THE PERIOPERATIVE MANAGEMENT OF SLEEP DISORDERED BREATHING

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Harbor-UCLA Medical Center
Clinical Professor of Medicine

Saturday, January 19, 2019 – 10:10 a.m. – 10:40 a.m.

Janine Vintch, MD, was born and raised in Southern California. She went to UCLA for her undergraduate training and then to USC for her medical school years. Upon graduation, she matched at Harbor-UCLA Medical Center in Torrance, California, where she has remained for her entire career. She did her Internal Medicine residency training, Chief Resident, and then Pulmonary-Critical Care fellowship at Harbor. At the end of her training years, she was jointly appointed as a faculty member to both the Division of General Internal Medicine and the Division of Pulmonary and Critical Care Medicine and is currently a full time Profession through the David Geffen School of Medicine at UCLA. In the early years of her faculty appointment, she focused on perioperative management strategies and general medicine consultations. She also had an interest in Sleep Medicine and was self-trained in this subspecialty area. She is a Diplomate of the American Board of Sleep Medicine as well as the American Board of Internal Medicine in Sleep in addition to her certification in Internal Medicine, Pulmonary Diseases, and Critical Care Medicine. In the last 10 years, she has developed an interest in the area of venous thromboembolic disease and participated in the last edition of the ACCP Guidelines on the Management of VTE. More recently, she is working on developing a PE Response Team and in one of the members of the University of California Alliance on Pulmonary Embolism (UCAPE). In addition to her clinical areas of interest, she has participated in the Medical Staff leadership at Harbor and is currently their Chief of Staff.

The Perioperative Management of Sleep-Disordered Breathing

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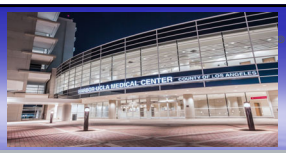
CTS 2019 Northern California Conference
January, 2019

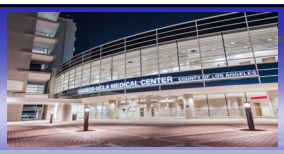
Harbor-UCLA MEDICAL CENTER



Disclosures

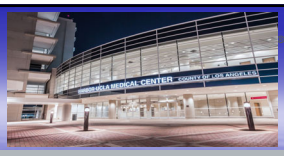
- No conflicts of interest

Learning Objectives



- Review the challenges that can be encountered in managing patients with sleep disordered breathing (SBD) in the perioperative period
- Discuss the preoperative preparation recommendations focusing on SDB
- Review management strategies for patients with SDB in the perioperative period to decrease their overall risk of complications and adverse outcomes

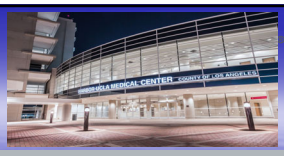
Introduction



- Every year approximately 250 million surgical procedures are performed worldwide
  - An increasing number are being performed in the ambulatory setting
- With both surgical volume and predisposing factors for SDB increasing, there is an increased interest in the impact of these disorders on perioperative outcome
  - Of note, the diagnosis of SDB including Obstructive Sleep Apnea (OSA) and Obesity Hypoventilation Syndrome (OHS) has not been established in the majority of surgical patients with these disorders

Debas HT. *JAMA Surg.* 2015;150:833-834.
Tsai A and Schumann R. *Curr Opin Anesthesiol.* 2016;29:103-108.

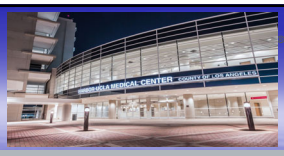
Introduction



- There are numerous variables that influence SDB in the perioperative period including:
  - Anesthesia
  - Upper airway injury after intubation
  - Fluid shifts
  - Pain medications
  - Administration of oxygen

Ayas NT et al. *Ann Am Thorac Soc.* 2018;15:117-126.

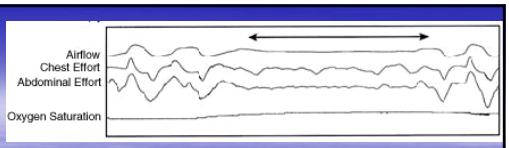
SDB in the Perioperative Period



- OSA
  - In the classic epidemiologic study by Young et al the prevalence of OSA defined as an AHI > 5 was 9% of women and 24% of men
    - Approximately 70% of patients with OSA are overweight or obese and has more than doubled in the past 40 years
  - Today, a high prevalence of OSA is noted in patients undergoing surgery with studies reporting ranges between 24 to 41%
    - Prevalence as high as 70% has been reported in bariatric surgery patients

Roesslein M and Chung F. *Eur J Anaesthesiol.* 2018;35:245-255.
Tsai A and Schumann R. *Curr Opin Anesthesiol.* 2016;29:103-108.
Young T et al. *N Engl J Med.* 1993;328:1230-1235.

