Peri-operative Complications in the Obstructive Sleep Apnea Patient

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Society of Anesthesia and Sleep Medicine
5th Annual Meeting
Practical Magic: Optimizing Resources for Best Outcomes

Disclosures

- Principle Investigator on multicenter pharmaceutical trials sponsored by Jazz Pharmaceuticals
- Receive Royalties from Up-To-Date (Sleep Section Editor)
- Receive Honoraria from Best Doctors

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Are complications higher in OSA pts undergoing surgical procedures? MAYBE…

Author	Type of Study	Number of Patients	Diagnosis of OSAS	Type of Surgeries	Complications	Results
Gupta et al.[99]	Case control study	101 patients with OSA and 101 matched controls	Polysomnography (PSG)	Orthopedic (hip or knee replasement)	Reintubation, hypoxemia, acute hypercapnia, myocardial infarction, arrhythmia, delirium, and ICU transfer	Patients with OSA had higher rate of postoperative complications (39% vs 18%). These patients also had increased hospital length of stay.
Auckley et al.[105]	Historical cohort study	81 patients with completed Berlin Questionnaire	Berlin Questionnaire	Elective surgery (type of surgeries is not included in the abstract)	Hypoxemia, hypercapnia, reintubation, atelectasis, pneumonia, arrhythmia, thromboembolism	Patients with high-risk of sleep apnea based on the Berlin Questionnaire had a higher rate of postoperative complications (20% vs 4.5%).
Sabers et al.[106]	Case control study	234 patients with OSA and 234 matched controls	Polysomnography	Non-otorhinolaryngologic outpatient surgical procedures	Unplanned hospital admission, bronchospasm, upper airway obstruction, hypotension, atrial fibrillation, pulmonary edema	No significant difference in the rate of unplanned hospital admissions (23.9% vs 18.8%) or other adverse events (2.1% vs 1.3%)
Kaw et al.[100]	Case control study	37 patients with OSA and 185 matched controls	Polysomnography	Cardiac	Encephalopathy, postoperative infections, and ICU length of stay	Patients with sleep apnea had higher rate of encephalopathy, postoperative infections (mediastinitis), and increased ICU length of stay.

Vasu T et al, JCSM 2012;8(2):199-207

Are complications higher in OSA pts undergoing surgical procedures? MAYBE…

Hwang et al.[102]	Historical cohort study	172 patients underwent home nocturnal oximetry	Home nocturnal oximetry	Abdominal, ENT, Thoracic, Vascular, Gyn, Neurosurgical, Urologic, Cardiothoracic, and Orthopedic	Arrhythmia, hypoxemia, atelectasis, GI bleed, pneumonia, pulmonary embolism,	Patients with ODI4% ≥ 5/h had a higher rate of postoperative complications than those with ODI4% < 5/h (15.3% vs 2.7%).
Gali et al.[104]	Prospective cohort study	693 patients with completed Flemons Criteria and SACS score	Flemons Criteria and SACS score	Orthopedic, Gyn, ENT, Urologic, Thoracic, Plastics, Neurosurgery, General abdominal	Arrhythmia, MI, ICU admission, pneumonia, need for the ventilator support	Postoperative respiratory events were associated with high SACS and PACU events
Liao et al.[99]	Retrospective matched cohort study	240 patients with OSA and 240 matched controls	International Classification of Disease (ICD-9) codes	Cardiac, ENT, Orthopedic, Spine, Urologic, General, Gyn, and Plastic	Hypoxemia, pulmonary edema, bronchospasm, arrhythmia, confusion	Patients with OSA had a higher incidence of postoperative complications (48% vs 36%)
Vasu et al.[76]	Historical cohort study	135 patients with completed STOP BANG Questionnaire	STOP BANG Questionnaire	Orthopedic, Abdominal, Head and Neck, ENT, Gyn, Vascular, Cardiothoracic	Hypoxemia, pneumonia, pulmonary embolism, atelectasis, hypotension, atrial fibrillation	Patients with high-risk of sleep apnea based on STOP BANG Questionnaire had a higher rate of postoperative complications (19.6% vs 1.3%) and the hospital length of stay.

