House Keeping in the ICU; Pain Management in Trauma Patients

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Pain Management in Trauma Patient

- State of problem in trauma pain
- Why pain is important?
- Concern of pain and related symptoms
- Mechanism of injuries and pain
- Posttraumatic pain: acute and chronic
- Strategies in pain management
- Pain in special groups of trauma
Trauma Patients and Pain

- Only 1.8% of trauma patients receive analgesia from out-of-hospital providers.
- Specialty critical care transport teams have reported higher administration rates but still do not offer analgesia to many trauma patients with pain.

Analgesia administration rate by initial pain report in the critical care transport environment

Pain Management in US & Canada Emergency Department

• N= 842
• ED pain intensity is high (median =8/10)
• Analgesics are underutilized
• The overall rate of analgesic delivery = 60%
• Delays to treatment are common:
  – median, 90 minutes; range, 0 to 962 minutes

Pain Intensity at ED Arrival and Discharge

Potential Pathological Effects of Undertreating Significant Posttraumatic Pain

<table>
<thead>
<tr>
<th>System</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Tachycardia, arrhythmias, hypertension, myocardial O₂ consumption, altered regional blood flow leading to limb ischemia, and DVTs</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Breathing and cough efforts which may lead as well to atelectasis, lung volumes, sputum retention, pneumonia, and hypoxemia</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Gastric and intestinal motility and accordingly emptying</td>
</tr>
<tr>
<td>Urinary</td>
<td>Retention</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Circulating catabolic hormones (including catecholamines, corticosteroids, GH, glucagons, aldosterone and ADH)</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>Spasms, immobility, chronic fatigue</td>
</tr>
<tr>
<td>Nervous</td>
<td>Chronic pain status</td>
</tr>
<tr>
<td>Psychological</td>
<td>Anxiety, insomnia, depression, phobias</td>
</tr>
</tbody>
</table>

Chronic Pain After Trauma

- USA studies in 69 hospitals: 3047 patients, age 18 to 84 years admitted to the hospital because of acute trauma and survived to 12 months after injury
- Outcome measure= pain at 12 months after injury measured with the Chronic Pain Grade Scale
- 62.7% of patients reported injury-related pain
- Most patients had pain >1 body region, the mean (SD) severity of pain in the last month was 5.5 (4.8) on a 10-point scale
- pain varied with age, common in women and those who had untreated depression before injury
- Pain at 3 months was predictive of both the presence and higher severity of pain at 12 months
- Suggest!!! Earlier and more intensive interventions to treat pain in trauma patients may be needed

# Chronic Pain Following Surgery

## Incidence of Chronic Pain

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Incidence of Chronic Pain</th>
<th>Number of Studies</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amputation</td>
<td>30–83%</td>
<td>9</td>
<td>6 months–50 years</td>
</tr>
<tr>
<td>Thoracotomy</td>
<td>22–67%</td>
<td>6</td>
<td>3 months–33 months</td>
</tr>
<tr>
<td>Breast surgery</td>
<td>11–57%</td>
<td>16</td>
<td>3 months–6 years</td>
</tr>
<tr>
<td>Gallbladder surgery</td>
<td>3–56%</td>
<td>16</td>
<td>3 months–10 years</td>
</tr>
<tr>
<td>Hernia surgery</td>
<td>2–37%</td>
<td>10</td>
<td>3 months–38 months</td>
</tr>
</tbody>
</table>

*Perkins FM, Kehlet H. Anesthesiology 2000;93(4)*
Risk Factors for the Development of Chronic Postsurgical Neuropathic pain (CPSP)

<table>
<thead>
<tr>
<th>Pre-operative</th>
<th>Intra-operative</th>
<th>Post-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate-severe pre-operative pain &gt;1 month; regional pain syndromes? (e.g. CRPS or PLP); pre-existing chronic pain?; chronic opioid therapy?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological factors: vulnerability (personality); anxiety?</td>
<td>Repeat surgery; nerve injury; type of surgery?</td>
<td>Moderate-severe, acute post-operative pain; acute wound hyperalgesia? Psychological factors: vulnerability; neuroticism; depression; anxiety Neurotoxic chemotherapy or radiotherapy Limb immobilisation?</td>
</tr>
</tbody>
</table>

