Improving Pain Management in Trauma Patients

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Disclosure

I have no conflicts of interest or disclosures related to this presentation today.
Pharmacists’ Learning Objectives

• Describe the benefits of adequate pain control in post-traumatic injuries

• Explain the pathophysiology of acute traumatic pain

• Develop strategies to treat post-traumatic pain using non-pharmacologic techniques and pharmacologic agents
Technicians’ Learning Objectives

• Describe the benefits of adequate pain control in post-traumatic injuries

• List medications used in pain management of trauma patients

• Compare non-pharmacologic and pharmacologic methods to reduce pain
Outline

Overview of pain
- Definitions
- Background

Traumatic pain
- Current state
- Pathophysiology

Treating traumatic pain
- Goals
- Treatment modalities
- Injury-specific therapeutic options
Definitions

• Pain = unpleasant sensory and emotional experience with actual or potential tissue damage, or described in terms of such damage

• Analgesia = blunting or absence of sensation of pain or noxious stimuli

• “Opiophobia” = fear of adequate pain management using opioids

• Oligo-analgesia = inadequate pain relief
Why Pain Control?

• Evidence shows pain control allows:
  o Earlier patient mobilization
  o ↓ Neuroendocrine side effects of injury
  o ↓ Incidence of thrombotic events
  o ↓ Pulmonary complications
  o ↓ Vascular graft occlusion

• Poor pain control associated with increased:
  o Chronic pain syndromes
  o Post-traumatic stress disorder
  o Morbidity & mortality

# Adverse Effects of Uncontrolled Pain

<table>
<thead>
<tr>
<th>Category</th>
<th>Effect</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>↑ Heart Rate</td>
<td>↑ Myocardial oxygen demand</td>
</tr>
<tr>
<td></td>
<td>↑ Blood pressure</td>
<td>↑ Hypercoagulation</td>
</tr>
<tr>
<td>Respiratory</td>
<td>↓ Lung volume</td>
<td>Atelectasis</td>
</tr>
<tr>
<td></td>
<td>↓ Decreased cough</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>Gastrointestinal/</td>
<td>↓ Gastric emptying</td>
<td>↓ Bowel motility</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>Ileus formation</td>
<td>Urinary retention</td>
</tr>
<tr>
<td>Other</td>
<td>Anxiety/fear</td>
<td>Muscle spasms</td>
</tr>
<tr>
<td></td>
<td>Poor wound healing</td>
<td>Altered release of hormones</td>
</tr>
</tbody>
</table>

Pain Control is Priority!

- JCAHO 2000: recognized poor provider and patient education regarding pain management leading to inadequate care
- Designed measures to overcome barriers within hospitals to facilitate appropriate pain management strategies:

Trauma Statistics

- 41 million emergency visits annually
- 2.3 million hospital admissions annually
- 2014: traumatic injuries accounted for 30% of all US life-years lost
- Estimated that 15% of all trauma patients require emergency surgery
- The single most prevalent condition among trauma patients is pain

How well do we treat traumatic pain?

- Literature review
  - No studies examining acute pain management in solely trauma patients
  - Extrapolated from similar populations
    - Emergency department patients with acute injuries
    - Surgical patients
  - Pre-hospital data

Patients’ Perceptions

• Carroll KC et al. study: 213 patients from 13 hospitals
  o 28% did not recall explanation of pain management
  o 64% reported moderate to severe pain while in ICU
  o Low satisfaction correlated with expectations of less pain, often being in moderate to severe pain and long wait for analgesic
  o 24 hours post-op: only 54% had numerical pain rating documented

• Despite moderate-severe pain, patients are generally satisfied with their relief

Patients have low expectations!

