MONITORING FOR OPIOID-INDUCED RESPIRATORY DEPRESSION: REVIEW OF NEW EVIDENCE

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Conflict of Interest Disclosure

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

RESPIRATION IS THE MOST VULNERABLE DURING SLEEP!!
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 is several ways:

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

Sasaki et al 2003
Ladd et al 2005
Santiago et al 1981
Li & vanDerm pol, 2008
Pattinson et al 2009
Hajiha 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 may collapse, stopping air from traveling freely in and from your lungs and disrupting 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

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<th>Specificity</th>
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<td>5</td>
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<td>7</td>
<td>12</td>
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SCORING: 3 / 8 positive
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 to 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 ≥ 30
- ABG PaCO₂ >45 mm Hg (normal 35-45)
- or
- Serum HCO₃ > 27 mmol/L [without other cause of metabolic alkalosis]


Recognizing Obesity Hypoventilation Syndrome

- 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 (millequivalents per liter).

Nursing Screen for OHS

- BMI ≥ 30
- Elevated HCO₃ (>27)
- Room air hypoxemia (<95%) while awake
- Persistent hypoxemia (<92%) 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>
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<th>Sensitivity %</th>
<th>Specificity %</th>
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<td>STOP-Bang ≥ 3 + HCO₃ ≥ 28</td>
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<tr>
<td>STOP-Bang ≥ 3 + HCO₃ ≥ 29</td>
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</tr>
<tr>
<td>STOP-Bang ≥ 3 + HCO₃ ≥ 30</td>
<td>16</td>
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</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.

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

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.

### Sedation scales

<table>
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<tr>
<th>Scale</th>
<th>2013 (n=102)</th>
<th>2009 (n=96)</th>
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<tbody>
<tr>
<td>Pasero Opioid Scale</td>
<td>53%</td>
<td>21%</td>
</tr>
<tr>
<td>Aldrete Scale</td>
<td>39%</td>
<td>30%</td>
</tr>
<tr>
<td>Ramsay Scale</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>Modified Ramsay 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>
</tr>
</tbody>
</table>

### 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.

### Pulse Oximetry

- Intermittent is standard of care
- 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

Taenzler, Pyke, Herrick, Dodds & McGrath (2014)

Young Lady Resulted with an Anoxic Brain Injury

Continuous PO
- Continuous PO on orthopedic patients decreased transfers to ICU and length of stay.
- Alarm threshold of 88% and HR <50 or >140 BPM
- Alarm delay of 15 seconds

Taenzler 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

Minute Ventilation
Summarize

- All patients receiving opioids in the hospital setting require increased vigilance.
- Absolute minimum standard is nursing assessment at peak drug effect and at least every two hours for the 1st 48 hours post-op.
- Continuous monitoring using appropriate device for that patient is the safest.

Summarize

- 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.

Summarize

- Nurses must be educated that respiration is the most vulnerable during sleep and under sedation.
References