Vasu T et al, JCSM 2012;8(2):199-207

Are complications higher in OSA pts undergoing surgical procedures? MAYBE…

Author	Type of Study	Number of Patients	Diagnosis of OSAS	Type of Surgeries	Complications	Results
Stierer et al.[107]	Prospective cohort study	A cohort of 2139 patients who underwent ambulatory surgical procedure	Probability of OSA based on demographic and questionnaire including Maislin index score	Orthopedic, ENT, Gyn, Plastic, Neurologic, Urologic, and general outpatient surgical procedures	Unplanned hospital admission, hypoxemia, cardiac arrhythmia, re-intubation, re-admission within 24 h of discharge, and need for lung ventilation	Increased propensity for OSA was not associated with unplanned hospital admission. However, it was associated with difficult intubation, increased oxygen requirement, and intraoperative tachycardia with increased need for labetalol or metoprolol.
Memtsoudis et al.[101]	Case control study	58358 orthopedic patients with OSA and 45547 general surgery patients with OSA were matched for controls in 1:3 manner	International Classification of Disease (ICD-9) codes	Orthopedic and general surgery	Aspiration pneumonia, pulmonary embolism, need for intubation and mechanical ventilation, ARDS	Patients with sleep apnea undergoing orthopedic and general surgeries were at a higher risk of aspiration pneumonia, ARDS, and the need for intubation and mechanical ventilation.
Kaw et al.[103]	Cohort study	471 patients who underwent non-cardiac surgery within 3 years of PSG	Patients with an apnea-hypopnea index (AHI) ≥ 5/h were defined as OSA, and those with AHI < 5 as controls	Non-cardiac surgery	Atrial fibrillation, respiratory failure, hypoxemia, delirium, transfer to ICU, congestive heart failure, myocardial infarction, hospital length of stay	Patients with OSA had a higher rate of postoperative hypoxemia (12.4% vs 2.1%), transfer to ICU (6.7% vs 1.6%), any complication (14.2% vs 2.6%), and hospital length of stay.

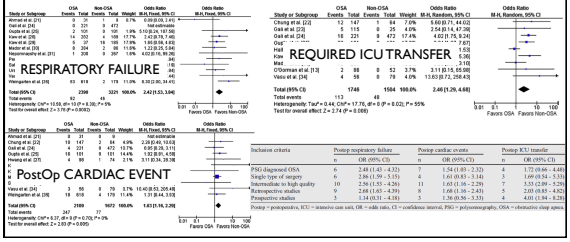
Vasu T et al, JCSM 2012;8(2):199-207

Are complications higher in OSA pts undergoing surgical procedures? MAYBE…

Author	Type of Study	Number of Patients	Diagnosis of OSAS	Type of Surgeries	Complications	Results
D'Apuzzo et al 2012	**Database anslysis (NIS)**	**258,455 (16,608 – 6.4% had OSA)**	**ICD-9 Diagnosis**	**Joint arthroplasty**	**Procedure related complications, PE, Anemia, mortality**	**Increased mortality. PE, wound hematomas**
Mohlesi et al 2013	**Database anslysis (NIS)**	**91,028 (33,196 – 36% had OSA)**	**ICD-9 Diagnosis**	**Bariatric surgery**	**Emergent ETI, resp failure/complication, AF, CV procedure, mortality**	**Decreased mortality, increased EETI, NIV, AF**
Mohlesi et al 2013	**Database anslysis (NIS)**	**1,058,710**	**ICD-9 Diagnosis**	**Orthopedic Prostate Abdominal CV**	**Emergent ETI, resp failure/complication, AF, CV procedure, mortality**	**Decreased mortality in ortho, abdominal, CV Increased EETI, NIV, AF in all groups**
Foldvary-Shafer 2015	**Prospective trial**	**107**	**PSG (in hospital)**	**Cardiothoracic**	**Insulin infusion, LOS, ICU readm, resp compl, CV compl, encephalopathy, infection, readm, mortality**	**AHI > 15 had lower EF, no increased events or higher mortality**

Are complications higher in OSA pts undergoing surgical procedures? MAYBE…

- Hai F et al: Meta-analysis of 17 studies; 7,162 patients
  - Increased risk of respiratory failure
  - Increased risk of cardiac events
  - More ICU transfers

