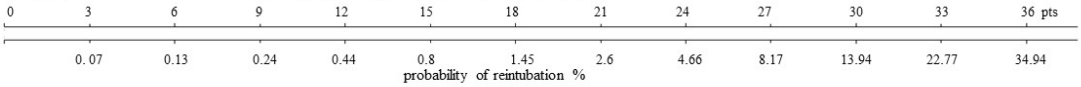


Table 1. Risk categorization for postoperative reintubation within 3 days: the accuracy of two models – SPORC+ versus SPORC

	SPORC+ (New Prediction Tool for Postoperative Reintubation) Risk Categories for Postoperative Reintubation				
SPORC - Risk Categories for Postoperative Reintubation	< 1% Risk	1-5% Risk	5-10% Risk	>10% Risk	Total Number
In 709 patients who were reintubated within 3 days after surgery					
<1% Risk	158	85	3		246
1-5% Risk	64	240	95	30	429
5-10 % Risk		3	9	14	26
>10%			3	5	8
Total Number	222	328	110	49	709
In 90676 patients who were not reintubated within 3 days after surgery					
<1% Risk	63523	4101	46	1	67671
1-5% Risk	9553	10008	1237	238	22268
5-10% Risk	1	117	151	106	375
>10%		5	26	25	56
Total Number	73077	15463	1460	370	90370

Figure 2. Prediction Score for Postoperative Reintubation "SPORC+"



This figure provides an illustration of the prediction score for postoperative reintubation (SPORC+) together with the association of probability of reintubation after surgery based on our cohort.

A Novel Modified Pediatric Face Mask Maintained Spontaneous Nasal Ventilation and Oxygenation in a Morbidly Obese Patient with Ventriculat Tachycardia During Repeated Prolonged Ablation Under MAC

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Background: Patients under monitored anesthesia care (MAC) often receive intravenous sedation and supplemental O_2 via nasal cannula. Over-sedation and/or airway obstruction may cause oxygen desaturation, especially in obese patients with obstructive sleep apnea (OSA). In severe cases, the procedures have to be interrupted in order to resuscitate the patient. A simple nasal PAP mask assembly using a pediatric face mask has been shown to maintain spontaneous ventilation and improve oxygenation in sedated obese patients with OSA .[1-5] However, a pediatric face mask has a tear-drop shape and does not always fit adult noses. We used a novel modified pediatric face mask to provide nasal CPAP in a morbidly obese patient with suspected OSA during ventricular tachycardia (VT) ablation under MAC.

Case Description: A 73 y/o morbidly obese female, 5'3", 286 lb, (BMI 50.8 kg/m^2), with HTN, CAD s/p MI, s/p PTCA with stent, LV apical aneurysm, atrial fibrillation, recurrent ventricular tachycardia with AICD x 4 discharges over the previous 4 days presented for ablation under MAC. Even though she denied a history of OSA but admitted of snoring. Furthermore, she had a full round face, a short neck, a small mouth and a Mallampati Class IV airway. She met STOP-BANG criteria to have OSA and was at high risk of sedation-induced airway obstruction. She was very anxious and didn't want to "know anything".
A tear-drop shaped infant face mask was modified to a round triangular nasal mask by compressing the mask for 2 minutes. The modified infant mask with fully inflated air cushion was secured over her nose with elastic head straps and connected to a long anesthesia breathing circuit and the anesthesia machine. The APL valve was adjusted to deliver 6-8 cm H_2O CPAP with 4 L/min O_2 flow. Her SpO_2 improved to 100% from 94%.
The patient maintained spontaneous nasal ventilation and 100% SpO_2 throughout the 6 hour procedure under midazolam/fentanyl/propofol (15-35 mcg/kg/min) sedation. She tolerated the procedure well without airway issue. She was elated that there was no awareness during the procedure.

She returned for repeated ablation (7-hr) 5 days later using the same technique, nasal CPAP oxygenation, which was well tolerated.

Discussion: Ventricular arrhythmia ablations present a challenge for the anesthesiologist as over-sedation can blunt induction of the arrhythmia, while maintaining a comfortable and cooperative patient. This modified pediatric face mask maintained spontaneous nasal

ventilation and improved oxygenation in a morbidly obese patient with suspected OSA during repeated and prolonged VT ablation. It avoided airway manipulation in sedated patients with OSA and difficult airway and thus reduced radiation exposure for anesthesia provider in a crowded cardiac catheterization suite. It takes less than 2 minutes to modify a tear-drop shaped pediatric face mask to a rounded triangular nasal mask that accommodates most adult noses. It may improve patient safety at a low cost.
Case reports are IRB-exempted. This patient gave her consent for taking photography and case report.

References: 1.www.TSEMask.com; 2.SAMBA 28th AM:MC, 2013; 3.SASM 3rd AM:MC, 2013; 4.NYSSA 67th PGA:MCC-7189, 2013; 5.ASA AM:MC-2201, 2015

Sleep Duration Among Adolescents with Chronic Pain

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Background: Chronic pain may contribute to poor sleep quality in adolescents, a relationship that may be mediated by symptoms of anxiety or depression.

General Aim: We used a population survey representative of adolescents in the US, to determine whether chronic pain was independently associated with inadequate sleep duration, even in adolescents without anxiety or depression.

Materials and Methods: This secondary analysis of de-identified survey data was exempt from IRB review. We identified adolescents age 13-17 years in the 2016 National Survey of Children's Health, which was completed by each child's caregiver. Adolescents were stratified according to whether their caregiver reported that they had frequent difficulty with chronic pain. Sleep duration was determined by caregiver reports of the number of hours of sleep the child gets on an average week night (<8 hours or ≥8 hours). Children were classified as having anxiety or depression if the caregiver reported 1) a health care provider had ever stated the child had the condition and 2) the child currently had the condition. Sleep duration was modeled using logistic regression, adjusted for adolescent and family characteristics, and weighted to account for non-equal probability of survey response.

Results: The analysis included 15,414 adolescents (59% female, age 15 ± 2 years), of whom 12% had chronic pain, 11% had anxiety, 6% had depression, and 30% had inadequate sleep. Among adolescents with chronic pain, 32% also had either anxiety or depression. On an average weeknight, 47% adolescents slept <8 hours in the group with chronic pain, compared to 28% among those without chronic pain ($p<0.001$). On multivariable analysis (**Table**), chronic pain was independently associated with shorter sleep duration (OR=2.1; 95% CI: 1.7, 2.7; $p<0.001$). While anxiety was weakly associated with shorter sleep duration (OR=1.4; 95% CI: 1.03, 1.8; $p=0.028$), depression was not (OR = 1.0; 95% 0.7, 1.4; $p=0.994$). Older age and African American race were associated with shorter sleep duration, while public insurance and a family income ≥400% of the federal poverty line were associated with longer sleep duration.

Discussion: In a national survey of adolescents in the US, chronic pain was associated with shorter sleep duration, even in adolescents without anxiety or depression. However, these results are limited by caregiver report of sleep duration and mental conditions.

Conclusions: Among adolescents, undertreated chronic pain may contribute to reduced sleep duration, regardless of mental health comorbidities.

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Table. Multivariable logistic regression model of inadequate sleep duration (N=15,414)

Characteristics[a]	OR	95% CI	P
Chronic pain	2.1	(1.7, 2.7)	<0.001
Female	1.0	(0.9, 1.2)	0.839
Age (years)	1.4	(1.3, 1.5)	<0.001
Caregiver concerned child's weight too high	1.1	(0.9, 1.4)	0.456
Race			
White	Ref.		
Black	1.9	(1.5, 2.5)	<0.001
Hispanic	1.1	(0.9, 1.4)	0.314
Other	1.3	(1.06, 1.7)	0.016
Family income			
<100% FPL	Ref.		
100-200% FPL	0.9	(0.7, 1.2)	0.595
200-400% FPL	0.8	(0.6, 1.1)	0.244
≥400% FPL	0.7	(0.5, 0.9)	0.019
Parental education			
High school or less	Ref.		
Some college	0.9	(0.7, 1.2)	0.421
Bachelor degree	0.8	(0.6, 1.0)	0.084
Higher education	0.9	(0.7, 1.2)	0.451
Insurance type			
Private	Ref.		
Public	0.8	(0.7, 0.96)	0.022
Other	1.3	(0.9, 2.0)	0.171
None	1.0	(0.7, 1.5)	0.960
Physical comorbidity			
Allergies	1.0	(0.9, 1.2)	0.721
Asthma	1.0	(0.8, 1.3)	0.825
Heart condition	0.8	(0.5, 1.4)	0.501
Other condition	0.9	(0.7, 1.2)	0.374
Mental comorbidity			
Anxiety	1.4	(1.03, 1.8)	0.028
Depression	1.0	(0.7, 1.4)	0.994
Other condition	0.9	(0.7, 1.1)	0.143

[a] Analysis also adjusted for state of residence (ORs not shown).
CI = confidence interval, FPL = federal poverty level, OR = odds ratio

The Epidemiology of Obstructive Sleep Apnea and Mild Cognitive Impairment: A Systematic Review and Meta-analysis

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Background: Mild cognitive impairment (MCI) is considered as the prodromal stage dissecting normal aging and the development of early dementia. A recent review demonstrated that between 14-59% of patients with MCI have sleep disturbances, including obstructive sleep apnea (OSA).[1] However, the true magnitude of OSA prevalence in patients with MCI is still unknown. This systematic review aimed to measure the burden of OSA in the MCI population.

