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5TH ANNUAL MEETING SYLLABUS

SASM 5TH ANNUAL MEETING
OCTOBER 22-23, 2015
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PRACTICAL MAGIC: OPTIMIZING RESOURCES FOR BEST OUTCOMES

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MEETING 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 interaction between sleep and various hospital outcomes within different scenarios and areas of the hospital.
- Examine the challenge to identify post-operative complications that many patients develop associated with sleep disordered breathing (SDB) under different scenarios. Most surgeries are now approached with an outpatient format. These outpatient surgery practices need special attention, especially for those with SDB.
- Provide an ideal format for continuous development and review for newer agents and procedural approaches. The need for appropriate sedation and analgesia in the hospital setting for surgical patients is widely promoted, but comes at the expense of respiratory and other complications.

LEARNING OBJECTIVES

1. Reveal and discuss the impact of quality sleep in hospitalized patients and the effects on outcomes
2. Target encouragement of more widespread appropriate use of the latest means to assess oxygenation and ventilation to promote best practices
3. Discuss the evolving perioperative evaluation and management of newly diagnosed obstructive sleep apnea (OSA) and provide tools to recognize this need and ways to optimize care of newly diagnosed OSA
4. Indicate the special considerations for patients with OSA undergoing outpatient surgery and offer solutions for reducing or eliminating post-operative complications
5. Offer new perspectives in sedation-analgesia practices focusing on reduction of complications while not losing sight of patient comfort

ACCREDITATION STATEMENT

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the Institute for the Advancement of Human Behavior (IAHB) and the Society of Anesthesia and Sleep Medicine (SASM). IAHB is accredited by the ACCME to provide continuing medical education for physicians.

CREDIT DESIGNATION STATEMENT

The IAHB designates this live activity for a maximum of ***13.0 AMA PRA Category 1 Credits™***. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

PROGRAM COMMITTEE & SPEAKER DISCLOSURES

PROGRAM COMMITTEE

Peter Gay, MD, MS
5th Annual Meeting Program Chair

Girish P. Joshi, MBBS, MD, FFARCSI
5th Annual Meeting Program Co-Chair

SPEAKERS

For a full list of speaker disclosures, please see insert.

SCHEDULE OF EVENTS

THURSDAY, OCTOBER 22, 2015

Time	Topic	Speaker
	Moderator: Peter Gay, MD, MS	*Room: Sapphire Ballroom P*
1:00 – 3:00 pm	Sleep Issues in Hospitalized Patients	
1:00 – 1:05 pm	Welcome – 5-Year Anniversary	*Peter Gay, MD, MS*
1:05 – 1:25 pm	Overview: Sleep and Disease Issues in the Hospitalized Patient	*David Hillman, MBBS*
1:25 – 1:45 pm	Impact of Sleep on Hospital Outcomes: What Can be Done?	*Vineet Arora, MD, MA*
1:45 – 2:05 pm	Sleep in the ICU	*Richard J. Schwab, MD*
2:05 – 2:25 pm	OSA and Outcomes After Elective Outpatient Procedures	*Amir Sharafkhaneh, MD, PhD*
2:25 – 2:45 pm	Sleep and Circadian Rhythm in the Perioperative Period	*Philip Kurien, MD*
2:45 – 3:00 pm	Q&A/Discussion	*Panel*
3:00 - 3:30 pm	Break	
	Moderator: Bhargavi Gali, MD	*Room: Sapphire Ballroom P*
3:30 - 5:30 pm	Rapid Fire Technology	
3:30 - 3:35 pm	Rapid Fire Technology Overview	*Bhargavi Gali, MD*
3:35 - 4:00 pm	High Flow Humidification Therapy	*Bernardo Selim, MD*
4:00 - 4:25 pm	Portable Sleep Testing in Hospitalized Patients	*Rami Khayat, MD*
4:25 - 4:50 pm	Evolving Options for Respiratory Monitoring on Med/Surgical Floors	*Frank Overdyk, MSEE, MD*
4:50 - 5:15 pm	Contrasting Neural Mechanisms of Sleep and Anesthesia	*Patrick Purdon, PhD*
5:15 - 5:30 pm	Q&A/Discussion	*Panel*
5:30 - 6:00 pm	Welcome Reception	*Room: Sapphire West Foyer C*
6:00 - 9:00 pm	Dinner *Additional Fee Applies for Non-Gold Patron Members	*Room: Sapphire Ballroom L*
6:00 - 6:05 pm	Welcome and Introductions	*Frances Chung, MB BS*
6:05 - 6:10 pm	Anesthesia & Analgesia: New Vision	*Jean-Francois Pittet, MD*
6:10 - 6:30 pm	Anesthetic Roulette, Anyone?	*David Dawson, MB, ChB, FRCA*
6:30 - 7:30 pm	Dinner	
7:30 - 8:00 pm	Innovation and Entrepreneurship in SDB	*Peter Farrell, BE, MS, PhD, DSc*

FRIDAY, OCTOBER 23, 2015

Time	Topic	Speaker
7:00 - 7:30am	Registration and Continental Breakfast	*Room: Sapphire CDGH*
7:30 - 7:55 am	Annual General Meeting	*Frances Chung, MB BS*
	Moderator: Frances Chung, MB BS	*Room: Sapphire Ballroom P*
8:00 – 10:15 am	Keynote Speakers and Special Topics	
8:00 – 8:05 am	Welcome	*Frances Chung, MB BS*
8:05 - 8:45 am	Keynote: Why Focus on Sleep Hygiene in the Perioperative and Critical Care Settings?	*Mervyn Maze, MB, ChB*
8:45 - 9:25 am	Keynote: Sleep Evaluation in Newly Discovered OSA in & After Hospital	*Clete Kushida, MD, PhD*
9:25 - 9:55 am	Outpatient ENT Surgery for OSA Patients: Is it Suitable?	*Eric Kezirian, MD, MPH*
9:55 - 10:15 am	Q&A/Discussion	*Panel*
10:15 – 10:45 am	Refreshment Break and Poster Viewing	*Room: Sapphire CDGH*
	Moderator: Babak Mokhlesi, MD, MSc	*Room: Sapphire Ballroom P*
10:45 - 12:15 pm	Sleep Issues and Post-Operative Complications	
10:45 - 11:10 am	Outpatient General Surgery Complications	*Nancy Collop, MD*
11:10 - 11:35 am	Sleep Disordered Breathing & Perioperative Atrial Fibrillation	*Reena Mehra, MD*
11:35 - 12:00 pm	Using Mobile to Educate and Empower Patients at Risk	*David Cook, MD*
12:00 - 12:15 pm	Q&A/Discussion	*Panel*

SCHEDULE OF EVENTS *(CONTINUED)*

FRIDAY, OCTOBER 23, 2015 *continued*

12:15 - 1:15 pm	**Luncheon (Sponsored by Masimo Corporation) With Speaker & Awards**	***Room: Sapphire CDGH***
12:15 - 12:25 pm	**Luncheon**	*Peter Gay, MD, MS*
12:25 - 12:50 pm	**Moderate Sedation by Anesthesiologists or Non-Anesthesiologists: An Institutional Perspective**	*Ronald Pearl, MD*
12:50 - 1:00 pm	**Research and Abstract Awards**	*Roop Kaw, MD* *Anthony Doufas, MD, PhD*
1:00 - 1:10 pm	**2014 Research Grant Recipient Presentation**	*Sapna Kudchadkar, MD*
	Moderator: Girish P. Joshi, MBBS, MD, FFARCSI	***Room: Sapphire Ballroom P***
1:15 - 2:45 pm	**Sleep and Anesthesia Messages**	
1:15 - 1:45 pm	**New Perspectives in Sedation-Analgesia**	*Pedro Gambus, MD*
1:45 - 2:10 pm	**Procedural Sedation in Patients with OSA**	*Girish P. Joshi, MBBS, MD, FFARCSI*
2:10 - 2:35 pm	**Impact of Opioid Free Anesthesia, Low Opioid and Opioid Anesthesia in Bariatric Surgery on Respiratory Complications**	*Jan Mulier, MD, PhD*
2:35 - 2:45 pm	**Q&A/Discussion**	*Panel*
2:45 - 3:05 pm	**Refreshment Break and Poster Viewing**	
	Moderator: Dennis Auckley, MD	***Room: Sapphire Ballroom P***
3:05 - 4:15 pm	**Preoperative Screening for OSA Patients**	
3:05 - 3:15 pm	**Consensus Statement Methodology and Design**	*Frances Chung, MB BS*
3:15 - 3:25 pm	**Does a Diagnosis of OSA Change Outcome?**	*Stavros Memtsoudis, MD, PhD*
3:25 - 3:40 pm	**Preoperative Screening for OSA**	*Satya Krishna Ramachandran, MD*
3:40 - 3:55 pm	**Best Perioperative Practices for Surgical Patients with Suspected or Known OSA**	*Dennis Auckley, MD*
3:55 - 4:15 pm	**Q&A/Discussion**	*Panel*
	Moderator: Norman Bolden, MD	***Room: Sapphire Ballroom P***
4:15 - 5:00 pm	**Obstructive Sleep Apnea Registry - Searching for the Light**	
4:15 - 4:30 pm	**Design of the Registry**	*Norman Bolden, MD*
4:30 - 4:50 pm	**Early Case Insights**	*Karen Posner, PhD*
4:50 - 5:00 pm	**Q&A/Discussion**	*Panel*
5:00 pm	**i-Pad Give Away and Closing Remarks**	*Peter Gay, MD, MS*
	The Next Five Years for the SASM	

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RESEARCH GRANT AWARD

Congratulations to Principal Investigator Mandeep Singh, MD, MSc, with the Toronto Western Hospital/ University Health Network, for winning the SASM 2015 Research Grant! Dr. Singh will be awarded at the 5th Annual Meeting luncheon on Friday, October 23, 2015.

Project Title: The Contribution of Rostral Shift of Fluid to Postoperative Worsening of Obstructive Sleep Apnea Severity in Surgical Patients – A Prospective Cohort Study

Principal Investigator: Mandeep Singh, MD, MSc

ABSTRACT AWARDS

BEST PRE-CLINICAL RESEARCH AWARDS

First Place Award

Abstract: Different From Other Sedatives, Dexmedetomidine Retains Respiratory Carotid Reflex and Induces Balanced Inhibition in Hypoglossal and Phrenic Nerve Activity in Rabbits

Co-Authors: Shinichi Nakamura, MD, JA Kumagaya General Hospital, Masahiko Suzuki, PharmD1, Masaaki Nishida, MD2, Kimie Terayama, MD2, Noriomi Ando, MD3, Takaomi Nomi, MD1, Atuhiro Sekiguchi, MD1, Tomomi Kaneko, MD1, Takero Arai, MD4, Yasuo Murakami, MD5, Kazushige Ohara, MD6, Akira Kitamura, MD1, Hiroshi Nagasaka, MD1, Michio Kimura, MD7

[1]Saitama Medical University, Saitama, [2]Hanyu General Hospital, Hanyu, [3]Saitama Rehabilitation Center, Ageo, [4]Dokkyo Koshigaya General Hospital, Koshigaya, [5]Japanese Red Cross Ogawa Hospital, [6]Ohara Hospital, Takasaki, [7]Kumagaya General Hospital, Kumagaya

Second Place Award

Abstract: Is the Alpha Frequency Band of the EEG a Marker of Unconsciousness During Sedation with Propofol and Remifentanil? The Influence of Aging

Co-Authors: Pedro Gambús, MD, Martín Leal, MSc, Anika Nguyen, MSc, Umberto Melia, PhD, Eng, Montse Vallverdú, PhD, Eng

Hospital CLINIC de Barcelona and Center for Research in Biomedical Engineering (CREB) Universitat Politecnica de Catalunya (UPC) Barcelona, Spain

Third Place Award

Abstract: Using HRV Metrics to Phenotype OSA Patients Who Develop Postoperative Respiratory Failure

Co-Authors: Rohan Gopinath[1], Hisham ElMoaqet, PhD[2], Dawn Tilbury, PhD[2], Satya Krishna Ramachandran, MD[3]

[1]University of Michigan Medical School, Ann Arbor, MI, [2]Department of Mechanical Engineering, University of Michigan, Ann Arbor, MI, [3]Department of Anesthesiology, University Hospital, Ann Arbor, MI

BEST CLINICAL RESEARCH AWARDS

First Place Award

Abstract: Postoperative Oxygen Therapy for Patients with Obstructive Sleep Apnea

Co-Authors: Pu Liao, MD, Mandeep Singh, MBBS, MD, MSc, FRCPC, Jean Wong, MD, David Wong, MD, Sazzadul Islam, MSc, Maged Andrawes, MD, Weimin Kang, MD, Colin Shapiro, MBBS, Frances Chung, MBBS, FRCPC

University Health Network, University of Toronto, Toronto, ON, CANADA

Second Place Award

Abstract: Does High Intra-Operative Inspiratory Oxygen Fraction Lead to Postoperative Respiratory Complications?

Co-Authors: Anne Staehr-Rye, MD1,2, Christian Meyhoff, MD, PhD2, Lars Rasmussen, MD, PhD, DMsc2,3, Tobias Kurth, MD, ScD4,5,6, Mona Gätke, MD, PhD2, Myrthe AC de Jong1, John Walsh, MD1, Matthias Eikermann, MD, PhD1,7

[1]Massachusetts General Hospital, Boston, MA, [2]Herlev Hospital, University of Copenhagen, Denmark, [3]Centre of Head and Orthopaedics, Rigshospitalet, Denmark, [4]Inserm Research Center for Epidemiology and Biostatistics (U897) – Team Neuroepidemiology, Bordeaux, France, [5]University of Bordeaux, College of Health Sciences, Bordeaux, France, [6]Brigham and Women's Hospital, Harvard Medical School, Boston MA, [7]Klinik fuer Anaesthesie und Intensivmedizin, Universitaetsklinikum Essen, Essen, Germany

Third Place Award

Abstract: Ability of Clinical Scores to Predict Mild, Moderate and Severe Obstructive Sleep Apnea (OSA) in a Preoperative Setting

Co-Authors: Eric Deflandre, MD, FCCP[1,2,3], Stephanie, Degey, MHS[2], Anne-Francoise, Donneau, PhD[1], Richard Frognier, MD[3], Virginie Massant, PhD[3], Robert Poirrier, MD, PhD[1], Jean-Francois Brichant, MD, PhD1, Vincent Bonhomme, MD, PhD[1]

[1]University of Liege, Liege, Belgium, [2]Cabinet Medical ASTES, Jambes, Belgium, [3]Clinique St-Luc, Bouge, Belgium

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ABSTRACT TABLE OF CONTENTS

*First Place Award Winner, **Second Place Award Winner, ***Third Place Award Winner

ABSTRACT TABLE OF CONTENTS

*First Place Award Winner, **Second Place Award Winner, ***Third Place Award Winner

1. Legal Outcomes of Adverse Perioperative Events in OSA Patients: A Survey Study

Authors and Institutions: Rajinish Jesudoss[1], Nickolas Fouladpour[2], Dennis Auckley[1]

[1]Division of Pulmonary, Critical Care and Sleep Medicine, MetroHealth Medical Center, Case Western Reserve University, [2]Division of Pulmonary, Critical Care and Sleep Medicine, University Hospitals, Case Western Reserve University, Cleveland, OH

Introduction: Obstructive sleep apnea (OSA) has been associated with adverse perioperative outcomes, which has led to an increasing number of malpractice lawsuits. We hypothesized that the majority of these cases are settled out of court.

Methods: We designed a national survey regarding malpractice claims relating to OSA and post-operative complications. The survey was sent to members of American Society of Health Risk Managers (ASHRM). The survey was emailed to 1000 of members of ASHRM in 3 different email blasts. The survey was completed in RED CAP and responses were collated and are described.

Results: There were 145 respondents (14.5% response rate) with 4 incomplete surveys. The majority of respondents were nurses and risk managers. 18% (25) reported at least one malpractice case related to OSA in the perioperative setting filed at their institution within the past 15 years. 80% were filed due to the death of the patient and 16% were due to chronic vegetative state. 85% of the lawsuits were settled out of court, 10% favored the plaintiff, and none favored the defendant. Compensation was mostly in the $100,000-500,000 range (33.3%) and $500,000-1,000,000 range (33.3%). Regarding the cases, the majority of the lawsuits related to postoperative complications following transferred to the floor (64%). 79.2% of the patients were taking narcotics at the time of complication. Most of the cases involved general (42%) or orthopaedic (40%) surgery. The majority of the lawsuits happened in community hospitals (72%). 40.4% of respondents reported they have an OSA perioperative protocol in place, 39.7% reported no protocol was in place and 19.9% were unsure.

Conclusion: This survey study suggests that malpractice suits involving complications related to OSA in the perioperative time period are primarily settled out of court and would not be searchable in legal databases. Settlements carried signficant financial penalties.

2. Quality Assurance Analysis of an OSA-Perioperative Protocol

Authors: Saema Tahir MD[1], Norman Bolden MD[2], Dennis Auckley MD[3]

Affiliations: [1]Department of Medicine, [2] Division of Pulmonary, Critical Care and Sleep Medicine, [3]Department of Anesthesiology, MetroHealth Medical Center, Case Western Reserve University, Cleveland, OH

Introduction: Patients with known or suspected obstructive sleep apnea (OSA) are at increased risk for postoperative complications. Available consensus-based guidelines often recommend increased postoperative monitoring and positive airway pressure (PAP) therapy. MetroHealth Medical Center (MHMC), an urban academic center, has had a protocol in place for the perioperative management of known or suspected OSA patients for more than 7 years. The protocol recommends continuous pulse oximetry in designated "OSA beds" on general surgical floors for patients receiving postoperative IV narcotics if they are suspected of having OSA (positive STOP questionnaire) or have moderate to severe OSA (apnea-hypopnea index > 15). The objective of this study was to assess adherence to the protocol across the institution as well as to evaluate rates of postoperative complications by patient category (low risk for OSA, known OSA, and suspected OSA).

Methods: A retrospective review of adults (> 18 years of age) that had known or suspected OSA and underwent elective surgery during June of 2014 was performed. All charts were reviewed to determine if preoperative screening took place and, if patients with suspected (positive on the STOP questionnaire = STOP+) or known OSA (polysomnogram (PSG) diagnosis) who stayed overnight postoperatively were managed per the protocol. Post-operative complications recorded included cardiac complications (arrhythmias, heart failure, ischemia, hypotension), pulmonary complications (remaining intubated, emergent intubation, emergent PAP therapy), urgent ICU transfer and unresponsiveness requiring naloxone.

Results: 810 charts were reviewed from the pre-surgical evaluation (PSE) clinic. 98.8% of patients were screened with the STOP questionnaire. Of these patients, 17.3% (140) had known OSA and an additional 10.2% (83) were STOP+. 34.1% (76) of these patients were admitted following surgery. Of these, 31.4% (11 of 35) of known OSA patients were not placed in appropriate OSA beds, and 90.9% (10 of 11) of these patients were treated with IV opioids in an unmonitored setting. Nineteen of 35 known OSA patients used PAP therapy at home but only 31.7% of these were supplied PAP therapy at the correct setting (an additional 15.8% were supplied PAP therapy at an incorrect setting). In the STOP + patients who stayed overnight (31), 48.4% were not placed in monitored beds and 80% of these patients were given IV opioids. Post-operative complications were mostly seen in STOP+ patients (12.9%) and included two patients remaining intubated, one cardiac complication and 1 patient requiring urgent naloxone. This compared to complication rates of 3.3% in the low risk patients and 2.6% in the known OSA patients.

Conclusion: In this retrospective quality assurance study, there is a high rate of screening for OSA at our institution but relatively poor adherence to the OSA postoperative protocol. A substantial percentage of patients at risk for postoperative complications were given IV opioids in unmonitored beds. Implementation of PAP therapy postoperatively was poor in patients with known OSA on home PAP therapy. Postoperative complications were seen most commonly in patients at risk for OSA. This study highlights the need for frequent monitoring of protocol adherence and suggests repeated education to raise awareness is warranted.

3. The Influence of General Anesthesia on the Sleep Architecture in Handicapped Patients Scheduled Dental Treatments

Terumi Ayuse DDS, Kawai Mari, DDS, PhD. Shinji Kurata, DDS, PhD. Sanuki Takuro, DDS, PhD. Takao Ayuse, DDS, PhD.

Nagasaki University, Dpt. Special Care Dentistry, Dental Anesthesiology

Object: It is reported that general anesthesia and local anesthesia might affect sleep cycle in a perioperative periods, but there is not the study that what kind of influence the general anesthesia for the person with a disability has on. Therefore this study examined a person with a disability who received dental treatment under the general anesthesia what kind of influence general anesthesia had in a sleep cycle in the perioperative period.

Method: We intended for eight people who received dental treatment under the general anesthesia. Using a mat-shaped sleep meter to establish under the futon of the patients (product made in Tanita Corporation, sleep scan SL503), we measured the sleep cycle at the home of the patients from five days ago on a surgery due date and after having been discharged after treatment under the general anesthesia, it lasted for five days and measured a sleep cycle. After all measurement was completed, we collected an instrument and analyzed the sleep cycle from an SD card had built-in. The analysis item assumed it total sleep time, a sleep cycle. deep sleep time (latency), initiation of sleep latency, body movement frequency, sleep efficiency, halfway awakening time.

Results: What the sleep cycle that was the index that how long REM sleep and light sleep and deep sleep appeared with a period of on the average extended at time one day after a day and surgery before a due date of the treatment under the general anesthesia was found. Whereas the change of the sleep cycle was not found including the execution day when it was carried out by intravenous anesthesia.

Conclusion: It was found that a sleep cycle was affected during perioperative periods of general anesthesia. The sleep depth had the tendency that deep sleep time decreased day before and one day later general anesthesia. As for the abnormality of the sleep cycle of the general anesthesia day before, the likelihood that stress for the hospitalization of the next day and preoperative instructions were associated with was thought about.