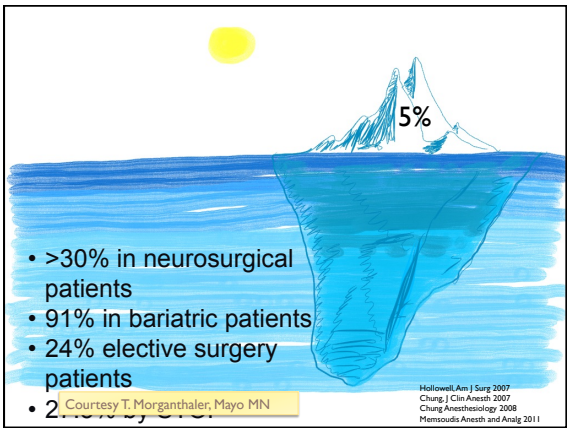


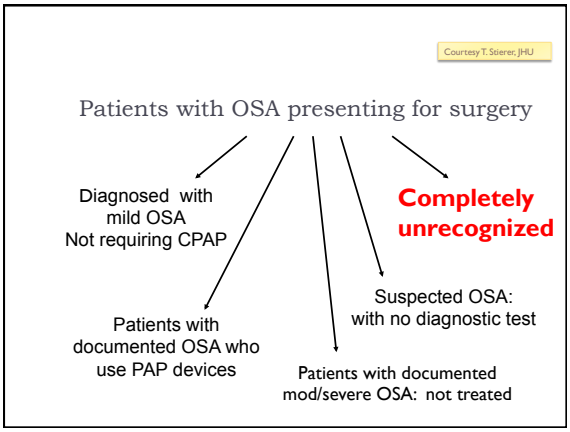
Based on current data:

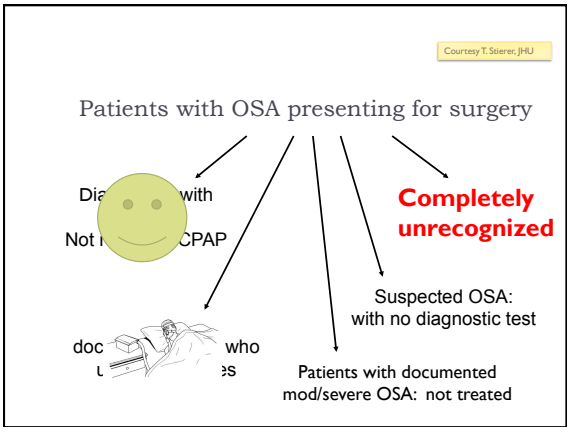
- Observational studies, Meta-analyses with low to moderate evidence
- Probably more postop complications
  - Intubations and need for NIV
  - Cardiac events (eg atrial fibrillation)
  - Infections
  - ICU transfers
- Not compelling data on length of stay
- Does not appear to increase mortality (only 1 study has shown ↑) but know by case series and case reports that mortality may occur in such patients

OSA and Comorbid Conditions

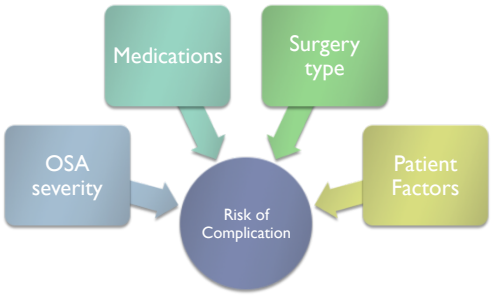
- Prevalence of OSA is very high in patients with common medical disorders
  - Diabetes: 80-90%
  - Stroke: 50-95%
  - Heart Failure: 20-35%
    - add central sleep apnea → higher
  - Acute Coronary syndrome: 65%
  - Atrial fibrillation: 32% (87% in therapy resistant)
  - Poorly controlled hypertension (64-85%; higher in males 90-95%)


5%
• >30% in neurosurgical patients
• 91% in bariatric patients
• 24% elective surgery patients
Courtesy T. Morganthaler, Mayo MN
Hollowell, Am J Surg 2007
Chung, J Clin Anesth 2007
Chung Anesthesiology 2008
Memsoudis Anesth and Analg 2011


Courtesy T. Stierer, JHU
Patients with OSA presenting for surgery
Diagnosed with mild OSA Not requiring CPAP
Completely unrecognized
Suspected OSA: with no diagnostic test
Patients with documented OSA who use PAP devices
Patients with documented mod/severe OSA: not treated


Courtesy T. Stierer, JHU
Patients with OSA presenting for surgery
Completely unrecognized
Suspected OSA: with no diagnostic test
Patients with documented mod/severe OSA: not treated