Compensation issues

- Female gender (thoracotomy, cholecystectomy);
- Younger age (inguinal hernia repair, CABG, mastectomy);
- Increased BMI (inguinal hernia repair, CABG, mastectomy)

Prior Considerations

• Mechanisms of injuries
  – Blunt or penetrating
  – Heat, electricity, drowning
• Underlying chronic pain 40%
• Therapeutic interventions differ according to trauma mechanics
  – restoration of oxygenation in drowning
  – immediate chest tube in penetrating thoracic injury
Mechanism of Posttraumatic Pain

• Tissue loss or damage from trauma
• Type of pain
  – Nociceptive pain
  – Sensitization
The 4 primary types of pain

A. Nociceptive Pain
- Noxious Peripheral Stimuli
  - Heat
  - Cold
  - Intense Mechanical Force
  - Chemical Irritants
- Pain Autonomic Response Withdrawal Reflex
  - Nociceptor Sensory Neuron
  - Spinal Cord
  - Brain

B. Inflammatory Pain
- Inflammation
  - Macrophage
  - Mast Cell
  - Neutrophil Granulocyte
  - Tissue Damage
- Spontaneous Pain Pain Hypersensitivity
  - Reduced Threshold: Allodynia
  - Increased Response: Hyperalgesia
  - Nociceptor Sensory Neuron
  - Spinal Cord
  - Brain

C. Neuropathic Pain
- Peripheral Nerve Damage
- Spontaneous Pain Pain Hypersensitivity
  - Brain Stroke
  - Spinal Cord Injury

D. Functional Pain
- Normal Peripheral Tissue and Nerves
- Abnormal Central Processing
- Spontaneous Pain Pain Hypersensitivity
- Brain

Stimulus | Representative receptor
---|---
NGF | TrkA
Bradykinin | BK₂
Serotonin | 5-HT₃
ATP | P₂X₁
H⁺ | ASIC₃/VR₁
Lipids | PGE₂/CB₁/VR₁
Heat | VR₁/VRL₁
Pressure | DEG/ENaC?
Contributions of primary sensory neurons to pain

A. Nociceptive Transduction

B. Peripheral Sensitization

C. Transcriptional Change in the DRG

Contributions of spinal cord dorsal horn neurons to pain

Pain Sensitization

Gottschalk and Smith, Am Fam Physician 2001
Peripheral Sensitization

Cell Damage  

Inflammation  

Sympathetic Terminals

Release of pain and inflammatory mediators  
eg, bradykinin, H\(^+\), prostaglandins

Nociceptor  

High Threshold  

Low Threshold  

Spinal cord

Central sensitization
- Hyperalgesia
- Allodynia
Neuronal Plasticity and Pain

- “Activation”: rapid onset, substantial, readily reversible
  “Autosensitization and Wind-up”
- “Modulation”: follows repeated, intense stimuli, substantial,
  slowly reversible
  “Peripheral and Central Sensitization”
- “Modification”: follows prolonged, intense stimuli or nerve
  damage, very long-lasting
  “Persistent, pathological (neuropathic) pain”

Woolf and Salter, Science 288: 1765-1768, 2000
Pain as classified by phase

- Acute pain: at injury (emergency) then healing when stabilization
- Chronic pain: at rehabilitation
Categorization of Posttraumatic Pain

• Pain as classified by pattern
  – Localized
    • Affects limited body area or surface
  – Regional
    • Confined to 1 region of the body
    • Board affects limited number of region of the body
  – Generalized
    • Affects multiple region or extensive regions
Categorization of Posttraumatic Pain