4. Continuous Surveillance of Oxygen Saturation and Respirations after Bariatric Surgery

Enrico M. Camporesi, M.D., Rachel Karlnoski, Ph.D., Jacob Shumac, B.S., Emily Alvey, B.S., Devanand Mangar, M.D.
TeamHealth Anesthesia, Tampa, FL, US

Background: Continuous, ventilatory, post-operative patient monitoring provides health care workers with earlier warning signs of patient deterioration. The Masimo Pulse CO-Oximeter (Masimo Corporation, Irvine, CA) with acoustic monitoring technology measures respiratory rate based on analysis of acoustic signals generated across the upper airway during turbulent flow with breathing .[1] As an additional safety measure for a randomized drug trial, we continuously monitored respiratory rate (RR) and oxygen saturation (SpO_2) in patients who underwent laparoscopic Roux-en-Y gastric bypass (RYGB). The secondary objective was to assess incidence of decreased RR (< 10 rpm), respiratory pauses and desaturation (< 90%) in a patient population that was at higher risk for hypoventilation.

Methods: After IRB approval, twenty subjects patients aged 18-65 with a BMI between 40 kg/m^2 and 60 kg/m^2 who received primary laparoscopic Roux-en-Y gastric bypass surgery (RYGB) by the same surgeon were randomized to receive intraoperative intravenous infusions of lidocaine or placebo (saline) in addition to IV PCA dilaudid as an adjunct for post-operative pain management. Respiratory rate and oxygen saturation were continuously monitored from the time of PACU arrival and for the following 24 hours through one night of recovery. The pulse-ox was set with an oxygen desaturation alarm setting at 90% and respiratory pause alarm at 30 seconds to ensure a rapid response. Data for SpO_2 and RR were graphed verses time for the 24 hour period for each patient. A subset of data was extracted at 5 minute intervals (to reduce the volume of data). The data were then sorted from least to greatest and graphed verses time to yield a graph representing cumulative time spent at each $Sp0_2$ level or respiratory rate. The data were categorized into two ranges for SpO_2 ($Sp0_2 \geq$ 90% and < 90%) and three ranges for RR (RR > 30, between 30 and 10, and < 10 breaths per minute). The percentage of time that the patient spent in each range was calculated. Median and range were calculated for each category (see Table 1).

Results: Of the 20 patients enrolled in the trial, the datasets from 3 of the patients were incomplete and were not included in the final analysis. The remaining 17 enrolled subjects had an average BMI of 47.3 kg/m^2, an average age of 47.4 years; 3 males and 14 females; 5 patients had a history of asthma; 13 had a history of sleep apnea, 12 of which used CPAP. During the 24 hour monitored period, the median percentage of time spent with an SpO2 below 90% was 5.4% (Table 1.) The median percentage of time that a subject had a respiratory rate of less than 10 resp/min was 0.0%. There was no correlation between SpO2 and respiratory rate. There was no correlation between the use of CPAP and oxygen saturation or respiratory rate. There

were no apnea periods longer than 30 seconds.

Conclusion: In this small group of obese patients, a low respiratory rate was not encountered during the first 24 hr after surgery.

Reference: Ramsay MA, et Al: Anesth Analg. 2013;117:69-75

Table. 1 Outcomes Data Collected from 17 Subjects after 24 Hours of Continuous Monitoring of Respiratory Rate and Oxygen Saturation

	# of Incidences with an SpO2 <90%	Percentage of Total Monitored Time with an SpO2 <90%	# of Incidence with an SpO2 ≥ 90%	Percentage of Total Monitored Time with an SpO2≥ 90%	# of Incidences with a RR ≤ 10	Percentage of Total Time Monitored with a RR ≤ 10	# of Incidences with a RR between 10- 30	Percentage of Total Time Monitored with RR between 10-30	# of Incidences with a RR >30	Percentage of Total Time Monitored with RR >30
Median	14.0	5.4	228.0	94.6	0.0	0.0	234.0	97.9	0.0	0.0
Range		0-39.7		60.3-100		0-39		57.4-100		0-22

NOT POSTED: Pre Operative STOP BANG Screening Predicts Post-Operative Pain and Opioid Use

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Objective: Currently 22 million Americans have moderate-severe sleep apnea with 80% undiagnosed. The prevalence of high-risk OSA patients undergoing surgery is 20-70%, which may increase postoperative risks. We determined whether pre surgery identification of risk with the STOP-BANG (SB) questionnaire is predictive of post surgery outcomes, specifically pain and opioid use.

Methods: We performed a retrospective review of 115 Henry Ford Hospital patients, 18-65 yrs old, undergoing elective surgeries (from 1-2014 to 5-2014) who completed the SB before surgery. We excluded patients with NYHA III-IV heart failure, severe COPD, neuromuscular disorder, history of drug/alcohol abuse or undergoing ophthalmological or cardiovascular surgery. Endpoints were: hourly post-operative visual analog pain scores in recovery, in-patient post operative day 1, day 2 pain scores, total morphine equivalents in recovery and during hospitalization.

Results: Compared to SB < 6 (n=101), SB ≥ 6 (n=14) was associated with greater overall use of opioids (total morphine mg equiv) than SB < 6: (367.6 vs 151.9 mg, $p<.002$), corrected for BMI. Compared to SB < 6, SB ≥ 6 was associated with greater daily average pain ratings on day 1 and day 2 (5.9 vs 4.9, $p < .03$). In SB question-by-question analyses; reporting Tiredness (n=33) was associated with greater recovery opioid use (30.3 vs 13.3 mg; $p<.04$) and total opioid use (282.3 vs 135.9 mg; $p< .004$) and greater recovery hourly pain ratings and inpatient pain ratings (5.6 vs 4.7; $p <.06$).

Conclusion: STOP-BANG scores ≥ 6 are predictive of patient opioid use and pain ratings post-operatively. Reporting Tiredness (yes-no) alone was associated with greater opioid use and pain ratings.

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5. Evaluation of the STOP Bang Questionnaire for OSA in a Sleep Clinic Population

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Background: Although obstructive sleep apnea (OSA) is common and associated with several co-morbidities, most of the patients are undiagnosed. Current screening tools are quite unspecific and the golden standard methodology for diagnosis, polysomnography (PSG), is expensive and time consuming, thus not suitable for screening. In perioperative medicine the STOP Bang screening questionnaire is currently the recommended screening tool, however this questionnaire has only been evaluated in a very limited numbers of sleep clinic patients. The STOP Bang questionnaire includes eight yes or no questions and yes to more than three items merits a positive result.

Aim: Does the STOP Bang score correlate to OSA diagnosis at a sleep clinic?

Materials and methods: After ethical approval and informed consent, adult patients were included into this prospective non-randomized observational study at their first visit to a sleep clinic. The patients answered the STOP-Bang screening questionnaire and underwent a portable polysomnography (PSG). Data are presented as mean ± SD for continuous variables and median and range for categorical variables.

Results: 203 patients with a mean age of 55 years, BMI of 30,5 and 56% male were included. 89 % of the patients were positive at STOP Bang and the median STOP-Bang score was 4 (3-6). An apnea hypopnea index (AHI) of >5 and >15 defining mild and moderate/severe OSA was seen in 72% and 41% of the patients, respectively. The mean AHI was 20 ± 22, oxygen desaturation index (ODI) 20 ± 20. There was a good correlation between the STOP Bang score and AHI.

Conclusions: The STOP BANG screening questionnaire might be a useful screening tool in the sleep clinic.

6. Postoperative Oxygen Therapy for Patients with Obstructive Sleep Apnea

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Background: Sleep disordered breathing (SDB) may get exacerbated after surgery. Untreated obstructive sleep apnea (OSA) is associated with an increased incidence of postoperative complications. Besides continuous positive airway pressure (CPAP), use of other treatment modalities such as oxygen therapy has not been tested peri-operatively. The objective of this randomized controlled trial is to determine if postoperative oxygen therapy improves oxygenation in surgical patients with OSA without increasing respiratory events.

Methods: After REB approval, preoperative patients over 18 years were consented. Patients with suspected nocturnal hypoventilation (elevated venous HCO_3^-) were excluded. Patients underwent a home polysomnography (PSG) with a 10-channel portable device (Embeltta X-100). The PSG recordings were scored by a certified PSG technologist. Patients with OSA (apnea-hypopnea index, AHI>5) were randomized (1:1) into oxygen therapy (O_2 group) or no oxygen therapy (Control group). Patients in O_2 group received oxygen at 3 l/min by nasal prongs for 3 postoperative nights. In both groups, patients were managed according to their routine care. Perioperative care team was allowed to use CPAP or oxygen therapy wherever necessary during the study period. Patients underwent an overnight PSG on the third postoperative night and monitored for oxygen saturation and CO_2 level with oximeter and transcutaneous PCO_2 monitor.

Results: One hundred and ninety-five patients out of 722 screened patients consented for home PSG. Of them, 123 patients with AHI>5 were randomized into the O_2 group (n=62) and Control group (n=61). All except 23 patients underwent PSG on postoperative night 3 due to drop-out from postoperative pain, nausea and vomiting. In the Control group, 11(18%) received oxygen and none in both groups received CPAP on postoperative night 3.
There was no significant difference in gender, age, BMI, neck circumference and preoperative AHI between O_2 group and Control group. Compared to the Control group, oxygen desaturation index (ODI), average SpO2, lowest SpO2 and time percentage with SpO2<90 (CT90) significantly improved in the O_2 group (Table). Patients in O_2 group had a significantly decreased AHI, central apnea index, hypopnea index and respiratory arousal index (Table). Oxygen therapy did not prolong the duration of the apnea events (Table).
Conclusions: Postoperative oxygen therapy improved oxygen saturation, decreased central apnea index and hypopnea index without increasing the duration of the apnea events.

Variable	Preoperative Baseline			Postoperative night 3		
	Oxygen	Control	p	Oxygen	Control	p
N	62	61		54	49	
AHI*	16.9(8.5, 29.5)	16.1(9.5, 32.8)	NS	3.5(1.3, 19.4)	15.8(8.3, 55.9)	0.0006
Obstructive Apnea Index*	7(2.5, 17.0)	8.1(2.4, 19.1)	NS	3.1(0.8, 14.1)	3.8(1.1, 17.3)	NS
Central Apnea Index*	0(0,0.6)	0(0, 0.8)	NS	0(0, 0.2)	0.2(0, 3.0)	0.0061
Mixed Apnea Index*	0(0, 0.1)	0(0, 0)	NS	0(0, 0)	0(0, 0.1)	0.0721
Hypopnea Index*	6.9(5.0, 10.5)	7(4.0, 11.4)	NS	0(0, 2.5)	7.3(2.1, 16.0)	<.0001
Respiratory Arousal Index*	3.7(1.6, 10.8)	5.1(2.4, 9.9)	NS	0.9(0.1, 5.6)	3.2(0.7, 5.6)	0.0281
Mean AH Duration*, s	23.2(18.8, 27.5)	23.1(19.8, 25.6)	NS	16.9(15.1, 20.9)	18.1(16.1, 22.3)	NS
Longest AH Duration*, s	56.2(44.6, 70.8)	59.1(46.0, 73.7)	NS	33.7(22.3, 47.0)	46(30.5, 63.2)	0.0174
ODI*	16.1(10.3,27.8)	14.1(9.5, 31.8)	NS	0.7(0, 5.7)	20.9(8.2, 58.1)	<.0001
Average SpO2*	93.5(92.5, 94.4)	93.2(91.8, 94.6)	NS	96.7(95.4, 97.8)	92.2(89.8, 93.7)	<.0001
Lowest SpO2*	83(77.0, 85.0)	81(75.0, 87.0)	NS	91(84.0, 94.0)	79(74.0, 85.0)	<.0001
CT90*	1.9(0.5, 8.0)	3.4(0.6, 9.2)	NS	0.13(0, 2.7)	10.2(2.1, 31.0)	<.0001

Table: The effect of postoperative oxygen therapy on respiratory events in patients with SDB

Note: *- data presented as median (25^{th}, 75^{th} percentile)

7. Sleep Apnea is Very Common Among Patients Scheduled for Surgery of Colorectal Cancer

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Background: Colorectal cancer is a leading cause of cancer morbidity and mortality worldwide, and a large proportion of such patients are subjected to surgery. Sleep apnea has been identified as a risk factor after surgery, but the prevalence of sleep apnea is unknown in patients with colorectal cancer scheduled for surgery. Age and obesity are risk factors for both colorectal cancer and sleep apnea.

Aim: We aimed to investigate the prevalence of sleep apnea among patients with colorectal cancer scheduled for elective surgery.

Method: Fifty patients including 16 women with colorectal cancer mean age 69 ± 11 years, BMI 26 ± 4 kg/m2 were included. Patients were investigated with polysomnography (Embla) including continuous recordings of respiration, breathing movements, oxygen saturation, EEG, EOG, chin EMG, ECG and body position sensor at hospital during the night before surgery. They were also investigated with lung-function, arterial blood gas measurements, questions on snoring, STOP-BANG, Epworth sleepiness scale, height, weight and Mallampati score.

Results: Forty of fifty patients (82%) had sleep apnea with 5 or more apneas and hypopneas per hour of sleep i.e. AHI >5. Forty percent had mild sleep apnea with AHI 5-15 sleep, 28% had moderate sleep apnea and 14% severe sleep apnea with AHI >30. Patients slept on average 41% of the time in the supine position. In the supine position, they had an AHI of 29 ± 22 versus 8 ± 9 in the lateral position. Mallampati score and age were related to sleep apnea, while gender, body mass index, Epworth sleepiness scale, STOP-BANG and a history of snoring was not.

Conclusion: Sleep apnea is very common among patients who undergo surgery for colorectal cancer. Age, sleeping in supine position and a high tongue according to Mallampati score were risk factors for sleep apnea.

8. Ability of Clinical Scores to Predict Mild, Moderate and Severe Obstructive Sleep Apnea (OSA) in a Preoperative Setting

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Introduction: Several clinical scores have been proposed for detecting patients at risk of mild, moderate and severe obstructive sleep apnea (OSA). Beside STOP-Bang (1), P-SAP (2), and OSA50 (3) scores, we recently proposed a new score based on morphological metrics only, the DES-OSA score (4). This study aimed at comparing them within the same surgical population, and regarding their ability to detect OSA. Mild, Moderate and Severe OSA were defined as an Apnea Hypopnea Index (AHI, number of apnea or hypopnea episodes per hour of polysomnography) > 5, > 15 and > 30, respectively.

Materials and Methods: Following informed consent and IRB approval, 1048 consecutive adults presenting to the pre-anesthesia visit were recruited (ClinicalTrial.gov: NCT02051829). For each patient, the above-cited four scores were collected. If the STOP-Bang and/or DES-OSA were positive ($\geq$ 5 and 7, respectively), the patient was referred to a pre-operative screening of OSA using a portable device (PD) or polysomnography (PSG). In case of existing recent PSG data, they were also collected. The ability of the 4 scores to predict OSA were compared using sensitivity (Se), specificity (Sp), positive predictive value (PPV), negative predictive value (NPV), area under ROC curve (AUROC) analysis, and prediction probability (PK). We also used the Cohen kappa coefficient to assess the degree of concordance between clinical scores and AHI. A two-tailed P value < 0.05 was considered significant. First analysis was performed on grouped PSG and PD data, and the second one only on PSG data, which are more accurate.

Results: PSG was performed in 110 patients, and PD in 57. All results are summarized in Table 1. When considering PSG data only, Se and Sp (%) at detecting severe OSA (AHI > 30) were 80.4 and 50.0 for STOP-Bang, 96.4 and 33.3 for P-SAP, 98.2 and 16.7 for

OSA50, and 91.1 and 75.9 for DES-OSA. STOP-Bang was significantly less sensitive than P-SAP and OSA50. DES-OSA and STOP-Bang were the most specific. For the same ability, PPV and NPV (%) were 62.5 and 71.1 for STOP-Bang, 60.0 and 90.0 for P-SAP, 55.0 and 90.0 for OSA50, and 79.7 and 89.1 for DES-OSA, and AUROC (95%CI) were 0.75 (0.65-0.84) for STOP-Bang, 0.76 (0.67-0.85) for P-SAP, 0.66 (0.56-0.76) for OSA50, and 0.91 (0.85-0.97) for DES-OSA. The AUROC of DES-OSA was significantly larger than the one of the other scores. PK's (95%CI) were 0.68 (0.62-0.73) for STOP-Bang, 0.66 (0.60-0.72) for P-SAP, 0.61 (0.55-0.67) for OSA50, and 0.79 (0.72-0.90) for DES-OSA. Cohen kappa coefficients (95%CI) were 0.31 (0.13-0.48) for STOP-Bang, 0.30 (0.12-0.48) for P-SAP, 0.15 (0-0.34) for OSA50, and 0.67 (0.53-0.81) for DES-OSA. Similar results were obtained for at least moderate OSA prediction. Between score differences were attenuated when considering mild OSA prediction. All scores were less effective when considering pooled PSG and PD data.

Conclusion: DES-OSA, which is the only available exclusively morphological score, appears to surpass the 3 other scores in their ability to predict moderate and severe OSA.

Note: Preliminary results were submitted for a poster presentation in March 2015 for the ASA annual Meeting (October, San Diego). These preliminary results took account of 733 patients (82 PSG and 38 PD), and the analyses were only performed for severe OSA (AHI > 30). We present here the complete study results.

Table 1: Ability of the four scores to predict mild, moderate and severe OSA (AHI > 5, 15 and 30, respectively) in terms of sensitivity (Se), specificity (Sp), positive predictive value (PPV), negative predictive value (NPV), area under the ROC curve (AUROC), prediction probability (PK), and Cohen kappa coefficient. Results are given for pooled polysomnography (PSG) and portable device (PD) data, and for PSG data only. Statistical comparisons between scores were made for sensitivity, specificity and AUROC. To correct for multiple comparisons and to avoid type I errors, the level of statistical significance was set at $P = 0.025$ (0.05/2). Significant results ($P < 0.025$) were indicated as follow: "1" between STOP-Bang and DES-OSA, "2" between STOP-Bang and P-SAP, "3" between STOP-Bang and OSA50, "4" between DES-OSA and P-SAP, "5" between DES-OSA and OSA50, "6" between OSA50 and P-SAP.

		AHI	STOP-Bang	P-SAP	OSA50	DES-OSA
PSG + PD n = 167	Se (%)	> 5	76.9[1,2,3]	89.0[2,4]	94.1[3,5]	60.4[1,4,5]
		> 15	77.4[2,3]	90.2[2,4]	94.1[3,5]	74.5[4,5]
		> 30	80.60[3]	95.5[2]	98.5[3]	88.1
	Sp (%)	> 5	76.9	53.8	38.5	84.6
		> 15	36.9[1,2,3]	21.5[2,4]	12.3[3,5]	70.8[1,4,5]
		> 30	34.0[1,2,3]	21.0[2,4]	13.0[3,5]	64.0[1,4,5]
	PPV (%)	> 5	97.5	95.8	94.8	97.9

		> 15	65.8	64.3	62.7	80.0
		> 30	45.0	44.7	43.1	62.1
	NPV (%)	> 5	21.3	29.2	35.7	15.3
		> 15	51.1	58.3	57.1	63.9
		> 30	72.3	87.5	92.9	88.9
	Area under the ROC curve (95% CI)	> 5	0.834 (0.747-0.920)	0.783 (0.678-0.888)	0.726 (0.604-0.848)	0.836 (0.736-0.916)
		> 15	0.670 (0.589-0.751)	0.645[4] (0.561-0.728)	0.649 (0.566-0.732)	0.757[4] (0.697-0.838)
		> 30	0.695[1] (0.612-0.778)	0.721 (0.640-0.802)	0.644[5] (0.557.0.730)	0.817[1,5] (0.748-0.886)
	PK (95% CI)		0.649 (0.599-0.699)	0.625 (0.574-0.677)	0.604 (0.557-0.651)	0.733 (0.687-0.780)
	Cohen kappa (95% CI)	> 5	0.241 (0.036-0.446)	0.309 (0.046-0.571)	0.315 (0.007-0.624)	0.146 (0.049-0.244)
		> 15	0.151 (0-0.315)	0.133 (0-0.306)	0.075 (0-0.255)	0.444 (0.307-0.582)
		> 30	0.129 (0-0.268)	0.139 (0.001-0.272)	0.095 (0-0.225)	0.487 (0.364-0.610)
PSG only n = 110	Se (%)	> 5	70.7[2,3]	85.9[2,4]	93.9[3,5]	63.6[4,5]
		> 15	75.3[2,3]	89.0[2]	94.5[3]	80.8[5]
		> 30	80.4[2,3]	96.4[2]	98.2[3]	91.1
	Sp (%)	> 5	81.8	54.5	36.4	90.9
		> 15	54.0[3]	32.4[4]	16.2[3,5]	75.7[4,5]
		> 30	50.0[1,2,3]	33.3[2,4,6]	16.7[3,5,6]	75.9[1,4,5]
	PPV (%)	> 5	97.2	94.4	93.0	98.4
		> 15	76.4	72.2	69.0	86.8
		> 30	62.5	60.0	55.0	79.7
	NPV (%)	> 5	23.7	30.0	40.0	21.7
		> 15	52.6	60.0	60.0	66.7
		> 30	71.0	90.0	90.0	89.1
	Area under the ROC curve (95% CI)	> 5	0.826 (0.726-0.927)	0.803 (0.694-0.913)	0.725 (0.567-0.884)	0.851 (0.761-0.942)
		> 15	0.726 (0.631-	0.714[4] (0.618-	0.690[5] (0.589-	0.858[4,5] (0.790-

			0.821)	0.810)	0.791)	0.926)
		> 30	0.746[1] (0.654-0.838)	0.763[4] (0.674-0.852)	0.661[5] (0.560-0.761)	0.909[1,4,5] (0.852-0.966)
	PK (95% CI)		0.677 (0.621-0.733)	0.658 (0.600-0.718)	0.609 (0.551-0.666)	0.787 (0.720-0.896)
	Cohen kappa (95% CI)	> 5	0.251 (0.028-0.475)	0.296 (0.009-0.584)	0.316 (0-0.665)	0.226 (0.089-0.362)
		> 15	0.292 (0.098-0.486)	0.242 (0.026-0.459)	0.131 (0-0.369)	0.558 (0.401-0.715)
		> 30	0.305 (0.127-0.484)	0.301 (0.121-0.481)	0.151 (0-0.338)	0.672 (0.535-0.809)

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9. Acute Postoperative Respiratory Complications in Patients Scheduled for Lung Cancer Surgery: Prediction and Consequences

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Background: Acute respiratory events after thoracotomy or VATS for lung cancer occur frequently and affect recovery.[1] The purpose of this study is to understand the factors that predict postoperative respiratory complications in patients undergoing lung cancer resection and to evaluate their effect on mortality.