Prevalence of Pain

• Berben SA et al. study: prospective cohort of 450 trauma patients
  o Admission: 91% population reported pain
  o Discharge: 86% population reported pain → 2/3 reported moderate to severe pain
  o Emergency department
    □ Few patients received pharmacological or non-pharmacological pain relieving treatment
    □ Pain decreased in only 37% of those that received management

Prevalence of Pain – 1 year later

- Rivara FP et al. study: prospective cohort of 3047 trauma patients among 69 hospitals
  - 12 months post-injury: 62.7% reported injury-related pain
  - Mean injury severity was 5.5 out of 10 (SD=4.8)
  - Pain at 3 months was predictive of presence and higher severity of pain at 12 months
  - Most common risk factors:
    - Women
    - Untreated depression prior to injury
    - Admission to ICU
    - Need for surgery

## Predictors of Pain – 1 year later

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. of patients</th>
<th>Pain related to injury weighted, %</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Injury mechanism</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetrating</td>
<td>273</td>
<td>67.5</td>
<td>0.26</td>
</tr>
<tr>
<td>Blunt</td>
<td>2774</td>
<td>62.1</td>
<td></td>
</tr>
<tr>
<td><strong>Neck or spine injury</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2970</td>
<td>62.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>77</td>
<td>45.9</td>
<td></td>
</tr>
<tr>
<td><strong>Upper extremity injury</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2929</td>
<td>63.2</td>
<td>0.01</td>
</tr>
<tr>
<td>Yes</td>
<td>118</td>
<td>52.6</td>
<td></td>
</tr>
<tr>
<td><strong>&gt;1 body area injured</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2199</td>
<td>57.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>848</td>
<td>75.6</td>
<td></td>
</tr>
</tbody>
</table>

Reasons for Pain

- Traumatic brain injuries
- Blunt thoracic trauma
- Penetrating trauma
- Fractures
- Spinal cord injury
- Nerve damage
- Burns

Poly-trauma

The Trauma Population

- Healthy, young adults
- Frail elderly
- Vulnerable children

- Multiple injuries
- Substance abuse
- Delayed care
- Psychological issues
- Emotional issues

Associated Factors

- Younger age
- Multiple surgeries → length/type of surgeries
- Poorly managed pain
- Nerve injury
- Duration of disability (i.e. time to return to work)
- Psychological – ↑ anxiety, depression, stress

Barriers to Pain Management

- Fear of masking injuries
- Fear of impacting hemodynamic status
- Fear or respiratory compliance
- Lower priority
- Underuse of effective techniques
- Lack of protocols
- Lack of knowledge or training

Vlaeyen JW, Linton SJ. Pain 2000;85(3):317-32
The Fear-Avoidance Model

Vlaeyen JW, Linton SJ. Pain 2000;85(3):317-32
Pathophysiology of Pain

- Nociceptors
  - C-polymodal receptors
  - A-delta polymodal receptors

- Somatic vs. Visceral pain
  - Sharp, throbbing vs dull, aching pain

Pathophysiology of Pain

- Peripheral sensitization
  - Primary hyperalgesia
  - Secondary hyperalgesia
- Central sensitization
- Leads to spinal wind-up
- Leads to permanent alterations in CNS

Pain in Trauma

• Neuroplasticity
  o The ability of neural tissue to change in response to repeated incoming stimuli
  o Leads to development of chronic, disabling neuropathic pain

• Complex, dynamic process

• Example: phantom limb pain

Stress Response in Trauma

- Cytokine and acute phase reactant release
- ↑ catecholamines
- ↑ cortisol
- ↑ growth hormone
- ↑ adrenocorticotropic hormone
- Activation of renin-angiotensin system
- Impaired coagulability
- Altered immune response

Long Term Implications

- Disability
- Post-traumatic stress disorder (PTSD)
- Development of chronic pain
- ↑ growth hormone
- ↑ adrenocorticotropic hormone
- Activation of renin-angiotensin system
- Impaired coagulability
- Altered immune response

Post-traumatic Stress Disorder

- Evidence that pain control is effective secondary prevention strategy.

- Zatzick DF et al. evaluated PTSD after injury
  - N=3000
  - Pain at 3 months was associated with significantly increased risk of PTSD.

- The unknown: Is better pain control or choice of pain control more important?