Methods: The following electronic databases were searched for published and unpublished studies from their date of inception until May 1, 2018: Medline, PubMed, Embase, Cochrane Central, Cochrane Database of Systematic Reviews, PsychINFO, Scopus, the Web of Science, ClinicalTrials.gov and the International Clinical Trials Registry Platform. We included relevant studies on adults (age ≥18 years) with MCI (as diagnosed using any recognized diagnostic criteria) that reported on the prevalence of OSA in this population. We excluded studies if they included mixed population with neurodegenerative disorders such as dementia and if they defined sleep disorders other than OSA (e.g., central apneas). Only English language articles were included. The meta-analysis was performed using a random-effects model (to account for heterogeneity). A pooled prevalence and Odds Ratio (OR) with 95% confidence interval (CI) were calculated.

Results: The search resulted in a total of 11,264 records, leading to 170 articles being selected for full-text review. Four cross-sectional studies that documented the prevalence of OSA in MCI patients were selected for inclusion in the review.[2-5] OSA prevalence estimates ranged from 27% to 71%. Two studies used polysomnography (PSG) and an Apnea-hypopnea Index (AHI) cut-off ≥ 5 events/hour to diagnose OSA. One study included only moderate-to severe OSA (AHI ≥ 15) patients who were diagnosed using ApneaLink™, a home sleep testing device. Finally, one study included patients that were high risk for sleep apnea on the Berlin Questionnaire. The general criteria, among the four studies, for MCI diagnosis was cognitive decline not normal for age that did not fulfill a dementia diagnosis with essentially preserved functional activities of daily living. To get an accurate prevalence estimate, we did a meta-analysis on the two studies that utilized PSG and had an OSA population with an AHI ≥ 5.[4,5] These two cross-sectional studies had similar patient characteristics with respect to age, BMI, AHI, OSA and MCI diagnosis criteria. The pooled prevalence of OSA in MCI was 70% (95% CI: 57-82, no significant heterogeneity, see Figure 1A). Two[4-5] of the four studies included complete data of a cognitively

normal control population, allowing for calculation of the OR. The pooled analysis of the 2 cross-sectional studies indicated that the odds of OSA was similar in patients with and without MCI (OR, 1.06; 95% CI, 0.47-2.41, no significant heterogeneity, Figure 1B).

Conclusions: Based on the limited evidence from two studies the prevalence of OSA in patients with MCI is quite high, 70%. We did not find an association between MCI and OSA. Prospective cohort studies are needed to evaluate the risk of developing MCI in patients with treated and untreated OSA.

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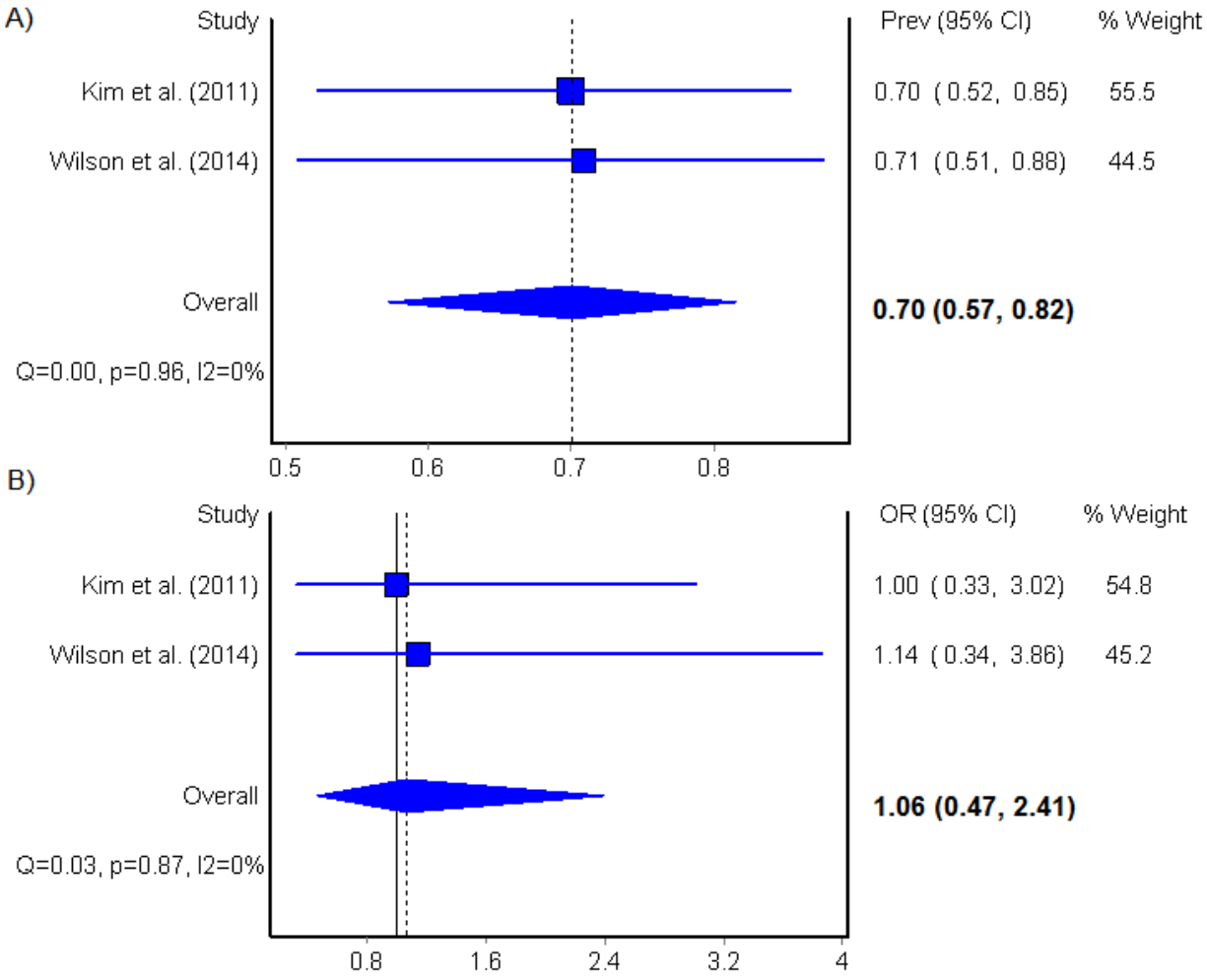

Figure 1. Forrest plots of cross-sectional studies showing A) the pooled prevalence of OSA in MCI (70%; 95% CI, 57-82; I^2=0%) and B) the association between MCI and risk of OSA (OR, 1.06; 95% CI, 0.47-2.41; I^2=0%, p=0.87. All effect estimates were pooled using a weighted random-effects model.

Risk Factors for Obstructive Sleep Apnea during Pregnancy: A Meta-analysis

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Background: Gestational obstructive sleep apnea (GOSA) is associated with increased risk of maternal and fetal morbidities. GOSA has gained increasing attention as these morbidities may be preventable by identifying risk factors for GOSA. There may be multiple risk factors which may not be applicable to all trimesters of pregnancy due to its dynamic nature. At present, no screening tool has been validated to identify patients with high-risk OSA during pregnancy.[1]

Objective: We conducted this meta-analysis to evaluate the risk factors associated with high-risk OSA during pregnancy.

Methods: The analysis was planned in accordance with the MOOSE (Meta-analysis Of Observational Studies in Epidemiology) guideline for non-randomized studies. A literature search of Medline, Medline In-process, Web of Science, Scopus, EMBASE, Cochrane Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials, and CINAHL up to October 2017 was conducted. The search was restricted to (1) cohort controlled studies in adult pregnant population who were screened as high-risk OSA or diagnosed as OSA by polysomnography; (2) All included studies in the English language must report at least one risk factor (i.e. either demographic, medical comorbidity or symptomatic risk factor) for both OSA and non-OSA patients. Studies not satisfying the inclusion criteria were excluded. Odds ratios and weighted Mean Differences (MD) were calculated for each risk factor. The quality of the studies was assessed using the Newcastle Ottawa Scale Scoring system. Statistical analysis was conducted using Cochrane Review Manager 5.3.

Results: Twelve comparative studies were included in the final analysis (n=7,232 patients; OSA vs. non-OSA: 1,266 vs. 5,966) (Table 1). The prevalence of OSA during pregnancy in this meta-analysis was 17%. Patients were from II and III trimesters of pregnancy. Among the demographic questionnaires, we identified that pre-pregnancy Body Mass Index (BMI) (MD: 5.9; 95% CI: 2.3 – 9.4; I^2: 95%; P=0.001), BMI during pregnancy (MD: 6.8; 95% CI: 2.3 – 11.3; I^2: 88%; P=0.003), weight during pregnancy (MD: 16.0; 95% CI: 1.5 – 30.5; I^2: 93%; P=0.03), and neck circumference (NC) (MD: 3.2; 95% CI: 2.0 – 4.5; I^2: 93%; P<0.00001) were the important risk factors associated with GOSA. Among the comorbidities, the risk factors were hypertension (OR: 3.18, P<0.000001), pre-eclampsia/eclampsia (OR 2.63, P<0.00001), asthma (OR: 3.85, P<0.00001) and history of smoking (OR: 1.16, P<0.02). Among the symptoms, snoring (ever, loudness, frequency), feeling tired and witnessed apnea had the elevated odds of GOSA (Table 1). The mean Apnea Hypopnea Index (AHI) is nine times higher and mean Oxygen Desaturation Index (ODI) is nearly five times higher in OSA group compared to non-OSA group. The lowest

oxygen desaturation in the OSA group was 85% compared to 91% in the non-OSA group (Table 1). The gravidity and parity of pregnancy did not show any significant difference between the OSA and non-OSA groups.