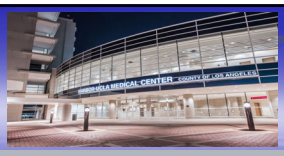
Sleep-Disordered Breathing: OSA



- OSA is characterized by repetitive partial or complete obstruction of the upper airway during sleep
  - These obstructions lead to oxygen desaturation, hypercapnia, and cortical microarousals in an attempt to restore upper airway patency
- OSA has been associated with various health-related consequences including increased rate of motor vehicle accidents, hypertension, myocardial ischemia, arrhythmias, heart failure, pulmonary hypertension, stroke, metabolic syndrome, and all-cause mortality

Adesanya AO et al. *Chest.* 2010;138:1489-1498.
Vasu TS et al. *J Clin Sleep Med.* 2012;8:199-207.

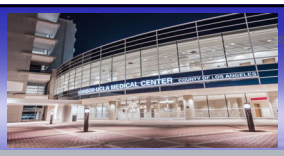
Sleep-Disordered Breathing: OSA



- The impact of OSA on postoperative pulmonary complications (PPCs) is an area of current active research
  - In 2006, the ACP guidelines suggested that PPCs may be higher among patients with OSA based on a case-control study of patients undergoing hip or knee replacement
- The importance of this was highlighted in 2008 when the Joint Commission proposed a National Patient Safety Goal focusing on preoperative screening as well as protocols for perioperative management of OSA

Bolden N et al. *J Clin Anesth.* 2009;21:286-293/
Health Leaders Media. JCAHO National Patient Safety Goals. 2011.
Smetana GW and Conde MV. *Clin Geriatr Med.* 2008;24:607-624.

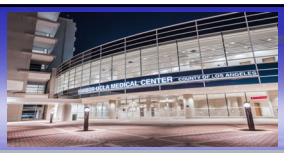
Sleep-Disordered Breathing: OSA



- A systematic review of 61 studies involving 413,304 OSA and 8,556,279 non-OSA patients to examine outcomes after procedures performed under general anesthesia, regional anesthesia, and sedation noted that OSA was associated with an increase in postoperative complications including
  - Difficult intubation
  - Pulmonary complications including need for intubation, prolonged mechanical ventilation support
  - Cardiovascular complications including atrial fibrillation, cardiac arrest
  - Delirium, agitation, confusion
  - Impaired wound healing
  - Higher resource utilization

Opperer M et al. *Anesth Analg.* 2016;122:1321-1334.

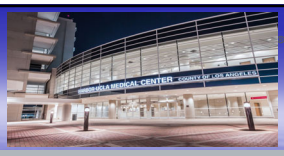
Sleep-Disordered Breathing: OHS



- OHS is a disease entity distinct from simple obesity and OSA
  - Defined as a combination of obesity with BMI > 30, daytime hypercapnia with P_aCO_2 > 45 mmHg during wakefulness with sleep-disordered breathing in the absence of an alternative neuromuscular, mechanical, or metabolic explanation for hypoventilation
  - OHS patients consume a greater level of healthcare resources than eucapnic patients with OSA
  - In contrast to OSA, new studies demonstrate a higher prevalence of OHS in women compared to men

Ayas NT et al. *Ann Am Thorac Soc.* 2018;15:117-126.
Bahammam AS. *Saudi Med J.* 2015;36:181-189.
Chau EHL et al. *Anesthesiology.* 2012;117:118-205.

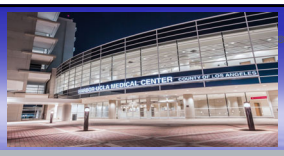
Sleep-Disordered Breathing: OHS



- The prevalence of OHS is approximately 0.15 to 0.6% of the general population and increases to 50% in patients with a BMI > 50
  - Approximately 90% of patients with OHS have concomitant OSA and is estimated to occur in 1/160 adults
    - Conversely only 10 to 20% of OSA patients have OHS
- OHS should be suspected in the following clinical scenarios:
  - Obese patients with an increased serum bicarbonate > 27 mEq/L
  - Room air hypoxemia while resting
  - Persistent hypoxemia during a sleep study

Ayas NT et al. *Ann Am Thorac Soc.* 2018;15:117-126.
Chau EHL et al. *Anesthesiology.* 2012;117:118-205.
Iftikhar IH and Roland J. *Clin Chest Med.* 2018;39:427-436.

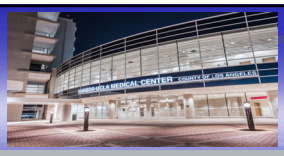
Sleep-Disordered Breathing: OHS



- Compared to eucapnic obese patients, OHS patients demonstrate
  - More severe upper airway obstruction
  - Impaired respiratory mechanics
  - Blunted central respiratory drive
  - Increased incidence of pulmonary hypertension (PH)
    - Severe PH was diagnosed in 28.6% of women and 14.3% of men in a prospective observational study of OHS patients

Priou P et al. *Chest.* 2010;138:84-90.
Iftikhar IH and Roland J. *Clin Chest Med.* 2018;39:427-436.

