

**RISK FACTORS FOR AND MANAGEMENT OF
OPIOID INDUCED RESPIRATORY
DEPRESSION IN THE HOSPITALIZED
PATIENT WITH COMORBID PAIN AND
HISTORY OF ADDICTION**

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Conflict of Interest Disclosure

- Authors Conflicts of Interest:
- Nurse Advisory Board – Medtronic, Inc.





Opioid Tolerance versus Opioid Induced Hyperalgesia

- History of Opioid Addiction increases the likelihood of experiencing:
- Opioid Tolerance
 - Opioid Induced Hyperalgesia
 - Uncontrolled Pain

Opioid Tolerance

- Opioid tolerant patients are more likely to experience:
 - Require higher doses of opioids
 - Uncontrolled pain
 - Increased lengths of hospital stay
 - Higher readmission rates

Gulur et al (2014)
Sen et al. (2016)

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- <https://www.youtube.com/watch?v=3hMBKUccZOg>

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RESPIRATION IS THE MOST VULNERABLE DURING SLEEP!!



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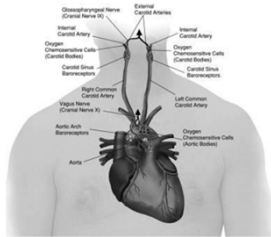
During Sleep

- We lose the muscle tone in our pharyngeal airway
- Our wake respiratory drive is gone



Review of Respiratory Physiology

- Chemoreceptors regulate breathing by detecting rising CO₂ levels
 - Central receptors in medulla
 - Peripheral receptors in carotid and aortic bodies
- CO₂ crosses the BBB, changes the pH via H⁺ ions that causes increase in respiratory rate to normalize the pH.



Opioids effect respiration in several ways:

- Diminish hypercapnic and hypoxic responses
- Decrease pharyngeal dilator and reflexes to collapsing airway
- Diminish arousal/awakening response

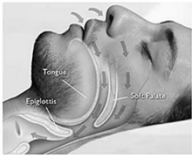
Sasaki et al 2013
Ladd et al 2005
Li & vanDen pol, 2008
Pattinson et al, 2009



Sleep Disordered Breathing

- Obstructive Sleep Apnea
- Central Sleep Apnea
- Obesity Hypoventilation Syndrome

Obstructive Sleep Apnea



Normal breathing
During sleep, air can travel freely to and from your lungs through your airways.



Obstructive Sleep Apnoea
Your airway collapses, stopping air from traveling freely to and from your lungs and disturbing your sleep.

Obstructive Sleep Apnea – noisy breathing



How to screen for OSA – STOP BANG Questionnaire

- **S** Snoring
- **T** Tiredness / sleepiness / fatigue
- **O** Observed apnea
- **P** BP (>140/90) Rx or no Rx
- **B** BMI >35
- **A** Age >50
- **N** Neck circumference >40 cm
- **G** Gender male

SCORING: 3 / 8 positive for OSA
 Chung et al. Anesthesiology 2008; 108:1-10

Sensitivity and Specificity for Moderate to Severe OSA (AHI > 15/hr)		
	Sensitivity %	Specificity %
≥ 5	56	74
≥ 6	28	88
≥ 7	12	96
≥ 8	0	99

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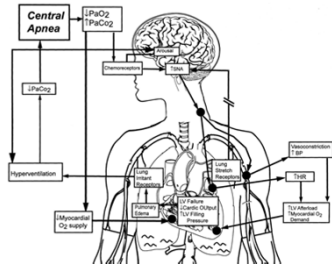
Screen for OSA – overnight oximetry

- Overnight oximetry is not diagnostic but is ok for screening
 - Average oxygen level over the night <93%
 - Oxygen desaturation events > 29/hr.
 - More than 7% of the night at less than 90% saturated
- If patient meets any of these criteria, they are 2.2 times more likely to experience a post-op complication.

Chung, 2014

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Central Sleep Apnea

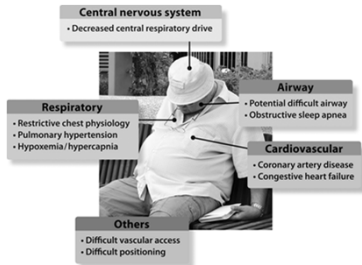


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Screening for Central Sleep Apnea

- Oximetry is the best
- STOP BANG really not as useful although OSA and CSA do co-occur
- Nurse observation!!!!