• Pain as classified by events
  – Background pain
    • Constant or occurs with ordinary activity such as moving in bed
  – Breakthrough pain
    • Pain Independent from background pain
    • Could be triggered by unusual activity or excessive ordinary activity
  – Incident pain
    • Related to specific activity such as wound dressing changes or physical therapy
Guideline for Evaluation of Posttraumatic Pain: General

• Assess pain regularly and systematically
• Believe the patient’s report (and their family if applicable)
• Choose appropriate management
• Deliver therapy in timely and organized style
• Enable patients to control their course of therapy
Guideline for Evaluation of Posttraumatic Pain: History

- Time and location of injury
- Time and location pain started
- Pain quality, intensity, severity, factors of relief and exacerbation
- Pain radiation
- Relationship with other symptoms or complaints, such as sleeplessness, anxiety, cough, etc.
- Relationship to activity
- Past pain history
- Past medical, surgical, family, social, and therapeutic history
- Review of systems
Examples of pain assessment tools
# Pain Assessment Behavioral Scale

**Behavioral pain assessment scale**
*(For Patients Unable to Provide a Self Report of Pain: Scored 0–10 Clinical Observation)*

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>Face Score:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>Face muscles relaxed</td>
<td>Facial muscle tension, frown, grimace</td>
<td>Frequent to constant frown, clenched jaw</td>
<td></td>
</tr>
<tr>
<td>Restlessness</td>
<td>Quiet, relaxed appearance, normal movement</td>
<td>Occasional restless movement, shifting position</td>
<td>Frequent restless movement may include extremities or head</td>
<td>Restlessness Score:</td>
</tr>
<tr>
<td>Muscle Tone*</td>
<td>Normal muscle tone, relaxed</td>
<td>Increased tone, flexion of fingers and toes</td>
<td>Rigid tone</td>
<td>Muscle Tone Score:</td>
</tr>
<tr>
<td>Vocalization**</td>
<td>No abnormal sounds</td>
<td>Occasional moans, cries, whimpers or grunts</td>
<td>Frequent or continuous moans, cries, whimpers or grunts</td>
<td>Vocalization Score:</td>
</tr>
<tr>
<td>Consolability</td>
<td>Content, relaxed</td>
<td>Reassured by touch or talk. Distractible</td>
<td>Difficult to comfort by touch or talk</td>
<td>Consolability Score:</td>
</tr>
</tbody>
</table>

**Behavioral Pain Assessment Scale Total (0 to 10) /10**

*Assess muscle tone in patients with spinal cord lesion or injury at a level above the lesion or injury. Assess patients with hemiplegia on the unaffected side. **This item cannot be measured in patients with artificial airways.*
Guideline for Evaluation of Posttraumatic Pain: Physical Exam

- General Appearance
- Painful site
- Injury site
- Neurological examination
- Systematic (ie, CV, respiratory, GI, etc.) examination
- Psychological examination
Posttraumatic Pain Therapies: Concept

• 3 main strategies
  – reduction of tissue inflammation
  – limiting transmission of action potentials to the secondary neurons
  – enhancing supraspinal inhibition

• Severe pain (or expected to worsen): consult pain specialist

• In major trauma: feelings affect interpretation of pain and subsequent management
  – fear, anxiety, guilt, loss of loved ones or body parts
### Posttraumatic Pain Therapies: Main Systemic Analgesics

#### Non-opioids
- NSAIDs: ibuprofen
- COXIBs: parecoxib, ketorolac

#### Opioids
- Weak: tramadol, codeine
- Strong: morphine, pethidine, fentanyl, methadone

#### Adjuvants
- Antidepressant
- Anticonvulsants
- NMDA antagonist
- Alpha 2 agonist
Preemptive Analgesia/ Preventive Analgesia

A. Surgical and postsurgical afferent input

B. Postsurgical analgesia

C. Presurgical analgesia

D. Presurgical and postsurgical analgesia

The pain pathway and modulation by interventions

- opioids
- ketamine
- Alpha 2 agonists

Modified from Kehlet H, Dahl JB. The value of "multimodal" or "balanced analgesia" in postoperative pain treatment. Anesth Analg 1993;77:1049
# Non-opioid Analgesics

