Acute Postoperative Pain

David Radvinsky, MD
March 24, 2016
Objectives

1. Discuss the multimodal approach to pain management and discuss the various classes of drugs based on receptor mechanism.

2. Give you applicable examples of pain regimens that you can start using on your patients today.

3. Discuss pain control and sedation in the ICU.
Is this painful yet?

- 55 yo male s/p laparoscopic low anterior resection.

What are your postoperative pain orders?
Is this painful yet?

- 55 yo male s/p laparoscopic low anterior resection.

  What are your postoperative pain orders?

- Ofirmev 1000 mg IVPB Q6hr
Is this painful yet?

- 55 yo male s/p laparoscopic low anterior resection.

What are your postoperative pain orders?

- Ofirmev 1000 mg IVPB Q6hr
- Morphine 4mg IM Q4hr prn
Is this painful yet?

• 55 yo male s/p laparoscopic low anterior resection.

What are your postoperative pain orders?

• Ofirmev 1000 mg IVPB Q6hr
• Morphine 4mg IM Q4hr prn
• Percocet 5/325 mg PO Q4-6 hr prn
Scale of 0-10

“Acute postoperative pain is a complex physiological reaction to tissue injury, visceral distention, or disease. It is a manifestation of autonomic, psychological, and behavioral responses that result in patient-specific unpleasant, unwanted sensory and emotional experiences.”

Wall & Melzack's Textbook of Pain

“Pain is a personal, subjective experience.”
Consequences

• **Physiologic**
  - Increased stress response
  - Cardiovascular events
  - Pulmonary complications
  - Ventilator dyssynchrony
  - Diaphragmatic dysfunction
  - Stress ulcers
  - Delayed wound healing
  - Immunosuppression
  - Thromboembolic events
  - Chronic pain

• **Psychologic**
  - Emotional stress
  - Delirium
  - Depression
  - Anxiety
  - Helplessness
  - PTSD

• **Social/Economic**
  - Increased length of stay
  - Increased mortality
  - Increased cost
  - Increased mechanical ventilation duration
  - Decreased quality of care
Classification of Pain

- **Nociceptive**: normal response to noxious insult or injury

- **Neuropathic**: pain initiated or caused by a primary lesion or disease in the somatosensory nervous system.

- **Inflammatory**: a result of activation and sensitization of the nociceptive pain pathway by a variety of mediators released at a site of tissue inflammation.
Pain pathways

- Periphery
- Primary afferent neurons
- Dorsal root ganglion
- Spinal cord
- Dorsal horn
- To higher centers

- Aβ fiber
- Noxious mechanical stimulus
- C fiber
- Noxious heat and chemical stimuli

- Opioids
- α2-agonists
- Acetaminophen
- NMDA antagonists

- Local anesthetics
  - Opioids
  - α2-agonists
  - NMDA antagonists

- Local anesthetics
  - NSAIDs
  - COXIBs
Multimodal therapy

• Response to the under treatment of postoperative pain
• Limitation of opioid monotherapy
• Introduced in the early 1990’s (Kehlet & Dahl)
• Administration of 2 or more analgesic agents with different mechanisms of action
• Synergistic effects
• Reduced opioid usage

The Value of “Multimodal” or “Balanced Analgesia” in Postoperative Pain Treatment

Henrik Kehlet, MD, PhD, and Jørgen B. Dahl, MD
Department of Surgical Gastroenterology and Anesthesiology, Hvidovre University Hospital, Hvidovre, Denmark
Guidelines on the Management of Postoperative Pain

Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists’ Committee on Regional Anesthesia, Executive Committee, and Administrative Council

- Preoperative/Methods of Assessment
- General Principles Regarding Multimodal therapy
- Systemic Pharmacologic Therapies
- Local/Topical Pharmacologic Therapies
- Peripheral Regional Anesthesia
- Neuraxial Therapies
Perioperative management

- Guidelines on the Management of Postoperative Pain
  - Preoperative expectations and realistic goals for pain control
    - Decreased opioid use
    - Less preoperative anxiety
    - Fewer requests for sedative medications
    - Reduced length of stay
  - Patient and family-centered, tailored education
  - Assessment & reassessment
  - Pain specialist
Opioids