Methods: Using data from the Massachusetts General Hospital sample of the Society of Thoracic Surgeons General Thoracic Surgery Database between September 2007 and December 2012, electronic anesthesia records, billing data, and chart review, the authors developed a score predicting acute postoperative respiratory complications in patients undergoing lung cancer surgery. Respiratory outcomes independently predicting 30-day mortality were determined using multivariate backwards-logistic regression. These predictors were then used to build the composite outcome "meaningful postoperative respiratory complications" in the second part of the study. Using multivariable logistic regression analysis, independent predictors of meaningful postoperative respiratory complications were determined and a score was postulated.

Results: Multivariate logistic regression identified ICD-codes for reintubation (incidence of 1%) and "early signs and symptoms of possible pulmonary edema" (incidence of 29%) within 7 days as the only respiratory events independently predicting 30-day mortality (OR 63.70 [95% CI 10.72-378.68], $P < 0.001$, and OR 11.98 [95% CI 1.39-103.05], $P = 0.033$, respectively). In our cohort of 1,025 patients undergoing lung cancer surgery, meaningful postoperative respiratory complications defined as early signs and symptoms of pulmonary edema or reintubation occurred in 303 cases (29.6%) within 7 days after surgery. Independent predictors of meaningful postoperative complications were: current smoker status, age over 62 years, undergoing pneumonectomy, procedure length of more than 3 hours, a preoperative DLCO of less than 72% predicted, congestive heart failure, chronic pulmonary disease, renal disease, and myocardial infarction (Table 1). A point value of 1.5, 1.5, 1.5, 1, 1, 1.5, 1.5, 1.5, and 3 was assigned to these predictors, respectively, based on theirβcoefficient in the predictive model. The 14-point Score for Prediction of acute post-Operative Respiratory Complication following Lung Cancer resection (SPORC-LC) yielded a calculated area under the curve of 0.68, whereas each point increment was associated with a 1.54-fold (odds ratio: 1.54 [95% CI, 1.40–1.69], $P<0.001$) increase in the odds for postoperative respiratory complications within 7 days of surgery predictive of death.

Conclusion: The SPORC-LC, a composite score derived from patient characteristics tracked in surgical and anesthesia databases, predicts meaningful postoperative respiratory events that in turn predict early postoperative death. Risk prediction along a continuum of pre- and postoperative care may focus clinical resources to rescue those patients at greatest risk of death after resection for lung cancer.

References

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Table 1

Predictor	Acute respiratory complications, % (n)		Risk increase (Odds ratio)	95% confidence interval	P-Value	Assigned Point Value
	Condition fulfilled	Condition not fulfilled				
Currently smoking	39.3 (55)	28.2 (246)	1.77	1.15-2.73	0.009	1.5
Age > 62	35.2 (191)	23.1 (112)	1.75	1.26-2.43	0.001	1.5
Pneumonectomy	43.2 (32)	28.5 (271)	2.18	1.23-3.84	0.007	1.5
Procedure duration > 3.34h	33.1 (167)	26.2 (136)	1.40	1.02-1.92	0.039	1
Predicted DLCO < 72%	37.4 (150)	23.7 (111)	1.55	1.13-2.12	0.007	1
Congestive Heart Failure	55.2 (42)	27.5 (261)	1.97	1.13-3.44	0.017	1.5
Chronic Pulmonary Disease	41.8 (140)	23.6 (163)	2.01	1.46-2.78	<0.001	1.5
Renal Disease	52.8 (19)	28.7 (284)	2.36	1.11-5.00	0.026	1.5
Myocardial Infarction	73.7 (14)	28.7 (289)	4.23	1.38-13.21	<0.001	3

10. Recognition of Obstructive Sleep Apnea in Pregnancy: A SOAP Provider Survey

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Background: Current literature suggests obstructive sleep apnea (OSA) is associated with adverse perinatal outcomes. Hypertensive disorders of pregnancy, gestational diabetes and obesity are of particular concern; disorders representing major causes of maternal and fetal morbidity and mortality, and significant healthcare expenditures. OSA is difficult to diagnose in pregnancy. Poor sleep and daytime sleepiness are expected and women report their sleep symptoms differently. Physicians caring for pregnant women should recognize associated risk factors and identify sleep symptoms in order to screen for OSA.

Aim: The purpose of this anonymous survey was to assess provider awareness of OSA in pregnancy and assess what guidelines and/or screening tools were in place to manage and detect this condition in developed nations.

Study Design: A 12-question, web-based survey was distributed in English to members of the Society for Obstetric Anesthesiology and Perinatology (SOAP). Responses were collected anonymously and analyzed by Survey Monkey®. Questions were in multiple-choice format, and respondents were able to write comments for select questions.

Results: The overall response rate is 285/1028 (27.7%). Respondents are mostly attending/consultant (92.2%), anesthesiologists (98.6%) who practice primarily in the United States (83%) and Canada (10.5%). Respondents work in both academic (70%) and private (30%) practice environments.

90.8% believe that OSA in pregnancy is a clinically relevant issue. 86.8% believe that management and treatment of OSA in pregnancy would improve maternal and/or neonatal outcomes. However, the majority of respondents (82.7%) said that their departments do not have OSA management guidelines for pregnant women. OSA guidelines exist during pregnancy (7.77%) or during labor (9.54%) in a minority of departments.

21.75% of respondents routinely screen for OSA in pregnancy, 35.44% screen only if patients are deemed at-risk, and most respondents (42.81%) never screen for OSA. Among those who do screen, 77% used the STOP-BANG questionnaire and 12.3% use the STOP questionnaire. Regarding OSA symptoms and history, the commonly asked questions were “prior history of OSA” (74%), followed by “night-time snoring” (64.9%),

and "observed apneas" (52%). Respondents were asked what diagnoses might make them concerned that a patient was at-risk for OSA. The top responses were risk factors in the non-pregnant population i.e. obesity (98.6%), difficult airway on physical examination (85.2%), essential hypertension (41.4%). Of note, 89.4% of respondents do not withhold neuraxial opiates for pregnant women with OSA.

Discussion: Our survey suggests that most clinicians agree that OSA in pregnancy is a clinically relevant issue, and if treated could potentially improve maternal and neonatal outcomes. However, only a minority of respondents screened for OSA routinely and departmental guidelines for the management of pregnant women with OSA are lacking. Recognition of associated risk factors for OSA in pregnancy i.e. hypertensive disorders, were not readily identified by obstetric anesthesiologists. STOP-BANG, the most commonly used screening tool, is not validated in pregnant women. When is the time to respond to this clinically relevant condition in pregnancy?

11. Does High Intra-Operative Inspiratory Oxygen Fraction Lead to Postoperative Respiratory Complications?

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A high intra-operative inspiratory oxygen fraction (FiO_2) may improve tissue oxygenation but lead to impairment of pulmonary function. We tested the hypothesis that a high FiO_2 increases the risk of major postoperative respiratory complications.

Methods: This cohort study included all intubated adult patients undergoing non-cardiothoracic surgery at Massachusetts General Hospital, Boston, MA between January 2007 and September 2012 (clinicaltrials.gov/NCT02399878). Data from two databases were retrieved and combined to provide pre-, intra-, and postoperative information: the Anesthesia Information Management System, and the Research Patient Data Registry. The exposure variable was median intraoperative FiO_2. The primary outcome was a composite of major respiratory complications (re-intubation, respiratory failure, pulmonary edema and pneumonia) developed within 7 days after surgery. Secondary outcomes included surgical wound breaks within 21 days, admission to the intensive care unit within 7 days and mortality within 7 and 30 days after surgery. The associations between FiO_2 and outcomes were examined across all quintiles of FiO_2 using the significance of the Pearson Partial Correlation Coefficient as the P for trend in an a priori defined logistic regression model including pre-defined covariates (age, gender, body mass index, American Society of Anesthesiologists physical status classification, chronic obstructive pulmonary disease, Charlson Comorbidity Index, Score for Prediction Of Postoperative Respiratory Complications,[1] duration of anesthesia, tidal volume, positive end-expiratory pressure, fluid administration,

dose of vasopressors, morphine, and neuromuscular blocking agents, blood transfusion, surgical procedure, acute surgery, outpatient surgery, relative value units of the procedure). Results are reported as number (percentage) or odds ratio (OR) and [95% confidence interval].

Results: A total of 45658 patients were included in the primary analysis (Table) of whom 1569 (3.4%) developed one or more respiratory complications within 7 days. Pulmonary edema was the most common complication, occurring in 1070 patients (2.3%). Surgical wound breaks were recorded in 168 patients (0.4%) within 21 days and 1045 (2.3%) patients were admitted to the intensive care unit within 7 days. Twenty-nine (0.1%) and 263 patients (0.6%) died within 7 and 30 days postoperatively. Median intra-operative FiO_2 was associated with an increased risk of major respiratory complications in a dose-dependent fashion (5^{th} quintile vs. 1^{st} quintile: 1.81 [1.46-2.24], P for trend<0.0001). Mortality within 30 days and ICU admission within 7 days were also significant increased with higher median FiO_2 (5^{th} quintile vs. 1^{st} quintile: 1.77 [1.03-3.04], P for trend<0.0001) and (5^{th} quintile vs. 1^{st} quintile: 1.66 [1.30-2.12], P for trend = 0.0056), respectively. In contrast, surgical wound breaks were dose-dependently reduced with a high FiO_2 (5^{th} quintile vs. 1^{st} quintile: 0.71 [0.38-1.32], P for trend = 0.0005).

Conclusion: We found that a high intra-operative FiO_2 was significantly associated with the occurrence of major postoperative respiratory complications, intensive care unit admission, and mortality within 30 days independent of predefined pre-and intraoperative risk factors. Further analyses are required to differentiate between preexisting impairment of gas exchange and intraoperative oxygen toxicity as mechanisms of postoperative respiratory complications.

1. Anesthesiology 2013;118:1276-85

Table. Clinical Characteristics of Patients

	FiO_2 1^{st} quintile (n=9000)	FiO_2 2^{nd} quintile (n=9290)	FiO_2 3^{rd} quintile (n=9970)	FiO_2 4^{th} quintile (n=10480)	FiO_2 5^{th} quintile (n=6918)
Median FiO_2	0.30 [0.27-0.31]	0.36 [0.34-0.39]	0.48 [0.45-0.50]	0.56 [0.55-0.58]	0.78 [0.69 0.93]
Age (years)	54 [41-65]	56 [44-67]	56 [44-66]	54 [42-65]	56 [43-67]
Gender (male/female)	47%/53%	45%/55%	45%/55%	37%/63%	43%/57%
BMI (kg/m^2)	27 [24-31]	27 [24-32]	28 [25-33]	27 [24-32]	27 [24-33]
ASA (I/II/III/IV/V/VI)	13%/63%/23%/1%/0.01%/0.02%	11%/64%/24%/1%/0.02%/0.04%	9%/63%/26%/1%/0.01%/0.04%	10%/63%/26%/1%/0.01%/0.03%	8%/53%/34%/2%/0.04%/0.03%

Duration of anesthesia (min)	163 [111-231]	139 [91-206]	152 [99-224]	145 [90-227]	115 [63-202]
Surgical body region					
Central nervous system	22%	12%	9%	7%	4%
Musculoskeletal	31%	30%	24%	11%	11%
Abdominal, gynecology or urology	18%	28%	42%	58%	58%
Other	29%	30%	25%	24%	27%

Data are reported as median [IQR] or percentage. FiO_2, intra-operative inspiratory oxygen fraction; BMI, body mass index; ASA, American Society of Anesthesiologists physical status classification;

12. Postoperative Effects on Sleep and Sleep Apnea in Patients Undergoing Open Surgery of Colorectal Cancer

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Background: Respiratory complications including atelectasis are common after major abdominal surgery. Sleep quality and sleep apnea are affected by surgery, but the effect on sleep and sleep apnea from open surgery of colorectal cancer is essentially unknown.

Aim: To study perioperative effects on sleep and sleep apnea in patients undergoing surgery for colorectal cancer

Method: 28 patients with colorectal cancer were included and monitored the night before and the second night after surgery. Arterial blood gas measurements, lung-function and overnight polysomnography (Embla) including continuous recordings of respiration, breathing movements, oxygen saturation, EEG, EOG, chin EMG, ECG and body position sensor were collected.

Results: The mean (SD) apnea-hypopnea index was 19 ±15 before surgery and 17 ±23 during the second night after surgery, $p=0.45$. The apnea-hypopnea index was significantly lower after surgery in both the side position and supine position, $p<0.01$. The apnea hypopnea index was higher in supine position, and patients slept significantly more in the supine position on the second night after surgery $p<0.001$ (Table). Sleep efficiency was reduced from 68% to 55% ($p<0.05$). The amount of stage 1 sleep increased significantly while stage 3, 4 and REM sleep was reduced postoperatively. The vital capacity decreased by 32% ($p<0.001$), PaO_2 decreased by 1.9 kPa ($p<0.001$), PCO2 was unchanged and Base Excess increased from 0.1 mEq/L to 1.4 mEq/L ($p=0.02$)

Conclusions: The frequency of sleep apnea is high both before and after surgery for colorectal cancer, especially when sleeping in the supine position. The apnea-hypopnea index is lower after surgery in both the supine and the side positions, but patients sleep more in the supine position which explain why total apnea-hypopnea index is unaffected by surgery. Sleep quality, lung function and oxygen partial pressure is reduced in the postoperative period.

13. Is the Alpha Frequency Band of the EEG a Marker of Unconsciousness During Sedation with Propofol and Remifentanil? The Influence of Aging

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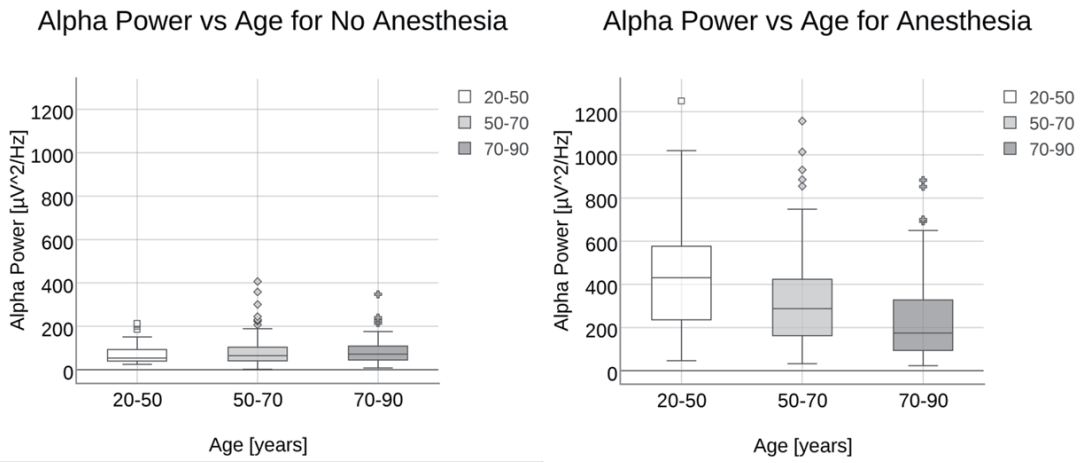
Introduction: Several aspects still remain unknown in the transition from consciousness to unconsciousness when anesthetic drugs are administered. It is probably due to the complexity of the phenomena and the contribution of different mechanisms and pathways involving different receptor systems. It has been recently proposed that a sudden, intense presence of α band in the spectral analysis of the EEG indicates lack of consciousness when propofol or sevoflurane has been administered(1). The goal of this study was to analyze a previously collected database of EEG recorded under sedation for endoscopic procedures(2,3) to study the possible influence of the aging process in the transition between consciousness and unconsciousness.

Methods: Under IRB approval data from 380 patients undergoing sedation and analgesia with target controlled infusion of propofol and remifentanil was recorded and stored. Three groups of age were defined: 20-50, 51-70, >70 years old. Raw EEG was processed to obtain the spectrogram. The power in the α frequency band (8-13Hz) was obtained for every patient in every group and the mean value was obtained and compared between groups. Data were analyzed with respect to age in baseline conditions and under sedation. Measurements of Ramsay Sedation Score (RSS) were performed as a behavioral assessment of the level of consciousness.

Results: 58 patients under 50 years old, 157 between 51 and 70, and 101 older than 70 were studied. As can be seen in the figure at baseline conditions (left panel) there is very little α activity in the EEG and it is comparable across different ages. Propofol and remifentanil administration induces an increase in power in the EEG that translates in about ten times higher power in the α frequency band under sedation (right panel). Changes in the distribution of total power, presence of burst suppression pattern and changes in the δ band were also detected and related to age groups. Under anesthesia it can be observed a trend towards less increase in α frequency as age increases



Even though there is almost no presence of α frequency activity in most patients older than 70 years, they were indeed unconscious according to their Ramsay Sedation Score ≥4.

Conclusion: α activity increases during sedation with propofol and remifentanil. In older patients α activity is minimal or absent despite being unconscious as evaluated by RSS. Further work will be required to study the underlying neurophysiologic changes induced by aging with respect to the EEG changes during propofol and remifentanil administration.

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14. Using HRV Metrics to Phenotype OSA Patients Who Develop Postoperative Respiratory Failure

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Purpose: Postoperative respiratory failure (PRF) is associated with increased mortality and hospital costs. Patients with obstructive sleep apnea (OSA) are at an increased risk of PRF requiring reintubation. OSA is characterized by dysregulation of arousal efferent loops associated with underlying autonomic nervous system (ANS) disturbances. Heart rate variability (HRV) is a parameter that provides a measurement of ANS responses. The aim of this study is to explore the value of frequency domain HRV metrics in phenotyping OSA patients who develop PRF.

Methods: Frequency domain metrics for normalized low frequency (nLF) and high frequency (nHF) were analyzed using a retrospective case-control design. HRV metrics were calculated using ECG channels from either a preoperative or postoperative overnight polysomnogram. The differences in HRV metrics between two groups of patients with a diagnosis of OSA were examined in (1) patients who did not have a PRF and (2) patients who required reintubation. Patients in (1) were case-matched to patients in (2) based on gender, age, OSA severity, and surgical service providing procedure.

Results: Each group included 20 patients of whom, 7 were on beta-blockers. In patients not treated with beta-blockers, the nHF was significantly increased for (2) compared to (1) by 11.40 (52.01 $\pm$ 9.45 vs. 63.41 $\pm$ 10.55, p-value: 0.01). Additionally, the nLF was significantly decreased for (2) compared to (1) by 11.44 (47.81 $\pm$ 9.49 vs. 36.37 $\pm$ 10.55, p-value: 0.01). Furthermore, the ratio of LF and HF power decreased for (2) compared to (1) by 0.38 (1 $\pm$ 0.61 vs. 0.62 $\pm$ 0.25, p-value: 0.04).

Conclusions: Patients with PRF were found to have HRV profiles indicating vagal predominance and decreased sympathetic influences. However, there was overlap of metrics, limiting its use as a classification tool at this stage. These results suggest that HRV metrics may inform development of novel prediction indices for PRF in OSA.

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15. Effects of Postoperative Residual Paralysis on Postoperative oxygenation and Hospital Length of Stay

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Objective: In this prospective cohort study we tested the hypothesis of postoperative residual paralysis being associated with impaired oxygenation, atelectasis, intensive care unit (ICU) admission and prolonged hospital length of stay (LOS).

Methods: Three thousand patients undergoing general anesthesia with neuromuscular blockade were included in this prospective, observer-blinded study. On arrival at the post-anesthesia care unit the train-of-four (TOF) ratio was measured and the ratio of peripheral oxygen saturation to fraction of inspired oxygen (S/F ratio, primary outcome) was assessed. The secondary outcomes included hospital LOS as well as the incidence of atelectasis and intensive care unit admission. With an exploratory intention we also analyzed effects on costs of hospital stay. Associations between TOF ratio and outcomes were assessed by logistic, ordinal, or zero-truncated Poisson regression, including adjustments for a priori defined covariates (age, body mass index, ASA, duration of surgery, high-risk surgery, neostigmine). Post hoc, we examined the P for trend between hospital LOS and degree of residual paralysis, assessed by a TOF ratio below 0.8, between 0.8 and 0.9 and above 0.9, as well as total dose of neuromuscular blocking agents (NMBAs), measured as multiples of ED95 and divided into quintiles, with the significance of the Pearson Partial Correlation Coefficient.

Results: The number of patients with a TOF-ratio<0.9 was 592 (20%). Patients with TOF-ratio<0.9 did not have a lower S/F ratio (odds ratio (OR) 0.88 [95% confidence interval (CI) 0.62-1.26]). The effect of residual paralysis on hospital LOS was dose (TOF-fade)-dependent (P for trend=0.009; incidence rate ratio (IRR) of TOF-ratio<0.9 compared to TOF-ratio>0.9: 1.14 [95% CI 1.08-1.20]). Postoperative residual paralysis was associated with a significantly higher incidence of atelectasis (OR 1.42 [1.01-1.99]) and the number of patients admitted to the ICU was significantly higher among patients with TOF ratio<0.9 compared to patients with no residual paralysis in the

unadjusted analysis (18 (3%) vs. 33 (1%), respectively, OR 2.10 [95% CI 1.18-1.76]). However, significance was lost in the adjusted analysis (OR 1.74 [95% CI 0.93 – 3.28]). Postoperative residual paralysis leaded to a significant increase in hospital costs (IRR 1.13 [95% CI 1.13-1.13]). Total dose of NMBAs translated to prolonged hospital LOS even when controlling for residual paralysis (5th quintile vs. 1st quintile of NMBAs: IRR 1.10 [1.00-1.21]).

