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

Carla R. Jungquist, ANP-BC, PhD, FAAN
Assistant Professor
School of Nursing

Conflict of Interest Disclosure

• Authors Conflicts of Interest:
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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)

RESPIRATION IS THE MOST VULNERABLE DURING SLEEP!!
During Sleep

- We loose 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 in and from your lungs through your airways.

Obstructive Sleep Apnea: Your airway collapses, creating air flow turbulence. Noise can be heard during 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

<table>
<thead>
<tr>
<th>Sensitivity %</th>
<th>Specificity %</th>
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Chung et al. Anesthesiology 2008; 108:1-10

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

Central Sleep Apnea
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

- Central nervous system
  - Decreased central respiratory drive
- Airway
  - Potential difficulty breath
- Sleep apnea
- Hypoxemia
- Hypertension
- Cardiac
  - Chronic heart failure
- Others
  - Obstructive sleep apnea
  - Difficult positioning

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 PaCO\(_2\) >45 mm Hg (normal 35-45)
- or
- Serum HCO\(_3\) > 27 mmol/L [without other cause of metabolic alkalosis]


Recognizing Obesity Hypoventilation Syndrome – (HCO\(_3\)<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
- HCO\(_3\) (bicarbonate) levels found on chemical profiles represent the renal retention of HCO\(_3\) in response to higher than normal carbon dioxide levels
- The normal range is 23 to 29 mEq/L (millequivalents per liter).

Nursing Screen for OHS

- BMI \( \geq 30 \)
- Elevated HCO\(_3\) (>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

<table>
<thead>
<tr>
<th>STOP-Bang ≥ 3 + HCO₃ ≥ 28</th>
<th>Sensitivity %</th>
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<td>STOP-Bang ≥ 3 + HCO₃ ≥ 29</td>
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<td>88</td>
</tr>
<tr>
<td>STOP-Bang ≥ 3 + HCO₃ ≥ 30</td>
<td>16</td>
<td>96</td>
</tr>
</tbody>
</table>

Chung F et al. Chest 2013

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.

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

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.


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

<table>
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<th>Scale</th>
<th>2013 (n=102)</th>
<th>2009 (n=96)</th>
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<tr>
<td>Pasero Opioid Scale</td>
<td>53%</td>
<td>21%</td>
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<tr>
<td>Aldrete Scale</td>
<td>39%</td>
<td>30%</td>
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<tr>
<td>Ramsey Scale</td>
<td>17%</td>
<td>15%</td>
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<tr>
<td>Modified Ramsey Scale</td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>Richmond Agitation-Sedation Scale</td>
<td>42%</td>
<td>12%</td>
</tr>
<tr>
<td>Riker Scale/Modified Riker Scale</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>Scale developed at your institution</td>
<td>8%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Motor Activity Assessment Scale</td>
<td>1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Glasgow Coma Scale</td>
<td>37%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>University of Michigan Scale</td>
<td>4%</td>
<td>&lt;1%</td>
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### 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, Pyle, Herich, Dodge & McGrath (2014)
Continuous PO

- Continuous PO on orthopedic patients decreased transfers to ICU and length of stay.
- Alarm threshold of 85% and HR <50 or >140 BPM
- Alarm delay of 15 seconds
- Using continuous PO decreased rescue events from 3.4% to 1.2%

Taenzar et al, 2010 Perioperative Medicine

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
Continuous PO
Preventing Alarm Fatigue

- Setting individualized alarm threshold


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

PAP/Capnography Interface
Capnography
Patient Safety and Algorithms

- Enhanced Patient Safety features
- Algorithms that integrated parameters

Capnography – Resources for training and instituting

Review paper presenting how to institute capnography in your facility:

Instrument to assess Nurses Knowledge of Capnography:
Noninvasive Acoustic Respiration Rate


Minute Ventilation
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.

References

References


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For more information visit: www.pcss-o.org

For questions email: pcss-o@aaap.org

Twitter: @PCSSProjects

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