Opioids and Post-Operative Hypoventilation

Presented By: Tad Anderson, RRT
Objectives

- Define opioids and post-operative hypoventilation/respiratory depression
- Understand the physiology of opioids and how they can effect the mechanism of the respiratory drive
- Application of effects of opioids to the post-surgical patient
- Identify the contributing risk factors of post-operative hypoventilation/respiratory depression
- Identify management and treatment options to prevent opioid induced hypoventilation
Opioids

- Opioids are powerful medications that can help manage pain through synthetic compounds having effects similar to natural opium alkaloids and their derivatives.

- Opioids are commonly prescribed because they are effective in relieving many types of pain.

- Commonly prescribed Opioids
  - Fentanyl
  - Hydrocodone
  - Morphine
  - Oxycodone
  - Hydromorphone

- Atypical Opioids
  - Tramadol
  - Buprenorphine
Respiratory Depression

Definition: A decrease in rate and depth of respiration from baseline

Average: RR- <10, SpO2 <90%

Recognized as a serious complication of opioid analgesic therapy
Physiology

- Fundamental drive to respiration is generated in the brainstem
- Most Opioids work primarily by binding with Mu receptors,
  - Mu receptors are located throughout the body, including parts of the brainstem, which are important in the role of respiration
- Chemoreceptors in the brainstem & other parts of the body, detect hypoxia & hypercarbia. The body responds by increasing the rate and depth of respiration
- Opioid system mediates many of these physiological effects
  - Opioids depress respiration by a number of mechanisms and neuronal sites
Physiology: Respiratory
Opioids effects on respiration

- Opioid receptors are abundant in respiratory control centers, such as the brainstem
- Opioids cause respirations to slow and become irregular leading to hypercarbia and hypoxia

- Lower Opioid doses = Change in Rhythm pattern
- Higher Opioid doses = Change in Tidal Volume
- Infusion = progressive respiratory depression/gradual increase in CO₂
- Bolus = Apnea / immediate rise in CO₂
Why do we care?

• 2001, The Joint Commission’s pain management standards increased awareness of the importance of safe and effective pain management
  - Pain is the 5th Vital Sign
  - The incidence of opioid related adverse drug events has more than doubled

• Opioid Drug Related Events (including deaths) 2004-2011
  - 47% - wrong dose medication errors
  - 29% - related to improper monitoring of the patient
  - 11% - other factors (excessive dosing, med interaction, adverse reactions)

  This shows the need for judicious monitoring and safe prescribing, and administration of opioids as well as the need for appropriate monitoring of patients receiving opioids
Why do we care?

- Patients on “unmonitored” clinical areas, which include a majority of post-surgical patients on opioid analgesic, are twice as likely to receive delayed defibrillation/ventilatory support

- Prominent subgroup of the 350,000-750,000 suffering from an in-patient arrest are opioid induced respiratory arrest (limited data)
  - Outcomes are catastrophic

- Most case reports of opioid induced respiratory arrest occurred at night, and were observed on an unmonitored clinical area
Risk Factors

Patient Related Risk Factors

• Advanced Age: patients >65 years are at increased risk
  • Can affect the metabolism & excretion of medications
  • Decreased Renal & Hepatic functions

• Obesity
  • Hypoxemia due to Increased WOB & Decreased Lung Capacity
  • PCA use in obese required as much as 10-fold range in dose, indicating the variability of drug metabolism in the obese
Risk Factors

Patient Related Risk Factors

- Sleep Apnea
  - Increased risk for Respiratory Events, including Respiratory Arrest
  - Absence of Normal warning signs prior to sudden respiratory events in patients with sleep apnea receiving opioids

- Impaired Renal, Pulmonary, Hepatic, Cardiac Function
  - Renal/Hepatic: affects the metabolism and excretion of opioids; leading to prolonged exposure and increased side effects
Risk Factors

Patient Related Risk Factors

- Controlled pain after a period of poor management
  - Pain stimulates breathing
  - Patients whose pain is managed poorly, then suddenly have pain controlled with medication have increased risk for respiratory depression
Risk Factors

Treatment Related Factors

- **Opioid Tolerance**
  - Tolerance to opioids develops after a patient receives opioids routinely for a week or more
  - Patients who are NOT opioid tolerant but are opioid naïve are more likely to experience respiratory depression

- **Concurrent use of Central Nervous System Depressants**
  - Combining anxiety meds, anti-histamines, anti-emetics, or muscle relaxers with opioids can produce excessive sedation that can lead to respiratory depression
  - Common: Phenergan, Benadryl, Ativan
Management