<table>
<thead>
<tr>
<th>Drug</th>
<th>Usual Analgesic Dose (mg)</th>
<th>Dose Interval (h)</th>
<th>Maximum Daily Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen</td>
<td>500–1000</td>
<td>4–6</td>
<td>4000</td>
</tr>
<tr>
<td>NSAIDs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin</td>
<td>500–1000</td>
<td>4–6</td>
<td>4000</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>400</td>
<td>4–6</td>
<td>2400</td>
</tr>
<tr>
<td>Celecoxib</td>
<td>200</td>
<td>24</td>
<td>800</td>
</tr>
<tr>
<td>Indomethacin</td>
<td>25</td>
<td>8–12</td>
<td>200</td>
</tr>
<tr>
<td>Ketorolac</td>
<td>Age &lt;65: 15 mg IM/IV</td>
<td>6</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Age &gt;65: 30 mg IM/IV</td>
<td></td>
<td>60 (limit use to 5d only)</td>
</tr>
<tr>
<td>Naproxen</td>
<td>500 mg initially then 250 mg or 500 mg</td>
<td>6–8</td>
<td>1250 mg first d then 1000 mg</td>
</tr>
<tr>
<td>Meloxicam</td>
<td>7.5 mg/d</td>
<td>24</td>
<td>15 mg per d</td>
</tr>
</tbody>
</table>
Posttraumatic Pain Therapies: In the Emergency Phase

- Initial management goal:
  - airway stabilization
  - hemodynamic stabilization
  - life preservation

- Proper patient’s oxygenation eg. Canula, ET

- Reduce anxiety; sedative, analgesics

- Relieve pain related to injuries eg. Reduce dislocation fracture, chest drain in pneumothorax

- Attention in alcohol and mood altering substances in massive trauma pt with hemodynamic/mental status
Posttraumatic Pain Therapies: In the Emergency Phase

• Analgesia which is simple and safe without interfere with respiratory & hemodynamic stability

• Intermittent short acting opioids eg. morphine, pethidine

• Shorter acting opioids, eg. fentanyl in certain circumstances such as hypersensitivity to other agents or if patient-controlled analgesia (PCA) is used

• Long acting opioids: methadone are not routinely used
Benzodiazepines

• Sedative-hypnotic agents
  – Sedative (anxiolytic): blocks acquisition and processing of new information
  – Hypnotic: produces drowsiness and encourages onset and maintenance of sleep.

• Lacks analgesia effects

• Issues:
  – CNS depression (additive)
    • Hypotension
    • Respiratory depression
  – Tolerance
  – Withdrawal
Benzodiazepines

Table 3. Pharmacology of selected sedatives (1, 30–32, 98–110)

<table>
<thead>
<tr>
<th>Agent</th>
<th>Onset After i.v. Dose</th>
<th>Half-life of Parent Compound</th>
<th>Metabolic Pathway</th>
<th>Active Metabolite</th>
<th>Unique Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazepam</td>
<td>2–5 min</td>
<td>20–120 hr</td>
<td>Desmethylation and hydroxylation</td>
<td>Yes (prolonged sedation)</td>
<td>Phlebitis</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>5–20 min</td>
<td>8–15 hr</td>
<td>Glucuronidation</td>
<td>None</td>
<td>Solvent-related acidosis/renal failure in high doses</td>
</tr>
<tr>
<td>Midazolam</td>
<td>2–5 min</td>
<td>3–11 hr</td>
<td>Oxidation</td>
<td>Yes (prolonged sedation, especially with renal failure)</td>
<td></td>
</tr>
</tbody>
</table>

