Overcoming Opioid-Induced Oversedation: More Than Meets the Eye
ANCC National Magnet Conference 2013
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Billings Clinic
- Largest healthcare organization in the region
- 1st Redesignation for Magnet in 2012
- >600 nurses
- Safest hospital in US according to Consumer Reports

Our Patients Deserve Excellence
#1 in Nation for Patient Safety
Hospital Review

09/09/2013
• Amanda
• 16 year old female
• 60% curvature of the spine
• Admitted to the hospital for spinal fusion and rod placement
• Allergic to morphine
• Pain managed with hydromorphone

Presentation Overview
• Summarize the problem of oversedation
• Describe strategies to address oversedation
  – Medication risks
  – High risk populations
  – Monitoring
  – Naloxone protocols
• Roles of an oversedation committee

The Challenge

OVER-treated
• Oversedation
  • Respiratory depression
  • Death
  • $$$

UNDER-treated
• PAIN
  • Delayed healing
  • Increased LOS
  • Poor satisfaction
  • $$$
Opioid-Induced Over Sedation

- Opioids
  - Mainstay of pain management in hospitalized patients
  - Pain management often suboptimal
  - Generally safe for most patients
  - Respiratory depression most serious adverse event
    - Preceded by sedation

Incidence

- Opioids frequently associated with adverse drug events
- British study
  - 3,695 inpatient adverse drug events
  - 16% attributable to opioids
- Post-operative respiratory depression
  - Estimated at 0.5%

Patient-Related Risk Factors

- Very young age
- Older age
- Sleep apnea
- Obesity
- Comorbidities
- Patients receiving other central nervous system and respiratory depressants
Health Care Related Factors

- Lack of knowledge
- Improper prescribing and administration
  - Hydromorphone
  - Morphine
  - Codeine
  - Methadone
  - Transdermal fentanyl
- Multiple opioids and administration routes
- Drug-drug interactions
  - Benzodiazepines
  - Phenothiazines
  - Cardiac medications
- Inadequate monitoring of patients on opioids

Opioid-Related Adverse Drug Events

- JCAHO Sentinel Event Database (2004-2011)
  - 47% wrong dose
  - 29% improper monitoring
  - 11% other factors
    - Excessive dosing
    - Medication interactions

Over Sedation Timeline

HM = hydromorphone
PRN = Pain Resource Nurse
Predictors of Opioid-Induced Over Sedation in Hospitalized Patients

- Nursing Research Study Guided Work
  - 4 nurse investigators
  - Pharmacist
- Purpose: Determine whether 1) individual characteristics, 2) comorbid characteristics and, 3) concurrent medication use predicted over sedation.
- Lead to the development of risk assessment tools
- IRB approved
- Database established of every over sedation in the organization
  - Tracked naloxone dispense reports
    - Included as an over sedation with a clinical response to naloxone

Predictors of Over Sedation: Preliminary Results

- Over 150 cases reviewed
- 75 cases included
- Randomized control cases currently being included to develop a predictive model
- Qualitative review of cases provided insight into trends
- Descriptive Analysis
  - 67% female
  - 63 mean age
  - 20% American Indian
  - 63% surgical cases
- Day 2 most common
  - 20% untreated sleep apnea

Codeine

- Converted to morphine via isoenzyme p450 2D6
- Poor versus ultra-rapid metabolizers
- FDA warnings and recent report of 3 home deaths

High Risk Opioids

- Transdermal fentanyl
  - Black box warning not to use on opioid naïve patients
  - 25 mcg approx = 60 mg oral morphine/day
  - Onset 12 hours
  - Peak 24-48 hours
  - Steady state 5 days

- Methadone
  - 30% of opioid-related deaths
  - Should only be used by experienced providers
  - Up to 20x more potent than morphine

Methadone

http://www.cdc.gov/vitalsigns/MethadoneOverdoses/

Hydromorphone Dose Limits

- Hydromorphone is a potent opioid
- Providers may underestimate its potency
  - 10 mg IV morphine = 1.5 mg hydromorphone
- Identified as a root cause through a research study
- Doses > 1 mg IV triggers a dose alert
  - Pharmacist calls provider to clarify
  - Reviews potency with provider
Over Sedation Timeline