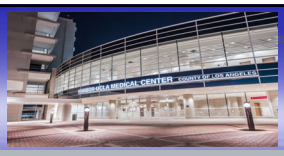
Sleep-Disordered Breathing: OHS



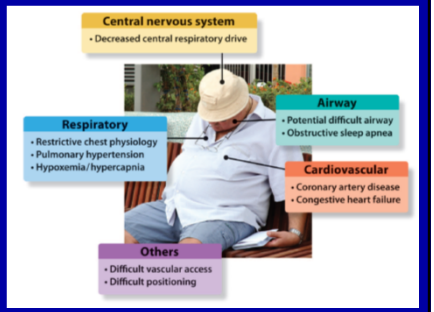
- Compared with patients who have OSA alone in the perioperative setting, patients with OHS have a increased risk of the following:
  - Respiratory failure = OR 10.9
  - Heart failure = OR 5.4
  - Prolonged intubation = OR 3.1
  - Tracheostomy = OR 3.8
  - ICU transfer = OR 10.9
    - Longer ICU stay
  - Longer hospital stay

Kaw R et al. *Chest.* 2016;149:84-91.

Sleep-Disordered Breathing: OHS and OSA

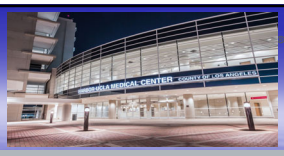


- Patients with a combination of OHS and OSA have a greater perioperative risk for cardiac and pulmonary complications as compared to patients with OSA without OHS
  - OHS was associated with 11 times increased odds for postoperative respiratory failure and ICU transfer
  - Increased incidence of postoperative heart failure (OR 5.4) and prolonged intubation (OR 3.1)
  - Longer LOS (7.3 versus 2.8 days)



Chung F et al. *Chest.* 2016;149:586-597.
Kaw R et al. *Chest.* 2016;149:84-91.

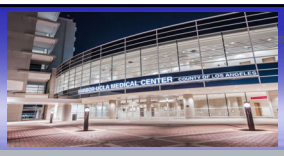
SDB in the Perioperative Period



- Several factors related to anesthesia and the operative intervention may contribute to complications in patients with underlying SDB
  - Medications such as hypnotics, opioids, muscle relaxants
  - Protracted supine position leading to decreased airway stability
  - Narrowing of the upper airway caused by pharyngeal edema following intubation
  - Perioperative discontinuation of CPAP
  - Disruption of sleep architecture
    - Sleep fragmentation with loss of REM sleep occurs initially followed by improved sleep and REM rebound seen between postop days 3 and 5

Ayas NT et al. *Ann Am Thorac Soc.* 2018;15:117-126.
Roesslein M and Chung F. *Eur J Anaesthesiol.* 2018;35:245-255.

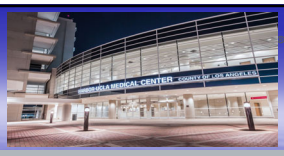
Preoperative Preparation



- The preoperative evaluation aims at gathering relevant information about the patient and formulating an anesthesia care plan
  - Diagnostic testing should be based on comorbidities and planned surgical intervention rather than on the mere presence of obesity
- Particular attention should focus on screening patients for SDB particularly obese patients
  - The 2013 Clinical Practice Guidelines for the Perioperative, Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient recommends screening ***all*** bariatric surgery patients for OSA

Leong SM et al. *J Clin Anesth.* 2018;45:63-68.
Mechanick JI et al. *Endocrin Pract.* 2013:19:337-372.
Nightingale CE et al. *Anaesthesia.* 2015;70:859-876.

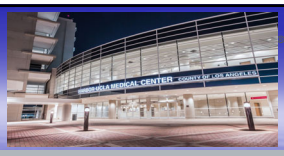
Preoperative Management



- Preoperative management should begin with a directed history and physical examination
  - Emphasis on airway examination and identifying comorbidities in order to optimize them prior to surgery with attention to identifying SDB
    - Neck circumference
    - BMI
    - Mallampati score and other airway characteristics
    - Difficulty with airway management or problems with previous anesthetics
    - Comorbidities including diabetes, hypertension, congestive heart failure, pulmonary hypertension

Adesanya AO et al. *Chest.* 2010;138:1489-1498.
Subramani Y et al. *Sleep Med Clin.* 2017;12:123-135.

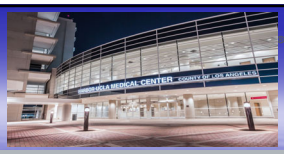
Preoperative Preparation: OSA Screening



- Many patients with underlying OSA may be undiagnosed and untreated at the time they present for surgery
- Screening for OSA in the preoperative period allows the provider to minimize postoperative complications by allowing the provider to:
  - Risk stratify the patient
  - Devise an anesthetic management plan with risk minimization
  - Plan for appropriate level and timing for postoperative monitoring

Nagappa M et al. *Anesth Analg.* 2017;125:1301-1308.