- Diazepam not used extensively in ICU, metabolites and renal excretion
Propofol

- IV general anesthetic agent
  - Sedative/hypnotic properties at lower doses
  - Rapid onset and rapid recovery (ambulate sooner)
- No analgesic properties
- Requires dedicated line for infusion
- Stored in lipid emulsion --> hypertriglyceridemia
  - 1.1 kcal/ml from fat, adjust tube feeds
  - Pancreatitis, particularly in prolonged or high-dose
  - Check triglyceride levels after 2 days
- Adverse Effects
  - Marked hypotension during induction, respiratory depression (apnea), bradycardia, arrhythmias, propofol infusion syndrome
Central alpha-agonists

• Unlike other sedatives, $\alpha_2$-agonists do not cause respiratory depression or hemodynamic instability
  – Facilitate extubation or withdrawal of mechanical ventilation

• Clonidine: $\alpha_2 > \alpha_1$-agonist
  – Initial pressor due to direct $\alpha_1$ stimulation of arterioles
  – Central $\alpha_2$ stimulation in CNS inhibits sympathetic activity, reduces plasma epinephrine and norepinephrine levels.

• Dexmedetomidine: a more selective $\alpha_2$-agonist than clonidine
  – Stronger sedative and analgesic properties
  – Requires attending approval for >24 hr use
Dexmedetomidine

- Helpful in extubating patients who failed previous weaning attempts following prolonged mechanical ventilation, especially if there exists component of agitation or delirium.

- Method:
  - Start infusion rate of 0.5-0.7 ug/kg/hr
  - Background sedation and analgesia titrated down or discontinued if possible
  - Dexmedetomidine titrated to blood pressure and heart-rate

Fentanyl

• High dose opioids have sedative properties
• Acute agitation can arise for a variety of etiologies, including pain.
• Short-acting opioid analgesics may provide immediate patient comfort thus reducing agitation associated with pain
  – May decrease sedation requirement
  – Respiratory depression is additive
• Fentanyl family includes: Alfentanil, remifentanil, sufentanil
Assessing Sedation

- Modified Ramsey Sedation Scale
  - Titrate sedation to $\geq 2$ and $<5$

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anxious and agitated or restless or both</td>
</tr>
<tr>
<td>2</td>
<td>Cooperative, oriented, tranquil</td>
</tr>
<tr>
<td>3</td>
<td>Responds to commands only</td>
</tr>
<tr>
<td>4</td>
<td>Brisk response to a light glabellar tap or loud auditory stimulus</td>
</tr>
<tr>
<td>5</td>
<td>Sluggish response to a light glabellar tap or loud auditory stimulus</td>
</tr>
<tr>
<td>6</td>
<td>No response to light glabellar tap or loud auditory stimulus</td>
</tr>
</tbody>
</table>

From Ramsay et al (18).

**Bangkok Hospital ; Ramsey sedation Scale**

0 wide awake & alert

1 drowsy on occasion but easily aroused

2 somnolent but easily aroused

3 somnolent but difficult to arouse
Posttraumatic Pain Therapies: In the Emergency Phase

• Localized and regional pain can be treated effectively by local, regional or neuraxial analgesia
  – Regional analgesia is great selectivity and have fewer hemodynamic side effects
  – Epidural analgesia allows pain control to be more selective with minimal opioid exposure and associated side effects
  – Epidural analgesia is absolutely contraindicated in patients with coagulation abnormalities due to high risk of developing spinal/epidural hematoma
Posttraumatic Pain Therapies: In the Healing Phase

• Systemic short-acting opioids are commonly used
  – Intermittent, continuous IV infusions, IV patient-controlled analgesia (PCA)
• Opioids can be given in oral, transdermal form. (extended-release and immediate-release formulations)
Posttraumatic Pain Therapies: In the Healing Phase

• Non-steroidal anti-inflammatory drugs (NSAIDs) can be used as an adjunct to opioids or as a first-line treatment
  – acts both in the periphery and in the central nervous system by inhibiting prostaglandin synthesis
  – therapeutic ceiling.
• Ketorolac = only NSAID that is given parenterally
  – Dosing of ketorolac and all NSAIDs should be done with caution in the elderly, asthmatics and patients with impaired renal function
• NSAID inhibition of platelet function and gastrointestinal toxicity
• cyclooxygenase-2 inhibitors (COXIB) may provide significant benefits. (beware of cardiovascular risk)
Posttraumatic Pain Therapies: In the Healing Phase