- Perform Risk assessment (Identify High Risk Patients)
  - Screening patients for respiratory depression risk
  - Assess patients history of analgesic use or abuse to identify those who are opioid naïve/tolerant

- Create individualized Plans based on risk assessment
  - All patients should be assessed for risk factors
  - Pain management plans which incorporate goal related pain management
  - Based on risk assessment:
    - Work with physicians/pharmacist to determine a safe and effective medication regimen
    - Potential sedating medications should be reviewed/replaced with less sedating meds. Route, duration, frequency should be changed
Management

Monitoring

• Respiratory Assessment
  • Observation of Respiratory Rate and Depth
  • Continuous mechanical monitoring with patients with risk factors
    • $\text{SpO}_2 (<90\%)$ – rarely correlates with low RR
      • May be late/absent in findings of respiratory depression
    • $\text{CO}_2 (35-45)$ – Beneficial to monitor RR easily, can be inaccurate, and expensive to apply

• Sedation Scales
  • Standardizing sedation scales assist nurses in consistently assessing and communicating sedation
  • Something easy to understand & apply (measuring only sedation)
Management

Monitoring

-Monitor sedation and respiratory status- every 1-2 hours for a 24 hour period in opioid naïve patients being treated for moderate to severe pain

-Pain Rating, sedation levels, and respiratory status should be assessed before and after opioid administration

-Type/Frequency may need adjustment for patients with increased risk factors

▷ Variability seen in studies
  • Missing data in vital signs, assessment
  • 77% of patients had missing data immediately before respiratory depression
Clinically significant respiratory depression can be prevented by:

1. Identification of High Risk Patients

2. Individualization of analgesic regimens through a patient specific pain management plan

3. Close monitoring of patients respiratory and sedation status
Case Study

- 66 yr old woman. 5’1”, 200lbs
- Surgical: Undergoing Bilateral Total Knee Replacement
- Hx: No significant medical history, although patient’s husband jokes that “she snores at night”
- Labs: All within normal limits
- Medications: No medications prior to admission
Post Surgery

Medications ordered:

Hydromorphone (1mg IV push Q3H PRN)

Promethazine (25mg IV push Q4H for nausea)

Back to Room after successful surgery

Anesthesia notes patient was slow to come out of anesthesia

Vital Signs:

HR-87, RR-14, SpO2- 100% @ 2L per NC, BP-126/84
Case Study

- Patient puts on call light at 1 am having complaints of pain 5/10 and nausea
  - Last pain dose 9pm
  - She is due for dose of promethazine
  - Vital Signs: HR-89, RR-18, SpO2-99@2L, BP-145/90

- Hydromorphone & Promethazine given for pain/nausea
  - 5 min later patient puts on call light and is having complaints of pain 9/10, and can’t get comfortable enough to rest
    - Patient is noted to be in significant distress/pain.
    - Vital Signs not taken

- Physician on-call notified, orders 2mg IV push dose of Hydromorphone
  - 2mg IV push of Hydromorphone given for pain management
Case Study – 30min Later

• Nurse returns to room to check on patient’s pain

• Patient appears to be sleeping comfortably

• No assessment performed to allow patient to rest
  • But nurse notes that patient has SpO2-97% @ 2L per NC
Case Study – 2 hours later

- Nurse walks by room and notices SpO₂ monitor alarming
- Patient does not respond to verbal stimuli, and is difficult to arouse
  - Vitals:
    - SpO₂-88%@2L
    - HR-60
    - RR-6
    - Pupils appear constricted
Is this Patient Experiencing Respiratory Depression??

- **YES!**

- **Risk Factors**
  - OSA (5’1, 200 lbs)
  - No history of prior use of opioids
  - Advanced age: >65

- **WHY??**
  - Most likely due to patient being opioid naïve and given multiple doses of opioids

- **Treatment??**
  - RRT called. Physician ordered stat dose of naloxone
  - After stat dose, patient more alert. Physician transfers to ICU for monitoring
Case Study - Prevention

- Perform Risk Assessment
  - Note areas of High Risk: patients age, risk of OSA, opioid naïve
- Talk to pharmacy/physician about careful dosing of opioids
- Talk to patient about creating a patient specific goal in regards to pain management
- Closely monitor patient
  - Post surgical / during nighttime hours
  - After doses of pain medication
References


QUESTIONS???