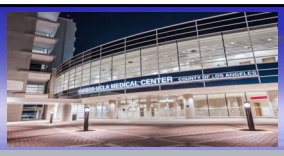
Preoperative Preparation: OSA Screening



- OSA screening tools have been developed and validated in surgical populations:
  - The STOP-Bang Questionnaire
  - The American Society of Anesthesiologists (ASA) Checklist
  - The Berlin Questionnaire
  - The Perioperative Sleep Apnea Prediction (P-SAP) Score
- These screening tools are designed to identify the presence of OSA rather than quantify the severity
- The inclusion of preoperative serum bicarbonate level may improve the predictive accuracy of the screening instrument

Rosslein M and Chung F. *Eur J Aneaesthesiol.* 2018;35:245-255.
Subramani Y et al. *Sleep Med Clin.* 2017;12:123-135.

OSA Screening: STOP-Bang Questionnaire



- The major drawback of all screening tools is their modest specificity with a high false-positive rate
  - STOP-Bang score > 3 is 93% sensitive but 43% specific for an AHI cut-off of 15
- Advantages of this tool is that it is brief, simple to administer, and requires only a fifth-grade reading level

STOP Questionnaire	BANG
Snoring	BMI >35
Tiredness	Age >50
Observed you stop breathing	Neck circumference >40 cm (>15.7")
Blood Pressure	Gender male

High risk: Yes to ≥3 items → Refer for sleep testing

Subramani Y et al. *Sleep Med Clin.* 2017;12:123-135.

OSA Screening: STOP-Bang Questionnaire

STOP Questionnaire	BANG
Snoring	BMI >35
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Observed you stop breathing	Neck circumference >40 cm (>15.7")
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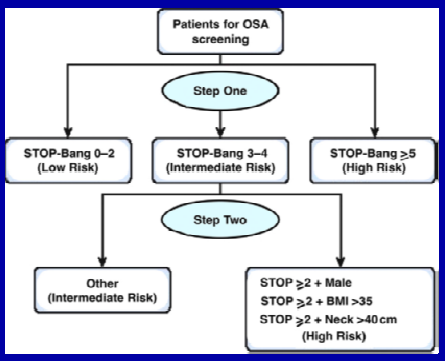
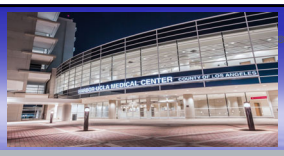
High risk: Yes to ≥3 items → Refer for sleep testing

- A new 2-step approach has recently been proposed
  - Patients with scores of 0 to 2 may be safely ruled out as low risk for moderate to severe OSA
  - Patients with scores of 5 or higher are at high risk of moderate to severe OSA
  - Among patient with scores of 3 or 4 (intermediate risk) who have 2 or the following are at higher risk as well
    - BMI > 35
    - Neck circumference > 40 cm
    - Male sex

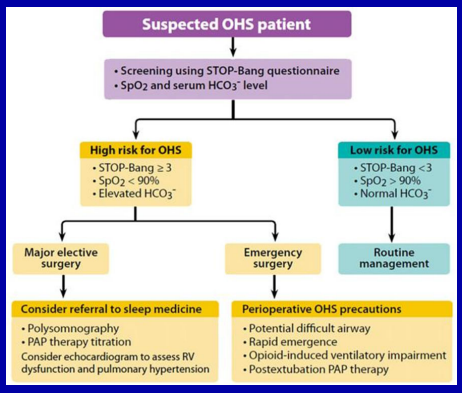


Chung F et al. *Anesthesiology.* 2008;108:812-821.
Madhusudan P et al. *Curr Opin Anesthesiol.* 2018;31:89-95.
Subramani Y et al. *Sleep Med Clin.* 2017;12:123-135.

Preoperative Preparation: OHS Screening

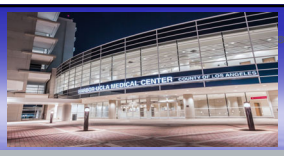


- A modified STOP-Bang Questionnaire with additional points for BMI and bicarbonate > 27 mEq/L was compared with the original STOP-Bang score for predicting OHS
  - Sensitivity 89.2% and a specificity 47.6% with a score of 6
  - Diuretics and steroid administration may lead to a primary metabolic alkalosis which may make a it to distinguish from a compensatory metabolic alkalosis



Bingol Z et a. *Sleep Breath.* 2016;20:495-500.
Chau EH et al. *Sleep Med Clin.* 2013 Mar; 8(1): 135–147.

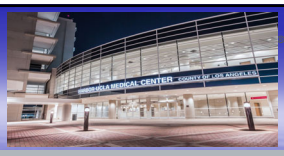
Preoperative Preparation



- Once a patient has been identified as high risk for OSA or OHS, the decision to proceed directly to surgery or to refer the patient for further evaluation will depend on the relative urgency of the surgery and made in consultation with the surgeon
  - If the plan is to proceed with surgery, all members of the healthcare team should be made aware of the patient's high-risk status in order to follow risk reduction strategies as outlined in guidelines such as the Society of Anesthesia and Sleep Medicine (SASM) and ASA

Adesanya AO et al. *Chest.* 2010;138:1489-1498.
Madhusudan P et al. *Curr Opin Anesthesiol.* 2018;31:89-95.