- Four major subtypes of opioid receptors
- **Side effects**: itchiness, sedation, nausea, respiratory depression, constipation, and euphoria.
- Tolerance and dependence develops with continuous use
- Withdrawal syndrome upon abrupt discontinuation.
Opioids

C.D.C. Painkiller Guidelines Aim to Reduce Addiction Risk

By SABRINA TAVERISE  MARCH 15, 2016

- 28,647 deaths from opioid overdose in 2014
- No evidence shows a long-term benefit of opioids vs. no opioids for chronic pain
- Extensive evidence shows the possible harms of opioids.
- Extensive evidence suggests benefits of non-pharmacologic and non-opioid pharmacologic therapy, with less harm.
- New York State
  - Electronic prescriptions
  - I-STOP/prescription monitoring
## Opioids

### Equianalgesic Opioid Dosing

<table>
<thead>
<tr>
<th>Drug</th>
<th>Equianalgesic Doses (mg)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parenteral</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Morphine</td>
<td>10</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Buprenorphine</td>
<td>0.3</td>
<td>0.4 (sl)</td>
<td></td>
</tr>
<tr>
<td>Codeine</td>
<td>100</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.1</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>NA</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>1.5</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Meperidine</td>
<td>100</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Oxycodone</td>
<td>10*</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Oxymorphone</td>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Tramadol</td>
<td>100*</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

*Not available in the US

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**NOTE:** Learner is STRONGLY encouraged to access original work to review all caveats and explanations pertaining to this chart.
Opioids

Total Daily MME = 105.0

MME ≥ 100

Methadone

Morphine
10mg (6 per day) 60.0

Add Additional

Add Additional

Oxycodone
5mg (6 per day) 45.0

Add Additional

Add Additional

Oxymorphone

Tramadol

MME ≥ 100

Your patient is taking ≥ 100 MME/day of opioids! Dosages ≥ 100 MME/day increase overdose risk by 9 times compared to dosages of 1-20 MME/day. Reassess your patient’s pain status and treatment plan. Consider other approaches to pain management.

(click here to learn how)
Opioids

• Guidelines on the Management of Postoperative Pain
  • Oral over IV opioids
  • Short-acting over long acting
  • No benefit to pre-operative opioids
  • Avoid using IM route for administration
  • PCA for systemic analgesia when parenteral route needed
  • No routine basal infusion of opioids with PCA
NSAIDs & Acetaminophen
# NSAIDs & Acetaminophen

<table>
<thead>
<tr>
<th>Selectivity</th>
<th>Medication</th>
<th>$\frac{1}{2}$ life (hrs)</th>
<th>Pharmacology</th>
<th>Risks</th>
</tr>
</thead>
</table>
|                  | Cox-2 selective                  | Celecoxib (PO)           | 11                                                | • COX-2 specific                                                     | • Increased risk of CV events
|                  |                                   |                          |                                                   | • Decreased GI effects                                               |                           |
| Semi-selective   | Diclofenac (PO)                   | 2                        | • Increased affinity for COX-2 but with some activity for COX-1 | • Use with caution in patients with CV risk
|                  | Indomethacin (PO)                 | 4.5                      |                                                   | • Diclofenac has highest CV risk                                    |                           |
|                  | Piroxicam                        | 50                       |                                                   |                                                                      |                           |
|                  | Sulindac                          | 7.8                      |                                                   |                                                                      |                           |
|                  |                                   |                          |                                                   |                                                                      |                           |
|                  | Ibuprofen (PO)                    | 2                        | • COX-2 and COX-1                                 | • Decreased risk of CV events
| Non-selective    | Caldalor (IV)                     | 2                        |                                                   | • Increased GI effects                                               |                           |
|                  | Naproxen (PO)                     | 2                        |                                                   | • Naproxen has the least CV risk                                    |                           |
|                  | Ketorolac (IM/IV)                 | 12-17                    |                                                   | • Ketorolac has a renal risk                                        |                           |
|                  | Sprix (IN)                        | 5                        |                                                   |                                                                      |                           |
|                  |                                   | 7                        |                                                   |                                                                      |                           |
|                  |                                   |                          |                                                   |                                                                      |                           |
| Irreversible     | Aspirin (PO)                      | 15-30                    | • COX-2 and COX-1                                 | • Cardioprotective                                                  |                           |
| Nonselective     |                                   |                          |                                                   | • Increased risk of GI effects                                      |                           |
| Non-selective    | Acetaminophen (PO)                | 6                        | • COX-1, COX-2, COX-3                             | • Hepatotoxicity with PO tylenol                                    |                           |
|                  | Ofirmev (IV)                      | 6                        |                                                   |                                                                      |                           |
NSAIDs & Acetaminophen

