Monitoring Opioid-Induced Ventilatory Impairment

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Conflicts of Interest

None to disclose
Anesthesia Patient Safety Foundation (APSF, 2006)

“We believe that unexpected and potentially harmful opioid-induced respiratory depression continues to occur. In most cases, there is inadequate monitoring...of oxygenation and/or especially ventilation, as well as a failure to consider unique characteristics of the patients’ history and physical status that place them at higher risk for respiratory depression from opioid analgesics.”

Physiology of OIVI

General Definitions of OIVI

OIVI is a decrease in the effectiveness of an individual’s ventilatory function following opioid administration.

There is a continuum of levels of consciousness and arousability ideally measured by reliable and valid criteria that are applied in clinical practice for safe and effective administration of opioid analgesics.
Opioid-induced ventilatory impairment (OIVI) and Safety

Reviewing data from 20,000 patients, the incidence of OIVI can be as high as 37%.

In a review of closed claims (>9000 events), up to 30% of events of OIVI could have been prevented with better monitoring.

OIVI events are multifactorial and potentially preventable with improvements in assessment of sedation level, monitoring of oxygenation and ventilation, and early response and intervention, particularly within the first 24 h postoperatively.

Lee et al, Anesthesiology (2015) 122(3):659-65
OIVI – Evidence for Continuous Monitoring

Taenzer and colleagues at Dartmouth-Hitchcock Medical Center in Hanover, NH implemented continuous monitoring (pulse oximetry) in all patients of a 36-bed surgical unit over 1 year.

They reduced rescue events by 60% and ICU admissions by 45%

They now have mandated that all patients receiving opioids on all floors, medical and surgical, must wear continuous monitoring or sign a safety waiver if they refuse

All patients should have oxygenation monitored by continuous pulse oximetry.

Capnography or other monitoring modalities that measure the adequacy of ventilation and airflow is indicated when supplemental oxygen is needed to maintain acceptable oxygen saturations.

Applying electronic monitoring selectively based upon perceived increased risk is likely to miss respiratory depression in patients without risk factors.

Monitoring continuous oxygenation and ventilation from a central location (telemetry or comparable technologies) is desirable. This information needs to be reliably transmitted to the healthcare professional caring for the patient at the bedside.

Structured assessment of the level of sedation/consciousness is a critical component of the nurse’s routine postoperative patient assessment for detecting respiratory depression.
Avoiding OIVI: starting in the operating room with multimodal pain management

- **Step 1: Mild Pain**
  - Acetaminophen, NSAIDs, or COX-2 selective inhibitors and local/regional anesthesia

- **Step 2: Moderate Pain**
  - Step 1 and Low doses of opioids

- **Step 3: Severe Pain**
  - Step 1 + Step 2 and Higher doses of opioids

Use of epidural catheters and regional anesthesia techniques

Appropriate management of patients with tolerance to opioids, such as chronic pain patients
Measuring OIVI in a Structured Manner – Pasero Scale

S = Sleep, easy to arouse
Acceptable; no action necessary; may increase opioid dose if needed

1. Awake and alert
Acceptable; no action necessary; may increase opioid dose if needed

2. Slightly drowsy, easily aroused
Acceptable; no action necessary; may increase opioid dose if needed

3. Frequently drowsy, arousable, drifts off to sleep during conversation
Unacceptable; monitor respiratory status and sedation level closely until sedation level is stable at less than 3 and respiratory status is satisfactory; decrease opioid dose 25% to 50%¹ or notify prescriber² or anesthesiologist for orders; consider administering a non-sedating, opioid-sparing nonopioid, such as acetaminophen or an NSAID, if not contraindicated.

4. Somnolent, minimal or no response to verbal or physical stimulation
Unacceptable; stop opioid; consider administering naloxone³,⁴; notify prescriber² or anesthesiologist; monitor respiratory status and sedation level closely until sedation level is stable at less than 3 and respiratory status is satisfactory.

Initiation of monitoring

**Continuous** pulse oximetry in patient receiving IV opioids, monitored at a central location

If patients cannot maintain saturations >92% on room air, supplemental oxygen and capnography should be implemented; *capnography is the earliest indicator of respiratory distress.*
Pulse oximetry (SpO$_2$)

Non-invasive method of measuring oxygenation of hemoglobin

Also measures heart rate

Values of 92-100% on room air are generally acceptable depending on the patient

Does have limitations with respect to opioid use – low values are a late finding of respiratory depression
Capnography and End-Tidal CO$_2$ (EtCO$_2$)

Capnography is the measurement of carbon dioxide (CO$_2$) of a sample of an exhaled breath, and end-tidal CO$_2$ is numerical value of exhaled carbon dioxide.

In the non-intubated patient, EtCO$_2$ is measured by a sidestream device such as nasal or nasal-oral cannula devices.

Capnography demonstrates respiratory rate, pattern, and effective elimination of CO$_2$.
Monitoring capnography

Courtesy CareFusion and Oridion Capnography
Monitoring capnography

Monitoring capnography
Troubleshooting

**False alarms:** Initially, if a patient’s RR was ≤ 10 bpm or there was “no breath” for 30 seconds, alarm would trigger. Also, EtCO$_2$ greater than 50 caused significant false alarms.

By analyzing extensive data retained in system memory, the team determined that changing the EtCO$_2$ parameter from 50 to 60 mmHg and resetting the RR from 10 to 6 would minimize nuisance alarms while maintaining patient safety.

We confirmed these values and parameters in clinical practice as we continuously monitored patients in the clinical environment. Settings can be adjusted if necessary based on patient requirements and physician order.

* Maddox and Williams. APSF Winter 2012 Newsletter*
Special Circumstances – COPD/emphysema

Baseline higher EtCO$_2$ – may need to adjust alarm parameters

 Depends on oxygen saturation for respiratory drive (unlike normal patients), so addition of nasal cannula may decrease respiratory drive

Baseline work of breathing is higher so may tire more quickly
Special Circumstances – Obstructive Sleep Apnea (OSA)

Definition: Obstructive sleep apnea is a potentially serious sleep disorder in which breathing repeatedly stops and starts during sleep.

Can be diagnosed or undiagnosed (STOP-BANG)
- S- snoring
- T- tired
- O- observed apnea
- P- pressure (high blood pressure)
- B- BMI > 35
- A- age >50
- N- neck circumference (thick neck, collar size 17 or greater)
- G- male gender

5 or greater “yes” answers correlates to moderate to severe OSA
Special Circumstances – Obstructive Sleep Apnea (OSA)

OSA patients are frequently more susceptible to respiratory depression due to drug kinetics, mechanical breathing problems, and altered physiology.

Consider committing to capnography measurements early in the hospital course while taking opioids.
Summary

OIVI is still a major problem with multiple causes as demonstrated by the number of respiratory events recorded in patients receiving opioids.

Monitoring patients on opioids with continuous pulse oximetry and capnography has been shown to decrease events; capnography is the more sensitive option and should be employed when possible.

Nursing assessment tools using reliable scales, such as the Pasero scale, is effective in communicating the condition of the patient and should be required in patients using opioids.

Employing multimodal pain control with other non-narcotic medications reduces OIVI.

Special consideration for the COPD and OSA patient on opioids will reduce the number of OIVI events.
Thank you!