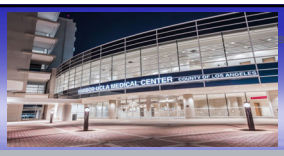
Preoperative Preparation: OSA Diagnosis



- Full-night, attended, in-laboratory polysomnography (PSG) is regarded as the gold standard in the diagnosis of OSA
  - PSG can provide the diagnosis, severity, and phenotype of OSA
  - However, the logistical issues associated with getting a PSG done timely can delay scheduled surgery
    - For non-bariatric procedures, there appears to be insufficient evidence in the current literature to support canceling or delaying surgery for a formal diagnosis unless there is evidence of associated significant uncontrolled disease or additional problems with ventilation or gas exchange

Memtsoudis SG et al. *Anesth Analg.* 2018;June 25.
Roesslein M and Chung F. *Eur J Anaesthesiol.* 2018;35:245-255.

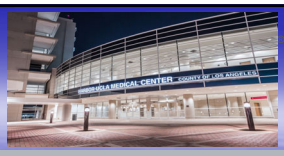
Preoperative Preparation: OSA Diagnosis



- Home sleep testing or other forms of testing such as pulse oximetry may be an alternative for patients with underlying high pre-test probability
  - Nocturnal pulse oximetry has been used as a surrogate to PSG for screening for OSA but is not accepted by CMS
    - Sensitivity can be as high as 98% for moderately severe OSA but specificity can be as low as 40% depending on how the data is interpreted

Park JG et al. *Mayo Clin Proc.* 2011;86:549-555.
Roesslein M and Chung F. *Eur J Anaesthesiol.* 2018;35:245-255.

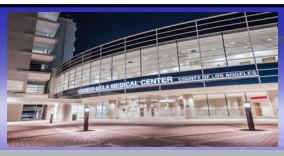
Nocturnal Pulse Oximetry



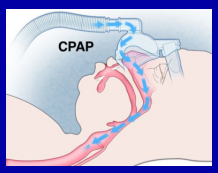
- Data from one study assessing pulse oximetry demonstrated that an oxygen desaturation index (ODI) > 5 had a higher rate of postoperative complications including respiratory and cardiac events
  - ODI = number of oxygen desaturation >4% events per hour of monitoring
- In another study comparing overnight oximetry with home sleep testing in 68 bariatric surgery patients found an ODI 3% had a negative predictive value of 95% to rule out OSA and a positive predictive value of 73%

Hwang D et al. *Chest.* 2008;133:1128-1134.
Malbois M et al. *Obes Surg.* 2010;20:326-331.

Preoperative Preparation: PAP Therapy

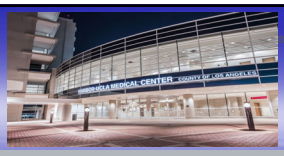


- Pneumatic splinting of the airway by applying CPAP is regarded as the gold standard treatment for OSA
  - It improves daytime sleepiness, accident risk, and quality of life
  - Several studies have also shown that it decreases the risks of several adverse cardiovascular outcomes such as hypertension and atrial fibrillation
  - CPAP use prior to surgery to prevent postoperative complications is not unequivocally confirmed in the literature
    - Because of its known benefits outside of the surgical arena, many guidelines do recommend its initiation in the perioperative period



Roesslein M and Chung F. *Eur J Anaesthesiol.* 2018;35:245-255.

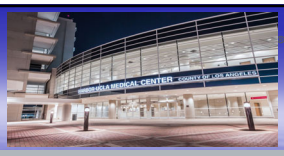
Preoperative Preparation: PAP Therapy



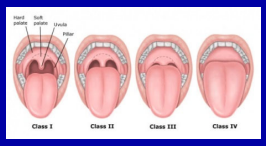
- The 2014 ASA Practice Guidelines strongly recommends considering the initiation of CPAP in the perioperative period in patients with OSA
  - Particularly for patients with severe OSA
  - It remains unclear what duration of preoperative CPAP is needed prior to elective surgery that leads to a positive impact
- For patients with OHS, PAP therapy should be also considered and if possible started during the few days or weeks before surgery
  - In a period as short as 5 days, gas exchange and SDB can improve significantly using either CPAP or NIV

ASA Task Force. *Anesthesiology.* 2014;120:268-286.
Chau EHL et al. *Anesthesiology.* 2012;117:188-205.