Additive factors



Courtesy T. Morganthaler, Mayo MN

Outpatient Surgery Challenges

- Many seen day OF surgery
- May or may not have access or time to get home sleep test or sleep lab if needed
- If not on any therapy, hard to institute it during this time period
- Should consider excluding the following pt populations:
  - Severe cardiac valve disease
  - EF < 30%
  - Chronic hypoxemia on oxygen
  - Moderate to sever pulmonary hypertension
  - COPD + OSA (overlap syndrome)
  - At fib + OSA

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Outpatient Protocols

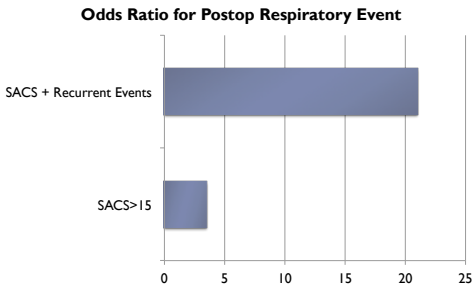
- Group One: Known OSA on CPAP
  - Should wear CPAP postop
- Group Two: Known Moderate/Severe OSA on CPAP not able to wear CPAP post op or not currently using CPAP
  - ***Evaluate comorbidities!!!***
  - Need postop monitoring and limit sedative/narcotic use
  - Postop monitoring shows "stress" consider overnight observation
- Group Three: Elevated suspicion for OSA but not currently diagnosed
  - If have time to do diagnostic testing, go for it
  - If not, treat as Group Two

Identifying risk for postoperative complications: Additive Model (Mayo Clinic)

- Use SACS to screen
- Measure PACU experience
  - Initial evaluation period = 30 min after extubation or PACU arrival
  - 2nd and 3rd evaluation periods at 30 minute intervals
  - Criteria: >1 defined as recurrent
    - Hypoventilation: < 8 bpm (3 episodes=Y)
    - Apnea: >10 sec (1 episode = Y)
    - Desaturations: SaO2<90% (3 episodes = Y)
    - Pain-Sedation Mismatch: RSS > 3; VAS > 5

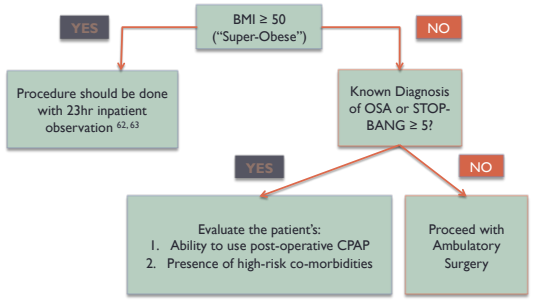
Gali, Anesthesiology 2009

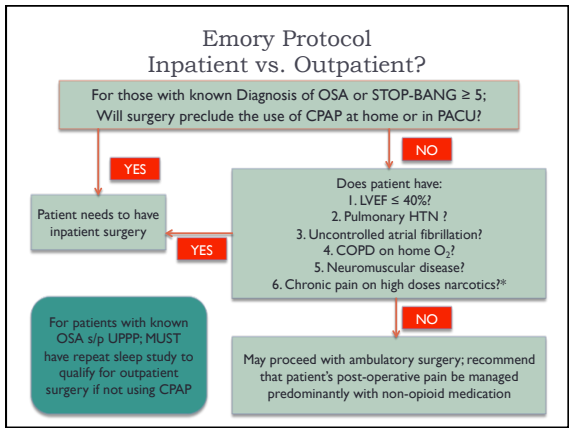
Identifying risk for postoperative complications: Additive Model (Mayo Clinic)