Conclusion – Our meta-analysis identified several risk factors associated with GOSA during pregnancy. The demographic risk factors are prepregnancy & pregnancy BMI, weight gain during pregnancy and neck circumference. The risk factors in comorbidities are hypertension, preeclampsia/eclampsia and history of smoking. As per symptoms, snoring (loudness, frequency, elbowing), feeling tired and witnessed apnea are the important risk factors. This information may be useful to develop new GOSA screening tool to identify suspected OSA during pregnancy.

References

1. Curr Opin Anaesthesiol 2016;29:317–24.

Table 1: Pooled data regarding risk factors associated with high risk-OSA during pregnancy

Parameters	Studies	Odds Ratio	95% CI
Symptoms			
Snore ever	3	2.8	1.5 – 5.2
Loud Snoring	2	18.4	1.0 – 329.7
Frequency Snoring	3	4.5	2.5 – 8.1
Tiredness	2	1.6	0.3 – 8.1
Observed apnea	2	14.5	4.3 – 48.8
Choking sensation	1	2.6	1.1 – 6.0
Frequent arousal from sleep	1	3.5	1.0 – 12.0
Demographic data			
#High BMI	6	6.8	2.3 – 11.3
#Neck circumference	3	3.2	2.0 – 4.5
At-risk pregnant population			
*Hypertension	10	3.1	1.9 – 5.1
*Preeclampsia/eclampsia	9	2.6	1.8 – 3.8
*Diabetes mellitus	9	1.9	1.0 – 3.3
Data on AHI & ODI			
Apnea Hypopnea Index	4	MD: 9.8	6.2 – 13.3
Oxygen Desaturation Index	3	MD: 4.9	2.5 – 7.3

AHI: Apnea hypopnea index; *Hypertension, preeclampsia and diabetes mellitus are at-risk pregnant population for high pretest probability of gestational OSA; #High BMI and Neck circumference are significant and consistently predictors of gestational OSA; MD: Mean Difference; ODI: The Oxygen Desaturation Index.

Risk Factors for Opioid Induced Respiratory Depression in Surgical Patients: A Systematic Review and Meta-Analyses

Presenting Author: Mahesh Nagappa
Co-Authors: Kapil Gupta, Arun Prasad, Lusine Abrahamyan, Jean Wong, Toby Weingarten, Frances Chung

Background: Post-operative opioid induced respiratory depression (OIRD) is one of the important iatrogenic cause of serious morbidity and mortality in the perioperative period.[1] The death and brain damage from OIRD may be easily preventable by better monitoring and identifying the potential risk factors.

Objective: This systematic review and meta-analysis was conducted to evaluate the risk factors associated with post-operative OIRD.

Methods: A systematic literature search was performed on postoperative OIRD in adult patients of the following databases from 1947 to November 2017: PubMed-MEDLINE, MEDLINE in-process, EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, PubMed and Clinicaltrials.gov. The inclusion criteria were: 1) adult patients (≥18 years) who were administered opioids after surgery and developed post-operative OIRD (OIRD group); 2) all studies which reported both OIRD events and predictive or associated risk factors 3) all studies with reported data for each risk factor on patients with no OIRD (control group); and 4) published articles in English language We used a random-effects inverse variance analysis to evaluate the existing evidence of risk factors associated with OIRD. Meta-analysis was conducted using Cochrane Review Manager 5.3.

Results: A total of 8,690 citations were screened, and 12 studies were included. The quality of the studies was evaluated by Newcastle Ottawa scale scoring system which varied from 5 to 9. The incidence of post-operative OIRD was 5.0 per 1,000 anesthetics (OIRD: 4,194; total patients: 841,424, 95% CI: 4.8-5.1). Eighty-five percent of OIRD occurred within the first 24 hours after surgery. Increased risk for OIRD were associated with pre-existing cardiac disease (OIRD vs. control: 42.8% vs. 29.6%; OR:1.7; 9% CI:1.2-2.5; I^2: 0%; P < 0.002), pulmonary disease (OIRD vs. control: 17.8% vs. 10.3%; OR: 2.2; 95% CI: 1.3-3.6; I^2: 0%; P < 0.001) and obstructive sleep apnea (OIRD vs. control: 17.9% vs. 16.5%; OR: 1.5; 95% CI: 1.2-1.8; I^2: 50%; P=0.0005). The morphine equivalent dose (MED) of post-operative opioids was higher in OIRD group than control group (OIRD vs. control: 24.6±14 mg vs 18.9±13.0 mg; MD: 1.69; 95% CI: 0.6-2.7; I^2: 81%; P = 0.002) (Figure). There was no significant difference in the length of hospital stay between the two groups.

Conclusion: This systematic review and meta-analysis demonstrated that patients with cardiac disease, pulmonary disease and obstructive sleep apnea were at increased risk for OIRD. Patients with OIRD received higher postoperative morphine equivalent doses. This information can be used to develop monitoring strategies to mitigate OIRD risk.

Reference

1. Anesth Analg 2005;100:162–8.

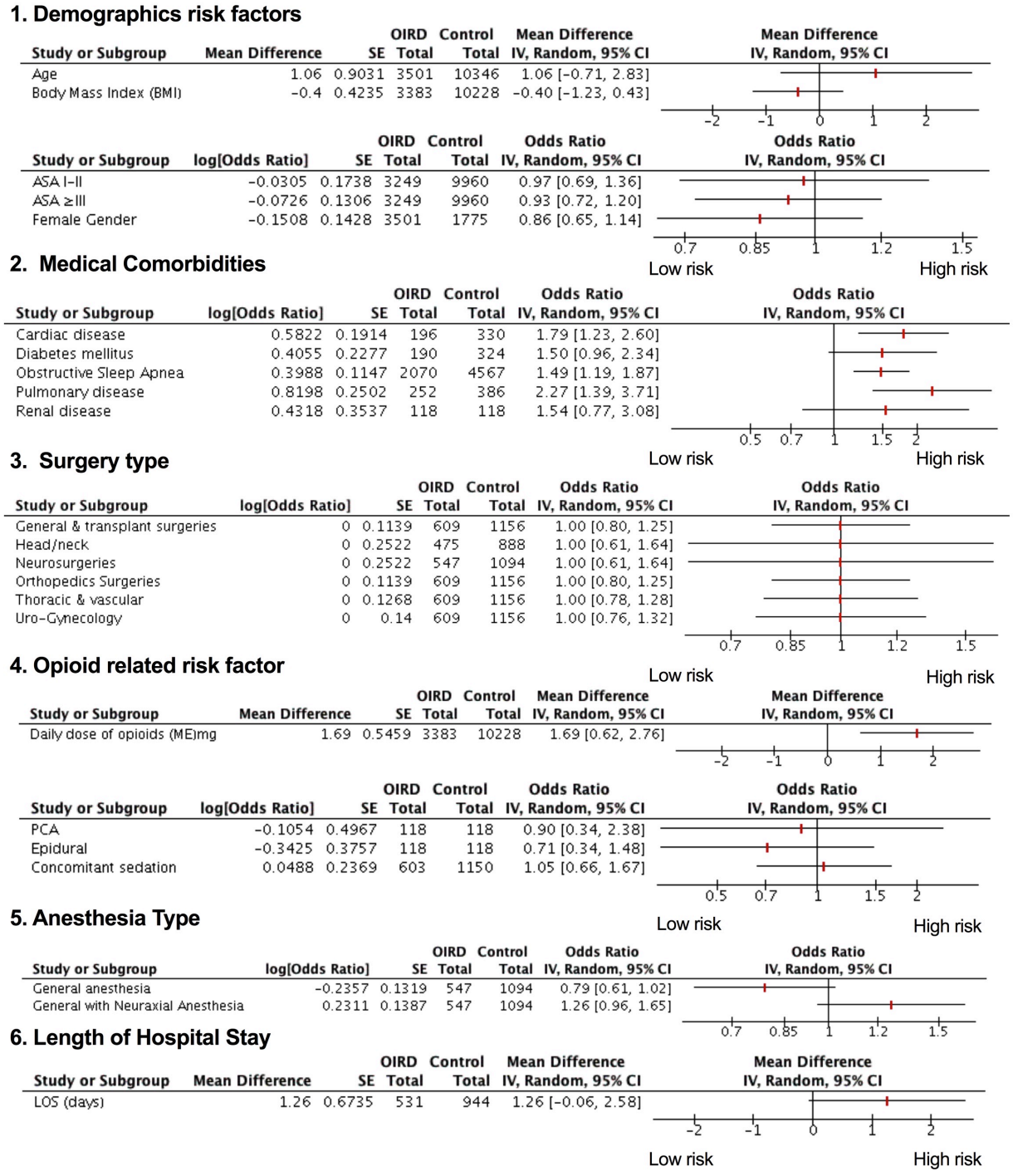

Figure 1 – Meta-analysis evaluating the risk factors for respiratory events between OIRD and control groups in patients undergoing surgery.

Utility of Reaction Time Assessment in Children with Sleep-Disordered Breathing

Presenting Author: Mohammed Hakim, MBBS
Co-Authors: Shabana Z. Shafy, M.B.B.S, Dmitry Tumin Ph.D; Joseph D. Tobias, MD; Vidya T. Raman, MD.