Summary: Residual paralysis did not impair the immediate postoperative oxygenation but was associated with a significant increase in hospital length of stay and a higher incidence of atelectasis, which translated to higher hospital costs.

Table 1. Clinical Characteristics and Outcomes

	TOF ratio < 0.9 (n=592)	TOF ratio ≥ 0.9 (n=2301)
Age (yrs)	57 [44-68]	57 [45-67]
BMI (kg/m^2)	28 [24-34]	28 [24-32]
ASA I/II/III/IV/V	11% / 58% / 30% / 0.7% / 0.2%	9% / 64% / 26% / 0.3% / 0.1%
Neostigmine Dose (ug/kg)	35 [19-52]	33 [12-49]
ND-NMBAs (ED95/kg/h)	1.5 [1.1-2.2]	1.5 [1.0-2.3]
Duration of surgery (min)	121 [76-186]	120 [76-186]
High-risk surgery	238 (40%)	765 (33%)
S/F ratio	164 [162-164]	164 [161-164]
Postoperative hospital LOS (days)	3 [2-5]	3 [2-4]
Atelectasis	63 (11%)	162 (7%)
ICU admission	18 (3%)	33 (1%)

Data are reported as median [IQR] or number (percentage).
TOF, Train-of-four; BMI, body mass index; ASA, American Society of Anesthesiologists physical status classification; ND-NMBAs, non-depolarizing neuromuscular blocking agent; S/F ratio, The ratio of peripheral oxygen saturation to fraction of inspired oxygen at arrival to the post-anesthesia care unit; LOS, length of stay; ICU, intensive care unit

16. Effect of Reverse Trendelenburg Position on Mask Ventilation During Induction of Anesthesia in Overweight Adult Patients

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Conflict of interest: Dr Kacmarek is a consultant for Covidien and has received research grants from Covidien and Venner medical .All other the authors have no conflict of interest for this study.

Introduction: Difficult mask ventilation during induction of general anesthesia often presents as an unpredictable event potentially causing serious complications. Obese patients are a high-risk group and prone to have difficult mask ventilation. The aim of this study was to determine the effect of 20˚ reverse Trendelenburg position on effectiveness of mask ventilation in obese patients during general anesthesia.

Methods: A total of 13 adult patients with body weight index (BMI) in the range of 26 to 47 kg/m^2 were recruited. After apnea, patients were ventilated in the pressure-support mode at peak inspiratory pressure (PIP) of 12~24 cmH_2O, ventilation rate 10 breaths/minute with mask held in place by the two-hand technique. Respiratory parameters during mask ventilation were recorded in both supine and 20˚ reverse Trendelenburg position. Tidal volumes were calculated using respiratory inductance plethysmography in the corresponding position.

Results: PIP reached the target values and there was no difference in PIP between the two positions. Expiratory tidal volumes (average 897 ml, median 828ml, IQR 760-1064ml) during mask ventilation in 20˚ reverse Trendelenburg position were larger than those in the supine position (average 673 ml, median 720ml, IQR 499-781ml) (P<0.001). The total dynamic and static compliances of the respiratory system increased by 34.1% (average 39.5 *vs.* 52.9 $ml/cmH_2O/s$) and 46.4% (average 20.0 *vs.* 29.3 $ml/cmH_2O/s$) respectively by changing from supine to 20˚ reverse Trendelenburg position.

Conclusion: The reverse Trendelenburg position significantly improved the effectiveness of mask ventilation. The improvement occurs as a result of an increase in respiratory system compliance in the 20˚ reverse Trendelenburg position in overweight patients. If not contra-indicated, reverse Trendelenburg position should be routinely used during induction of anesthesia for obese patients.

17. Perioperative Cognitive Changes in Obstructive Sleep Apnea Patients

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Background: Obstructive Sleep Apnea (OSA) is a sleep-breathing disorder that affects roughly 25% of adults and 70% of these individuals are undiagnosed. In the perioperative setting, OSA patients are at increased risk for postoperative cognitive decline (POCD). We aim to determine which cognitive functions are impaired in the early postoperative period in OSA patients.

Methods: We recruited volunteers aged ≥50 years undergoing non-cardiac surgery with a minimum postoperative stay of 24 hours. After obtaining informed consent, all patients were asked to wear WatchPAT™, a portable sleep apnea monitoring device to gather baseline apnea-hypopnea index (pAHI). Cognitive functions were assessed using the word list, verbal fluency, and digit symbol substitution tests (DSST) and completed once preoperatively and once postoperative day (POD)1. An independent t-test was performed comparing cognitive performance of patients with moderate to severe OSA (pAHI>15) with patients with mild or no OSA (pAHI≤15) at preop and POD1.

Results: 10 patients who completed the portable sleep apnea monitoring device and cognitive assessments were included. The average age was 65 ± 10 years and 70% were male. 30% of patients had a pAHI>15. At preop, there was a trend where patients with pAHI>15 performed worse than patients with pAHI≤15 on verbal fluency and word list ($P<0.2$). On POD1, patients with pAHI>15 performed worse than patients with pAHI≤15 on verbal fluency ($P<0.2$).

Discussion: Patients with OSA may have greater acute POCD. Based on the results, it may be possible that the ability to organize thoughts and short-term memory may be affected the most. These results suggest that a lager sample size is necessary to confirm these preliminary findings.

18. Respiratory Safety: A Systems Approach using STOPBang and Risk Protocol

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Introduction: Patients with undiagnosed or diagnosed but untreated obstructive sleep apnea (OSA) has been characterized as an epidemic[1]. These patients are at increased risk when prescribed sedatives and narcotics (S/N), especially if they have other comorbidities. A respiratory safety protocol was developed and implemented across our 3 hospital system that triaged the use of respiratory monitoring for their patients. The baseline, at risk patients were unknown at our institution. The hypothesis is that implementation of a standard protocol will decrease the incidence of severe outcomes.

Methods: A protocol for identification for respiratory risk was initiated by:

1. Development an algorithm by assessing known protocols[2] and assessing all inpatient admissions with STOPBang as the assessment tool, coupled other risk identifiers (patient comorbidities).
2. A "best practice alert" tied a narcotic or sedative (S/N) order to the score done on admission. "Moderate" or "High" risk monitoring protocols were suggested based on a STOPBang score of 3-4 or 5 and greater.
3. Equipment needs were defined and purchase with system educational resources focused on the training and implementation of the assessment, and plan.
4. Local Data extraction was developed for feedback.
5. Retrospectively, the at risk patients were defined. All Rapid response (RRT) events for 1 year were analyzed by a STOPBang score extrapolated from an in house database, and chart review to define whether the protocol for monitoring could have captured the event, and what the severity outcome was for those patients who fit the protocol. After the first 5 months of implementation a random chart audit of 40% of the RRT events were analyzed similarly. After implementation, those patients had known STOPBang scores.

Results: In the first 4 months of implementation, 96% (5998/6223) of patients admitted to our academic medical center were assessed. 72% of patients admitted had a S/N ordered. 69.9% of patients with STOPBang of 3 or > and S/N had enhanced respiratory monitoring.

(Table 1)

Retrospective chart review determined that 85% of at the defined at risk patients could have been detected by the protocol, and 26% of those patients had severe outcome or death. After the implementation of the protocol, the number of Severe outcome or death decreased to 7% in those who were monitored with the protocol.

Conclusion: A system use of the best practice alerts can drive a match between OSA patients and resources for respiratory monitoring in the inpatient environment. Preliminary data demonstrates improvement in outcome.

References:

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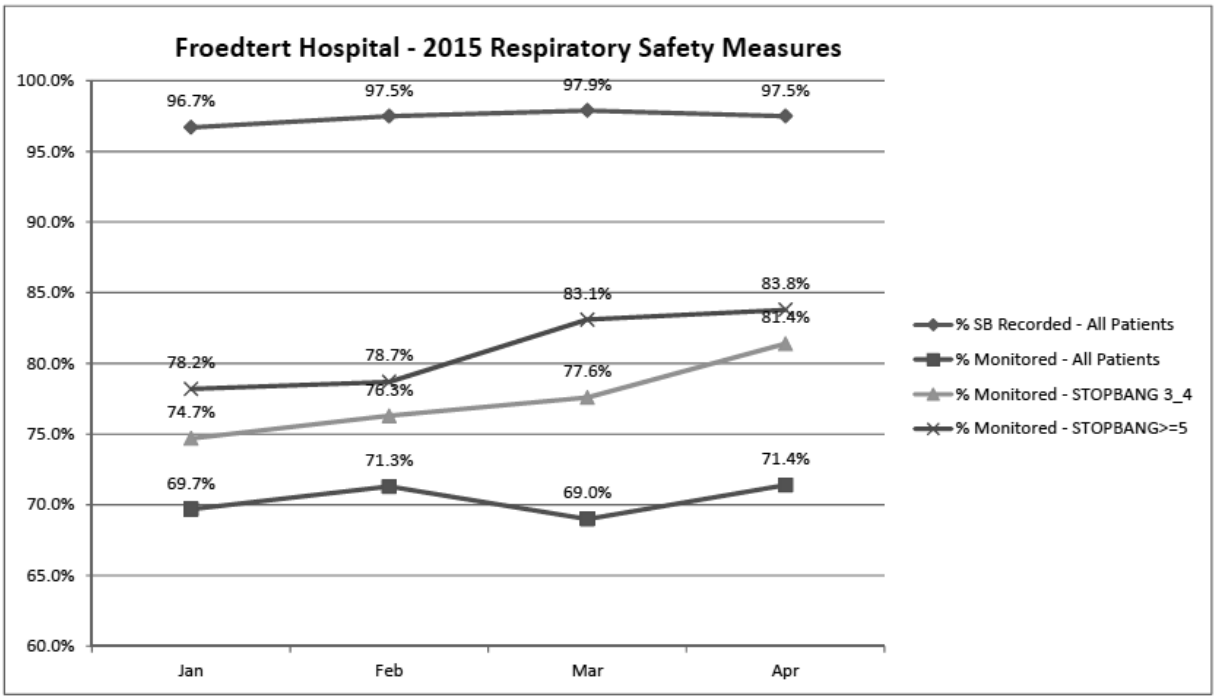
Table 1



Patient Denomintors (N)	Jan	Feb	Mar	Apr
All Admitted Patients	3,307	2,863	3,291	3,243
Patients with STOPBANG 3-4	914	772	665	657
Patients with STOPBANG >= 5	687	644	575	544

19. Effect of Ventilation Strategy on Compensation of Mask Leakage Using an Operating Room Ventilator and a Regular Full Face Mask: A Bench Study

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Conflict of Interest: Dr Kacmarek is a consultant for Covidien and has received research grants from Covidien and Venner medical. All other the authors have no conflict of interest for this study.

Background: Noninvasive ventilation (NIV) is safe and effective[1,2]. It is often provided using an ICU ventilator and a special mask designed for NIV[3]. However, NIV is frequently needed during anesthesia[4,5] or after extubation[6,7], but neither ICU ventilators nor special masks for NIV are immediately available in the operating room. Anesthesia ventilators and regular anesthesia masks are frequently used to provide brief periods of NIV until an ICU ventilator and NIV mask become available. The major challenge of such an approach is significant mask leakage and inability of operating room ventilator to compensate for mask leak[8,9]. The aim of this study is to determine the optimal strategy for NIV using a commonly available operating room ventilator and regular facemask.

Methods: We tested three operating room ventilators (Dägger Apollo piston ventilator, Dägger Fabius Tiro piston ventilator and Dägger Perseus A500 turbine ventilator) on a "normal" lung model with compliance of 50ml/cmH_2O and resistance of 5 cmH_2O/L/s. The ventilator was set using three ventilation strategies: pressure control ventilation (PCV) with peak airway pressure (PIP) 10, 15, 20 or 25 cmH_2O, volume control ventilation (VCV) or AutoFlow (VAF) with inspiratory tidal volumes 500, 750, 1000 or 1250 ml. Respiratory rate was set at 15 breaths per minute, I: E ratio at 1:1 and rise time of 0.5 second. Fresh gas flow (FGF) was set at 10L/min and maximal oxygen flow was 13 L/min for Apollo or 26 L/min for Perseus A500 and Fabius Tiro ventilators. Mask leak was set at 5 levels (level I to level V) from no leak to up to

40L/min by the use of customized T-pieces which were placed between the lung model and the distal end of breathing circuit connecting to the ventilator. Expired tidal volume from the lung model (VTe), leakage and PIP were recorded via two flow/pressure sensors placed proximal and distal to the T-pieces.

Results: All 3 operating room ventilators delivered target VTe at no leak for each ventilation strategy. Vte decreased as the level of leak increased and increased as fresh gas flow increased in all ventilators (Figure 1). At leak level II to V, PCV produced greater VTe than VCV and VTe obtained with VAF was in between those of PCV and VCV for Perseus A500 and Apollo.

Conclusion: Operating room ventilators compensate for circuit leaks much better with PCV than with VCV. VAF compensated for leaks better than VCV. There was significant difference among the 3 ventilators in term of VTe at any given level of leak ($p<0.01$). Perseus A500 in PCV compensated at the highest leak better than the other two ventilators. It seems operating room ventilators in conjunction with regular facemasks can be used as a bridge to NIV. Clinical studies are needed to validate this observation.

Keywords: ventilator, non-invasive ventilation, air leak, pressure control ventilation, volume control ventilation, volume with auto-flow.

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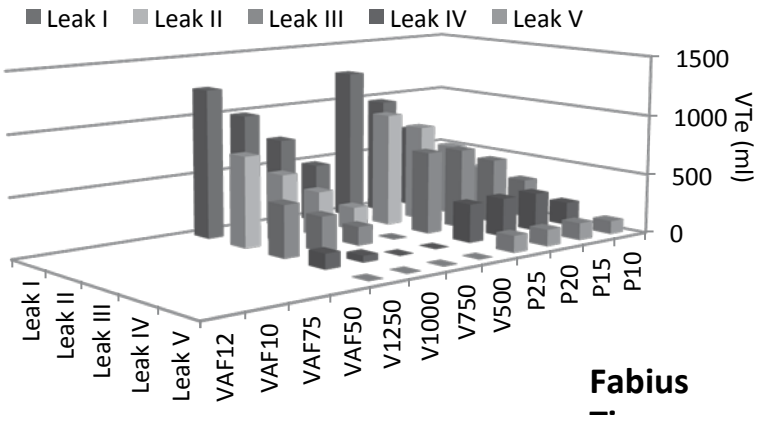
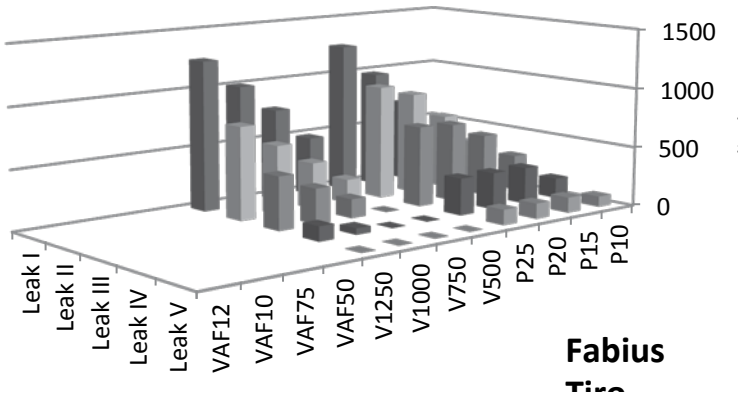
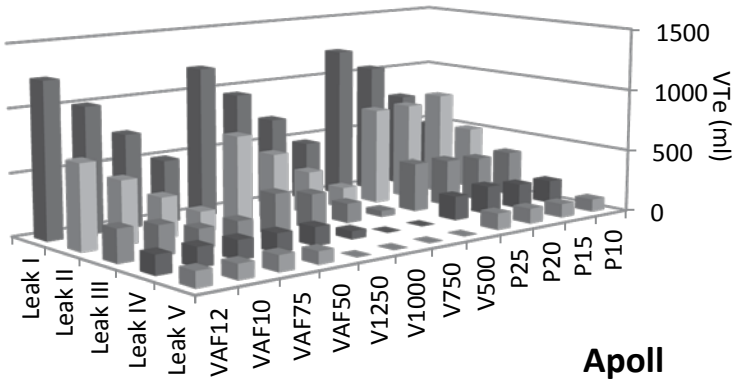


Fabius



Fabius



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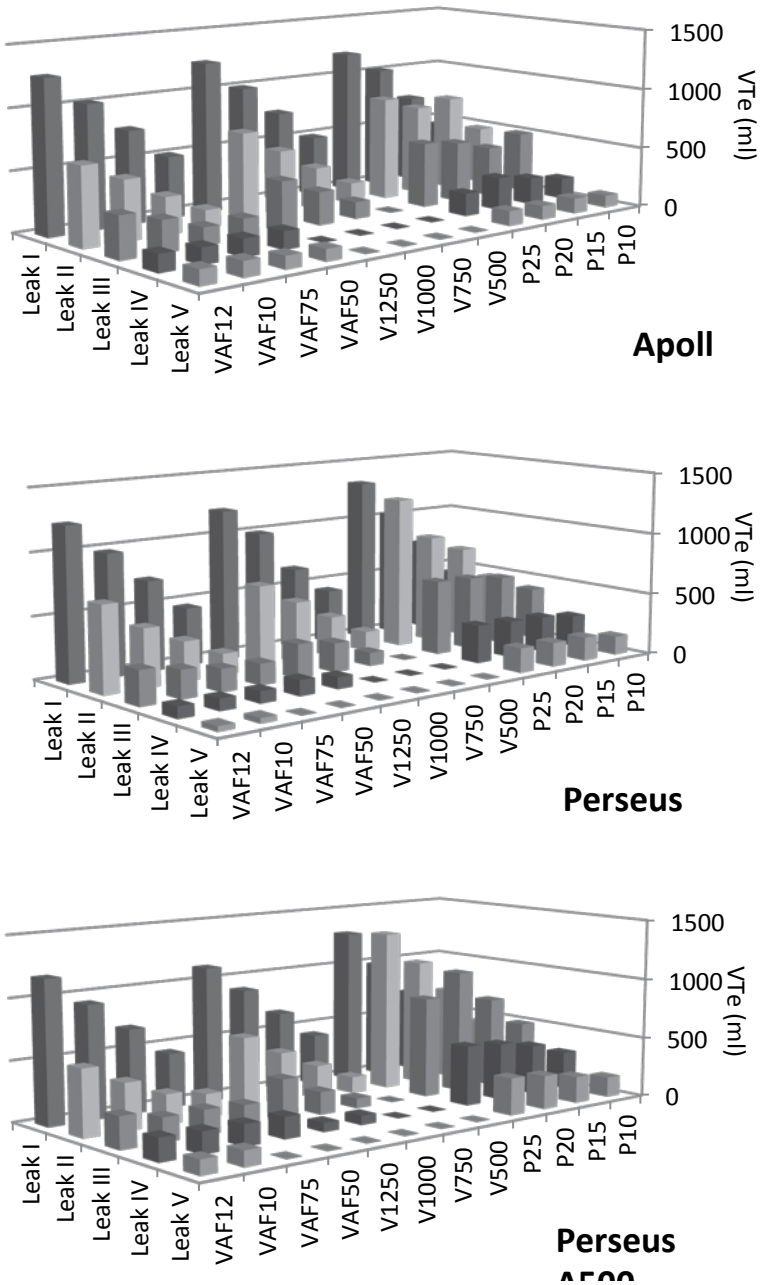

Figure 1. Expired tidal volume obtained with 3 operating room ventilators with different ventilation strategies and variable mask leak.

Panels on the left side illustrate the effect of ventilatory settings and leak levels on the expired tidal volume at fresh gas flow rate of 10 L/min and panels on the right at maximal oxygen flow rate. P, pressure control ventilation; V, volume control ventilation; VAF, auto-flow; Leak I-V, no leak to high leak; VTe, expired tidal volume; VTe is greater with PCV than with VCV when a leak is present ($p<0.01$). The histogram bars show mean values of VTe.

20. Survey of Sedation Knowledge of Anesthesiologists and Non-Anesthesiologists in a Single Institution

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Mehran Ebadi-Tehrani, MD; Mary Therese Biltucci, MA; Suzanne Karan, MD

Background: To the non-anesthesiologist, the difference between sedation and sleep may not be an obvious one. An understanding of sedatives and the physiological changes that occur with their administration is an important aspect of safe patient care. As anesthesiologists, we possess intimate knowledge and experience with the changes that occur in patients receiving sedation. However, with respect to patient safety, an anesthesiologist is not always present when sedation is being administered within the hospital. The non-anesthesiologist should possess basic knowledge regarding the levels of sedation and at what point intervention may be required. This is particularly significant when an anesthesiologist is not present to secure an airway and provide hemodynamic support.[1] The objective of this study was to qualify the knowledge of sedation practitioners (both anesthesiologist and non-anesthesiologist) in a single institution.

Methods: A brief survey was created via SurveyMonkey® using eight clinical scenarios, which represented different levels of sedation as defined by the ASA including mild, moderate, deep, and general anesthesia. The survey was sent to the departments of Anesthesiology, Emergency Medicine, Internal Medicine, Surgery, Pediatrics, Dentistry, and Oral and Maxillofacial Surgery within the University of Rochester School of Medicine and Dentistry. Participants were requested to identify their respective department and level of training, but personal identity was not solicited.

Results: A total of 402 surveys were distributed and 146 surveys were completed with participants including attendings, residents, and certified registered nurse anesthetists. The survey was also available to other non-physician sedation practitioners in other specialties but no responses were received. The results from the survey are demonstrated in Table 1.