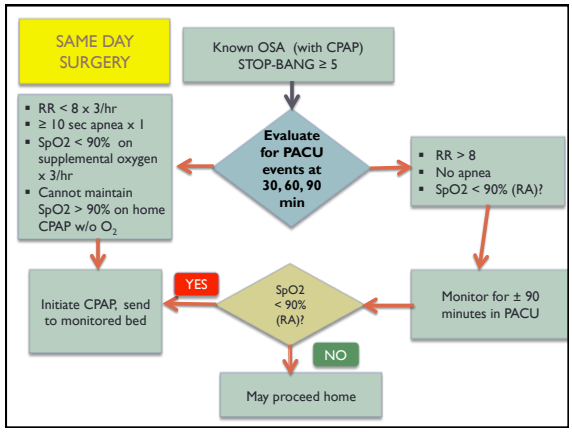


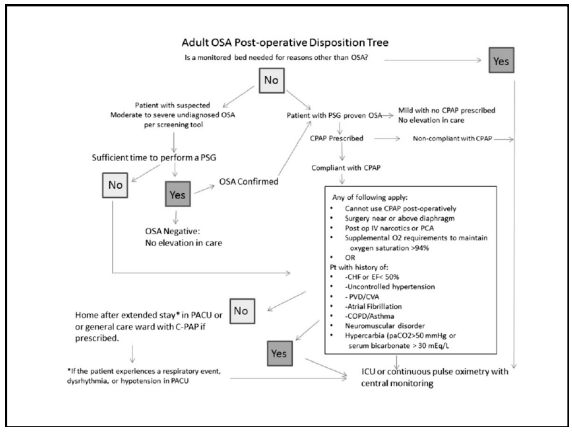
Gali, Anesthesiology 2009

Emory Protocol Inpatient vs. Outpatient?




Emory Protocol
Inpatient vs. Outpatient?
For those with known Diagnosis of OSA or STOP-BANG ≥ 5;
Will surgery preclude the use of CPAP at home or in PACU?
YES
NO
Patient needs to have inpatient surgery
Does patient have:
1. LVEF ≤ 40%?
2. Pulmonary HTN ?
3. Uncontrolled atrial fibrillation?
4. COPD on home O2?
5. Neuromuscular disease?
6. Chronic pain on high doses narcotics?*
YES
NO
For patients with known OSA s/p UPPP; MUST have repeat sleep study to qualify for outpatient surgery if not using CPAP
May proceed with ambulatory surgery; recommend that patient's post-operative pain be managed predominantly with non-opioid medication


SAME DAY SURGERY
Known OSA (with CPAP)
STOP-BANG ≥ 5
RR < 8 x 3/hr
≥ 10 sec apnea x 1
SpO2 < 90% on supplemental oxygen x 3/hr
Cannot maintain SpO2 > 90% on home CPAP w/o O2
Evaluate for PACU events at 30, 60, 90 min
RR > 8
No apnea
SpO2 < 90% (RA)?
Initiate CPAP, send to monitored bed
YES
SpO2 < 90% (RA)?
Monitor for ± 90 minutes in PACU
NO
May proceed home


Adult OSA Post-operative Disposition Tree
Is a monitored bed needed for reasons other than OSA?
Yes
No
Patient with suspected Moderate to severe undiagnosed OSA per screening tool
Patient with PSG proven OSA
Mild with no CPAP prescribed No elevation in care
CPAP Prescribed
Non-compliant with CPAP
Sufficient time to perform a PSG
Compliant with CPAP
No
Yes
OSA Confirmed
OSA Negative: No elevation in care
Any of following apply:
Cannot use CPAP post-operatively
Surgery near or above diaphragm
Post op IV narcotics or PCA
Supplemental O2 requirements to maintain oxygen saturation >94%
OR
Pt with history of:
-CHF or EF< 50%
-Uncontrolled hypertension
- PVD/CVA
-Atrial Fibrillation
-COPD/Asthma
Neuromuscular disorder
Hypercarbia (paCO2>50 mmHg or serum bicarbonate > 30 mEq/L
Home after extended stay* in PACU or or general care ward with C-PAP if prescribed.
No
Yes
*If the patient experiences a respiratory event, dysrhythmia, or hypotension in PACU
ICU or continuous pulse oximetry with central monitoring

Outpatient Management for OSA pts

- Schedule first case of the day if possible (allows for longer observation period)
- Anticipate a difficult airway
- Aspiration prophylaxis
- Local or regional block preferred if feasible
- Use sedating drugs that are short acting and/or have antidotes
- Extubate when fully awake and following commands
- HOB 30 degrees
- Monitor SpO2 and capnometry if available

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Inpatient Protocols

- Disadvantages:
  - May not have luxury of getting a diagnosis/treatment before surgery (emergency or urgency)
  - More serious and complicated procedures
  - More comorbidities
- Advantages
  - Longer observation periods in monitored setting
  - Better control of medications