Introduction: The incidence of obstructive sleep apnea (OSA) and sleep-disordered breathing (SDB) among children exceeds the availability of polysomnography (PSG) to definitively diagnose OSA and identify patients at higher risk of perioperative complications. As sleep deficits are associated with slower reaction times (RTs), measuring RT may be a cost-effective option to determine presence of SDB. The current study compares RT between children with and without caregiver-reported SDB.

Materials and Methods: Following Institutional Review board approval. Children ages 6-11 years were enrolled in 2 study groups. The SDB group included children undergoing adenotonsillectomy with a noted history of SDB, OSA, or snoring. The control group included children undergoing any procedure other than tonsillectomy or adenoidectomy, with no noted history of SDB, OSA, or snoring. RT was measured via a 10 minute psychomotor vigilance test (PVT, Ambulatory Monitoring Inc., NY), where patients were asked to press a button as quickly as possible in response to a visual stimulus randomized to appear every 2-10 seconds. The primary outcome was the median RT during the trial period, which was compared to age-gender-specific published norms. Neck circumference (NC), body mass index (BMI), and caregiver-reported SDB symptoms were also measured. Categorical data were compared by group (SDB vs. control) using Chi-square tests, and continuous data were compared using rank-sum tests.

Results: The study cohort included 50 patients in the SDB group and 30 patients in the control group. Patient characteristics and PVT performance are summarized in the **Table**. There were 26 patients in the SDB group (52%) exceeded median RT norms compared to 13 of 30 controls (43%; 95% confidence interval [CI] of difference: -31%, 14%; p=0.453). When evaluating continuous RT data, there was no significant difference between the SDB group (median = 417 ms; interquartile range [IQR]: 352, 525) and the control group (median = 454 ms; IQR: 388, 556; 95% CI of difference: -30, 87; p=0.299). Children in the SDB group were older, had higher BMI, and had larger NC than the control group. Children in the SDB group were more likely to have caregiver-reported symptoms of SDB and to exceed BMI norms. Commonly reported symptoms in the SDB group included frequent snoring, loud breathing, breathing through the mouth, and not waking up feeling refreshed.

Discussion: Approximately half of the patients in both groups exceeded published norms for RT on PVT. Therefore, the use of RT alone may be insufficient to add risk stratification when the presence and severity of OSA or SDB are uncertain. By contrast, overweight according to BMI and caregiver-reported SDB symptoms appeared to differ significantly according to presence of SDB.

References :

1. Paed Anesth 2016;26:655-664.
2. International Journal of pediatric otolaryngology 2016;91:43-48.

Table. Patient characteristics according to history of sleep disordered breathing, obstructive sleep apnea, or snoring

	SDB (N=50)	**Controls (N=30)**	P
	N (%) or Median (IQR)	N (%) or Median (IQR)	
Patient characteristics			
Female	23 (46%)	17 (57%)	0.356
Age (years)	8 (7, 9)	6 (6, 8)	0.009
BMI (kg/m2)	21 (16, 26)	17 (15, 18)	0.003
Exceeds BMI norm	29 (58%)	3 (11%)	<0.001
NC (cm)	31 (28, 34)	28 (27, 29)	<0.001
Exceeds NC norm	32 (64%)	16 (53%)	0.346
PVT performance			
Mean RT	495 (386, 716)	551 (448, 756)	0.292
Exceeds mean RT norm	22 (44%)	10 (33%)	0.346
Median RT	417 (352, 525)	454 (388, 556)	0.299
Exceeds median RT norm	26 (52%)	13 (43%)	0.453
Caregiver-reported symptoms			
Snores more than half the time	44 (92%)	1 (3%)	<0.001
Always snores	32 (67%)	0 (0%)	<0.001
Snores loudly	34 (71%)	1 (3%)	<0.001
Has “heavy” or loud breathing	39 (91%)	1 (3%)	<0.001
Has stopped breathing during the night	12 (28%)	0 (0%)	0.002
Breathes through the mouth	38 (83%)	7 (32%)	<0.001
Has dry mouth in the morning	35 (83%)	5 (20%)	<0.001
Wakes up feeling not refreshed	29 (63%)	5 (17%)	<0.001
Has problem with sleepiness during the day	25 (56%)	4 (13%)	<0.001
Teacher has commented child appears sleepy during the day	10 (22%)	1 (3%)	0.023
Hard to wake up in the morning	25 (50%)	8 (27%)	0.040
Wakes up with headaches	13 (27%)	1 (3%)	0.008
Overweight	20 (43%)	1 (3%)	<0.001
Snores at least 3 times a week	45 (94%)	4 (17%)	<0.001

BMI = body mass index, IQR = interquartile range, NC = neck circumference, PVT = psychomotor vigilance test , RT = reaction time, SDB = sleep disordered breathing

A Novel Modified Pediatric Mask Provided Continuous Active Nasal Oxygenation in an Obese Patient with OSA, Micrognathia and Difficult Airway during General Anesthesia Induction and Post-Extubation Airway Obstruction

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Background: Patients who have difficult airway often receive topical anesthesia, intravenous sedation and O_2 via nasal cannula (NC), fiberoptic bronchoscope (FOB), or endoscopic face mask during awake/sleep FOB or video laryngoscopic (VL) endotracheal intubation (ETI).

A simple nasal PAP mask assembly has been shown to improve oxygenation by maintaining spontaneous ventilation and allowing immediate assisted nasal ventilation in obese patients with OSA under sedation or in patients with difficult airway during awake/sleep ETI (1-4). We used a modified infant mask in an obese patient with OSA, micrognathia, and difficult airway to provide nasal mask oxygenation during general anesthesia induction and post-extubation airway obstruction.

Case Description: A 70-year-old female, 5'2", 161 lbs, BMI 30.5kg/m^2 with OSA, non-compliant with nocturnal facial CPAP support due to claustrophobia, presented for outpatient robotic-assisted laparoscopic hysterectomy.

She had a small jaw, a small mouth, a Mallampati Class IV airway, 3cm mouth opening and a short neck.

In the pre-operative area, patient was fitted with a modified infant mask (size #2) with fully inflated air cushion. The patient was then pre-treated with 2mg midazolam and transported to the OR. The modified infant mask was secured over her nose with elastic head straps and connected to an anesthesia breathing circuit. The APL valve was adjusted to deliver 5-6cm H_2O CPAP with 4L/min O_2 flow.

Following nasal mask CPAP pre-oxygenation, her SpO_2 increased from 96% to 100% and her ETO_2 was 98%. GA was induced slowly with 100mcg fentanyl, 100mg lidocaine, and 150mg propofol. Rocuronium 50mg was given after her ventilation was easily supported with pressure-controlled (PC) ventilation (PIP 13cm H_2O, PEEP 5cm H_2O, and RR 20/min). Endotracheal intubation was challenging because of her small mouth opening, but was accomplished with video-laryngoscopy. She received continuous PCV and oxygenation throughout intubation and maintained 99% SpO_2 and stable hemodynamics. She tolerated the surgical procedure and was extubated while awake.

An adult face mask was secured over her nose and mouth after extubation. Despite receiving facial CPAP with high flow O_2 (12L/min), her airway was obstructed and her SpO_2 decreased

from 99% to 88% in <3 min. The face mask was replaced with the modified nasal mask and she was supported with nasal BiPAP using PC ventilation (PIP 14cm H_2O, PEEP 5cm H_2O, RR 10/min). Her SpO_2 increased from 88% to 98% in 1 min. The patient was transported to the PACU with NC O_2 and a face tent(1) after 6 minutes with no further complications.

Discussion: This simple modified nasal PAP mask assembly provided CPAP pre-oxygenation, PC nasal ventilation, active oxygenation during VL intubation, and post-extubation BiPAP in an obese patient with OSA and difficult airway. It takes two minutes to modify a teardrop shaped pediatric face mask to a rounded triangular-shaped nasal mask that would fit an adult nose. It may improve patient safety at a very low cost.

Case reports are IRB-exempted. This patient gave her consent for taking photography and case report.

References:1.www.TSEMask.com; 2.SAMBA 28th AM, April 2013; 3.SASM 3rd AM:P27, 35 & 43, Oct 2013; 4.ASA 2014 AM, MC39, MC43, MC188, MC208


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Impact of Obstructive Sleep Apnea Screening on the Utilization of PACU and CPAP Prescription, and Requirement of Postoperative Mechanical Ventilation

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Background: In 2006, the National Patient Safety Goals of the Joint Commission suggested that hospitals develop preoperative screening protocols for managing patients with diagnosed or potential obstructive sleep apnea (OSA) (1). Thus, several institutions established screening instruments such as the STOP (2)/-BANG (3).
At the Beth Israel Deaconess Medical Center (BIDMC) in Boston, we developed the BOSTN screening tool and incorporated it into routine clinical practice in May 2008, comprising:

- **B**MI $\geq$ 30 kg/m^2
- **O**bserved apnea
- loud **S**noring
- daytime **T**iredness and
- **N**eck circumference $\geq$ 16.5in in females or $\geq$ 17.5in in males

A point value of $\geq$ 2 was defined as high OSA risk. At BIDMC, BOSTN is preoperatively applied by nurses. Patients with high OSA risk are then flagged in the medical record, and electronic decision support options are provided to clinicians.

General Aim: We hypothesized that BOSTN $\geq$ 2 is associated with increased requirement of postoperative mechanical ventilation within 7 days after surgery (primary). We also tested the secondary hypothesis that clinicians treat patients with BOSTN $\geq$ 2 more often with non-invasive ventilation and observe them in the PACU for a longer time.