- Guidelines on the Management of Postoperative Pain
  - Less postoperative pain or opioid consumption when used in conjunction with opioids than opioids alone.
  - Increased risk of CV events, GI bleeding, and renal dysfunction
  - Celecoxib dose preoperatively (30 minutes to 1 hour) associated with reduced opioid use postoperatively (Not in CABG).
NMDA antagonists

• **Ketamine (IV)** – ½ life 2-3 hours
  - Decreased incidence of acute and chronic pain
  - Reduced opiate consumption
  - Significantly lower pain scores
  - Great option for analgesia in children
  - **Adverse effects**: dissociative analgesia, emergence delirium, hallucinations, increased HR, SV, BP; bronchodilation, increased salivation and secretions, nystagmus, blurred vision

• **ICU**
  - Continuous sedation for chronically ventilated patients
  - Severe status asthmaticus unresponsive to standard therapy

• **Memantine (PO)** – phantom limb pain

• **Magnesium (IV)** – perioperative reduction of opiates
NMDA antagonists

• Guidelines on the Management of Postoperative Pain
  • Recommends clinicians consider ketamine as a component of multimodal therapy
  • Particularly useful in patients with difficulty titrating opioids because of a high opioid tolerance
  • Recommended dosing
    • Preoperative bolus – 0.5 mg/kg
    • Intraoperative drip – 10 ug/kg/min
Central calcium receptors

- Gabapentin, Pregabalin
  - Gaba-receptors; Anticonvulsants
- Gabapentin/Pregabalin
  - Pre and post operative reduction in opiates
  - Major and minor surgeries
  - Higher doses of medication are more effective
    - 600-1200 mg gabapentin
    - 150-300 mg pregabalin
  - Adverse effects: dizziness, dose reduction in impaired renal function.
  - Limited evidence in children
Central calcium receptors

- Guidelines on the Management of Postoperative Pain
  - Recommends clinicians consider gabapentin or pregabalin as a component of multimodal therapy
Alpha-2 central agonists

- Clonidine and Dexmedetomidine
  - Central and peripheral nervous system
  - **Prolongs local anesthetic action**
  - **Adverse effects**: myocardial ischemia, decreased cardiac output, decreased peripheral vascular resistance, bradycardia, orthostatic hypotension, rebound hypertension on withdrawal
- Clonidine – ½ life – 8 hours
- Dexmetomdine – ½ life – 2 hours
  - No respiratory depression
  - Decreased need of opiates
  - Preserves arousability
  - Neuroprotective
- Dosing – Load 1 mcg/kg over 10 mins, then 0.2-1.4 mcg/kg/hr
Guidelines on the Management of Postoperative Pain

Clinicians should consider the addition of clonidine as an adjuvant for prolongation of analgesia with a single-injection peripheral neural blockade.

- Might prolong the duration of analgesia and potentially reduce the need for a continuous infusion.

[Diagram image with annotations]
Sodium channel antagonist

- **Lidocaine (IV) – ½ life 90 – 120 min.**
  - Stabilizes the open state of the sodium channel - deactivation
  - Analgesic, anti-hyperalgesic, and anti-inflammatory
  - Shorter duration of ileus and better quality of analgesia
  - Decreased need for opioids
  - **Adverse effects:** drowsiness, headaches, confusion, numb tongue, arrhythmia, seizure, respiratory distress, cardiovascular arrest
  - At low doses no major adverse events recorded
  - Administration as a bolus of 1.5mg/kg then infusion of 0.5–2.0 mg/kg/hr
Sodium channel antagonist