Preoperative Preparation: Airway Assessment

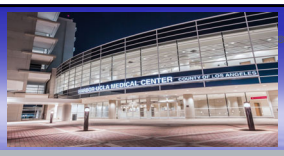


- Obesity alone is associated with up to a 30% greater chance of a difficult airway or failed intubation
  - Bag-mask ventilation is also known to be more difficult in the obese with reports as high as 79%
- Risk factors beyond BMI predictive of a difficult intubation include:
  - Reduced mobility of the lower jaw
  - Male sex
  - Large neck circumference
  - OSA: Risk appears independent from Mallampati score and BMI
    - In a case-control retrospective study of 253 patients, difficult intubation was found to occur 8 times more often in OSA patients than controls



Hillman DR and Chung F. *Respirology.* 2017;22:230-239.
Nightingale CE et al. *Anaesthesia.* 2015;70:859-876.

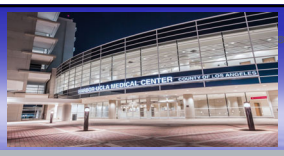
Intraoperative Care: Regional Anesthesia



- Many reviews and guidelines recommend regional as preferred to general anesthesia when possible as it offers distinct advantages
  - Minimal airway manipulation
  - Avoidance of anesthetic drugs with cardiopulmonary depression
  - Reduced postoperative nausea and vomiting
  - Reduced perioperative opioid requirements
- There is a higher risk of failure of regional techniques in the obese
  - An airway management plan should always be in place
- Sedation, if required, the should be kept to a minimum

Nightingale CE et al. *Anaesthesia.* 2015;70:859-876.
Raveendran R et al. *Curr Opin Anesthesiol.* 2017;30:146-155.

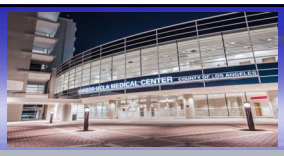
Intraoperative Care: Regional Anesthesia



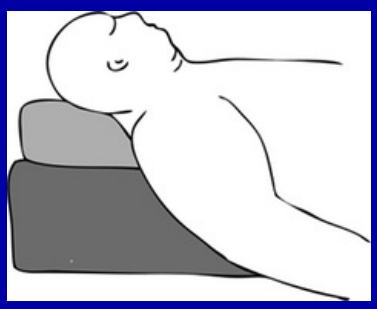
- In a study of 40,316 OSA patients undergoing hip and knee arthroplasty, the use of neuraxial anesthesia versus general anesthesia were compared
  - Neuraxial anesthesia was associated with
    - Decreased odds for the need for mechanical ventilation
    - Decreased admissions to the ICU postoperatively
    - Shorter length of stay
    - Decreased cost

Memtsoudis SG et al. *Reg Anesth Pain Med.* 2013;38:274-281.

Intraoperative Care: Induction of Anesthesia

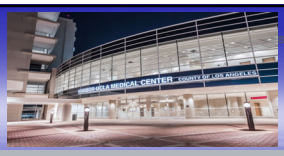


- Easily reversible drugs, with fast onset and offset, are the agents of choice for patients with SDB
- For obese patients, since their work of breathing is increased, tracheal intubation with controlled ventilation is the airway management technique of choice
  - During induction, the patient should be positioned in a ramped position with the tragus of the ear at the level of the sternum and the arms away the chest
    - HELP = Head Elevated Laryngoscopy Position
    - Sniffing position



Nightingale CE et al. *Anaesthesia.* 2015;70:859-876.

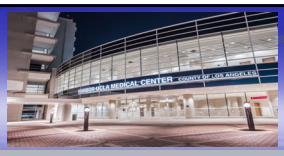
Intraoperative Care: Induction of Anesthesia



- Minimizing the time from induction to intubation will reduce the risk of oxygen desaturation should bag-mask ventilation prove difficult
  - Preoxygenation for more than 3 minutes with a tightly fitted mask can increase apnea tolerance time
    - Application of CPAP or PEEP can achieve a higher oxygen tension and longer time to desaturation
- One needs to be prepared and avail all specialized anesthesiology instruments and assistance
  - In extreme cases use of awake fiberoptic intubation be necessary

Iftikhar IH and Roland J. *Clin Chest Med.* 2018;39:427-436.
Nightingale CE et al. *Anaesthesia.* 2015;70:859-876.

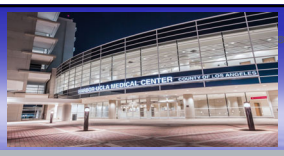
Intraoperative Care: Ventilatory Support



- Observational studies suggest that obese patients are at higher risk of being ventilated with large, potentially injurious tidal volumes
  - In a study of patient undergoing major abdominal surgery, intraoperative ventilation with low tidal volumes (6 to 8 ml/kg predicted body weight) as well as PEEP and recruitment maneuvers impart outcome benefits
    - Composite end points of pneumonia, respiratory failure, sepsis, and death
  - In a small study of 30 gastric bypass surgery patient, it was found that PEEP and recruitment maneuvers combined reduced atelectasis and improved oxygenation in morbidly obese patients whereas PEEP or recruitment maneuvers alone did not

PROVE Network Investigators. *Lancet.* 2014;384:495-503.
Reinius H et al. *Anesthesiology.* 2009;111:979-987.