Materials and Methods: IRB approval was obtained from the Institutional Review Board at BIDMC (protocol number: 2012P000388), with informed consent waived. We included 187,291 adult patients undergoing non-cardiac surgery at BIDMC between 2008-2017. Patients with an ASA classification of 6, being transferred to an ICU immediately after surgery or undergoing multiple surgical procedures in one day were excluded (Table 1). Our multivariable logistic and negative binomial regression models included an a priori defined confounder model adjusting for patient demographics, comorbidities and intraoperative factors.

Results: In our cohort 35,450 (18.9%) patients were categorized high risk of OSA with the BOSTN screening. Clinicians provided immediate postoperative CPAP more frequently, and observed patients in the PACU for a longer time if patients were flagged as high-risk of OSA (OR 1.57, 95% CI 1.48-1.67, p<0.001, and IRR 1.07, 95% CI 1.07-1.08, p<0.001, respectively). Accordingly, patients with the dichotomized exposure BOSTN $\geq$ 2 showed lower odds for postoperative mechanical ventilation (aOR 0.85, 95% CI 0.77-0.94, p=0.001). Only 642 (1.81%) high-risk patients required mechanical ventilation within 7 days after surgery. The effect was robust in several sensitivity analyses including those focused on documented

reintubations after OR discharge. Additionally, patients with BOSTN $\geq$ 2 were discharged earlier (aIRR 0.9, 95% CI 0.89-0.91, p<0.001).

Conclusion: Patients at high risk of OSA identified by routine preoperative OSA screening, receive CPAP therapy more frequently, and stay longer in the PACU. Based on these interventions, their respiratory complication and hospital utilization rates are lower compared to patients without high OSA risk.

References:

(1) JCAHO 2006 recommendation of National Patient Safety Goals, published Dec 8 2006
(2) Anesthesiology. 2008 May;108(5):812-21.
(3) Br J Anaesth. 2012 May;108(5):768-75.

Table 1 | Characteristics of study population*

Characteristics	BOSTN Score < 2 (n=151,841)	BOSTN Score ≥ 2 (n=35,450)
Body mass index, kg/m^2	26.63 ± 5.91	34.13 ± 6.60
BMI ≥ 30kg/m^2	26,392 (17.4%)	27,955 (78.9%)
Observed apnea	331 (0.2%)	5,578 (15.7%)
Snoring	31,666 (20.9%)	30,290 (85.4%)
Daytime Tiredness	1,947 (1.3%)	6,385 (18.0%)
Neck Circumference >17.5in (males) / >16.5in (females)	954 (0.6%)	14,618 (41.2%)
Gender, male	61,311 (40.4%)	16,317 (46.0%)
Age, years	53.87 ± 17.25	55.26 ± 14.64
ASA Classification	2.00 (2.00, 3.00)	2.00 (2.00, 3.00)
Charlson Comorbidity Index [1]	1.00 (0.00, 2.00)	1.00 (0.00, 3.00)
Duration of surgery (minutes)	80.25 ± 78.26	90.2 ± 85.06
Work Relative Value Unit	11.24 ± 8.27	12.18 ± 8.44
SPORC^ Score [2] ≥ 7	4,830 (3.2%)	1,092 (3.1%)
High Risk Surgical Service	52,164 (34.4%)	12,554 (35.4%)
ASA Emergency Status	6,411 (4.2%)	1,003 (2.8%)
Fluids in ml	2,000 (1,250, 3,000)	2,500 (1,300, 3,500)
Packed Red Blood Cell Units	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
Long-acting Intraoperative Opioids (oral morphine equivalents), mg	0.00 (0.00, 13.60)	0.00 (0.00, 17.00)
Short-acting Intraoperative Opioids (oral morphine equivalents), mg	25.00 (0.00, 37.50)	25.00 (0.00, 50.00)
NMBA Total Equivalents, mg	0.00 (0.00, 166.67)	0.00 (0.00, 200.00)
MAC for Volatiles and Nitrous	0.72 ± 1.17	0.78 ± 0.51
Intraoperative Neostigmine Dose, mg	0.00 (0.00, 3.00)	0.00 (0.00, 3.00)
Total intraoperative vasopressor dose (norepinephrine equivalent), mg	0.00 (0.00, 0.02)	0.00 (0.00, 0.03)
Median PEEP	3.00 (2.00, 5.00)	4.00 (2.00, 5.00)
Median Endtidal Volume, ml	335.13 ± 260.13	387.02 ± 276.92
Median FiO_2	51.00 (0.00, 61.00)	52.00 (0.00, 61.00)
Mean Intraoperative SpO_2	99 (98, 100)	98 (97, 99)

* Values provided as frequency (prevalence in %), mean ± standard deviation, or median [interquartile range (25^{th}-75^{th} Percentile), values separated by comma]. ^ Score for Prediction of Postoperative Respiratory Complications.

[1] Charlson et al., Journal of chronic diseases, 1987.
[2] Brueckmann et al., The Journal of the American Society of Anesthesiologists, 2013.

Respiratory Depression Following Ambulatory Urological and Gynecological Procedures: A Retrospective Analysis

Presenting Author: Sinokuthaba L Sibanda, BSN
Co-Authors: Bhargavi Gali, MD; Sarah R Gritzner, BSN; Amy J Henderson, BSN; Toby N Weingarten, MD

Introduction: Postprocedural respiratory depression has not been well characterized in patients undergoing uro-gynecological procedures in ambulatory surgical centers (ASC).[1] There are concerns about the safety of performing these procedures in ASCs among patients with obstructive sleep apnea (OSA).[1] We assess the rate of this complication and test for potential associations with clinical characteristics.

Methods: Medical records of patients undergoing uro-gynecological procedures at our ASC from July 1, 2010 to December 31, 2015 were abstracted. Cases of postoperative respiratory depression using established clinical criteria were identified, and risk factors were assessed with multivariable analysis.[2]

Results: During the study timeframe, 9,141 patients underwent procedures, of which 1,174 (12.8%) had OSA. Respiratory depression complicated 221 procedures, yielding a rate of 2.4, 95%CI 2.1 – 2.8, per 100 cases (158 documented desaturations, 58 hypoventilation, 57 apnea, and 38 pain-sedation mismatch). Risk increased with male sex (odds ratio 4.65, 95%CI 2.85 – 7.61, P<0.001, OSA (OR 3.92, 95%CI 2.88 – 5.32, P<0.001), morbid obesity (OR 1.97, 95%CI 1.26 – 3.08, P=0.003), and advancing age (OR 1.21, 95%CI 1.06 – 1.37, per decade of life, P=0.004) (Table). The rates of respiratory depression varied by procedure type, with higher rates in male-specific procedures (prostate procedures) and lower rates in female-specific procedures (gynecological procedures) (P<0.001). Patients with respiratory depression had longer anesthesia recovery, 135 [110, 166] vs. 105 [80, 138] minutes, P<0.001. There were 290 emergency room visits and/or hospitalization within 48 postprocedural hours, but risk for this escalation of medical care was not increased by respiratory depression (OR 2.34, 95%CI 0.86 – 6.33, P=0.095) or OSA (OR 1.79, 95%CI 0.89 – 3.62, P=0.103). Only one patient was admitted for postoperative respiratory depression, a frail elderly woman with preexisting OSA who had apnea during anesthesia recovery. There were 11 deaths within 30 days, 9 cases related to cancer, one case of pulmonary embolism 2 weeks after procedure, and one unknown cause 3 weeks after the procedure. None of these occurred in patients who had postoperative respiratory depression.

Conclusion. Postprocedural respiratory depression following uro-gynecological procedures performed at an ASC was 2.4 *per* 100 cases; however, the clinical impact of this complication appears to be low in our outpatient setting.

References:

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2. Gali B, Whalen FX, Schroeder DR, Gay PC, Plevak DJ. Identification of patients at risk for postoperative respiratory complications using a preoperative obstructive sleep apnea screening tool and postanesthesia care assessment. Anesthesiology. 2009;110:869-77.

Table. Respiratory Depression during Anesthesia Recovery Following Ambulatory Uro- gynecological Procedures.