Department	n	Minimal Sedation	Moderate Sedation	Deep Sedation	General Anesthesia
Anesthesiology (102)	67	59.70%	54.40%	70.10%	54.40%
Emergency Medicine (50)	27	68.50%	59.20%	62.90%	9.20%
Surgery (70)	10	60%	50%	60%	5%
Internal Medicine (95)	17	58.80%	44.10%	58.80%	8.80%
Pediatrics (70)	17	70.50%	47%	70.50%	8.80%
Dentistry (5)	2	75%	50%	50%	50%
OMFS (10)	6	75%	80%	66.60%	25%

Table 1 – Respondents and percent correct

In addition to the clinical scenarios, respondents were asked if general anesthesia requires the presence of an endotracheal tube. 96% of anesthesia providers answered correctly and only 41% of non-anesthesiologists responding correctly.

Discussion: The results of this survey demonstrate that both anesthesiologists and non-anesthesiologists identified minimal and moderate sedation at approximately the same rate. However, non-anesthesiologist differed from anesthesiologists in their ability to correctly identify general anesthesia. Providers of deep sedation need to be able to rescue from general anesthesia; thus, knowledge of how this state presents is imperative. The results of this survey will be useful for the sedation officer of our institution (an anesthesiologist) to guide the appropriate education of sedation providers under our aegis. A literature search did not yield a similar study and this questionnaire has high applicability to other institutions with respect to sedation education and patient safety. This survey may be considered for both use in a multi-center analysis of knowledge of sedation as well as medical student education.

References:

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Appendix i:

1. A healthy 22 year old man was involved in a head to head collision in a soccer game with subsequent scalp laceration. He is anxious while waiting in urgent care and asks for medication to help calm him down. Following administration of oral midazolam, he is mildly uncoordinated and is slow to respond to questions but answers appropriately. His laceration is infiltrated with 10 cc of 1% lidocaine with epinephrine and subsequently closed. What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation
   D- General Anesthesia

2. A 58 year old woman presents to an OMFS clinic after sustaining a fall down a flight of stairs resulting in a fractured tooth. She is morbidly obese (BMI 65) and is an extremely difficult IV placement. After several failed attempts, she is refusing any further attempts without some sedation. She is given 4L N2O by nasal mask wiith no significant changes in her vital signs. Her response to verbal questioning is delayed but appropriate. What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation

D- General Anesthesia

3. An otherwise healthy 6 year old child, weighing 20 kg, presents to the ED with a dislocated elbow after falling from a tree. He is extremely anxious and in significant pain. He will not sit still for any vital signs to be obtained or allow an IV to be placed. In the ED he is restrained by three RNs and given 100 mg of intramuscular ketamine by the intern for sedation. In 5 minutes, the patient is dissociative but breathing spontaneously requiring only 2 L/min of O2 by nasal cannula and occasional jaw thrust. He is not responsive to painful stimuli. What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation
   D- General Anesthesia

4. A 38 year old obese woman with Complex Regional Pain Syndrome affecting her right lower extremity has been admitted to the hospital for pain management. She has been managed with a fentanyl patch and oral oxycodone IR as well as diazepam for anxiety. Over the last 2 hours, the patient has become increasingly unarousable to verbal stimuli. Her blood pressure and heart rate remain stable but she begins to hypoventilate and exhibits signs of airway obstruction with snoring and occasionally gasping for air. She has worsening room air oxygenation resulting in an SpO2 dropping from 99% to 85%. Stimulation of her right ankle results in withdrawal of the right lower extremity. What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation
   D- General Anesthesia

5. A 70 year old man presents for a routine colonoscopy. An anesthesiologist was consulted as the patient has a history of congestive heart failure and has an AICD in place. After placement of an IV catheter, the patient receives propofol and is unresponsive to verbal stimulation but continues to breathe spontaneously while receiving oxygen via nasal cannula and having his capnography monitored. As the colonoscope is placed, the patient moves in discomfort, reaching for the colonoscope, with a brief increase in heart rate but as the scope is further advanced, his movement ceases and heart rate returns to baseline. What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation
   D- General Anesthesia

6. A 45 year old woman was admitted to the Neurology service with double vision and headaches. An MRI is required to rule out intracranial neoplasm. The patient states she is extremely claustrophobic and cannot lie flat due to her back pain. She agrees to receive sedation and pain control "through the IV" and attempt the MRI. She receives intravenous diazepam and morphine. She becomes increasingly sedated but maintains spontaneous ventilation and is able to answer questions although her responses are delayed and her voice is soft. What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation
   D- General Anesthesia

7. A 56 year old male is intubated in the ICU following a COPD exacerbation. The patient is being weaned by having him perform a trial of breathing via a t-piece. An intravenous infusion of dexmedetomidine is being administered to provide sedation and analgesia. When asked, he appropriately moves all four extremities and nods/shakes his head in response to questions." What is the patient's current level of sedation?
   A- Minimal Sedation
   B- Moderate Sedation
   C- Deep Sedation
   D- General Anesthesia

8. General anesthesia requires placement of an endotracheal tube or LMA?
   A- True
   B- False

NOT POSTED: Preoperative Sleep Medicine: A Novel Approach to Hospital Finances and Patient Safety

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Luisa Bazan, MD, Henry Ford Health System
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Obstructive sleep apnea (OSA) is the most common sleep related disorder with a prevalence in the surgical population of up to 70% with most undiagnosed. Patients with OSA may have an increased risk for perioperative morbidity and mortality especially if they undergo elevated risk procedures requiring general anesthesia and opioid therapy. It is, therefore, critical to establish processes for rapid diagnosis and treatment in the preoperative period. Algorithms have been established to accomplish this systems based practice.

Aim: The aim of this project is to establish processes within 6 months for urgent diagnosis and treatment of obstructive sleep apnea (OSA) in the preoperative patient through a multidisciplinary group, including surgeons, anesthesiology, hospitalists, and – sleep medicine.

Method: Weekly meetings with key members of the sleep medicine team resulted in quality improvement processes for immediate patient evaluation in the Preop Clinic, home sleep testing, and therapeutic CPAP mask fittings BEFORE surgical procedure.

Conclusions: ALL preop patient evaluations resulted in a POSITIVE diagnosis. We have around 50 new patients to the sleep medicine clinic. A 2014 abstract to the American Thoracic Society meeting demonstrated patients with preoperative OSA diagnosis had LESS transfers to intensive care unit, and LOWER median hospital costs ($23,905 to $17,782) in the UVA Orthopedic Clinic patients.

In application of these numbers:

$23,905 – $17,782 = $6,123 per patient in **hospital cost savings**
$6,123 x 50 = $306,150 for 50 newly diagnosed and treated patients *in a 4 month time period*
$306,150 x 3 = **$918,450** hospital cost savings per year

While the preoperative period is "a teachable moment," some patients refused sleep evaluation. This list of patients will serve as a control group for future study.

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21. Double Trouble: Association of Bronchial Asthma and Sleep Disordered Breathing with Pediatric Respiratory Adverse Events

Olubukola O Nafiu (MD, FRCA, MS)

Introduction: Bronchial asthma (BA) shown dramatic increase worldwide affecting an estimated 300million people and it is presently the most common chronic childhood disease worldwide (2). In consonance with this is the alarming increase in the prevalence of SDB among adults and children particularly those belonging to the high BMI category (2). The parallel increase in the prevalence of these two chronic disorders not only makes them important public health problems but has also increased the likelihood that they may occur concurrently in the same patient.

Because these "two protagonists" are so pervasive in the general population, it becomes increasingly likely that children undergoing anesthesia and surgery will have one or two of these disorders with the implicit potential to increase the risk of perioperative complications, particularly, perioperative airway complications.

Critical airway obstruction such as laryngospasm and bronchospasm are serious perioperative complications with potentially devastating consequences (3). About 1in3 children who develop laryngospasm suffer significant physiological perturbation (3). Indeed, occurrence of laryngospasm and or bronchospasm in children is frequently associated with rapid escalation of care in the perioperative period.

Although BA and SDB are frequently cited as risk factors for perioperative pulmonary complications (4,5), it is presently unknown whether children with concurrent diagnosis of BA and SDB have increased rates of perioperative critical airway obstruction. Therefore, the objective of this study was to compare the rates of perioperative critical airway obstruction among children with dual diagnosis of BA and SDB who did not have this diagnosis

Methods: Data for this report were derived from an earlier (IRB approved) prospective observational study in 1018 children aged 6-18yr, undergoing elective, non-cardiac operations. Clinical (age, ASA status, history of physician-diagnosed asthma, habitual snoring or OSA diagnosis) and detailed anthropometric data (height, weight, neck circumference, waist circumference) were prospectively collected in all patients. Rates of perioperative laryngospasm and bronchospasm were compared between the two groups. Univariate comparison of perioperative variables made across study groups. Clinically relevant risk factors were entered into a backward logistic regression model to calculate the adjusted odds ratio for laryngospasm.

Results: The overall prevalence of high BMI (overweight/obese) was 32.7% while 20.4% of children had a diagnosis of asthma. BA/SDB was present in 10% of patients.

Perioperative laryngospasm occurred in 45 (4.1%) subjects. Children in the SDB/asthma group had 1.8 times higher unadjusted odds of developing critical airway obstruction (OR = 1.8; 95% CI = 1.59-6.23, p =0.001). After adjusting for several relevant covariates (age, gender, intubation yes/no, OSA history, induction method) in a logistic regression model, SDB/asthma remained a consistent risk factor for intraoperative CAO in these patients (OR = 1.3; 95%CI = 1.18-9.5, p = 0.003).

Conclusion: These results indicate that children who were SDB and BA at the time of surgery have higher rates of perioperative CAO compared to their peers. Mechanisms underlying these increased risks deserve further elucidation but may be related to systemic and airway inflammation. Recognizing these children as an at-risk group could prove helpful for perioperative risk stratification of patients and appropriate allocation of resources.

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22. Validation of the STOP-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea Patients Among Different Populations: A Systematic Review and Meta-Analysis

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Introduction: The diagnosis of patients with suspected obstructive sleep apnea (OSA) is important because of the increased risk of perioperative complications. Polysomnography (PSG) - the gold standard for diagnosis of OSA - is time consuming and costly. The STOP-Bang questionnaire is a validated screening tool for obstructive sleep apnea[1]. We conducted this systematic review to compare the effectiveness of STOP-Bang to screen OSA patients in the different population.

Methods: A search of the literature databases MEDLINE (from 2008 to April 2014), Medline-in-Process & other non-indexed citations (up to May 2014), Embase (from 2008 to May 2014), Cochrane Central Register of Controlled Trials (up to May 2014), Cochrane Databases of Systematic Reviews (from 2008 to march 2014), Google Scholar, Web of Sciences (from 2008 to August 2014), Scopus (2008to August 2014) and PubMed (from 2008 to August 2014) was carried out. The search yielded 340 citations. Irrelevant papers were excluded by title and abstract review, leaving 46 manuscripts. Inclusion criteria were: 1) Studies that used STOP-Bang questionnaire as a screening tool for OSA in adult subjects (>18 year); 2) The accuracy of the STOP-Bang questionnaire was validated by polysomnography - a gold standard for diagnosing OSA; 3) OSA was clearly defined as apnea/hypopnea index (AHI), apnea index (AI), or respiratory disturbance index (RDI) ≥ 5; 4) Publications in English language. Validity criteria assessing internal and external validity were explicitly described and coded according to Cochrane methods group on screening and diagnostic tests. Statistical analysis was carried out using the Review Manager 5.3 software. The data about predictive parameters was pooled and the diagnostic odds ratio and AUC was estimated.

Results: The systematic review was carried out in 17 studies including a total of 9,026 patients (11 studies in the sleep clinic patients, n=3175; 3 studies in the surgical patients, n=827 and 3 studies in the general population and renal patients, n=5027). These prospective studies were conducted in 8 different countries. In the sleep clinic population, a STOP-Bang score ≥3 for an AHI cutoff ≥5 has an excellent sensitivity (88%) and high PPV (90.9%) for the detection of OSA. Moreover, a STOP-Bang score ≥3 showed a high discriminative power to exclude moderate and severe OSA as reflected by a negative predictive value of 78.4% and 91.7% respectively. In the surgical population, a STOP-Bang score ≥3 for an AHI cutoff ≥5 has high sensitivity (84%) and moderate PPV (76%) for the detection of OSA. Similarly, a STOP-Bang score ≥3 showed a high discriminative power to exclude moderate and severe OSA as reflected by a negative predictive value of 84.1% and 97% respectively. In all these population the

sensitivity increased with the increasing severity of OSA at the cost of decreasing specificity (Table 1).

Conclusion: The STOP-Bang questionnaire has been validated in the general population, sleep clinic patients and in the surgical patients.

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Table 1 - The Pooled Predictive Parameters of STOP-Bang of 3 Questionnaires for Screening OSA

Predictive parameter	AHI ≥ 5	AHI ≥ 15	AHI ≥ 30
9A – Sleep clinic population			
	(11 studies, n = 3175)	**(10 studies, n = 1751)**	**(8 studies, n = 1572)**
Sensitivity	88.0 (87.0-89.0)	94.0 (93.0-96.0)	**97.0 (95.0-98.0)**
Specificity	**49.0 (45.0-54.0)**	33.0 (30.0-37.0)	27.0 (24.0-30.0)
Positive predictive value	**90.9 (89.7-91.9)**	69.1 (66.7-71.5)	50.0 (47.3-52.7)
Negative predictive value	41.9 (37.8-46.1))	78.4 (73.2-83.0)	**91.7 (87.7-94.7)**
Positive likelihood ratio	1.7 (1.5-1.9)	1.4 (1.16-1.58)	1.3 (1.14-1.46)
Negative likelihood ratio	0.2 (0.2-0.3)	0.2 (0.16-0.28)	0.2 (0.1-0.29)
Diagnostic odds' ratio	7.7 (6.1-9.7)	7.12 (5.16-9.86)	7.92 (4.62-13.56)
SROC	0.7388	0.7811	0.7257
9B – Surgical population			
	(2 studies, n = 827)	**(3 studies, n = 923)**	**(2 studies, n = 827)**
Sensitivity	84.0 (81.0-87.0)	91.0 (87.0-93.0)	**96.0 (92.0-98.0)**
Specificity	**43.0 (38.0-49.0)**	32.0 (28.0-36.0)	29.0 (26.0-33.0)
Positive predictive value	**76.3 (72.9-79.4)**	46.3 (42.7-50.0)	23.8 (20.7-27.2)
Negative predictive value	55.5 (48.8-62.0)	84.1 (78.8-88.5)	**97.0 (93.7-98.7)**

Positive likelihood ratio	1.6 (1.2 – 2.1)	1.3 (1.0-1.64)	1.4 (1.19-1.69)
Negative likelihood ratio	0.4 (0.3-0.5)	0.3 (0.15-0.65)	0.1 (0.03-0.57)
Diagnostic odds' ratio	4.46 (2.5-7.96)	4.08 (1.58-10.53)	11.31(2.07-61.7)
SROC		0.9523	

Data presented as percentage (95% Confidence Interval)

23. The Predictive Probability of Moderate-to-Severe Obstructive Sleep Apnea by the STOP-Bang Questionnaire

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Introduction: Diagnosing the patients with moderate-to-severe (Apnea Hypopnea Index [AHI] >15 events/hr) and severe (AHI >30) obstructive sleep apnea (OSA) is important because of the increased risk of perioperative complications. Polysomnography (PSG) - the gold standard for the diagnosis of OSA - is time consuming and costly. The STOP-Bang questionnaire is a validated screening tool for obstructive sleep apnea[1]. We conducted this meta-analysis to determine the predictive probability of moderate-to-severe (AHI >15) and severe (AHI >30) OSA by the STOP-Bang questionnaire.

Methods: A search of the literature databases MEDLINE (from 2008 to April 2014), Medline-in-Process & other non-indexed citations (up to May 2014), Embase (from 2008 to May 2014), Cochrane Central Register of Controlled Trials (up to May 2014), Cochrane Databases of Systematic Reviews (from 2008 to march 2014), Google Scholar, Web of Sciences (from 2008 to August 2014), Scopus (2008to August 2014) and PubMed (from 2008 to August 2014) was carried out. The search yielded 340 citations. Irrelevant papers were excluded by title, abstract and full-text review, leaving 5 manuscripts for analysis. Inclusion criteria were: 1) Studies that used STOP-Bang questionnaire as a screening tool for moderate-to-severe and severe OSA in adult subjects (>18 year); 2) The accuracy of the STOP-Bang questionnaire was validated by polysomnography - a gold standard for diagnosing OSA; 3) Availability of data on AHI or respiratory disturbance index (RDI) ≥15; 4) and probability of moderate-to-severe and severe OSA at the different STOP-Bang scores 5) Publications in the English language. Validity criteria assessing the internal and external validity were explicitly described and coded according to the Cochrane methods group on screening and diagnostic tests. The data about the probability of moderate-to-severe and severe OSA and the different STOP-Bang scores were pooled and presented as a bar graph.

Results: The meta-analysis was carried out in 5 prospective studies including a total of 2,792 patients (3 studies in the sleep clinic patients,[2-4] n=1835 and 2 studies in the surgical patients,[5,6] n=957). The data on the predictive probabilities for the different severities of OSA with the corresponding STOP-Bang scores were shown in Figure.

In the sleep clinic population, the probability of moderate-to-severe OSA for a score of 3 is 52%. With a stepwise increase of the STOP-Bang score to 4, 5, 6 and 7/8, the probability rises proportionally to 62%, 72%, 82% and 92% respectively (Fig 1A). Similarly, the same pattern exists for severe OSA. With a stepwise increase of the STOP-Bang score of 4, 5, 6 and 7/8, the probability of severe OSA climbs to 35%, 45%, 55% and 75% respectively (Fig 1B).

In the surgical population, the probability of moderate-to-severe OSA for a score of 3 is 40%. With a stepwise increase of the STOP-Bang score to 4, 5, 6 and 7/8, the probability soars proportionally to 48%, 60%, 68% and 80% respectively (Fig 1C). With a stepwise increase of the STOP-Bang score of 4, 5, 6 and 7/8, the probability of severe OSA escalates to 25%, 35%, 45% and 65% respectively (Fig 1D). A higher STOP-Bang score reflects a higher cumulative score of the known risk factors and the greater the probability of moderate-to-severe and severe sleep apnea.

Conclusion: In the sleep clinic and the surgical patients, the higher the STOP-Bang score, the greater the probability of patients suffering from moderate-to-severe and severe sleep apnea.

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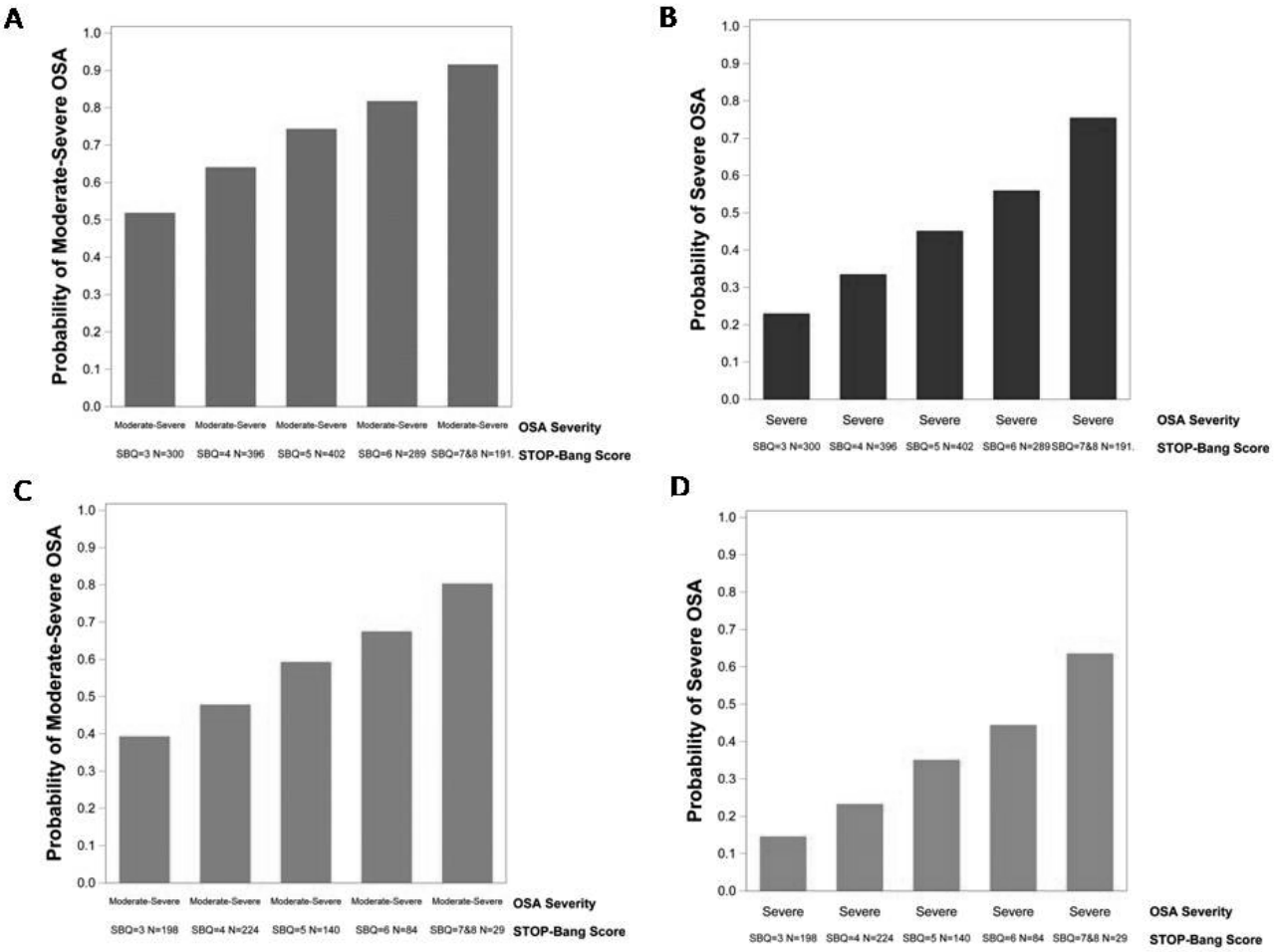

Figure 1: The relation between STOP-Bang questionnaire score and the probability of obstructive sleep apnea (OSA).