- Guidelines on the Management of Postoperative Pain
  - Clinicians should consider i.v. lidocaine infusions in adults who undergo open and laparoscopic abdominal surgery who do not have contraindications
    - Contraindications: heart block, hypotension, bradycardia
Local Anesthesia

- Lidocaine, bupivacaine, liposomal bupivacaine
  - Subcutaneous or intraarticular infiltration at surgical site
- Lidocaine – 4 mg/kg; 7mg/kg with epi
- Bupivacaine – 2.5 mg/kg
- Liposomal bupivacaine – max dose 266mg
  - Don’t use more than 50% if administering with bupivacaine
  - Works for 72 hours
- No benefit to 50/50 mixture compared to independent use.
- Topical Lidocaine patches
Local Anesthesia

• Guidelines on the Management of Postoperative Pain
  • Consider surgical site specific local anesthetic infiltration for surgical procedures.
  • Does not recommend intrapleural analgesia with local anesthetics for pain control after thoracic surgery.
  • Recommends that clinicians use topical local anesthetics in combination with nerve blocks before circumcision
Regional/Neuraxial

- Nerve blocks, Epidural, Intrathecal
  - Decreased postoperative pain scores
  - Decreased opioid use
  - Decreased postoperative mortality
  - Decreased VTE, MI, pneumonia, ileus, respiratory depression
- Epidural – continuous or PCA with local anesthetic
  - Optimal for multiple rib fractures
- Spinal – single dose of opioid
- Paravertebral block
- Transversus abdominis plane (TAP) block
Site specific regional blocks
Regional/Neuraxial

- Guidelines on the Management of Postoperative Pain
  - Surgical site–specific local anesthetic–based peripheral regional
    - Thoracotomy, lower extremity joint surgery, shoulder surgery, cesarean section, hemorrhoid surgery, circumcision
  - Clonidine as an adjuvant for prolongation of analgesia
  - Neuraxial analgesia for major thoracic and abdominal procedures
    - Cardiac complications, pulmonary complications, or prolonged ileus
  - Avoid neuroaxial administration of magnesium, benzos, neostigmine, tramadol, ketamine - no clear benefit
Muscle relaxants & Benzos?

- Ativan, klonipin, xanax, valium
- Flexeril (cyclobenzaprine), Robaxin (Methocarbamol), Baclofen
  - Gaba-receptors
- No clear evidence to suggest benefit for treatment of acute post-operative pain
- Still used by many experts as adjuncts to multimodal therapy
Regimens

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Systemic Pharmacologic Therapy</th>
<th>Local, Intra-articular or Topical Techniques*</th>
<th>Regional Anesthetic Techniques*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracotomy</td>
<td>Opioids†&lt;br&gt;NSAIDs§ and/or acetaminophen&lt;br&gt;Gabapentin or pregabalin§&lt;br&gt;i.v. ketamine¶</td>
<td>Local anesthetic at incision&lt;br&gt;i.v. lidocaine infusion</td>
<td>Paravertebral block</td>
</tr>
<tr>
<td>Open laparotomy</td>
<td>Opioids†&lt;br&gt;NSAIDs§ and/or acetaminophen&lt;br&gt;Gabapentin or pregabalin§&lt;br&gt;i.v. ketamine¶&lt;br&gt;i.v. lidocaine</td>
<td></td>
<td>Transversus abdominis plane block</td>
</tr>
<tr>
<td>CABG</td>
<td>Opioids†&lt;br&gt;Acetaminophen&lt;br&gt;Gabapentin or pregabalin§&lt;br&gt;i.v. ketamine¶</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Neuraxial anesthetic treatment – Epidural with local anesthetic (+/- opioids) or intrathecal opioids
- Nonpharmacologic – Cognitive modalities, TENS
## Regimens