	Respiratory depression N = 221	No respiratory depression N = 8,920	P	Odds Ratio, (95%CI)	P
Patient Characteristic					
Age, years	65.6 ± 12.1	58.4 ±16.7	<0.001	1.21 (1.06, 1.37)*	0.004
Male sex	191 (86.4)	4,713 (52.8)	<0.001	4.65 (2.85, 7.61)	<0.001
Morbid obesity†	31 (14.0)	489 (5.5)	<0.001	1.97 (1.26, 3.08)	0.003
Obstructive sleep apnea	100 (45.2)	1,074 (12.0)	<0.001	3.92 (2.88, 5.32)	<0.001
Cardiovascular Disease	42 (19.0)	758 (8.5)	<0.001	1.21 (0.82, 1.79)	0.739
Diabetes	62 (28.7)	1,017 (11.8)	<0.001	1.34 (0.96, 1.87)	0.085
Pulmonary Disease	28 (12.7)	961 (10.7)	0.380	0.78 (0.50, 1.21)	0.261
Home opioids	132 (59.7)	4,063 (45.6)	<0.001	1.13 (0.83, 1.52)	0.442
Home benzodiazepine	18 (8.1)	811 (9.1)	0.722	0.86 (0.51, 1.45)	0.569
Surgical Characteristic					
Duration, minutes	40 [23, 69]	25 [15, 50]	<0.001	0.98 (0.94, 1.03)*	0.457
Anesthetic Characteristics					
Airway management			<0.001		
Native airway	18 (8.1)	2,194 (24.6)		REF	
Secured airway	203 (91.9)	6,726 (75.4)		3.14 (1.84, 5.36)	<0.001
Volatile maintenance	129 (58.4)	3,713 (41.6)	<0.001	1.42 (1.04, 1.93)	0.027
Medications					
Opioids, IVME	11.7 [10, 16.7]	10 [5, 13.3]	<0.001	1.70 (1.30, 2.21)*	<0.001
Midazolam	17 (7.7)	742 (8.3)	0.902	1.36 (0.77, 2.38)	0.289
Ketamine	53 (24.0)	2,091 (23.4)	0.872	1.31 (0.91, 1.89)	0.142
NDMR	17 (7.7)	679 (7.6)	0.898	0.98 (0.56, 1.71)	0.937
Ketorolac	30 (13.6)	2,681 (30.1)	<0.001	1.03 (0.63, 1.69)	0.909

Abbreviations: IVME = intravenous morphine equivalents, NDMR = nondepolarizing muscle relaxant.

*Per increment of 10 units. †Morbid obesity is defined as body mass index ≥ 40 kg/m^2.

Cost-Utility Analysis of Pre-Operative Screening Strategies for Obstructive Sleep Apnea Among Patients Undergoing Major Elective Non-Cardiac Surgery

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Background : Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder that is associated with increased risk of postoperative and long-term complications, with potential impact on resource utilization (1). Although guidelines recommend preoperative screening for OSA, balancing cost and resources with diagnostic accuracy can be challenging. The gold-standard polysomnography (PSG) has a high diagnostic accuracy but is resource-intensive; validated screening questionnaires, such as STOP-BANG (SB) are inexpensive and easy to administer but exhibit diagnostic inaccuracies; a more cost-effective alternative may be level 3 portable monitors (PM), which have acceptable diagnostic accuracy but have not been examined in the perioperative context (2,3). There is no consensus on recommended screening protocol (2) and conducting a prospective study to examine this effect is both costly and resource intensive.

General Aim: Our objective was to evaluate the cost-utility of preoperative OSA screening strategies among adults undergoing major elective non-cardiac surgery.

Materials and Methods : We compared four screening strategies: *(i) No Screening; (ii) Screening with SB; (iii) SB with PM (SB+PM) if SB+; (iv) SB with PSG (SB+PSG) if SB+.* An individual-level Markov model with monthly cycles was constructed to evaluate the cost-utility of candidate screening strategies from the hospital perspective over a lifetime horizon. The base case was modeled after a cohort of patients who underwent major elective non-cardiac surgery (4). Institutional research ethics requirements were waived as no patient-level data was utilized. Diagnostic properties of *SB, PM* and *PSG* were obtained, and probabilities of OSA were estimated (3). Perioperative OSA treatment was instituted in all screen-positive patients, while long-term treatment was adjusted to time to definitive diagnosis and treatment compliance. Postoperative and long-term complication risks were modeled according to OSA and treatment status. Costs were considered from the hospital perspective. The costs of surgery, diagnosis and treatment for OSA, and complications were obtained from the Ontario Case Costing Analysis Tool, in a single-payer universal health care system in Ontario, Canada. The probabilities of postoperative and long-term complications, and associated utilities, were obtained by a structured literature search (1,5). The primary outcome was the cost in 2016 Canadian dollars per quality-adjusted life-year (QALY).

Results: From the hospital perspective, *No Screening* was the least costly ($11196) and least effective (18.7 QALY) strategy, while *SB* was costliest ($11986) and most effective (19 QALY) over a patient's lifetime. Compared to *No Screening*, each of *SB+PM* and *SB+PSG* were costlier

($11439 and $11464, respectively) but also more effective (18.80 and 18.93 QALY, respectively). Every screening strategy was cost-effective compared with No Screening at the $50,000/QALY threshold. In probabilistic sensitivity analyses, *SB* was the favored strategy in 68.4% of iterations at the $50,000/QALY willingness to pay threshold (FIGURE 1).

Discussion and Conclusions : In this first examination of cost-utility of OSA screening strategies, preoperative screening using any strategy was cost-effective compared with No Screening. Among the screening strategies, *SB* exhibited greatest cost-utility, followed by *SB+PSG* and *SB+PM*. Findings from our study will inform key stakeholders in formulating evidence-based perioperative clinical pathways for patients with OSA.

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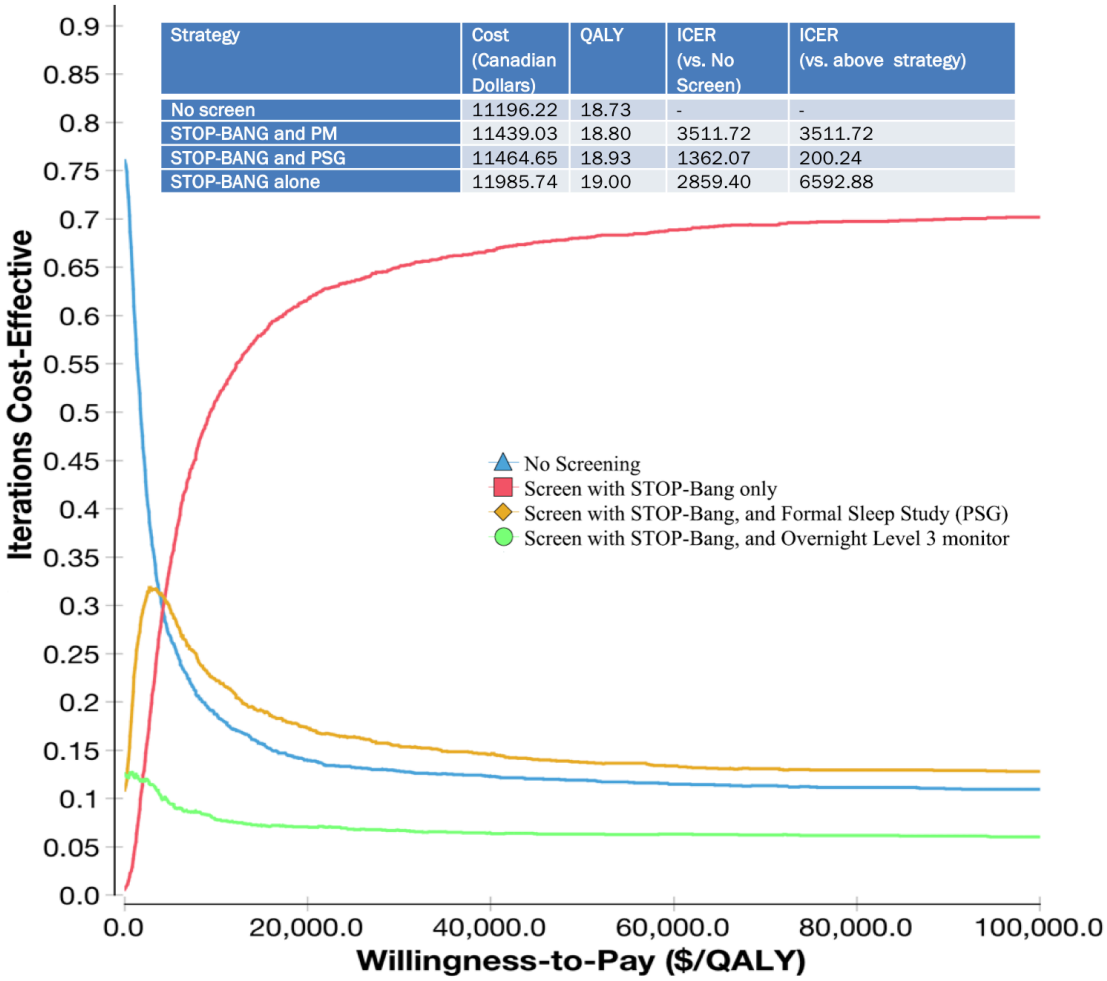

ICER: Incremental Cost-Effectiveness Ratio, PM: Portable Monitor; PSG: Polysomnography; QALY: Quality-adjusted life-years

FIGURE 1: Cost effectiveness acceptability curve indicating the proportion of iterations each screening strategy was cost effective at varying willingness-to-pay (WTP) thresholds. Above a WTP of approximately $4,000/QALY, STOP-BANG only (red) was the preferred strategy.

A Novel Modified Pediatric Face Mask Provided Nasal CPAP and Maintained Spontaneous Ventilation and Oxygenation in a Morbidly Obese Patient with Severe Orthopnea and OSA during Hysteroscopy and D&C under Spinal Anesthesia

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Background: Patients under monitored anesthesia care or regional anesthesia often receive IV sedation and O_2 via nasal cannula. Over-sedation and/or airway obstruction may cause oxygen desaturation, especially in obese patients with obstructive sleep apnea (OSA). A simple nasal PAP mask assembly using a pediatric face mask has been shown to maintain spontaneous ventilation and oxygenation in sedated patients(1-5). We used a modified pediatric face mask to provide nasal CPAP in a morbidly obese patient with severe orthopnea/OSA under spinal anesthesia.