Panel A: STOP-Bang questionnaire score and the probability of moderate-severe OSA (AHI>15) in sleep clinic patients.

Panel B: STOP-Bang questionnaire score and the probability of severe OSA (AHI >30) in sleep clinic patients.

Panel C: STOP-Bang questionnaire score and the probability of moderate-severe OSA (AHI >15) in surgical patients.

Panel D: STOP-Bang questionnaire score and the probability of severe OSA (AHI >30) in surgical patients.

24. Different From Other Sedatives, Dexmedetomidine Retains Respiratory Carotid Reflex and Induces Balanced Inhibition Between Hypoglossal and Phrenic Nerve Activities in Rabbits

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Background: Sedation with benzodiazepines (Bz) or propofol often induces respiratory depression, such as upper airway obstruction and insufficient ventilation. These unfavorable phenomena are thought to come from the Bz-$GABA_A$ receptor complex system, and animal studies have shown that these sedatives inhibit hypoglossal nerve activity (HGA, keeping upper airway patency) more than phrenic nerve activity (PNA, making inspiratory negative force); this is thought to be one of the main causes of upper airway obstruction.

In contrast it is well known that dexmedetomidine (Dx), a highly selective alpha2-adrenergic agonist, is thought to provide effective sedation without appreciable upper airway obstruction; but its mechanisms have not been examined in detail.

Our study was designed to estimate the effects of step-increased doses of Dx on HGA, PNA and on the respiratory-related carotid chemoreceptor reflex (RCR) in anesthetized rabbits. These were done as a means of assessing the relationship between Dx and

upper airway obstruction.

Methods: The Saitama Medical University Animal Care Committee approved the studies. Experiments were done on adult rabbits (n=5) that were vagotomized, paralyzed and artificially ventilated with 50%N_2O, 50%O_2 and 0.5%sevoflurane for basal anesthesia. Animals were administered Dx (1.0, 10, 30 and 50 micro-gram/kg iv) incrementally every 25 min.

We measured the following parameters on the integrated neurogram before and after Dx (1, 5, 15 and 25 min after each administration): the peak amplitude (AMP) and the root mean square (RMS) in both HGA and PNA, and the neural respiratory cycle (Tc) composed of phrenic inspiratory (Ti) and expiratory (Te) time.
RCR was elicited by a bolus injection of CO_2-saturated saline into the right carotid bifurcation before Dx, and 15 min after each dosage of Dx administration.
Other parameters including arterial blood pressure, heart rate, end-tidal CO_2 and rectal temperature were also continuously monitored.

Statistical analyses were performed by ANOVA with Dunnett's test; $p<0.01$ was considered significant.

Results: During every experiment, $ETCO_2$ was maintained in a physiological range by adjusting artificial ventilation rate. Under the conditions of this study, Dx produced a dose-depended inhibition in both HGA and PNA in a same magnitude without any RCR depression (Refer to Figures).

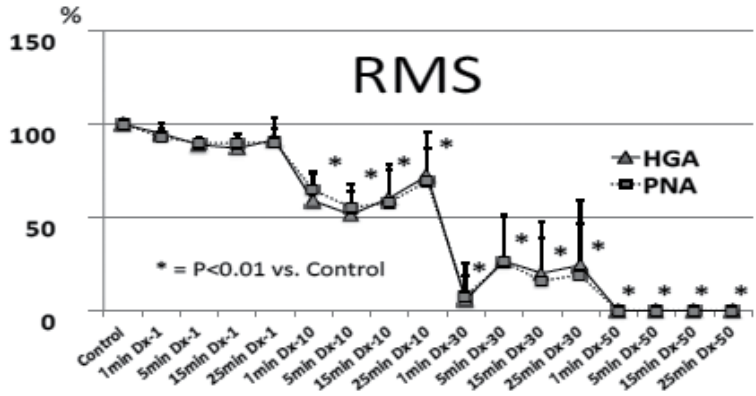
The initial dose of Dx (1.0 micro-gram/kg) reduced HGA and PNA to around 90%. These depressions were not statistically significant. The second dose of Dx (10 micro-gram/kg) caused significant reduction in both nerve activities with significantly prolonged Tc.

Cyclic inspiratory discharge in HGA and PNA disappeared at the 30 micro-gram/kg of Dx in three of five animals. At the highest dose of Dx (50 micro-gram/kg), both HGA

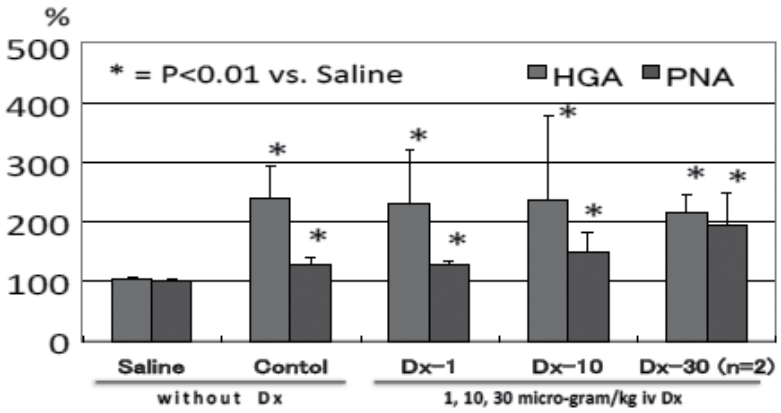
and PNA vanished simultaneously in all cases.

RCR was characterized by the augmentation of both HGA and PNA (approximate increase of 110% and 25% in AMP respectively). Dx did not produce any significant changes in RCR until these nerve activities vanished.

Conclusion: These results could be implicated as a reason for our clinical experience where dexmedetomidine has been shown to have excellent sedative properties with fewer episodes of oxygen desaturation and airway obstruction. Thus, requiring less airway interventions than other sedatives.



Dexmedetomidine depressed HGA and PNA in an equal way in RMS



Dexmedetomidine showed no negative effects on Carotid Chemoreceptor Responses

25. Continuous Non-Invasive Respiratory Volume Monitoring Of Obese Postoperative Patients Reveals Low Minute Volumes In The Absence Of Low Respiratory Rates

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Introduction: Obese patients have a high prevalence of obstructive sleep apnea (OSA) & are at risk for postoperative respiratory complications. Respiratory rate (RR) monitoring alone has been advocated as an early warning sign for compromise. A non-invasive respiratory volume monitor (RVM, ExSpiron, Respiratory Motion, Inc., Waltham, MA) that provides measurements of RR, tidal volume (TV) and minute ventilation (MV) has previously shown an accuracy of >90% for volumes & 98% for RR. The goals of this study were to determine whether RR alone could identify Low Minute Volume (LMV) in obese surgical patients & quantify the incidence of LMV.

Methods: RVM data from patients (BMI ≥ 35 kg/m^2) undergoing general and orthopedic surgery were collected from their PACU & general hospital floor (GHF) overnight stay. The STOP-Bang (SB) OSA risk score was assessed. LMV was defined as an MV < 40 % of predicted MV (MV_{PRED}) & low RR was defined as RR<6 over a given 30-sec episode. We correlated LMV episodes and TV with RR using the Spearman correlation. Data are reported as means ± SEM or ranges ( ).

Results: Ten patients with a BMI of 44.0 (35.9-59.6) kg/m^2 & aged 40.0(20-65) years, were enrolled, of whom 8 had an SB score ≥3. Patients were monitored for 3.0 ± 0.4 hrs and 6.1±2.1
hrs in the PACU and on the GHF respectively. A total of 11,650 paired RR & MV measurements were documented. 52% of MV recordings were below 80 % MV_{PRED} and 2% were below 40% while 95% of RR measurements were between 11.6 and 21.7 b/min and < 0.1% were below 8 (Fig 1 A,B,C). The correlation between RR and MV was significant but not clinically useful to detect LMV episodes (r=0.58, Fig. 1 D). LMV had an incidence of 230 episodes, during which RR ranged between 8 and 16. Not a single measurement coincided with a low RR. The lowest RR recorded was 6.0 breaths/min, found only once. An RR cut-off of 6 breaths/min as a predictor of LMV had a sensitivity of zero in this small cohort. Fig 1 E shows the correlation between RR and TV indicating that some LMV episodes with an unremarkable RR were due to TVs at or close to physiologic deadspace (r = 0.28).

Conclusion: In this small obese cohort with an OSA SB risk score ≥ 3 in 8/10 patients, relatively few LMV episodes occurred. These LMV episodes correlated with decreases in TV and were not associated with clinically concerning RR values, suggesting that RR

monitoring alone may be insufficient to identify potentially inadequate MV in postoperative patients. Future studies need to confirm these findings in a larger cohort in diverse clinical settings and should explore the effects of postoperative opioid administration as well. Objective MV monitoring as part of standard postoperative care in selected patients has the potential to improve safety.

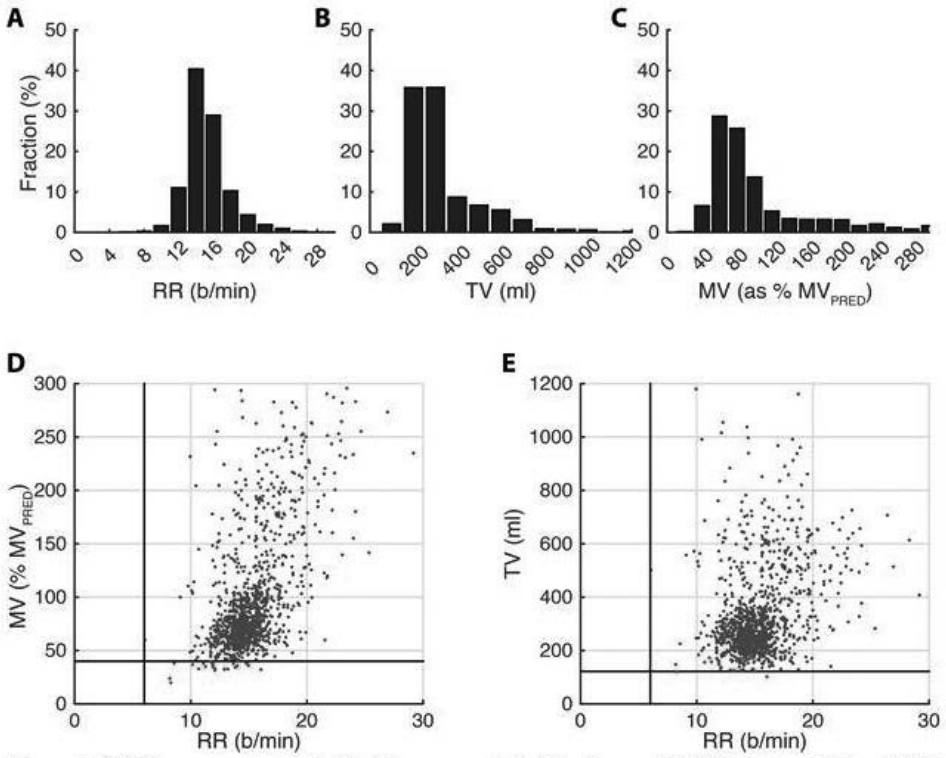

Figure 1: (A) RR measurements indicating a normal distribution and 95% between 11.6 and 21.7 breaths/min. **(B) and (C)** TV and MV (as %MV$_{PRED}$) measurements with a skewed distribution. 95% of TV measurements are between 155 and 737 ml and 95% of MV measurements are between 42.3% and 264.4% of MV$_{PRED}$. **(D)** Correlation between individual RR and MV measurements (r=0.58), vertical line = RR of 6, horizontal line = LMV threshold of 40% MV$_{PRED}$. **(E)** Correlation between RR and TV (r=0.28), vertical line = RR of 6, horizontal line = average deadspace volume of 126 ml. Red dots = LMV episodes in D & E.

26. A Systematic Review of Postoperative Pulmonary Outcomes with Intraoperative Ventilation Strategies in Obese Patients

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Introduction: Lung protective ventilation strategies are commonly used in intensive care. Intraoperative ventilation strategies in obese patients can potentially improve oxygenation and pulmonary physiology and decrease postoperative respiratory complications.

Methodology: A systematic search was done in Medline, Embase and Cochrane database from 1946 until December 2014 for intraoperative ventilation strategies in obese patients.

Results: Intraoperative ventilation strategies in obese patients were evaluated in seven randomized control trials and one meta-analysis. Two observational studies compared the effect of intraoperative position on ventilation and two prospective studies compared intraoperative ventilation strategies in obese vs. normal individuals.

Intraoperative ventilation strategies in obese patients					
Author **Study type**	**Surgery**	**No**	**Comparison**	**BMI**	**Results**
Aldenkortt 2012 Meta-analysis	Abdominal & non-abdominal surgery	505		>30	RM+ PEEP vs. PEEP alone improved oxygenation (PaO_2/F_iO_2). (P=0.0001) PCV vs. VCV: no difference in oxygenation
Baltieri 2014 RCT	Bariatric surgery	40	4 groups: Preop. BiPAP, Intraop. PEEP Postop.BiPAP	40-55	Positive pressure reduced atelectasis Postop BiPAP: Maximum benefit

			Control group		
Desfresne 2014 RCT	Lap gastric bypass	50	PEEP 10 vs. PEEP 10 + two RM.	>35	Two intraop RMs did not improve postop. lung function (FRC) and oxygenation.
Dion 2014 RCT	Bariatric surgery	20	PCV vs. VCV vs. PC-VG for 20 min	>40	PCV and PC-VG: lower peak inspiratory pressure than VCV. (P< 0.01) No difference in oxygenation.
Enekvist 2011 RCT	Lower abdomen surgery	20	Normal TV vs. large TV	>25	Large TV increased arterial O_2 tension (P<0.05)
Gupta 2012 RCT	Lap. cholecyst.	102	VCV vs. PCV	30-40	PCV increased arterial oxygenation. (P<0.05)
Hager 2006 RCT	Open gastric bypass	30	Normocapnia (ET_{CO2} 35mmHg) vs. hypercapnia (ET_{CO2} 50mmHg)	61 ±17	Mild hypercapnia increased tissue oxygenation (P=0.03)
Remistico 2011 RCT	Bariatric surgery	30	RM (PEEP 30cm H_2O, inspiratory plateau pr. 40cm H2O) vs. no RM		RM decreased postop. pulmonary complications. (P=0.02)
Intraoperative position and oxygenation					
Pelosi 1996 Prospective		10	Prone vs. supine position	>30	Prone better than supine position. Prone position improved FRC, lung compliance and oxygenation. (P<0.01)

Perilli 2003 Prospective	Bariatric surgery	20	PEEP vs. 30^0 reverse trendelen.	>40	PEEP vs. reverse trendelenberg. No difference in oxygenation
Ventilation strategies comparing obese vs. normal patients					
Sprung 2003 Prospective	Lap.surgery	12	TV (600-700ml) with RR10 vs. Double TV (1200-1400ml) RR10 vs. TV600, RR20		Increasing TV or RR did not affect oxygenation.
Futier 2010 Prospective		40	Stepwise increase in PEEP		Increase in PEEP did not improve oxygenation.

PEEP= Positive end expiratory pressure, RM=Recruitement maneuver, TV=Tidal volume, RR=Respiratory rate, VCV=Volume control ventilation, PCV=Pressure control ventilation, PC-VG=Pressure controlled volume guaranteed ventilation, cholecyst=cholecystectomy, trendelen= trendelenberg

Conclusion: Recruitment maneuver combined with PEEP improves intraoperative oxygenation with short lasting effects. No difference in oxygenation was found with various modes of ventilation (pressure vs. volume vs. pressure controlled volume guaranteed). More research is needed to determine the ideal ventilation strategies in obese patients.

27. A Systematic Review of Effect of Preoxygenation Strategies in Obese Patients on Oxygenation

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Introduction: Morbidly Obese patients are at increased risk for difficult mask ventilation and intubation during induction of general anesthesia. Atelectasis is known to occur rapidly in obese patients after induction, decreasing oxygen reserve. A high body mass index (BMI) and a low functional residual capacity (FRC) are associated with a rapid decrease in oxygen saturation following induction. The rationale for preoxygenation is to increase the safety period of apnea from induction to intubation by maximising the intrapulmonary oxygen reserves.

Methods: A systematic search was done in Medline, Embase and Cochrane database from 1946 until December 2014. Ten randomized controlled trials (RCT) were identified which compared the various methods to enhance preoxygenation in the obese patients. Three RCTs compared positioning (supine vs. head-up or sitting), four RCTs studied the effect of continuous positive airway pressure (CPAP) vs. conventional ventilation, two RCTs reviewed the benefit of apneic oxygenation and one RCT examined preoxygenation with the supraglottic airway device vs. conventional bag-mask oxygenation.

Results: The findings of preoxygenation and positioning; preoxygenation and CPAP; apneic oxygenation and use of supraglottic device are shown in the Table

Preoxygenation and positioning							
Author	**Study type**	**No.**	**Comparison**	**Surgery**	**Mean age (Yr.)**	**BMI**	**Results**
Altermatt 2005	RCT	40	Sitting 90^0 vs. supine	Elective surgery	41 (20-58) 37 (20-55)	43(5) 43(6)	Supine patients desaturate earlier vs. sitting
Dixon 2005	RCT	42	Head up 25^0 vs. supine	Gastric bypass	41(6) 45(10)	45(6) 47(7)	Supine patients desaturate earlier vs. head-up
Lane 2005	RCT	40	Head up 20^0 vs. supine	Cholecystectomy.	59 (19) 56 (13)	26(5) 28(5)	Supine patients desaturate earlier vs. head-up
Preoxygenation with CPAP							
Cressey 2005	RCT	20	CPAP 7.5 vs. Mapelson A	GA (RSI)	34 (8) 47 (11)	45(7) 44(6)	CPAP vs. Mapelson A. No difference in oxygenation
Harbut 2014	RCT	44	CPAP 5 +PSV 5 vs. none	Lap gastric bypass	47 (13) 42 (12)	43(6) 44(6)	CPAP + PSV Better oxygenation, less desaturation.
Futier 2010	RCT	66	Conv. O2 vs. NPPV vs. NPPV + RM	Lap gastric surgery	41 (9) 42 (10) 43 (11)	46(4) 46(2) 45(	NPPV+RM > NPPV> conv. O2 at improving oxygenation

			induction vs. control				
Apneic oxygenation							
Baraka 2007	RCT	34	Preoxy vs. Preoxy +nasopharyngeal insufflation.	Gastric bypass	36 (11) 37 (11)	43(5) 42(7)	Nasopharyngeal O_2 insufflation increases safe apnea duration.
Ramachandran 2010	RCT	30	Apneic oxygenation vs, none	Elective surgery	53(9) 53 (7)	31(1) 31(1)	Apneic oxygenation increases safe apnea duration
Preoxygenation with supraglottic device							
Sinha 2013	RCT	40	Proseal LMA vs. facemask	Bariatric surgery	41(14) 39(13)	47(8) 46(6)	Better oxygenation in Proseal LMA group.

CPAP= continuous positive airway pressure, PEEP= positive end expiratory pressure, RM= recruitment maneuver, NPPV=non invasive positive pressure ventilation

Conclusion: Preoxygenation in obese patients improves with CPAP and head up or sitting position. Apneic oxygenation is helpful to increase safe apnea duration after induction of anesthesia until intubation.

28. Fowler's Position Improves Nocturnal Desaturation Early After Delivery: A Prospective, Randomized, Parallel-Group, Controlled Study

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Background: An important cause of anesthesia-related maternal death is postpartum airway obstruction. We have shown in a small, randomized, crossover study that 45-degree elevated upper body position decreases the apnea hypoxemia index (AHI) during sleep early after delivery[1]. Based on these results, we hypothesized that elevated upper body position (Fowler's position) improves oxygenation in postpartum women during the first night after delivery.

Methods:

In this prospective, randomized, parallel-group, controlled study, consent was obtained in 99 patients. A total of 80 patients completed the study, in either the Fowler's position or non-elevated position (Table 1).

Oxygen saturation was measured using a wrist pulse oximeter (WristOx Model 3150) during the in-bed time (387 [240-387] min) on the first night after delivery. The primary outcome measure was the duration of SpO_2 <90%. Following the study night, investigators assessed patient's quality of sleep, discomfort due to the assigned

sleeping position, and overall pain level during the study night on a scale from 0-10. In addition, opioid use as post-delivery pain therapy was obtained in the form of total morphine IV equivalent dose. Finally, sleep apnea risk was assessed using the Perioperative Sleep Apnea Score (P-SAP).

A sample size of 40 patients per group was planned to provide a >80% power to identify a significant difference in the primary outcome (difference in effect size: 3 minutes with a SD of 4.5 minutes). Mann-Whitney U and Chi-Square tests were used to test the hypothesis.
ClinicalTrials.gov: NCT02330055

Results: Fowler's position significantly reduced the time spent below SpO2 90% (median 0.45 [upper quartile 6.65] min to 0 [0.55] min; p=0.005) and increased both basal SpO_2 (median 94.7 [IQR 93.3-95.4] % to 95.2 [94.4-96.2] %; p=0.02) and nadir SpO_2 (87 [82-90] % to 90 [87-92] %; p=0.001) but did not affect the oxygen desaturation index (ODI) significantly (3.9 [2.5-6.7] to 3.2 [2.2-5.8]; p=0.264).