Obesity Hypoventilation Syndrome



Obesity Hypoventilation Syndrome – Risk of Post Op Complications

Compared with OSA, pts with OHS were more likely to develop:

- Postop ICU transfer OR:10.9
- Tracheostomy OR: 3.8
- Higher ICU and hospital length of stay

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

Recognizing Obesity Hypoventilation Syndrome

- BMI \geq 30
- ABG PaCO₂ >45 mm Hg (normal 35-45)
- or
- Serum HCO₃ > 27 mmol/L [without other cause of metabolic alkalosis]

Hart N. et al. Thorax 2014 Manuel AR et al. Chest 2015

Recognizing Obesity Hypoventilation Syndrome – (HCO₃<27)

- During sleep, patients with OHS hypoventilate causing higher than normal carbon dioxide levels
- Carbon dioxide levels return to normal during wakefulness in most patients
- HCO₃ (bicarbonate) levels found on chemical profiles represent the renal retention of HCO₃ in response to higher than normal carbon dioxide levels
- The normal range is 23 to 29 mEq/L (milliequivalents per liter).

Nursing Screen for OHS

- BMI \geq 30
 - Elevated HCO₃ (>27)
 - Room air hypoxemia (<95%) while awake
 - Persistent hypoxemia (<93%) during sleep
- Remember that most all patients with OHS will have OSA and about 10% of patients with OSA will have OHS.

Screening for OHS – STOP BANG plus HCO3

	Sensitivity %	Specificity %
STOP-Bang ≥ 3 + HCO3 ≥ 28	47	79
STOP-Bang ≥ 3 + HCO3 ≥ 29	30	88
STOP-Bang ≥ 3 + HCO3 ≥ 30	16	96

Chung F et al. Chest 2013

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Significance of the Problem – around 1% incidence

- Postsurgical patients experiencing opioid-related adverse drug events have:
 - 55% longer hospital stays
 - 47% higher costs associated with their care
 - 36% increased risk of 30-day readmission
 - 3.4 times higher risk of inpatient mortality compared to those with no opioid-related adverse drug events.
- Adverse opioid related sentinel events cost the healthcare system \$2.5 million per claim on average.

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Significance of the Problem --- Opioids in combination with benzodiazepines

Study of 21,276,691 inpatients discharges between 2008-2012 using the Premier Database revealed:

- 96,554 cardiopulmonary respiratory resuscitation and arrests (CPRA) occurred
- Patients who received opioids **and** sedatives had an adjusted odds ratio for CPRA of 3.47 (95% CI: 3.40 – 3.54; p <0.0001)
- Opioids alone and sedatives alone were associated with a 1.81-fold and a 1.82-fold (p<0.0001 for both)
- Only 42% of patients survived CPRA and only 22% were discharged home

Overdyk F.J, Dowling O, Marino J, Qiu J, Chien H-L, Erlon M, et al. (2015) Association of Opioids and Sedatives with Increased Risk of In-Hospital Cardiopulmonary Arrest. PLoS ONE 11(2)

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Why hospitals care about this problem

- Institute of Medicine – Reducing Preventable Harm in 1999
- Affordable Care Act – Insurance providers no longer paying for care that results from preventable harm.
- Rapid Response Teams – Hospitals put in place teams that will concentrate on quickly assessing and addressing rapid patient decline.
- Electronic Medical Records – Smart technology and algorithms are being developed to help the healthcare team recognize decline before the eye can observe it.

Current Recommendations and Guidelines

- American Society of Anesthesiologists Task Force on Neuraxial Opioids
- American Society of Regional Anesthesia and Pain Medicine
- The Anesthesia Patient Safety Foundation
- American Society for Pain Management Nursing
- Anesthesia Patient Safety Foundation
- Institute for Healthcare Improvement
- Centers for Medicare and Medicaid Services
- The Joint Commission

Problems with continuous monitoring all patients on opioids using capnography

- Expense
 - Alarm fatigue
 - Lack of education of nurses on what the devices are monitoring
 - Patients being tethered to their beds
- Although perhaps nurses are seeing a decrease in sentinel events.

Monitoring - definition

- Monitoring by nursing assessment
- Electronic Monitoring
 - Pulse Oximetry
 - Capnography
 - Minute Ventilation
 - Noninvasive Acoustic Respiration Rate

Nursing Assessments – *Minimum Standards*

- Triad of parameters necessary:
 1. Respiratory rate and quality
 2. Pulse Oximetry
 3. Sedation Scale
- Timing should be at peak drug effect and at least every two hours for the first 24 hours.

Jungquist, Correll, Fleisher, Gross, Gupta, Pasero, Stoelling, Polomano (2016). Avoiding Adverse Events Secondary to Opioid Induced Respiratory Depression: current monitoring practices. *Journal of Nursing Administration. J Nurs Adm. Feb;46(2):87-94*

2012 Hospital Practice

- Comparing Best Practice to the hospital monitoring practices, we found that:
 - 8.3% of the patients on opioid IV PCA were being monitored per best practice.
- If we changed the timeframe to every 4.5 hours
 - 26.8% of the patients were monitored using the 3 parameters of RR, PO, SS.
- None of the patients being monitored every two hours using 3 parameters required naloxone intervention
- 1% of the rest of the patients received a dose of naloxone.