HM Alerts

HM = hydromorphone
PRN = Pain Resource Nurse

Morphine Metabolites

- Morphine-3-glucuronide (M3G)
  - conjugation accounts for over 50%
  - antagonizes analgesic effect of morphine and M6G
  - Paradoxical neuroexcitatory effects
- Morphine-6-glucuronide (M6G)
  - conjugation accounts for over 5%
  - more potent analgesic activity than morphine
  - contributes to overall analgesic effect
- Renal Alert
  - Retention of metabolites with renal compromise
  - No dose is safe

Morphine Renal Dose Alert
Over Sedation Timeline

Refining Processes for High – Risk Patient Populations

High Risk Populations

- Obstructive Sleep Apnea
- Patient Controlled Analgesia
Obstructive Sleep Apnea Team
“The Bulldogs”

• Team initiated in 2011
• OSA is characterized by
  – Repetitive episodes of upper airway during sleep resulting in oxygen desaturation & arousals during sleep
• It is estimated that nearly 80% of men and 93% of women with moderate to severe sleep apnea are undiagnosed

Headlines

Obstructive sleep apnea associated with cerebral hypoxemia and death
Mark E. Ruben, MD, Thomas Tynan, MD, Christopher L. Olson, M.D., of the University of California, San Diego, and Herbert A. Berger, MD

We present two cases of traumatic brain injury with sleep apnea in which the sudden unexpected death occurred following a traumatic brain injury. The second patient was a subject to a sudden unexpected death following a traumatic brain injury. Both patients had severe sleep apnea and were undergoing sleep studies for evaluation of their symptoms. The first patient was a 57-year-old man with a history of traumatic brain injury. The second patient was a 62-year-old woman with a history of traumatic brain injury. Both patients had severe sleep apnea and were undergoing sleep studies for evaluation of their symptoms.

“The prototypical OSA malpractice case… is finding a postoperative patient ‘dead in bed’.”
Why is it important during hospitalization?

- OSA may be exacerbated by effects of anesthetics, opioids, and other CNS depressant medications
- These medications can:
  - Reduce muscle tone in the upper airway increasing the propensity for airway collapse
  - Increase threshold for hypoxia and hypercapnia
  - Increase arousal threshold
  - Increase episodes & duration of hypoxemic events in the patient with sleep apnea

Identifying & treating patients with OSA is an important steps in preventing complications during hospitalized.


Case Study

- Patient Information
  - 68 year old
  - S/P Right TKA
  - Admitted post-op @ 10:12

- Patient History
  - Sleep apnea
    - Comment: "CPAP"
  - CPAP not ordered on admission
  - BMI: 34
  - Kidney disease (not noted in H & P)
    - Creatinine 1.5
    - Normal 0.6-1.1
  - Previous hospitalization for surgery
    - Over-sedation event (obtained from patient interview post-event)

Event – Oxygen Desaturation (untreated OSA)

<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Oxygen Saturation</th>
<th>O2 Flow</th>
<th>O2 Delivery Method</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/14/11, 15:00</td>
<td>92%</td>
<td>1 L</td>
<td>Nasal Cannula</td>
<td>MD notified &amp; order for CXR obtained.</td>
</tr>
<tr>
<td>3/14/11, 18:44</td>
<td>91%</td>
<td>2 L</td>
<td>Nasal Cannula</td>
<td></td>
</tr>
<tr>
<td>3/14/11, 22:23</td>
<td>70%</td>
<td>1 L</td>
<td>Nasal Cannula</td>
<td>MD notified &amp; order for CXR obtained.</td>
</tr>
<tr>
<td>3/14/11, 22:24</td>
<td>85%</td>
<td>4 L</td>
<td>Nasal Cannula</td>
<td></td>
</tr>
<tr>
<td>3/14/11, 22:26</td>
<td>87%</td>
<td>5 L</td>
<td>Nasal Cannula</td>
<td></td>
</tr>
<tr>
<td>3/14/11, 22:29</td>
<td>92%</td>
<td>5 L</td>
<td>Nasal Cannula</td>
<td></td>
</tr>
<tr>
<td>3/15/11, 00:21</td>
<td>93%</td>
<td>5 L</td>
<td>Nasal Cannula</td>
<td></td>
</tr>
<tr>
<td>3/15/11, 00:42</td>
<td>91%</td>
<td>6 L</td>
<td>CPAP</td>
<td>Home CPAP; no order found.</td>
</tr>
<tr>
<td>3/15/11, 01:15</td>
<td>93%</td>
<td>6 L</td>
<td>CPAP</td>
<td></td>
</tr>
</tbody>
</table>
Standards of Care for Patients Diagnosed with Sleep Apnea