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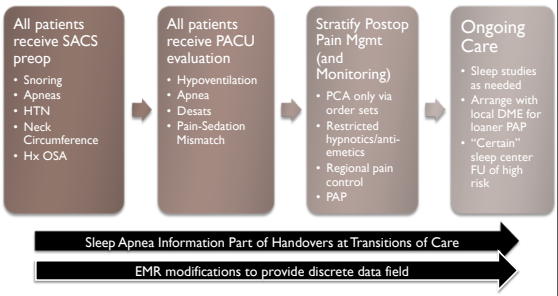
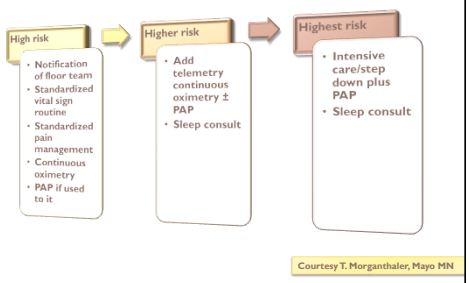
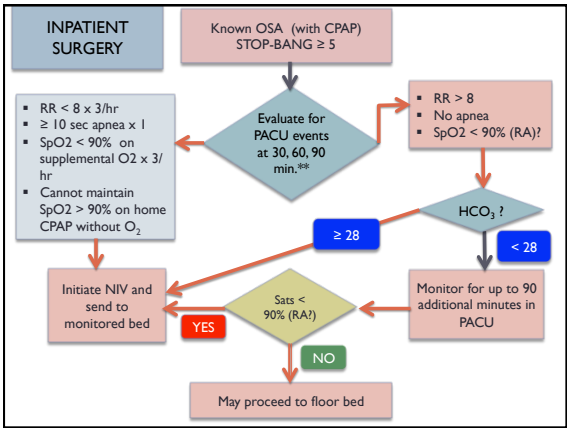
Courtesy T. Morganthaler, Mayo MN

Mayo System



Mayo Post Op care stratification





What about using CPAP? What do we know?

- PAP
  - Positive airway pressure
    - CPAP : pressure is always within 1-2 cm H2O of set pressure
    - APAP : internal machine algorithm reacts to flow changes and alters pressure within user defined minimum and maximum
    - BPAP : delivers a set inspiratory pressure (IPAP) and expiratory pressure (EPAP); switch from IPAP to EPAP based on flow change
    - BPAP – T : same as BPAP but adds a backup rate
- In perioperative setting, multiple studies on CPAP; a few on APAP; not much on BPAP

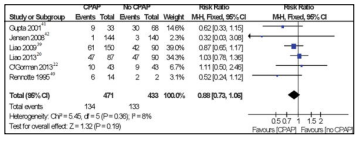
What about using CPAP? What do we know?

- Empiric CPAP :
  - Meta-analysis on abdominal surgery:
    - 9 studies included
    - Reduced postop pulmonary complications
  - Aortic surgery:
    - Reduced pulmonary complications and LOS
  - Cardiac surgery:
    - Reduced pulmonary complications

What about using CPAP? What do we know?

- CPAP in OSA patients
  - Case series and case control studies have shown higher postop complications, more ICU transfers and longer LOS in OSA patients who did not use CPAP
  - Meta-analysis (904 pts):
    - 4/6 studies CPAP was used pre and post op; 1/6 used preop only, 1/6 used postop only
    - 471 pts in CPAP group, 43 did not use home CPAP preop and 211/428 used CPAP postop
    - No difference in postop adverse events between groups
    - AHI (when studied) was lower in CPAP group

Figure 4



The Effects of Continuous Positive Airway Pressure on Postoperative Outcomes in Obstructive Sleep Apnea Patients Undergoing Surgery: A Systematic Review and Meta-Analysis.

Nagappa, Mahesh; MD, DNB; Mokhlesi, Babak; MD, MSc; Wong, Jean; MD, FRCPC; Wong, David; Kaw, Roop; Chung, Frances; MD, FRCPC

Anesthesia & Analgesia. 120(5):1013-1023, May 2015. DOI: 10.1213/ANE.0000000000000634

Figure 4 . Forest plot of the association of postoperative adverse events in obstructive sleep apnea patients with continuous positive airway pressure (CPAP) versus no-CPAP treatment. CI = confidence interval; Chi2 = [chi]2 test; df = degrees of freedom.

What about using APAP? What do we know?