- Epidural infusion is particularly useful in thoracic, abdominal, pelvic or lower extremity injuries
- Opioids, local anesthetics and a variety of adjuvant analgesics (such as clonidine) can be used in continuous, intermittent or combined forms
- Regional transcutaneous electrical neurostimulation (TENS units) have shown to be of benefit
- Initiate non-pharmacologic modalities of pain relief and rehabilitation eg. physical therapy and psychological interventions (eg, hypnosis, relaxation counseling)
Posttraumatic Pain Therapies: In the Healing Phase

- Acetaminophen (paracetamol) and NSAID not sufficient to treat severe presentations of posttraumatic pain if given alone
- Combined formula eg. Tylenol with codeine, Ultracet (tramadol+paracetamol)
Analgesics for Moderate to Severe Pain

- Codeine: combined with paracetamol
- Antitussis, constipating, nausea is not infrequent
- 7% caucasian is poor metaboliser (lack the necessary enzyme to convert codeine to its active (morphine) moiety
- Dose 30 mg q 4 hr
• Tramadol: combined with acetaminophen
• its active M1 metabolite acts as an opiate agonist, m-receptor
• inhibits reuptake of certain monoamines (norepinephrine, serotonin)
• renal or hepatic impairment: decreasing the frequency of administration
• Side effects: dizziness or vertigo (dose related)
• Dose 400 mg/d max, reduce 50% in renal/liver diseases
Morphine: metabolized in liver to
- M3G (hyperalgesia, myoclonus)
- M6G (potent effect)

Excretion 90-95% renally

No ceilings

dosing interval for morphine must be increased or reduction the dosage in patients with dehydration or acute or chronic renal failure impairs renal clearance
## Opioids Selection in Renal Failure

<table>
<thead>
<tr>
<th>Opioid</th>
<th>Renal Failure</th>
<th>Parent Drug</th>
<th>Metabolites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methadone</td>
<td>Appears safe</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>Appears safe</td>
<td>+/-</td>
<td>none</td>
</tr>
<tr>
<td>Morphine</td>
<td>Use with caution/dose adjust</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td></td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td></td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>Inadequate data</td>
<td>Inadequate data</td>
<td>Inadequate data</td>
</tr>
<tr>
<td>Codeine</td>
<td>Do not use</td>
<td>Inadequate data</td>
<td>Inadequate data</td>
</tr>
<tr>
<td>Meperidine</td>
<td>Inadequate data</td>
<td>Inadequate data</td>
<td>Inadequate data</td>
</tr>
<tr>
<td>Propoxyphene</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Opioid Equianalgesic Conversions

<table>
<thead>
<tr>
<th>Drug</th>
<th>IV/IM Dose (mg)</th>
<th>Oral Dose (mg)</th>
<th>Starting Oral Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>10</td>
<td>30</td>
<td>30–60</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>1.5</td>
<td>7.5</td>
<td>4–8</td>
</tr>
<tr>
<td>Methadone</td>
<td>10</td>
<td>10</td>
<td>5–10</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>—</td>
<td>20–30</td>
<td>5–30</td>
</tr>
<tr>
<td>Meperidine</td>
<td>75</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Codeine</td>
<td>130</td>
<td>200</td>
<td>30–60</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.1</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>
Methadone

- Average oral bioavailability approximately 80%
- Long and unpredictable half-life
- A racemic mix of the d-isomer and l-isomer of methadone
- d-isomer has antagonist activity NMDA receptor and may be beneficial in controlling neuropathic pain
- Possible prolongation of QTc interval, leading to torsades de pointes and ventricular arrhythmia
- For patients who have opioid-induced hyperalgesia (OIH)
Transdermal Fentanyl