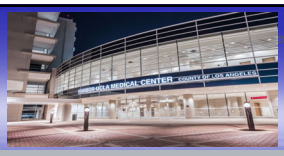
Intraoperative Care: Ventilatory Support



- The Protective Ventilation with Higher versus Lower PEEP during General Anesthesia for Surgery in Obese Patients (PROBESE) trial seeks to answer the question of PEEP in obese patients by comparing intraoperative ventilation strategies
- While awaiting additional studies to guide ventilatory strategies, some authors recommend the following intraoperative ventilator settings
  - Low tidal volume: 6 to 8 mL/kg predicted body weight
  - Higher PEEP: 8 to 15 cm H_2O
  - Peak airway pressure limit: 30 to 35 cm H_2O
  - Recruitment maneuvers

PROBESE. Bluth T et al. *Trials.* 2017;18:202.
Tsai A and Schumann R. *Curr Opin Anesthesiol.* 2016;29:103-108.

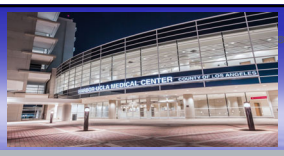
Postoperative Management: Extubation Plan



- Extubation should be performed in a similar manner to intubation
  - Patients should be in a sitting position or with the upper body elevated
  - Assure return of stable protective arousal responses is key
  - Neuromuscular blockade should be reversed if necessary
    - Patient should be able to sustain a head lift for > 5 seconds
    - Use of suggamadex or other reversal agent can be given if needed
  - Supplemental oxygen should be provided until baseline oxygenation status is achieved
    - This measure has recently been found to improve oxygenation and decrease AHI in OSA patient without increasing the duration of apnea or hypopnea events

Liao P et al. *Chest.* 2017;151:597-611.
Huschak G et al. *Best Pract Res Clin Endocrinol Metab.* 2013;27:247-260.

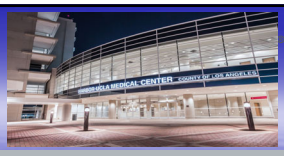
Postoperative Management: Monitoring



- Close and continuous monitoring can take place in the Post-Anesthesia Care Unit (PACU) to identify behaviors that indicate particular vulnerability to UA obstruction and/or hypoventilation in at-risk patients
  - Such patients are monitored for a longer period of time in this environment so that observations can be made well beyond the immediate emergence from anesthesia
    - Exact amount of time is controversial with some suggesting 90 minutes

Chau EHL et al. *Anesthesiology.* 2012;117:188-205.
Hillman DR and Chung F. *Respirology.* 2017;22:230-239.

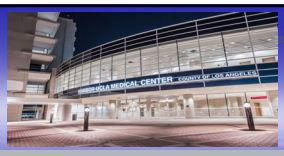
Postoperative Management: Monitoring



- The presence of the following may highlight vulnerability to ventilatory problems beyond the PACU
  - Recurrent bradypnea (RR < 8 breaths/minute)
  - Witnessed obstructive events (apneas lasting longer than 10 seconds)
  - Persistent hypoxemia requiring oxygen therapy
    - Desaturations < 90%
  - Other indices of hypoventilation such as elevated bicarbonate levels or hypercapnia
  - Mismatch between complaints of pain and levels of sedation
- If these are noted, further continuous oximetry and monitoring of ventilation should be considered

Hillman DR and Chung F. *Respirology.* 2017;22:230-239.
Raveendran R et al. *Curr Opin Anesthesiol.* 2017;30:146-155.

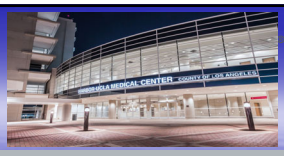
Postoperative Management: PAP Therapy



- Resumption of CPAP therapy, if feasible, should occur in the immediate postoperative period
  - Many guidelines recommend that the patient bring in their own machine and mask to ensure compliance and comfort with this interface
- Consider initiation of CPAP in individuals at risk for SDB who have recurring respiratory events while monitored in the PACU
  - A single fixed CPAP setting may not be effective in this setting likely related to fluid shifts, supine positioning, residual sedative effects
  - Use of autotitrating PAP (APAP) has shown significant reduction in postoperative AHI and improved oxygen saturations
    - Use with caution in patients at risk for OHS and opioid-induced hypoventilation

Chung F et al. *Chest.* 2016;149:586-597.
Rosslein M and Chung F. *Eur J Anaesthesiol.* 2018;35:245-255.