Case Description: A 56 y/o female, 5'4", 273lbs, BMI 47kg/m^2, with HTN, NIDDM, hypothyroidism, severe orthopnea, OSA on home CPAP, asthma and herniated disc at C5-C6 presented for hysteroscopy and D&C. She was very concerned about anesthesia because of prior anesthesia related complications. She reportedly had “a near respiratory arrest” under propofol sedation during colonoscopy and required assisted face mask ventilation resulting in vomiting and aspiration pneumonitis. She also reported developing post-extubation respiratory failure requiring re-intubation during knee arthroscopy.

Her airway exam was Mallampati IV with limited range of neck motion and thyromental distance <7cm. To avoid post-puncture headache, spinal anesthesia was initially attempted with a 25G pencil-point needle in sitting position. However, it was difficult due to lack of landmark and calcification. She developed vasovagal reaction with lightheadedness, bradycardia (HR of 40-50) and stable BP. She was positioned to LLD and received 2 mg of midazolam. After her symptoms were resolved, spinal was successfully performed in LLD with 22G spinal needle at L3-L4 with 0.75% bupivacaine x1.6 cc.

An infant mask with a fully inflated air cushion was secured over her nose with head straps and connected to the anesthesia machine via a breathing circuit. She was breathing comfortably with 8 cm H_2O nasal CPAP by adjusting the APL valve with 4L O_2/min. She was positioned in lithotomy position for hysteroscopy and D&C.

She maintained spontaneous ventilation at 98-100% SpO_2 throughout hysteroscopy. She was engaged in conversation with anesthesia and surgery team during the procedure. The surgeon was able to perform hysteroscopy and D&C. The patient was elated that the procedure was completed without any complication and was discharged home. During next day telephone follow-up interview, she was cheerful and reported no complications.

Discussion: Obese patients can be difficult to manage intra and postoperative period due to increased risk of rapid oxygen desaturation and inability to maintain the airway. Certain group of patients in this category can benefit from spinal anesthesia and novel modified nasal CPAP mask supported spontaneous ventilation in the setting of certain procedures such as, but not limited to hysteroscopy and D&C. This avoids the need to intubate the patient and post-extubation complications. It takes <2 minutes to modify a tear-drop shaped pediatric face mask to a rounded triangular nasal mask that accommodates most adult noses. It may improve patient safety at low cost.

Case reports are IRB-exempted. This patient gave her consent for taking photography and case report.

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A Novel Modified Pediatric Face Mask Maintained Spontaneous Nasal Ventilation and Oxygenation in a Super-Obese Patient with OSA During Lumbar Epidural Local Anesthetics/Steroid Injection in the Prone Position

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Background: Patients under monitored anesthesia care (MAC) often receive IV sedation and supplemental O_2 via nasal cannula. Sedated obese patients with OSA often have airway obstruction and experience oxygen desaturation. It is especially challenging to maintain spontaneous ventilation and oxygenation in these patients in the prone position. A simple nasal PAP mask assembly has been shown to maintain spontaneous nasal ventilation and improve oxygenation in obese patients with OSA during deep sedation and provide continuous oxygenation in patients with difficult airway during general anesthesia induction.[1-7] We used a modified pediatric face mask to maintain spontaneous ventilation and oxygenation in a super-obese patient with OSA and anticipated difficult airway undergoing epidural injection in the prone position.

Case Description: A super-obese 49 year old male, 6', 380 lb, BMI 51.5 kg/m^2, with HTN, NIDDM, OSA non-compliant with nocturnal CPAP and chronic low back pain (CLBP) for epidural injection. Pre-operative assessment revealed a Mallampati Class III airway and a room air SpO_2 of 96%. The patient was extremely anxious because he felt "everything" during previous treatment. The previous anesthesia record revealed that he received 2 mg of midazolam and 100 mcg of fentanyl in small boluses. He was fitted with a modified infant mask (size #2) with a fully inflated air cushion. He gave his consent for using the nasal CPAP mask and taking photography for educational purposes.

He received 4 mg of midazolam prior to assuming the prone position. The modified infant mask was secured over his nose with elastic head-straps. The nasal mask was connected to the anesthesia machine through a breathing circuit with 4L/min of O_2 and the APL valve was adjusted to deliver CPAP of 11-13 cm H_2O. His SpO_2 improved from 93% to 100%. The patient received small boluses of fentanyl (4x25 mcg) and 100 mg lidocaine. A propofol infusion was started at 20 mcg/kg/min and titrated to 10 mcg/kg/min.

The patient was deeply sedated and didn't response any stimulation. He maintained spontaneous ventilation with CPAP 28-30 cm H_2O and 99-100% SpO_2 throughout the procedure. He was awakened in a timely fashion at the end of the case and was elated that he didn't feel "anything". He was discharged home after a brief time in the same day surgery recovery room.

Discussion: This modified nasal PAP mask assembly was used to maintain spontaneous ventilation and improved oxygenation in a super obese patient with OSA under sedation in the prone position. It is very simple to modify a tear-drop shaped pediatric face mask to a rounded

triangular shaped nasal mask by compressing the face mask for 2 minutes. This modified pediatric mask fits most adult noses and may improve patient safety at a very low cost.

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Routine Preoperative Obstructive Sleep Apnea Screening of Elective Surgical Patients: A Single Institution Prevalence Assessment

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Purpose: Guidelines recommend routine preoperative Obstructive Sleep Apnea (OSA) screening as means to prevent perioperative morbidity and mortality. We conducted a Cross-Sectional Prevalence study of elective surgical patients to delineate our site specific OSA demographics, set criteria for positive screening, and establish the percentage of patients who either screened positive or had prior work up for OSA. This is a first step to understanding clinical and clerical resources needed to establish routine screening practice.

Methods: The study was approved by the UBC Research Ethics Board. For three months, researchers enrolled patients during Anesthesia consultation or on the day of surgery. Patients with previous work up for OSA recalled the type of sleep study done, and what therapy, if any, they were on. Those with negative or no previous OSA workup were administered STOP-BANG screening. Recovery Room nurses subsequently caring for patients noted any complications.

Results: 1,761 patients enrolled, representing > 10% of our total elective surgical population for 2017. 298 had previous OSA work up. 1,563 were screened for OSA. STOP-BANG scores were significantly lower than a comparative study. At STOP-BANG positive cut offs of ≥ 3 and ≥ 5, 54% and 15% were screen positive respectively. Post-op complications were either in keeping with previous studies or underpowered to quantify.

Conclusion: In the population studied, lower comparative scores justify a STOP-BANG positive cut off of ≥ 5. Resource allocation can anticipate 15% of patients to screen positive for OSA, while 17% will have some prior OSA work up. Individual institutions should similarly examine their surgical populations to establish their site specific screening practices.

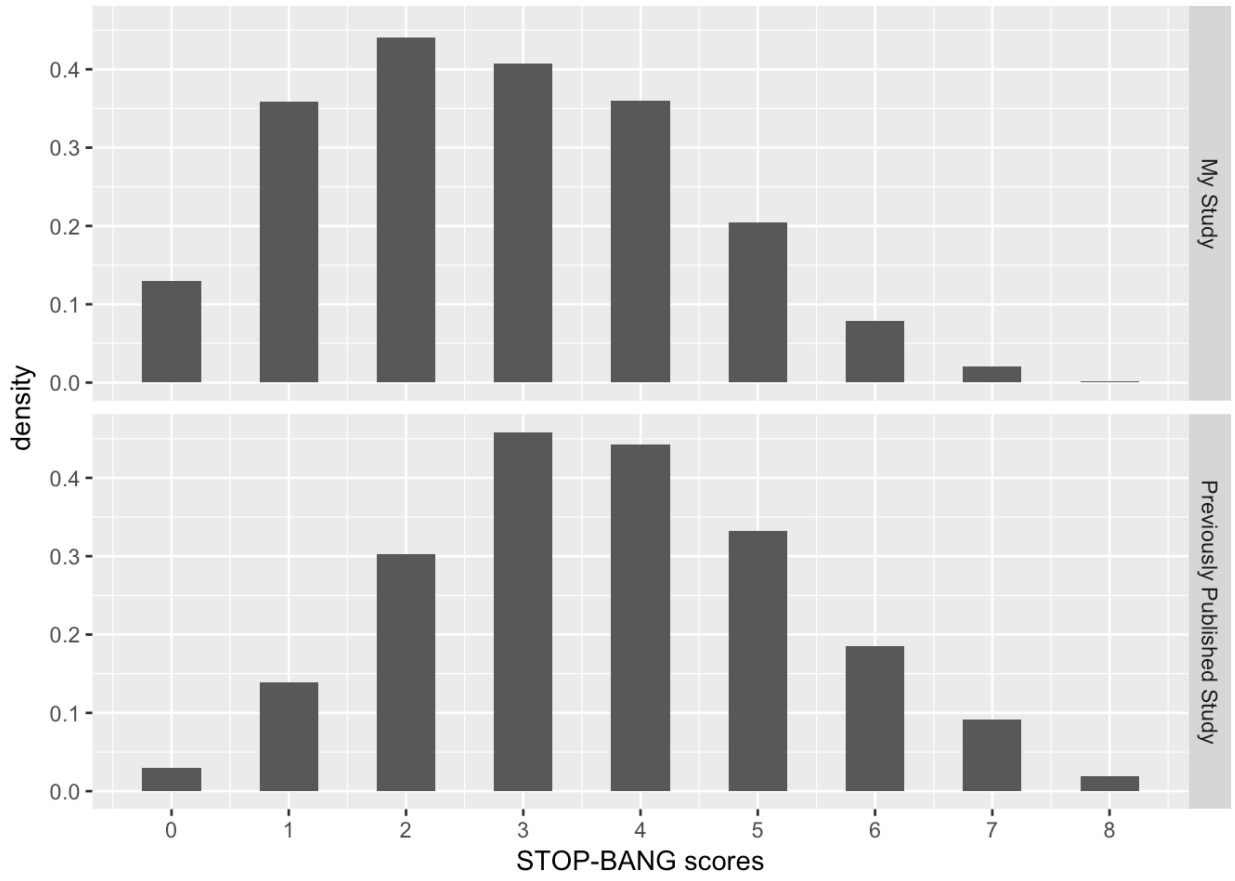

Figure 1: Comparative frequencies of STOP-Bang scores between data collected in this study (upper panel) vs. those of a previously published study[11] (lower panel).