- Highly lipophilic: apply at the area with subcutaneous fat, no hair
- Lag period of onset 12-17 hour and 12 hr after removal
- Last 48-72 hr
- Suitable for stable routine opioid dose patients
- Less constipation
Opioid Allergy VS Side Effects

- Side effects of opioids (nausea, sedation) pharmacologic tolerance except **constipation**
- Urticaria, pruritis, and bronchospasm could be direct opioid effects or signs of allergy
- Treatment rash/urticaria from histamine release + routine administration of long-acting, nonsedating oral antihistamines
- **True anaphylaxis**, should be replaced with another from a different class
Posttraumatic Pain Therapies: In the Chronic Phase

• As any non-malignant chronic pain eg. headaches, neuropathic pain, musculoskeletal, and myofascial pain

• Pharmacologic management
  – opioid analgesics
  – non-opioid analgesics (NSAIDs and COXIB)
  – adjuvant analgesics
Posttraumatic Pain Therapies: In the Chronic Phase

• Non-pharmacologic treatments
  – rehabilitation adjuvants eg. physical therapy, physiatric techniques, osteopathic maneuvers, occupational therapy
  – psychological intervention eg. psychological treatment, behavioral treatments, biofeedback and cognitive-behavioral treatment
  – neurostimulation, invasive mild and radical minor or major neuromodulation procedures
  – alternative therapies eg. massage therapy, hydrotherapy, spinal manipulations and acupuncture
Posttraumatic Neuropathic Pain

• Most common in trauma: complex regional pain syndrome
  – regionally, with abnormal findings exceeding in both magnitude and duration the expected course of the inciting event
  – significant impairment of motor function and show variable progression over time

• Conservative treatment
  – PT, early ambulation, TENS, epidural infusion (sympathetic overactivity phase)
# Medications for Neuropathic Pain

<table>
<thead>
<tr>
<th>Antidepressants</th>
<th>Anticonvulsants</th>
<th>Opioids</th>
<th>NMDA antagonists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amitriptyline</td>
<td>Carbamazepine</td>
<td>Methadone</td>
<td>Dextromethorphan</td>
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<tr>
<td>Nortriptyline</td>
<td>Gabapentin</td>
<td>Morphine</td>
<td>Ketamine</td>
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<tr>
<td>Citalopram</td>
<td>Lamotrigine</td>
<td>Oxycodone</td>
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<tr>
<td>Clomipramine</td>
<td>Phenytoin</td>
<td>Tramadol</td>
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<td>Desipramine</td>
<td>Pregabalin</td>
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<tr>
<td>Duloxetine</td>
<td>Topiramate</td>
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<td>Fluoxetine</td>
<td>Valproate</td>
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<td>Imipramine</td>
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<td>Paroxetine</td>
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<tr>
<td>Venlafaxine</td>
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</tr>
</tbody>
</table>

Pain in Burn Patients

- Mechanisms: nociceptive, neuropathic pain
- Repeat debridement: sensitization
- Psychological impact
- Increase tolerance to opioids and benzodiazepines
- Ketamine iv reduce windup pain
Pain in Injured Child & Elderly

- Self report for pain assessment sometimes difficult
- Anxiety: anxiolytics and sedatives
- Depression in elderly
- Opioid for severe pain
- Cognitive impair in elderly
- Response of the medications, not precalculated dosage
Pain in Pregnants

- NSAIDS is not recommend to avoid fetal complications
- Abdominal trauma: abruptio placenta
Pain in Opioid Tolerant Patient

- On opioid treatment for chronic pain, current or past history of opioid abuse, or undergoing addiction rehabilitation treatment with methadone
- Provide adequate analgesia, prevent withdrawal, manage withdrawal
- Maintenance doses of methadone should be provided to the awake, non-sedated patient if the oral route is available or using equianalgesic dose of a parenteral opioid
- An addiction specialist consultation occasionally becomes warranted.
- Regional techniques are highly recommended when applicable.
Thank you