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Systemic Pharmacologic Therapy</th>
<th>Local, Intra-articular or Topical Techniques*</th>
<th>Regional Anesthetic Techniques*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hip replacement</td>
<td>Opioids†, NSAIDs§ and/or acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶</td>
<td>Intra-articular local anesthetic and/or opioid</td>
<td>Site-specific regional anesthetic technique with local anesthetic</td>
</tr>
<tr>
<td>Total knee replacement</td>
<td>Opioids†, NSAIDs§ and/or acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶</td>
<td>Intra-articular local anesthetic and/or opioid</td>
<td>Site-specific regional anesthetic technique with local anesthetic</td>
</tr>
<tr>
<td>Spinal fusion</td>
<td>Opioids†, Acetaminophen† Gabapentin or pregabalin§ i.v. ketamine¶</td>
<td>Local anesthetic at incision</td>
<td></td>
</tr>
<tr>
<td>Cesarean section</td>
<td>Opioids†, NSAIDs§ and/or acetaminophen</td>
<td>Local anesthetic at incision</td>
<td>Transversus abdominal plane block</td>
</tr>
</tbody>
</table>
Step up approach

- Recognizing pain
- Removing or modifying the cause
- Non-pharmacologic therapies (reassurance, position change, ice packs)
- Pharmacologic therapies
  - NSAIDS, acetaminophen
  - Opiates (weak to strong)
  - Adjuncts (gabapentin, pregabalin, flexeril, baclofen)
- Regional/Neuroaxial blocks
- Pain experts
The addicted patient

- Tolerance -> Dependence -> Addiction
- May require increased doses of analgesia
- Look for signs of withdrawal of opiates
  - Nausea, vomiting, diaphoresis, abdominal cramps, convulsions
- Opiate withdrawal symptoms can be suppressed with clonidine and dexmetomidine
- Methadone should be restarted as soon as possible
- Alternatives to opiates in former drug addicts - relapse
ICU pain management

- Assess pain 4 times per shift
- Treat and assess within 30 mins
- Validated scores – not vitals
- Pain meds before procedure – wait for effect!
- Daily sedation breaks
- Early mobilization

Table 3 Behavioral Pain Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial expression</td>
<td>Relaxed</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially tightened (eg, brow lowering)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully tightened (eg, eyelid closing)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Grimacing</td>
<td>4</td>
</tr>
<tr>
<td>Upper limb movements</td>
<td>No movement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially bent</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully bent with finger flexion</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Permanently retracted</td>
<td>4</td>
</tr>
<tr>
<td>Compliance with mechanical</td>
<td>Tolerating movement</td>
<td>1</td>
</tr>
<tr>
<td>ventilation</td>
<td>Coughing but tolerating ventilation for most of</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>the time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fighting ventilator</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Unable to control ventilation</td>
<td>4</td>
</tr>
</tbody>
</table>

*a* Score ranges from 3 (no pain) to 12 (maximum pain).
ICU pain/sedation

- **Benzos** increase LOS and duration on mechanical ventilation
  - Independent risk factor for delirium
- **Dexmetomadine/Propofol** – less delirium
- **Remifentanil** – shorter duration to extubation, better neurologic evaluation
- **Ketamine** – minimal hemodynamic effects; decreased volume resuscitation in TBI patients
- Regional/Neuroaxial blocks
Questions?
Question

- The maximum safe dose of local anesthetic administered subcutaneously in a 70 kg man

- A. 40-50 mL of 1% bupivacaine
- B. 10-20 mL of 1% lidocaine
- C. 40-50 mL of 1% lidocaine without epinephrine
- D. 40-50 mL of 1% lidocaine with epinephrine
- E. 40-50 mL of 2% lidocaine with epinephrine
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• D. 40-50 mL of 1% lidocaine with epinephrine
• E. 40-50 mL of 2% lidocaine with epinephrine
Question

Which of the following is true concerning PCA?

A. satisfactory pain relief is provided with administration of low dose narcotics

B. Technique cannot be used in the semiconscious or uncooperative patient

C. PCA is as safe as IM administration

D. Excessive administration of narcotics can be limited with a lockout duration

E. All of the above
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Question

• 63 yo male undergoes elective colon resection for adenocarcinoma found in a polyp. His home meds include NSAIDs and H2 blockers. A continuous infusion epidural supplemented by general anesthesia are used during the case. Two days later he has headache, stiff neck, and fever to 38.6. Which of the following is true

• A. Hydration and bed rest are curative
• B. Vasodilators are needed to relieve spasm of the anterior spinal artery
• C. Exam of the CSF fluid is warranted
• D NSAIDs are probably contributing to the complication
• E. Injection of a blood patch into the epidural space will alleviate the symptoms
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