Sedation scales

	2013 (n=102)	2009 (n=90)
Pasero Opioid Scale	53%	21%
Aldrete Scale	39%	30%
Ramsey Scale	17%	15%
Modified Ramsay Scale	13%	13%
Richmond Agitation-Sedation Scale	42%	12%
Riker Scale/Modified Riker Scale	6%	8%
Scale developed at your institution	8%	<1%
Motor Activity Assessment Scale	1%	<1%
Glasgow Coma Scale	37%	<1%
University of Michigan Scale	4%	<1%

Pulse Oximetry

- Intermittent is common practice
- Continuous is recommended for patients who are at high risk
- Positive points
 - Readily available
 - Sensitive enough if the patient is not on supplemental oxygen
 - Comfortable to wear esp for those using CPAP
- Negative points
 - Will miss rising carbon dioxide levels
 - Often not measured accurately

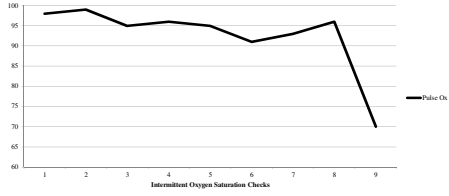
Intermittent Pulse Oximetry Measurement

- Nursing procedure
 - Measure the PO when the patient is still sleeping

Taenzer, Pyke, Herrick, Dodds & McGrath (2014)
A Comparison of Oxygen Saturation Data in
Inpatients with Low Oxygen Saturation Using
Automated Continuous Monitoring and Intermittent
Manual Data Charting. *Anesth Analg* ;118:326-31

Young Lady Resulted with an Anoxic Brain Injury

Pulse Oximetry Over 36 Hours



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Continuous PO

- Continuous PO on orthopedic patients decreased transfers to ICU and length of stay.
- Alarm threshold of 80% and HR <50 or >140 BPM
- Alarm delay of 15 seconds

- Using continuous PO decreased rescue events from 3.4% to 1.2%

Taenzer et al, 2010 *Perioperative Medicine*

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Continuous PO

- 1.7% of anaesthetic-related deaths or 0.3% of peri-operative mortality.

Burn et al. (2014)
Bulletin of the World Health Organization. 92(12):858-67

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Continuous PO Preventing Alarm Fatigue

- Setting individualized alarm threshold

Sendelbach, Wahl, Anthony & Shotts (2015), Stop the Noise: A Quality Improvement Project to Decrease Electrocardiographic Nuisance Alarms. Crit Care Nurse 35, 4

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Capnography

- Advantages:
 - Able to capture CO2 retention
 - More effective for patients on oxygen
- Disadvantages:
 - Nasal cannula is uncomfortable for patient
 - Interface for capnography and PAP delivery is very expensive and most often not used

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PAP/Capnography Interface



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Capnography Patient Safety and Algorithms

- Enhanced Patient Safety features
- Algorithms that integrated parameters

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Capnography – Resources for training and instituting

- Review paper presenting how to institute capnography in your facility:
- Carlisle, H. (2015) *Promoting the Use of Capnography in Acute Care Settings: An Evidence-Based Practice Project*, Journal of PeriAnesthesia Nursing, Vol 30, No 3 (June), 2015; pp 201-208
- Instrument to assess Nurses Knowledge of Capnography:
- Kiekkas, Stefanopoulos, Konstantinou, Bakalis, & Diamanto (2014) *Development and psychometric evaluation of an instrument for the assessment of nurses' knowledge on capnography*. www.sciencedirect.com

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 Signal Extraction
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Noninvasive Acoustic Respiration Rate




McGrath, S.P., Pyke, J. &
 Taenzer, A.H. J Clin Monit
 Comput (2016).

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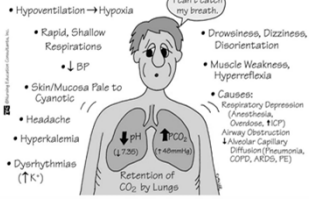
Minute Ventilation



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Signs and Symptoms

RESPIRATORY ACIDOSIS



Medicare and Medicaid Guidelines for home supplemental oxygen

While awake:

- O2 saturation < 89%

During Sleep:

- O2 saturation below 88% for at least 5 minutes.

Summarize

- Nurses must be educated that respiration is the most vulnerable during sleep and under sedation
- All patients receiving opioids in the hospital setting require increased vigilance especially when you add on a sedative.
- Absolute minimum standard is nursing assessment at peak drug effect and at least every two hours for the 1st 24 hours post- op or initiating opioid PCA.
- Continuous monitoring using appropriate device is the safest, especially during sleep.
- Continuous electronic monitoring alarm thresholds should be set to control for false alarms
- When the patient is on PAP therapy, pulse ox or MV may be more comfortable choices
- When continuous monitoring is not available, the high-risk patient should be transferred to a higher level of care for the first 48 hours and given opioid sparing pain management strategies.

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