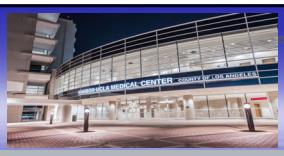
Postoperative Management: PAP Therapy



- A meta-analysis of 6 studies including 904 patients examined the effectiveness of CPAP therapy on postoperative outcomes, postoperative AHI, and length of stay in surgical patients with OSA plus CPAP versus patients with OSA without CPAP therapy
  - No significant difference in postoperative adverse events between the two groups
  - Patients who used CPAP either preoperatively and/or postoperatively compared with no CPAP had a risk ratio of 0.88 (0.73-1.06) and a 12% risk reduction of postoperative adverse events with a corresponding NNT to benefit of 45
  - The CPAP group had a significantly reduced postoperative AHI and a trend towards a shorter LOS

Chung F et al. *Chest.* 2016;149:586-597.
Nagappa N et al. *Anesth Analg.* 2015;120:1013-1023.

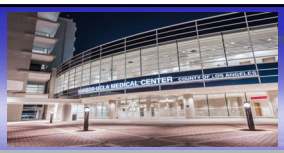
Postoperative Management: PAP Therapy



- Data collected from the Michigan Surgical Quality Collaborative of 52 community and academic hospitals compared postoperative 30-day cardiopulmonary complications between treated and untreated patients with OSA
  - Of 26,842 patients 2,646 (9.9%) had a diagnosis or suspicion of OSA and 55% of them were untreated
  - Documented OSA without therapy or suspicion of OSA was associated with higher cardiopulmonary complications (6.7% vs 4%; OR 1.8)
    - Myocardial infarction (adjusted OR 2.6) and reintubations (adjusted 2.5) were significantly higher in untreated OSA patients

Abdelsattar ZM et al. *Sleep.* 2015;38:1205-1210.
Chung F et al. *Chest.* 2016;149:586-597.

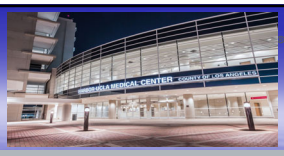
Postoperative Management: Analgesia



- Pain control is essential to allow patients to participate in deep breathing and coughing strategies postoperatively
- A multimodal approach to pain management should be applied and can include a combination of any of the following
  - Nonopioid adjuncts including acetaminophen, NSAIDs
  - Steroids
  - Ketamine
  - α_2 adrenergic agonists
    - Dexmedetomidine has sedative, amnestic, and analgesic properties and shown to decrease postoperative opioid without respiratory depression
  - Regional analgesia with local infiltration, epidural anesthesia, or peripheral nerve blockade

Hillman DR and Chung F. *Respirology.* 2017;22;230-239.
De Raaff CAL et al. *Curr Opin Anesthesiol.* 2018;31:104-109.

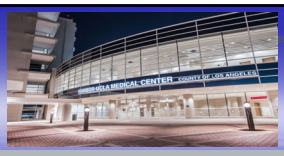
Special Considerations: Ambulatory Surgery



- The Society for Ambulatory Anesthesia has provided guidelines for the selection of OSA patients for ambulatory surgery
- STOP-Bang for screening should be performed prior to surgery
- Patients with OSA can be considered for ambulatory surgery if they have the following conditions met
  - Compliant on a stable PAP setting and able to use it upon discharge home
  - Comorbid conditions are optimized
  - Postoperative analgesia plan can be predominantly non-opioid
- Schedule the patient for the first case of the day to enable a longer monitoring time in the postanesthesia period

Joshi G et al. *Anesth Analg.* 2012;115:1160-1168.
Nightingale CE et al. *Anaesthesia.* 2015;70:859-876.

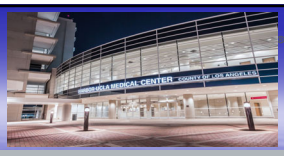
Future Directions



- **Risk stratification based on OSA phenotype**
  - An understanding of the predominant pathophysiology of OSA, known as the endotype and the identifiable morphological characteristics of an individual, known as the phenotype will give us more insight to guide screening, monitoring, and management strategies
  - Areas that play an important role in the pathogenesis of OSA include:
    - Upper airway anatomy
    - Tone of the upper airway dilator muscles
    - Arousal response of an individual
    - Stability of the respiratory system control

Madhusudan P et al. *Curr Opin Anesthesiol.* 2018;31:89-95.

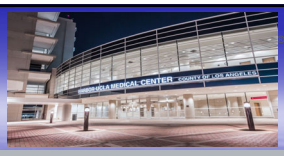
Future Directions



- **Areas for improvement include**
  - Development of better perioperative risk stratification with wider use of portable monitoring
  - Use of other metrics of OSA severity besides AHI
  - Closer regard for the possibility of coexistent hypoventilation
  - Development of cost-effective methods to continuously monitor ventilation outside high dependency areas such as the PACU and ICU
  - Use of telemetered data particularly for patients not being managed in a high dependency area
  - Increase use of PAP therapies postoperatively

Hillman DR and Chung F. *Respirology.* 2017;22:230-239.

Conclusions



- It is important to recognize obese patients with suspected sleep-disordered breathing including OSA and OHS preoperatively as many remain undiagnosed prior to this encounter with the healthcare system
  - There is growing evidence that patients with OHS have worse outcomes than patients with OSA alone
- A multidisciplinary care pathway is necessary to manage these high-risk patients to decrease their perioperative risk