Compared with non-elevated position, the Fowler's position also significantly reduced the incidence of any desaturation event (SpO_2 < 90%) (70% vs. 40%, p=0.013, respectively) and decreased the proportion of patients with prolonged desaturation, defined as SpO_2<90% longer than three minutes, from 30% (n=12) to 10% (n=4) (p=0.048).
Sleep quality did not differ between the two groups. Moreover, Fowler's position neither caused discomfort due to position nor changed the subjective pain score during the study night significantly.

Conclusion: Fowler's position decreased incidence of prolonged nocturnal desaturation following delivery by two-third but did not significantly affect the ODI, a marker of sleep apnea. Improved oxygenation without significant effects on ODI is consistent with positional effects on pulmonary gas exchange. Fowler's body position improves nocturnal desaturation without exposing the mothers to additional discomfort.

References:

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Table 1. Clinical Characteristics of Study Patients

	Non-Elevated Position [n=40]	Fowler's Position [n=40]	p-value
Patients Characteristics:			
Age [years]	35 [31-39]	32 [30-36]	0.135
End pregnancy BMI [kg/m^2]	27.11 [23.45-31.46]	25.58 [22.96-30.82]	0.645
• First prenatal visit	32.20 [29.00-36.35]	31.46 [26.30-36.96]	0.324
• End-pregnancy			
Delivery type - Vaginal/C-section [No.]	20/20	20/20	
Anesthesia - neuraxial/general/none [No.]	37/0/3	36/3/1	
Post-delivery opioid dose [mg]#	0 [0-5]	0 [0-7.5]	0.678
P-SAP score	2[1-3]	2 [0-3]	0.301
Hospital length of stay [days]	3 [2-4]	2 [2-4]	0.507
Primary outcome:			
SpO_2 < 90% [min]	0.45 [0-6.65]	0 [0-0.55]	0.005*
Secondary outcomes:			
Basal SpO_2 [%]	94.7 [93.3-95.4]	95.2 [94.4-96.2]	0.02*
Nadir SpO_2 [%]	87 [82-90]	90 [87-92]	0.001*
ODI > 3 [1/h]	3.9 [2.5-6.7]	3.2 [2.2-5.8]	0.264

Values are presented as Median [Interquartile Range]
*denotes statistical significance ($p<0.05$)
#post-delivery opioid dose does not account for residual effects of intraoperatively administered Duramorph

29. The Association of CPAP Compliance and Nocturnal Hypoxemia in the Perioperative Period in Patients with Obstructive Sleep Apnea- A Protocol

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Introduction: Obstructive sleep apnea (OSA) is associated with postoperative adverse events like hypoxia, respiratory failure, cardiac events and ICU transfers. Hypoxemia commonly occurs between postoperative nights two to five in patients with OSA.[1] Although Continuous Positive Airway Pressure (CPAP) is the first line treatment for OSA patients, evidence on its efficacy in the perioperative period is largely lacking. The frequency and impact of perioperative CPAP non-compliance has not been evaluated in a prospective systematic fashion. The objective of our study is to determine the magnitude of perioperative CPAP compliance and prospectively evaluate its effects on oxygenation in surgical patients with OSA. These OSA patients on CPAP may have desaturation due to perioperative fluid shifts, position, and respiratory depression from opioids.[2] We also aim to determine the degree of postoperative desaturation despite the use of CPAP in the perioperative period.

Methods: This study is approved by the University Health Network, Research Ethics Board (15-8946 AE). All adult surgical patients (>18 yr) with a diagnosis of OSA with or without a CPAP prescription are enrolled into this prospective cohort study (Figure 1). Patients scheduled for tonsillectomy, septoplasty, uvuloplasty, pharyngoplasty, tracheostomy, pregnant patients and those on preoperative supplemental oxygen are excluded. OSA patients with a CPAP prescription are followed up to determine their compliance to CPAP therapy. In addition, the data on their CPAP machine will be examined to obtain the objective evidence of their CPAP compliance. OSA patients without a CPAP prescription are followed up perioperatively to determine the severity of their OSA. Preoperative overnight oximetry will be performed on all the OSA patients at home before surgery. In the postoperative period, all patients are followed up with a nocturnal oximetry in the first two post-operative nights of hospital stay. Postoperative compliance to CPAP will be evaluated and recorded in all the patients. Patients' charts will be reviewed for any postoperative adverse events.

Statistical Analysis: Statistical analysis will be done using statistical software – Graph Pad Prism-6. Baseline characteristics will be tabulated using appropriate summary statistics. The statistical tests will be two tailed tests and $P < 0.05$ will be considered as statistically significant. We expect to enroll at least 72 patients with a CPAP prescription (36 compliant and 36 noncompliant) and 36 patients without a CPAP prescription.

Hypothesis:

1) The rate of CPAP non-compliance is high in surgical patients.

2) CPAP non-compliance is associated with significant postoperative hypoxemia.

3) Despite the use of CPAP, hypoxia may occur in the postoperative period which may be due to factors such as fluid shifts, position, and respiratory depression from opioids etc.

Results: We are collecting data at present.

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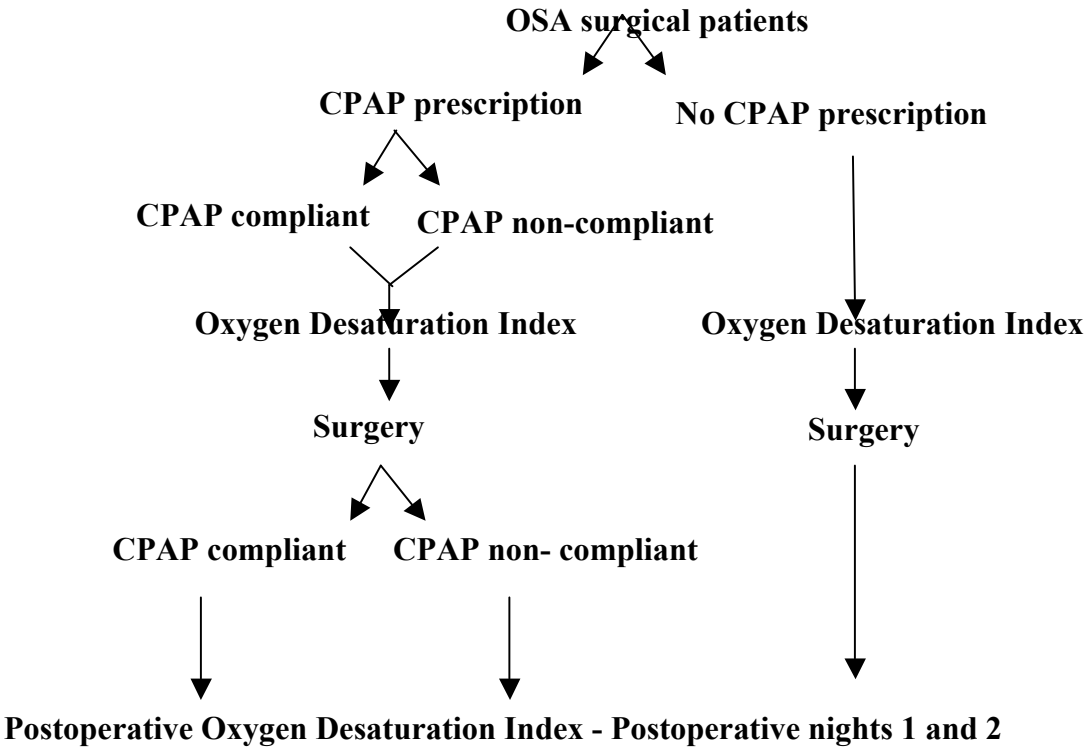

NOT POSTED: Anesthetic Management of Pediatric Drug-Induced Sleep Endoscopy for Upper Airway Evaluation

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Background: Drug Induced Sleep Endoscopy (DISE) is a procedure performed in the operating room under anesthesia to identify anatomical sites of obstruction in patients with obstructive sleep apnea (OSA). The ultimate goal of providing adequate anesthesia for DISE is to reproduce the airway collapse that mimics the airway collapse, which occurs during natural sleep while preventing adverse complications. Adult patients have received midazolam, diazepam, or propofol for the performance of DISE.[1,2,3]

The anesthetic regime for pediatric DISE has not been studied in the past. With our previous experience on airway hemodynamics with Dexmedetomidine,[4,5] we tested the hypothesis that a combination of dexmedetomidine and ketamine (Group DK) would have less effect on upper airway tone and airway collapsibility when compared to propofol (Group P) or sevoflurane/propofol (Group SP), ultimately providing favorable conditions with fewer required airway interventions during DISE in children with OSA.

Methods: In this retrospective, descriptive study, we reviewed the records of 59 children (49 had preoperative polysomnography) who presented for DISE between October 2013 and March 2015. Data analyzed included demographics, OSA severity, and hemodynamics. The primary outcomes were airway intervention (i.e. jaw thrust, chin lift, airway adjuncts), airway desaturation during DISE to <85%, and successful completion (as assessed by otolaryngologists) of DISE between the 3 groups (Group DK, Group P, Group SP). Analysis was conducted using SAS software.

Results: Demographics were comparable between the three groups (Table 1a). There were significantly more patients with severe OSA in Group P (P=0.007) (Table 1a). Group DK had significantly less airway interventions (p=0.03), significantly less desaturation to < 85% during DISE (p=0.004), and significantly higher successful completion (p=0.04) (Table 1b). Overall, DISE was interpretable in 100% of children in Group DK.

Conclusions: A combination of Dexmedetomidine and ketamine provided less airway interventions, less airway desaturation, better hemodynamics with a significantly higher rate of successful completion than propofol *or* sevoflurane plus propofol during DISE in children.

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Table 1a: Demographic Data

	All Subjects (n=59)				Patients with PSG (n=49)			
	DK (n=32)	P (n=13)	SP (n=14)		DK (n=26)	P (n=10)	SP (n=13)	
Age (months)	61 (14-131)	98.4 (9-181)	63 (18-108)	0.56	61 (11-152)	92 (9-181)	62 (18-108)	0.60
Weight (kg)	17 (10-51)	24 (7-74)	19 (8-48)	0.79	19 (10-57)	20 (10-57)	19 (8-48)	0.73
BMI (kg/m2)	17 (14-36)	19 (11-42)	17 (12-33)	0.91	19 (14-39)	19 (11-45)	17 (12-33)	0.79
ASA 2/3/4	5/26/1	1/12/0	3/11/0	0.81	4/21/1	0/10/0	3/10/0	0.51
DS	9 (28.1)	8 (61.5)	4 (28.6)	0.09	9 (34.6)	7 (70)	4 (30.8)	0.13
OSA Mild/Moderate/Severe					1/10/15	2/2/6	1/5/7	0.55
RDI					14 (9-21)	13 (8-40)	10 (9-12)	0.55
AHI					12 (9-19)	21 (8-66)	13 (7-21)	0.05

Table 1b: Comparison of outcomes between each group

All Subjects (n=59)			P values		Patients with PSG (n=49)			P values	
DK (n=32)	P (n=13)	SP (n=14)	DK vs. P	DK vs. SP	DK (n=26)	P (n=10)	SP (n=13)	DK vs. P	DK vs. SP
Airway Intervention n (%)									
1 (3.1)	2 (15.4)	3 (21.4)	0.196	0.08	0 (0)	2 (20)	3 (23.1)	0.07	0.03
Desaturation to < 85% during DISE n (%)									
1 (3.1)	5 (38.5)	2 (14.3)	0.005	0.216	1 (3.9)	5 (50)	2 (15.4)	0.004	0.253
Lowest saturation during DISE [Median (Interquartile Range)]									
97.5 (91-99)	92 (72-97)	94 (87-99)		0.02	97 (91-99)	88 (71-97)	91 (87-99)		0.01
Successful completion n (%)									
32 (100)	12 (92.3)	11 (78.6)	0.6376	0.04	26 (100)	9 (90)	10 (76.9)	0.615	0.06

Data presented as n (%) and Median (Interquartile range).
AHI = Apnea Hypopnea Index; ASA = American Society of Anesthesiologists; BMI = B
Mass Index; DISE = Drug Induced Sleep Endoscopy; DS = Down's Syndrome;
DK = Dexmedetomidine + Ketamine; OSA = Obstructive Sleep Apnea; P = Propofo
PSG = Polysomnography; RDI = Respiratory Disturbance Index;
SP = Sevoflurane + Propofol

30. Determining Predictors of Sleep Apnea following Extubation in the Surgical Intensive Care Unit

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Background: The severity of sleep apnea appears to increase during the first 72h after surgery, while sleep apnea is associated with an increased incidence of reintubation.

Mechanically ventilated patients in the intensive care unit (ICU) are vulnerable to postoperative reintubation and possibly also to sleep apnea after extubation.
The primary objective of this study was to assess if residual drug effects (sedation [opioids, benzodiazepines, neuroleptics]) and neuromuscular blockade (NMBAs) in the ICU prior to extubation are associated with moderate to severe sleep disordered breathing (AHI>15).

Methods: Following approval from Partner's Institutional Review Board and obtaining informed consent, we have so far enrolled 45 ICU patients (anticipated n=50) in this prospective, observational study, who were mechanically ventilated for at least 24 hours. We performed polysomnography (Alice PDx, Philips Respironics Inc, Murrysville, PA) during the first night after extubation, measured pulmonary function using spirometry (EasyOne Plus, ndd Medical Technologies, Andover, MA) and muscle strength (medical research council strength score as well as grip strength, JAMAR Hand Dynamometer Sammons Preston Rolyan, Bolingbrook, IL).
Data were analyzed using binary logistic regression analysis, stepwise backwards regression analysis, zero truncated poisson regression, X^2-test and spearman correlation.

Results: Moderate to severe sleep disordered breathing (SDB) was present in one third of patients following mechanical ventilation in the ICU.

Univariate analysis demonstrated a significant association between upper airway obstruction during wakefulness expressed as the ratio between maximum expiratory and maximum inspiratory airflow at 50% of vital capacity (MEF50/MIF50) (p=0.001) as well as opioids given 24 and 72 hours before extubation (odds ratio, OR 13 [95% CI 1.7-99.4] and 21.9 [1.9-260.7] respectively) and AHI>15. We found a marginal significance of propofol dose administered 24 hours prior to extubation leading to a higher risk (OR 1.35 [0.99-1.85]) of AHI>15. Interestingly, increasing duration of mechanical ventilation

was inversely associated with developing SDB (OR 0.08 [0.01-0.95]) while a prolonged ventilation time was significantly correlated with decreasing doses of propofol 24 hours prior to extubation (p=0.043). Through stepwise backwards regression analysis, we identified opioid administration 24 hours before extubation (p=0.012) and the duration of mechanical ventilation (p=0.013) as independent predictors of SDB.
Neither BMI (p=0.262) nor muscle weakness predicted SDB.
AHI>15 was associated with a prolonged hospital length of stay (27 vs. 31 days; incidence rate ratio=1.14 [95% CI 1.02-1.28]).

Conclusion: In this study, opioids and sedatives were the main predictors of moderate to severe sleep apnea after extubation in the surgical ICU. The requirement of high-dose sedatives and opioids to facilitate mechanical ventilation early after intubation may explain our unexpected negative association between duration of mechanical ventilation and sleep apnea. Sleep apnea is associated with a prolonged hospital length of stay.

Table 1. Clinical Characteristics and Outcomes

	AHI < 15 (n=30)	AHI ≥ 15 (n=15)	p-value*
Gender (male/female)	17/13	11/4	
Age (yrs)	65.5 [48-75]	65 [56-72]	
BMI (kg/m²)	26.6 [23.3-33.1]	29.2 [23.5-35.4]	0.262
ASA	3 [3-4]	3 [3-4]	
Opioid equivalent dose (mg) *24h prior to extubation*	3.9 [0-25]	35 [10-83.3]	**0.013**
Opioid equivalent dose (mg) *72h prior to extubation*	8.1 [0-32]	116.6 [16-216.5]	**0.014**
Duration of mechanical ventilation (days)	5 [3-9]	2 [1-5]	**0.045**
Propofol (mg) *24h prior to extubation*	1043 [0-1793]	1725 [1050-5550]	0.056
NMBAs *72h prior to extubation*	5 (19%)	2 (13%)	0.666
MEF50/MIF50-ratio	0.63 [0.41-0.93]	0.99 [0.82-1.69]	**0.001**
Grip strength	0 [0-2]	0 [0-3]	0.964
MRC-Score	40 [32-55]	40 [26-60]	0.216

Data are reported as median [IQR] or number (percentage).
BMI, body mass index; ASA, American Society of Anesthesiologists physical status classification; MEF50/MIF50 ratio, the ratio of maximum expiratory flow to maximum inspiratory flow at 50% of the vital capacity; MRC, Medical Research Council Scale for Muscle Strength
*p-values were determined using univariate binary logistic regression, Chi²-test and Spearman Correlation

31. Does Pregabalin Improve Pain Management After Posterior Spinal Fusions?

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Spinal fusion surgery patients experience both persistent nociceptive and neuropathic pain, as well as narcotic-induced hyper-analgesia, mediated via non-conventional neural pain pathways, which may be best managed using a multimodal approach. Pregabalin is effective in the treatment of neuropathic pain and in some acute pain models; hence we hypothesized that the addition of Pregabalin after posterior spinal fusions (PSF) would reduce narcotic requirements and improve outcome.

Methods: With IRB approval, 86 patients for elective 1-2 level posterior lumbar fusions were randomly assigned to receive Pregabalin (P) or a placebo (C). Patients in the P group received 150 mg of Pregabalin one hour prior to surgery and then 150mg daily; C group patients received a placebo tablet during the same time period. All patients received a similar general endotracheal anesthetic; extubated in the OR and within 15min of arrival in the PACU started on i.v. PCA of hydromorphone (0.2mg/ml). Postoperative pain was assessed daily until discharge using a verbal NRS at rest and with physical therapy. Patients also assessed twice daily for level of sedation and nausea and/or vomiting. Expected physical therapy milestones were assessed daily. All narcotics (i.v. ;oral) were documented.

Results: Demographics and operative time between groups were similar. PCA hydromorphone usage was statistically similar for both groups, however during the first 24 hours patients in the Placebo group attempted to receive more i.v. hydromorphone (33 versus 27 attempts, $p<0.05$). This was reflected in higher pain scores and oral opioid intake, as well as increased incidence of nausea and vomiting in the Placebo group. Verbal pain scores and oral opioid use were similar in both groups after PT on POD 1. Both groups were also similar with respect to achieving physical therapy milestones and hospital discharge day.

For preoperative narcotic tolerant patients (n=13), PCA hydromorphone usage was significantly higher in the control group (101 ml) versus the Pregabalin group (59ml; $p=.03$).

Conclusion: After spinal fusion surgery, we were unable to demonstrate an advantage in Pregabalin 150mg/day in reduced iv narcotic usage, improved physical therapy miles-stones or reduced length of hospital stay. During the first 24 hours after surgery, NRS scores, oral opioid usage and n/v was reduced in the Pregabalin patients.

Narcotic tolerant patients may benefit more from the addition of Pregabalin to the pain regimen.

	Placebo	Pregabalin
Age (y)	56.2±12	57.5±13
Weight (kg)	88±20	81±19
Height (cm)	170±10	168±8
Length of Surgery (h)	4.9±0.9	5.2±1.1
Patient-controlled Analgesia (ml) 0-6h	15±9	12±8
7-12h	11±11	9±13
13-18h	10±11	8±9
19-24h	8±9	7±8
24-48h	15±5	14±6
NRS Day of Surgery	3.9±2.6	3.1±2.2
Rest POD1	3.7±2.1	3.3±2.4
PT POD1	4.3±3.0	4.5±3.4
Rest POD2	3.3±2.0	3.4±2.2
PT POD2	4.6±2.7	3.9±2.4
Rest POD3	3.1±1.8	3.2±1.8
PT POD3	2.6±2.5	3.3±2.3
Oral Opioid * POD1	91.7±115	63.2±121
POD2	87.2±93	85.7±151
POD3	80.5±86	72.8±95
**% Patients Ambulating POD 2	93	91
Days Until Hospital Discharge	4.8±2	4.7±2
Nausea/Vomiting Day of Surgery	7.0%	5.8%
POD1	10.5%	2.3%*
POD2	11.6%	3.0%*

* Morphine equivalents in mg. **% of patients who were able to walk unassisted down a hospital floor.

32. Predictors and Outcomes following Naloxone Administration During Phase I Anesthesia Recovery

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Background: Postoperative hypoventilatory respiratory depression can be attributed to residual anesthetic or analgesics medications, preexisting sleep disordered breathing, or a combination.[1] Naloxone administration has been proposed as a surrogate marker for opioid induced respiratory depression.[2] There is limited evidence regarding naloxone administration during Phase I recovery to treat respiratory depression or oversedation. Our primary aim was to assess whether preclinical characteristics and perioperative variables were associated with naloxone administration during Phase I anesthesia recovery. A secondary aim was to characterize the clinical outcomes of these patients.

Methods: Patients who received naloxone to reverse opioid-induced respiratory depression or sedation during Phase I postanesthesia recovery from January 1, 2010 to December 31, 2013 were identified and matched to 2 controls based on age, sex, and surgical procedure during the same year. A chart review was performed to identify factors associated with risk for intervention requiring naloxone as well as to note the occurrence of adverse postoperative outcomes, which included myocardial infarction, pneumonia/ARDS, ICU transfer from postsurgical ward, emergency response team activation, or death. Analyses to assess characteristics potentially associated with naloxone use were performed using conditional logistic regression taking into account the 1:2 matched set case-control study design.