- **Pre-Admission Testing**
  - Patients educated on importance of CPAP use during hospitalization and/or while receiving opioids
  - Asked to bring in CPAP device

- **Intra-Operative**
  - Anesthesia uses opioid sparing techniques

- **Post-Op**
  - Extended recovery / Education handouts for Outpatients
  - CPAP follows patient to PACU for use as needed
  - Developed CPAP orders for ordering use of home device
  - Apply continuous electronic monitoring for inpatients on opioids
  - Additional interventions: Positioning, notification of provider for apnea episodes

STOP-Bang Screening

- **House-wide screening to identify patients with undiagnosed OSA**

- **Score displayed on “patient summary”**

Moderate to High Risk Patients

- **New CPAP orders developed**
  - Use for patients with obvious sleep apnea not previously using CPAP
  - Pressure protocols for Respiratory Therapy to adjust CPAP

- **Notification to PCP for consideration of sleep screen after hospital discharge**
Patient Controlled Analgesia (PCA) Task Force

- Team formed June 2009
- Goal
  - Implement evidence and literature based standard of care for safe and effective pain management using the analgesic pump
- Why
  - PCA pump medication delivery is a high-risk treatment that is associated with harmful events and deaths

Over Sedation Timeline

Background

- US Pharmacopeia (USP) medication error databases revealed a combined total of 6,069 PCA errors.
  - 460 resulted in fatality or some level of harm to the patient
- Review of PCA practice in a hospital with 9,000 PCA patients per year revealed 56 PCA-related adverse events.
  - 71% resulted from PCA programming errors

Standardized PCA Order Sets

- Reduces
  - Likelihood of ordering error
  - Incidence of respiratory depression
- Standard order sets
  - Guide drug selection, doses, and lockout periods
  - Patient monitoring


Patient Monitoring with PCA

- Monitoring standards part of order set
  - Reminders for assessment frequency appear on the nursing task-list

Additional Safeguards

- Independent double check required for:
  - Initiation
  - Cartridge change
  - Programming changes (e.g., dose, rate, time, etc.)
  - Whenever RN patient assignment changes
  - Minimum of every 12 hours
- Implementation of “smart” pump technology
  - 11 near misses (programming errors) caught with use of drug library hard / soft limits in the first 60 days after go-live
Nurse Controlled Analgesia

- Option when patient not appropriate for PCA
- Only the authorized agent can push the button and this is the nurse caring for the patient

Monitoring Hospitalized Patients Receiving Opioids

Monitoring Standards Based on Opioid Pharmacokinetics

<table>
<thead>
<tr>
<th>Route of Opioid Administration</th>
<th>Frequency for Monitoring:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral or rectal</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
<tr>
<td>Intranasal, Intravenous or Intramuscular</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
<tr>
<td>Continuous IV Infusion (includes PCA with basal infusion)</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
<tr>
<td>Patient Controlled Analgesia, Nurse Controlled Analgesia</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
<tr>
<td>Epidural</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
<tr>
<td>Transdermal</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
<tr>
<td>Intrathecal Duramorph</td>
<td>- Respiratory rate/quality</td>
</tr>
<tr>
<td></td>
<td>- Sedation level</td>
</tr>
</tbody>
</table>

- Respiratory rate/quality: Every 4 hours & PRN
- Sedation level: Every 4 hours & PRN
Continuous Electronic Monitoring for High-Risk Therapies

- Apply *continuous* pulse oximetry for patients receiving
  - Continuous IV opioid infusion
  - Intravenous Patient Controlled Analgesia
  - Epidural opioids
  - Duramorph Intrathecal (first 24 hours)

Next Steps in Monitoring

- Capnography for patients on oxygen therapy
- Implementation: October 24th, 2013

Oversedation Team

- Expertise
  - Anesthesiology
  - Nursing
  - Pharmacy
- Meet monthly
  - Examine trends, root cause of oversedations
- Report to Patient Safety Committee
Looking Ahead

Current State
• Prospective review
  – Hourly "Narcan® Report"
  – Rounding and Follow-up?
• Acute Pain Pharmacist

Future State
• Capnography equipment
• Acute Pain Team
  – Interdisciplinary
• Continued education
  – Certified Pain Educator
  – Pain Newsletter
  – Pain Resource Nurses

QUESTIONS?
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