- 2 randomized trials
  - Liao P et al, Anesthesiology 2013;119:837-47
    - All had AHI > 15; randomized to APAP or "routine care"
    - APAP group had it on 2-3 preop nights and 5 postop nights
    - Oximetry done on 7-8 night and PSG on postop night #3
    - 87 APAP, 90 control (n = 177); 100 completed PSG
    - APAP use average 2.4-4.6 hrs/nt; only 45% of pts used APAP on all nts
    - AHI fell from 30.1 to 3.0 on APAP (Control 30.4 to 31.9)
    - No difference in adverse events

				Pressure, cm H_2O‡		Leakage*		
	Time, h*	Time, h‡	N (%)† (≥4 h/Night)	Median	95% Percentile	Median	95% Percentile	Apnea Index*, Events/h
Preop night1	2.0 (0, 7.0)	4.3 ± 5.3	38 (44)	6.6 ± 2.4	9.2 ± 2.8	0 (0–4.8)	16.8 (8.6, 22.8)	0.7 (0, 3.1)
Preop night2	3.8 (0, 7.1)	4.6 ± 4.6	42 (48)	7.2 ± 2.6	10.2 ± 2.3	1.2 (0–6.0)	16.8 (9.0, 27.6)	1.1 (0.1, 2.8)
Preop night3	2.9 (0, 5.7)	3.6 ± 4.1	37 (43)	6.9 ± 2.1	9.4 ± 2.4	1.2 (0–8.4)	18.6 (9.0, 27.0)	1.1 (0.1, 2.1)
Postop night1	1.8 (0, 7.8)	4.1 ± 5.3	34 (39)	7.0 ± 1.9	9.9 ± 2.3	2.4 (0–10.8)	21.6 (10.8, 30.0)	2.2 (0.7, 5.3)
Postop night2	1.0 (0, 7.0)	4.1 ± 5.9	34 (39)	7.1 ± 2.3	9.5 ± 2.6	2.4 (0–15.6)	21.6 (9.6, 39.6)	0.8 (0.2, 2.9)
Postop night3	1.3 (0, 6.7)	3.6 ± 4.8	30 (35)	6.8 ± 2.0	9.5 ± 2.6	3.6 (0–13.2)	21.6 (12.0, 34.8)	1.6 (0.4, 5.4)
Postop night4	0 (0, 5.2)	2.8 ± 3.9	28 (32)	6.7 ± 2.0	9.1 ± 2.5	0.6 (0–8.4)	21.6 (12.0, 36.0)	0.9 (0, 2.6)
Postop night5	0 (0, 4.6)	2.4 ± 3.6	23 (26)	6.5 ± 1.9	9.0 ± 2.8	0 (0–8.4)	19.2 (8.4, 33.6)	0.6 (0, 4.7)

* Data presented as median (25th, 75th percentiles). † Frequency (%). ‡ Data presented as mean ± SD.
APAP = auto-titrated continuous positive airway pressure; CPAP = continuous positive airway pressure; Postop = postoperative; Preop = preoperative.

What about using APAP? What do we know?

- 2 randomized trials
  - O'Gorman SM et al, Chest 2013;144:72-8.
    - Elective total knee or hip arthroplasty
    - High SACS score randomized to APAP or standard care
    - 43 randomized to each group; 38/43 used APAP
      - 63% used it every postop night, 14 % used it for 2/3rds of postop nts
    - No difference in length of stay or postop complications between groups
      - Low rate overall
      - Low adherence rate to APAP
      - APAP did not do a good job reducing AHI (residual AHI = 13.5)

Conclusions about PostOp PAP

- Data not very positive about its ability to reduce complications, LOS; may improve oxygenation
- Patients do not appear to tolerate too well
  - Nausea, vomiting, pain, feeding tubes, MRSA or other infections
  - APAP does not appear to have much advantage over CPAP (maybe worse)
  - Hospital respiratory therapists typically not as well "schooled" in PAP therapy as they are in other ventilation modes
    - Hospital equipment is less accommodating than in a sleep lab
- Probably good for those on it and used to it; less clear for "novices"

Thorny Issues

- Hypoventilation syndromes
  - Blood gases usually not obtained preop – use serum bicarb if available?
  - Optimal therapy not clear
  - Highest risk of respiratory failure after elective surgery (44.4% versus 2.6%)
  - Empiric bilevel PAP: IPAP16–18 cm H2O and EPAP of 9-10 cm H2O may be successful
- Transition to home issues
- Scaling of ideal monitoring

Conclusions

- Postop complications are higher in OSA patients
  - Pulmonary, cardiac, infections
- Data on increased mortality is conflicting but we all know cases in which death occurred that may have been prevented
- Therefore, it is important to identify patients at high risk for OSA preop
- Use the immediate postop period to observe for clues that a patient may need closer monitoring
- PAP therapy is probably indicated for those already on it but the use of empiric therapy is unclear at this time