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Sleep Study and Oximetry Parameters for Predicting Postoperative Complications in Patients with Obstructive Sleep Apnea

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Background: In the surgical setting, obstructive sleep apnea (OSA) is associated with an increased risk of postoperative complications. At present, risk stratification using OSA-associated parameters derived from polysomnography (PSG) or overnight oximetry to predict postoperative complications has not been established. The objective of this narrative review is to evaluate the literature to determine the association between parameters extracted from in-laboratory PSG, portable PSG, or overnight oximetry and postoperative adverse events.

Methods: We obtained pertinent articles from Ovid MEDLINE®, Ovid MEDLINE® In-Process & Other Non-Indexed Citations and EMBASE (2008 to December 2017). The search included studies with adult surgical patients diagnosed for OSA with portable, in-laboratory PSG, or overnight oximetry that reported on specific sleep parameters and at least one adverse outcome. The search was restricted to English language articles.

Results: The search yielded 1,810 papers, of which 21 were included in the review. Preoperative apnea hypopnea index (AHI) and measurements of nocturnal hypoxemia such as oxygen desaturation index (ODI), cumulative sleep time percentage with SpO_2 < 90% (CT90), minimum SpO_2, mean SpO_2, and longest apnea duration were associated with postoperative complications.

Conclusions: OSA is associated with postoperative complications in the surgical population. Significant association between 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 minimal SpO_2, and longest apnea duration have been shown to be associated with postoperative complications and may provide additional value in risk stratification and minimization.

Are Patients with Obstructive Sleep Apnoea (OSA) Difficult to Bag Mask Ventilate and Intubate?

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Background: A pro-con debate on whether OSA patients are associated with difficult bag mask ventilate and difficult laryngoscopy (DL) is emerging. Long standing literature suggests patients with OSA are difficult to bag mask ventilate and present with a higher Cormack and Lehane grade at laryngoscopy. Kurtipek et al mentions several studies along with his own analysis concluding OSA patients have a higher DL ratio than that of non-OSA patients. This is thought to be associated with anatomical variations, BMI, gender and neck circumference. In contrast, Neligan and colleagues conclude no correlation between OSA and difficult laryngoscopy and conclude Mallampati score and male gender had better correlative results with DL.

The Royal National Throat Nose and Ear Hospital is the biggest sleep apnoea centre in England; giving rise to a high volume, high turnover patient cohort for evaluation.

Aim: To assess ease of bag mask ventilation and intubation grade in patients with OSA.

Methods: Adult patients (>18 years old), ASA I-III, undergoing elective sleep apnoea and snoring surgery were included in this prospective audit. Paper data collection forms were distributed to anaesthetists at the Royal National Throat Nose and Ear Hospital, London. Data collection was carried out between March 2018 and June 2018. The survey consisted of two airway related questions requiring categorical and numerical responses: ease of bag mask ventilation, Cormack and Lehane grade of laryngoscopy by the consultant anaesthetist.

Data were analysed using Google drive and Microsoft Excel. Categorical data were summarised as frequencies with percentages. Continuous data were summarised as means with standard deviations. Free text responses were reviewed for common themes and summarised.

Results:
One handed bag mask ventilation was carried out in 87% of patients.
Two handed bag mask ventilation was carried out in 13% of patients.
A guedel was used in 32% of patients during bag mask ventilation.
58% patients presented with grade 1 CL laryngoscopy
27% of patients presented with grade 2 CL laryngoscopy.

Discussion/ Conclusion: Our data set suggests that there was no difficulty in bag mask ventilation for this patient group. Grade of intubation was CL grade 1 or 2 in 85% of patients. This outcome suggests that OSA alone does not significantly contribute to difficult bag mask ventilation or difficult laryngoscopy.

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Anaesthesia and Analgesia. Volume 109;1182-6 Obstructive sleep apnea is not a risk factor for difficult intubation in morbidly obese patients.

Can We Give Intra-Operative Opioids to Patients with Sleep Apnoea?

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Co-Authors: Jamie Turnbull (MBBS, FRCA), Michael Gilhooly (MBChB, FRCA)
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Background: There is an increasing number of patients with obstructive sleep apnoea (OSA) requiring anaesthesia for surgery. Cautiousness with intra-operative opioids has been noted in the literature with concerns over respiratory depression and sedative effects leading to adverse events in the post-operative period. The cause of respiratory depression is thought to be two fold; OSA is associated with the upregulation of mu receptors producing a hyperalegsic effect with opioid use. Intermittent hypoxia associated with OSA induces several cytokine pathways that are related to increased sensitivity to opioids. These mechanisms are not mutually exclusive to OSA patients.

Aim: The Royal National Throat Nose and Ear Hospital carries out the largest number of sleep apnoea and snoring surgeries in England. Long acting opioids are routinely used during these procedures and the majority of surgeries are day cases.
Our aim was to demonstrate that opioids can be given to patients with OSA, and would not prevent them from being discharged on the same day of surgery.

Materials and Methods: Survey of intra-operative opiod use in OSA patients undergoing sleep apnoea surgery at a single London teaching hospital. Data collection forms were filled in by Anesthetists at the Royal National Throat Nose and Ear Hospital between March and June 2018. Data was fed into a larger sleep apnoea database. The forms consisted of analgesic related questions requiring categorical and numerical responses: fentanyl usage and dose; morphine usage and dose; ketamine usage and dose. The data collection form also looked at whether the surgery was a day case procedure or not.
Data were analysed using Google drive Microsoft Excel. Categorical data were summarised as frequencies with percentages. Continuous data were summarised as means with standard deviations. Free text responses were reviewed for common themes and summarised.

Results: All patients received fentanyl intra-operatively. 87% of patients received morphine. Of these patients, the dose ranged from 4mg to 10mg (Mean 7mg). 27% of patients received ketamine, with a dose range between 15mg-50mg.

Discussion: All patients undergoing sleep apnoea or snoring surgery received a short acting opiate and the majority received a long acting opiate intra-operatively. There was no reported adverse respiratory or sedative effects in the post operative period. Three quarters of the cohort group were day case procedures. No patients stayed due to adverse effects associated with opiod use.

Conclusion: In contrast to the literature, use of long acting opiates was deemed clinically safe and effective in our patients. Our results may be explained by specific surgical cohort undergoing surgeries to improve sleep apnoea/ snoring.

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Medication Protocols Post Sleep-Apnoea and Snoring Surgery

First Author: Yohinee Rajendran MBBCh, FRCA
Co-Authors: James Turnbull (MBBS, FRCA), Michael Gilhooly (MBChB, FRCA)

Background: The Royal National Throat Nose and Ear Hospital London is the largest provider of sleep apnoea and snoring surgeries for National Health Service (NHS) patients in the UK. It is well known that sleep apnoea surgery is extremely painful in the post-operative period and this pain can last up to two weeks. A literature search revealed no published medication protocols country wide.

Aim:

1. To assess adequacy of analgesia day 7 post surgery
2. Devise a post-operative take home medication protocol to provide analgesia, steroids, laxatives, and antibiotics.
3. Devise a trust wide patient leaflet for medications to take post sleep apnoea/ snoring surgery

Methods: Survey of practice at a single London teaching hospital. Data collection forms were distributed at the Royal National Throat Nose and Ear Hospital, London between March 2018 and June 2018. The survey consisted of pain scores and analgesic requirements 7 days post surgery. A free text box was also included for the documentation of adverse outcomes and side effects.

Data were analysed using Google drive and Microsoft Excel. Categorical data were summarised as frequencies with percentages. Continuous data were summarised as means with standard deviations. Free text responses were reviewed for common themes and summarised.

Results:
98% patients suffered moderate to severe pain, with 95% requiring ongoing analgesics. 13% either had or were planning further GP, Accident and Emergency, pharmacy appointments for further pain advice and medication.

Discussion: Results showed almost all patients had ongoing pain at day 7 post surgery. Analgesic intake was suboptimal. We offered phone advise to optimize symptoms and incorporated the information into our take home medication protocol and patient medication leaflet.

MEDICATION	DOSE	DURATION
REGULAR ANALGESIA		
Paracetemol	1g QDS	14 days
Ibuprofen	400mg QDS	10 days
Dihydrocodeine	30mg six hourly	10 days
PRN ANALGESIA		
Difflam oral rinse	15 mls three hourly	1 bottle
Tramadol	50mg QDS	7 days

Table 1

Conclusion: Sleep apnoea surgery is very painful post operatively. By producing a trust analgesic protocol and patient medication leaflet we have improved patient education and optimisation of analgesia in the post operative period.

Tables:
Table 1: Take home medication protocol for the Royal National Throat Nose and Ear Hospital

References:
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