References:
Goals of Pain Management

- Communicate importance of pain management
- Decrease or modulate inflammatory/stress response
- Early restoration of function
- Mitigation of chronic debilitated state
- Treat pain early and throughout continuum of care

Pain Assessment

O - Onset of the event
P - Provocation or palliation
Q - Quality of the pain
R - Region and radiation
S - Severity
T - Time (history)

Early Pain Management

• Pre-hospital Evidence Based Guideline
  o Use narcotic analgesics to relieve moderate to severe pain (strong recommendation; moderate quality evidence)
    ▪ IV or IO morphine (0.1mg/kg)
    ▪ IV, IO or IN fentanyl (1mcg/kg)
  o Reassess every 5 minutes & re-dose at half the original dose if necessary

• Basis: Time to documented pain relief is significantly reduced if analgesia is initiated in pre-hospital setting

Preventative Analgesia

- Viable option for post-traumatic surgery patients
- Preventive analgesia=reducing nociceptive inputs throughout the entire hospital stay
- Reuben & Eckman 2007 showed decreased complex regional pain syndrome in multimodal preventative group compared to controls (7% vs. 1%; p<0.001)

Pharmacologic Interventions

• Regional modalities
  o Epidurals
  o Intrapleural analgesia
  o Regional nerve blocks

• Systemic modalities
  o Non-opioid analgesics
    □ Acetaminophen (PO or IV)
    □ NSAIDs (PO NSAIDS + IV ketorolac)
    □ Ketamine
    □ Gabapentin
  o Opioid analgesics

Multimodal Pain Control

• Rationale: To capitalize on the synergistic action between pharmacologic agents and techniques

• Benefits
  o Decreased doses
  o Avoid adverse effects or complications

• Advocated by:
  o Agency for Healthcare Research & Quality
  o American Society of Anesthesiologists Task Force on Acute Pain Management

Multimodal Pain Control

Acetaminophen

α-2 agonists/Opioids/α2-δ ligands

Dorsal Horn (Interneuron Cells)

CNS

Surgical Trauma

NSAIDs Corticosteroids

Local Anesthetics Cryotherapy

Multimodal Pain Control

Injury Specific Management

- Isolated injury vs. poly-trauma
- Requires assessment of all injuries
- Analgesia selection to take advantage of:
  - Underlying mechanism of pain
  - Unique routes of administration

Injury Type – Blunt Thoracic Trauma

• Strong indicator of severe internal injury

• Pulmonary complications: ↓ cough reflex → sputum retention, atelectasis & ↓ functional residual capacity

• Management
  o Thoracic epidurals
  o Interpleural analgesia
  o Intercostal nerve blocks
  o Nonopioid analgesics
  o Opioid analgesics

## Comparative Analysis

<table>
<thead>
<tr>
<th>Technique (drug)</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Contraindications</th>
</tr>
</thead>
</table>
| **Thoracic epidurals (LA ± opioids)** | Superior analgesia  
Hemodynamic stability | Pruritis  
Risk of delayed respiratory depression  
Potential LA toxicity | Aortic or mitral stenosis  
Increased ICP  
Spinal injury  
Hypovolemia  
Bleeding disorders |
| **Interpleural or intercostal analgesia (LA)** | No CNS depression  
Single placement | Reduced efficacy in presence of pleural fluids  
Risk of pneumothorax (intercostal)  
Potential LA toxicity | Aortic or mitral stenosis  
Increased ICP  
Spinal injury  
Hypovolemia  
Bleeding disorders |
| **Systemic opioids or non-opioids** | Simplicity  
No need for positioning  
Utility as a supplement  
Lack of CNS or CV ADEs (non-opioids only) | Opioids:  
CNS and respiratory depression  
Non-opioids:  
Risk of peptic ulcers  
Platelet dysfunction  
Risk of renal damage | CNS depression  
Hypotension  
Peptic ulcer disease  
Hemostatic defects  
Renal dysfunction  
Hypoperfusion |

CNS=central nervous system; CV=cardiovascular; LA=local anesthetics; ADE=adverse drug events; ICP=intracranial pressure