Results: During the study period, 164,809 patients underwent general anesthesia, of those, 413 patients were administered naloxone, with incidence of 2.5 *per* 1,000 (95% CI 0.7 – 6.5) anesthetics. The presence of obstructive sleep apnea (OR = 1.74, 95% CI 1.22 – 2.48, P=0.002), ASA Physical Status ≥ III (OR 1.44, 95% CI 1.08-1.92, P=0.013) and greater opioid administration (OR 1.22, 95% CI 1.12 – 1.33, per 10 mg intravenous morphine equivalents mg, P<0.001) were associated with naloxone administration. Naloxone administration was associated with increased adverse events (OR 3.39, 95% CI 2.22 – 5.23, P < 0.001). The rates of postoperative complications in the subset of patients discharged from the PACU to the ICU were not significantly different between cases (41 of 159 ICU admissions, 25.8%) and controls (21 of 119 ICU admissions,

17.6%), (odds ratio 1.62, 95% CI 0.91 – 2.97, P = 0.104). The rate of postoperative complications among patients discharged from the PACU to standard postoperative wards was higher in cases (17 of 254 standard ward admissions, 6.7%) compared to controls (17 of 707 standard ward admissions, 2.4%), (odds ratio 2.91, 95% CI 1.45 – 5.83, P = 0.003).

Conclusions: Obstructive sleep apnea, higher ASA-PS scores and greater doses of intraoperative opioids were associated with naloxone administration during Phase I recovery. Patients administered naloxone had increased adverse events after discharge from recovery room and may benefit from a higher level of postoperative care.

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33. Neuroinflammation Following Sleep Fragmentation in a Pediatric Model

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Background: Children admitted to the pediatric intensive care unit (PICU) are exposed to multiple stimuli, both physical and pharmacological, that result in sleep fragmentation and an altered sleep-wake rhythm. However, the neurochemical and behavioral alterations induced by sleep fragmentation in the developing brain are understudied. In adults, sleep fragmentation plays a role in daytime somnolence and a reduction in performance in attentional and vigilance tasks. Rodents who experience sleep fragmentation exhibit a reduction in NREM episodes, but not REM episodes, and transient microglial activation. The effects of sleep fragmentation on microglial state and subsequent cytokine expression on the developing brain and associated long term behavioral consequences have not been studied.

Methods: New Zealand White rabbit kits were used to examine the neurodevelopmental correlates of sleep fragmentation. At post-natal day 3 rabbit kits were assigned to one of three conditions: fragmentation, sham, and control. The fragmentation group was placed on an orbital shaker controlled by a timer to induce repetitive on/off cycling set at 100rpm on a 120s cycle (30s on, 90s off) for 72 hours. The sham group was removed from maternal care and placed in an incubator for 72 hours, while the control group remained in contact with the dam. Fragmentation and sham groups were returned to maternal care to feed or were handfed using Woombaroo rabbit milk supplement 3 times daily. Kits were subsequently sacrificed 3-14 days after the last day of fragmentation. Each hemisphere was processed separately for immunohistochemical detection of microglial activation and cytokine expression using rt-PCR.

Results and Discussion: Immunohistochemical evidence of microglial activation was visible up to 2 weeks post-fragmentation in the cortex, hippocampus, and periventricular regions. This was associated with alterations in the expression of the pro-inflammatory cytokines TNF-α and Il-1β and the anti-inflammatory cytokine Il-10 in the brain. This indicates that sleep fragmentation may lead to immune dysregulation in the immature brain that can have implications for normal development in infants and children.

34. Hospital Variability in Early Post-Operative Non-Invasive Ventilation Usage for Patients with Obstructive Sleep Apnea

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Purpose: Obstructive sleep apnea (OSA) has been associated with respiratory complications in the early postoperative period, but the optimal management strategies to modify this risk remains unclear[1, 2]. **E**arly **P**ostoperative **N**on-**I**nvasive **V**entilation (EP-NIV) within the first 24 hours after surgery is recommended as a method of reducing complications related to OSA.[3] However, there are no previous studies exploring hospital-level utilization rates of EP-NIV, or its effects on postoperative complication rates. We hypothesized that postoperative complication rates in patients with OSA exposed to EP-NIV would be influenced by hospital rates of utilization of EP-NIV.

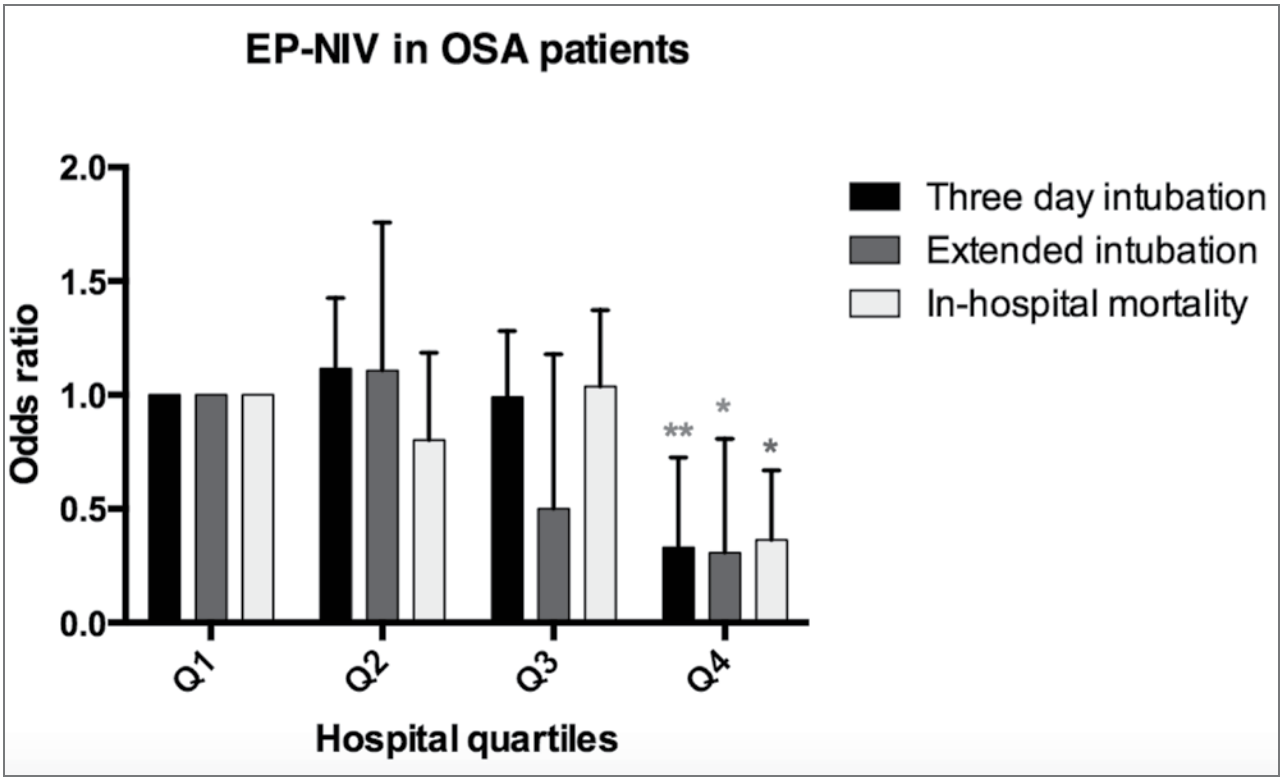
Methods: Data from 2007-2011 were obtained from the Nationwide Inpatient Sample, a hospital billing database that represents data from several thousand hospitals per year. Our cohort included hospitals that had more than 10 patients with OSA undergoing elective surgery. Patients who developed intrapulmonary causes of respiratory failure (pulmonary edema, atelectasis, pulmonary embolism, pneumonia, pneumothorax and ARDS) were considered confounding factors for EP-NIV use and were excluded from the analysis. Hospitals were assigned to quartiles based on the rate of EP-NIV use in OSA patients on day 0 or day 1 after surgery. Hospitals with 0% EP-NIV use were excluded from the analysis in order to investigate directional effects with increasing EP-NIV rates. The primary outcome was the rate of early re-intubation, defined as occurring within the first 3 days after surgery, but after EP-NIV utilization date. Secondary outcomes included the occurrence of long-term mechanical ventilation (>96 hours) and in-hospital mortality. Mixed models were developed to adjust for key patient, procedure and hospital characteristics, and clustering at the hospital level.

Results: The trend-weighted cohort included 4,479,263 patients from 518 hospitals, after excluding data from 1,733 hospitals with 0% EP-NIV rates. Of these patients 210,732 (4.7%)had a diagnosis of OSA and overall 6.2% of OSA patients received EP-NIV. Hospital quartile rates of EP-NIV were 0.1-3.2%, 3.3-6.6%, 6.7-11.9% and >11.9%. As seen in Fig 1, OSA patients treated with EP-NIV in Quartile 4 hospitals but not in other quartiles, had significantly with lower adjusted odds of early re-intubation [AOR 0.33, $p<0.005$], long-term mechanical ventilation [OR 0.31, $p<0.05$) and in-hospital mortality (OR 0.364, $p=0.01$). Other independent associations with study outcomes

included surgical type, Elixhauser comorbidity score, hospital size, hospital region, ambulatory surgical%, and discharges per year.

Conclusions: The majority of hospitals in this large national database have no reported utilization of EP-NIV. Through this study, we have shown that hospital rates of usage of NIV are important determinants of treatment effectiveness of EP-NIV in OSA patients, with clinically important implications for respiratory and survival outcomes. The study findings may be explained by unmeasured differences in familiarity and implementation of EP-NIV protocols at higher utilization hospitals.

Figure 1:



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35. Anesthetic Preconditioning Promotes Accelerated Maturation of Social Behavior in Larval Zebrafish

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Abstract: Anesthetic preconditioning is a process by which neuronal cells previously exposed to volatile anesthetics exhibit a selective advantage, particularly against future cellular insult. The exact molecular mechanism by which this occurs still remains elusive. The hypothesis is that preconditioning evokes molecular events that result in downstream changes (i.e. specific genetic expression) that offer a selective advantage in terms of neuronal function. Previously, we observed that adult zebrafish (1 YPF, year post-fertilization), which were exposed to trifluoroethanol (TFE), an anesthetic mimetic, exhibit greater exploratory behavior and better short-term memory compared with un-treated controls. This current project exposed zebrafish larvae to TFE. Larval zebrafish (3 DPF, DaysPF) were exposed to TFE (0.1mM for 3hr at 28°C) then kept at standard conditions and tested after 24hrs for select markers of neuronal function (i.e. cognitive, behavioral, and social). The study protocol involved observational endpoints as an indicator of neuronal changes that would evoke a selective advantage. A light-dark test was performed in which a petri dish was positioned to generate delineated sections (80% light, 6,700 lux; 20% dark, 150 lux), and the average number of larvae that occupied each section of the dish at timed intervals was determined. At 4min, a startle noise was generated at the polar end of the lit area, and the average number of larvae in each section was again determined at intervals over the succeeding 2min. Additionally, at 5 DPF, social behavior was tested under standard lighting; we quantitated four types of schooling and shoaling behaviors. All results were compared using *t*-tests and 95% confidence levels for significance. We observed that TFE-exposed larvae spent more time in the dark area (typically an adult-like response) than control larvae (an average of 0.2 ±0.08 [SEM] for control larvae versus 1.0 ±0.15 for TFE larvae; $p < 0.001$). The response of the TFE larvae to the noise startle was directly opposite of the controls. The TFE larvae swam towards the source of the startle (into the lighted area), whereas the control larvae swam away from the source of the startle (into the dark). The larvae also exhibited several differences in social behaviors, including single-direction schooling and shoaling (two larvae: cross shoaling; three larvae: group shoaling). The TFE-group showed 5.6 ±1.21 single-direction schooling events per 5min period versus controls (3.0 ±1.26; $p < 0.001$). The TFE-group exhibited 12.4 ±1.36 cross-shoaling events per 5min period compared with controls (5.0 ±1.58; $p < 0.01$). While the long-term effects have yet to be determined, these results shed light on the mechanism of anesthetic preconditioning. These complex zebrafish behaviors normally develop with age and therefore represent, in the TFE-exposed group, a pattern of accelerated maturation of neuronal function, which is attributed to the preconditioning effect of TFE.

36. The Opioid Safety (Op-Safe) Study Protocol: A Multi-Center, Prospective Observational Cohort Study to Evaluate and Implement an Innovative Screening and Education Program in Chronic Pain Clinics

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Background: The overall rate of opioid-related mortality has increased more than 200% over the past two decades in Canada to more than 40 deaths per million in Ontario alone.[1] This increase in opioid-related mortality has paralleled an increase in the prescribing of opioids for the treatment of chronic non-cancer pain (CNCP).[2] A recent systematic review showed an association between sleep-disordered breathing (SDB), which includes obstructive and central sleep disordered breathing, and the use of opioids for CNCP.[3] The goal of this study is to design and validate an opioid safety (Op-Safe) program consisting of a standardized education program on opioids and opioid-SDB related screening that is currently lacking in contemporary chronic pain practice.

Hypothesis: We hypothesize that patients undergoing the Op-Safe Program would demonstrate better knowledge than those receiving standard education. Also, the

SDB screening algorithm would accurately predict SDB in patients on opioids for chronic pain.

Study Objectives:

1. To determine whether an educational program about opioid-related side effects will lead to improved opioid-related knowledge scores.

2. To develop a sensitive and cost-effective screening algorithm that is comparable to laboratory polysomnography (PSG) to detect SDB in patients on opioids for chronic pain.

Methods: A multi-center prospective cohort study will be conducted at four academic chronic pain clinics in Ontario. Institutional REB approval has been obtained from all sites. Patients will be eligible if they demonstrate CNCP (symptoms > 3 months); who receive opioid medication, and exhibit cognitive capability to comprehend the educational intervention. Exclusion criteria include a prior diagnosis of SDB or the need for urgent referral due to serious medical conditions.[4] All patients will complete the STOP-Bang questionnaire and Epworth Sleepiness Scale, and undergo an airway assessment. Demographic data and medications will be collected. The educational intervention consists of a modified information pamphlet and online video from the Institute for Safe Medication Practice Canada (ww.ismp-canada.org) and physician-guided education of opioid-related effects on SDB. The Patient Opioid Education Measure (POEM) instrument, validated to assess patients' opioid-related knowledge and attitudes will be used.[5] An overnight oximetry (PULSOX-300i), will be performed. Patients will then undergo laboratory PSG, based on the AASM recommendations.[6] The study sleep physician will provide patients with their PSG diagnosis and treatment, if appropriate.

Outcome and Statistical analysis:

1. The changes in opioid-related knowledge: POEM scores at Day 0 (knowledge acquisition), and Day 90 (knowledge retention), using ANCOVA analysis.

2. The predictive performance of the Op-safe screening algorithm. Diagnostic properties (sensitivity, specificity, positive predictive value, negative predictive value, and the area under receiver operating characteristic [ROC] curve) of the new screening algorithm for sleep disordered breathing. The results of this pathway will be validated against the gold-standard PSG results.

Results and recruitment: We have initiated study recruitment at all four sites. The calculated sample size is 304. We anticipate completion of study in two years.

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37. Effect of Continuous Positive Airway Pressure (CPAP) on Symptoms of Patients with Fibromyalgia Syndrome and Obstructive Sleep Apnea (OSA): A Prospective Randomized Controlled Clinical Trial.

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Background: Fibromyalgia (FM) is a chronic widespread pain condition with characteristic tender points on physical examination; often associated with a constellation of symptoms such as fatigue, sleep disturbances and mood disorders.[1] Obstructive sleep apnea (OSA) is the most prevalent sleep-breathing disturbance, affecting 24% of the general population.[2] Despite its poor health outcomes and economic burden, OSA remains largely undiagnosed.[3] Sleep-disordered breathing was found to be common in FM patients with 45% meeting criteria for OSA, and 17% having moderate to severe OSA (Apnea/Hypopnea Index >15).[4] Both FM and OSA are common disorders that may be correlated. Since pain, fatigue, sleep and psychological symptoms in FM seem to be all linked by neuroendocrine mechanisms[5], the study of the effect of CPAP on different manifestations of OSA and FM may be warranted.

Study Objectives:

1. Primary Objective: To determine whether treatment with CPAP for 6 months in addition to treatment of FM will improve pain of FM on a Numerical Rating Score (NRS) ranging from 0 to 10 vs. treatment of FM alone, in a patient population suffering from both FM and OSA.
2. Secondary Objectives:
   a. To determine the effect of CPAP and FM treatment vs. FM treatment alone on other morbidity parameters such as sleepiness, quality of sleep, quality of life, inflammatory markers and consumption of pain medications.
   b. To determine the prevalence of moderate/severe OSA in a FM patient population.
   c. To validate STOP-Bang questionnaire against ApneaLink Plus™ in the FM patient population.
   d.

Hypothesis: In patients with both FM and OSA, the treatment of moderate/severe OSA with CPAP in addition to treatment of FM improves pain; sleep quality and quality of life of FM patients vs. treatment of FM alone.

Methods: Target population is adult FM patients (18-80 years), diagnosed according to the American College of Rheumatologists 2010 criteria. Following REB approval and participants' consent, STOP-Bang questionnaire will be administered.

Participants will receive ApneaLink Plus™ (ResMed, San Diego, California, USA) to self-administer an overnight sleep study. They will screen positive if their Apnea Hypopnea Index (AHI) is ≥10. Patients confirmed by laboratory Polysomnography (PSG) to have moderate/severe OSA will be considered for randomization into one of two intervention groups:

1. Intervention group: Treatment for FM at Pain Clinic and CPAP therapy for 6 months immediately after diagnosis of OSA via PSG.

2. Control group: Treatment for FM only. Patients in this group will be referred for CPAP treatment after 6 months of diagnosis.

Statistical Analysis: Descriptive statistics will be used to characterize our study population at baseline and at each time point (3 and/or 6 months depending on outcome). Categorical data will be presented as frequency and percentage, continuous data will be presented as mean and standard deviation or median and interquartile range depending on data distribution. For each group, we will compare baseline with final or intermittent measurement using a paired t-test or repeated measures ANOVA as appropriate. $P < 0.05$ is considered significant.

Results: We will be recruiting patients and collecting data following REB approval.

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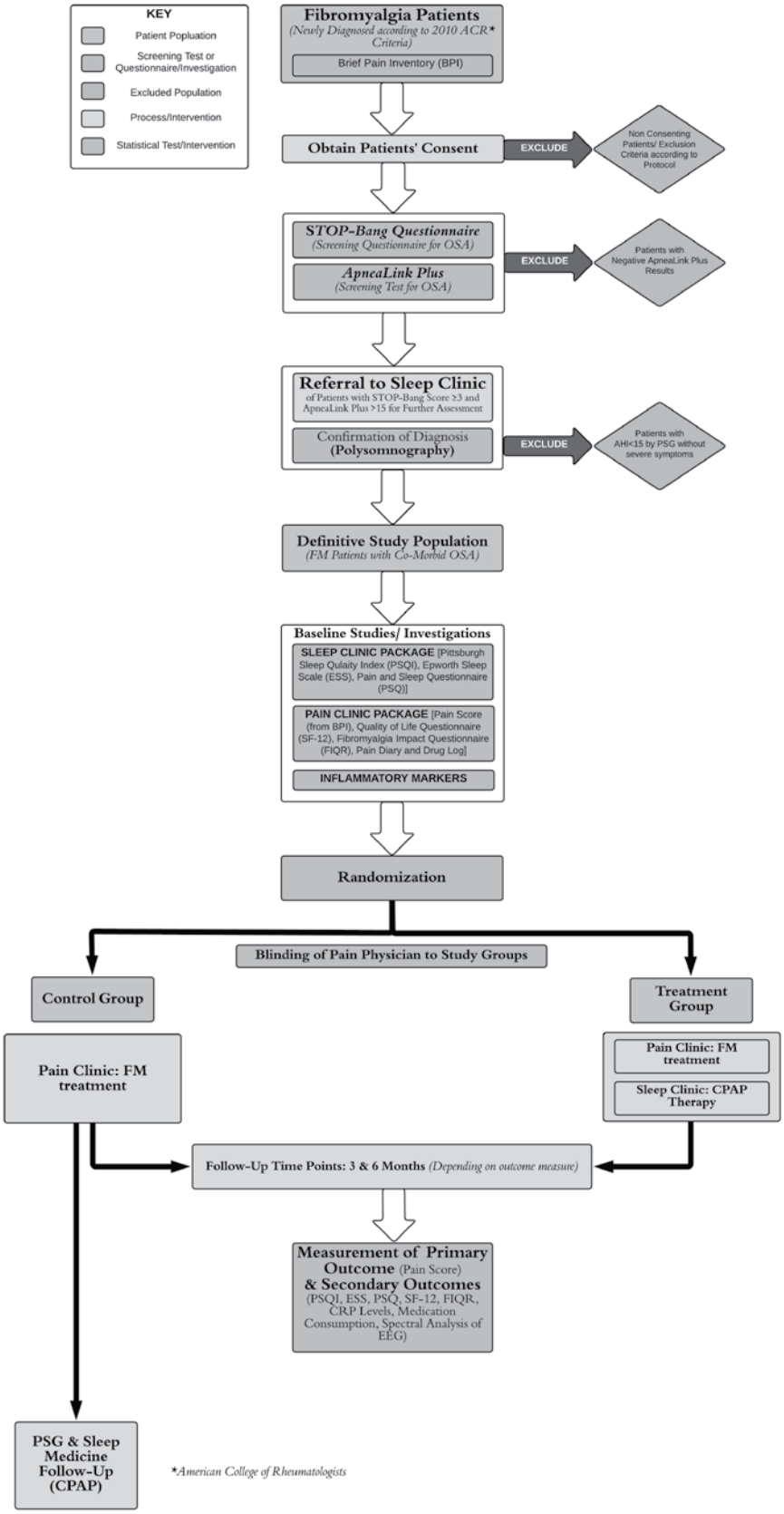
Flowchart of the Study



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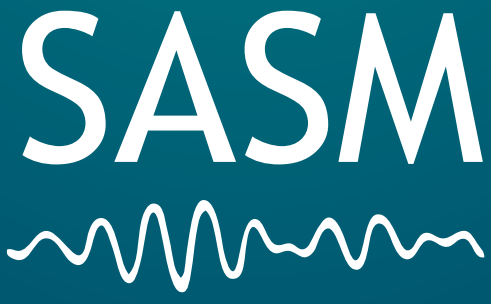

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