## Comparative Efficacy

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Groups</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabram SG et al.</td>
<td>• Intrapleural bupivacaine</td>
<td>Intrapleural method experienced:</td>
</tr>
<tr>
<td>Prospective, randomized</td>
<td>• Systemic narcotics</td>
<td>• More improvement in forced vital capacity at discharge</td>
</tr>
<tr>
<td>(n=48)</td>
<td></td>
<td>• Less need for additional mode of analgesia (10% vs 50%)</td>
</tr>
<tr>
<td>Moon MR et al.</td>
<td>• Opioid PCA</td>
<td>Epidural method resulted in:</td>
</tr>
<tr>
<td>Prospective, randomized</td>
<td>• Epidural morphine-bupivacaine</td>
<td>• Greater pain relief</td>
</tr>
<tr>
<td>(n=34)</td>
<td></td>
<td>• Greater tidal volumes &amp; maximal inspiratory force</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Decreased IL-8</td>
</tr>
<tr>
<td>Mackersie RC et al.</td>
<td>• Epidural fentanyl</td>
<td>Epidural method resulted in:</td>
</tr>
<tr>
<td>Prospective, randomized</td>
<td>• Systemic fentanyl</td>
<td>• Greater maximum inspiratory pressure &amp; tidal volumes</td>
</tr>
<tr>
<td>(n=32)</td>
<td></td>
<td>• No significant changes in PaCO$_2$ or PO$_2$</td>
</tr>
</tbody>
</table>

PCA=patient controlled analgesia

EAST Group Treatment Guidelines

• Level I Recommendations
  o Epidural analgesia (EA) is optimal modality of pain relief and is superior to intravenous narcotics
  o EA is associated with less respiratory depression, somnolence and gastrointestinal symptoms

• Level II Recommendations
  o EA may improve outcomes as measured by ventilator days, ICU length of stay and hospital length of stay
  o Patients with >4 rib fractures who are ≥65 years of age should be provided with EA unless contraindicated

EAST Group Treatment Guidelines

• Level III Recommendations
  o The approach for pain management requires individualization for each patient
  o Presence in elderly patients of cardiopulmonary disease or diabetes should provide additional impetus for EA
  o IV narcotics may be used as initial management for lower risk patients presenting with stable and adequate pulmonary performance
  o High risk patients who are not candidates for EA should be considered for intrapleural analgesia
Injury Type – Burns

• Frequent dressing changes/wound debridement
• High rate of pulmonary complications
• Management
  o Topical anesthetics
  o Opioids – gold standard
  o Ketamine
  o Sedatives
  o Antihistamines (for “itching” sensation)

Injury Type – Vertebral Fractures

• Significant cause of morbidity & mortality in elderly
• Results in impaired activities of daily living
• Management
  o NSAIDs – first line therapy
  o Opioids
    □ Patient controlled analgesia
    □ Oral administration → long acting agents
• Prevention of future fractures is key!

Injury Type – Spinal Cord Injury

• 10,000 persons annually sustain spinal cord injury (SCI)
• Reported prevalence of pain is 18 to 77%
• Associated types of pain
  ◦ Spasticity
  ◦ Central or dysesthetic pain
  ◦ Miscellaneous pain
    □ Visceral pain
    □ Pressure-ulcer related pain

Spasticity

- Contributes to mechanical and musculoskeletal pain
- Reported prevalence of pain: 18 to 77%
- Management
  - Anti-seizure medications
  - Botulinum toxin
  - Skeletal muscle relaxants
  - Benzodiazepines

Central Pain

• Most common form of pain after SCI

• Hallmark: incredible variability
  o Burning, lancinating, and aching
  o Throbbing, pulling, icy

• Commonly occurs below level of injury

• Pathophysiology: unknown

Central Pain Management

- Gabapentin – Tai Q et al.
  - Prospective, randomized, crossover study
  - Reduced incidence of neuropathic pain in gabapentin group
  - Most effective when initiated within 6 months

- Lamotrigine – Finnerup NB et al.
  - Prospective, randomized, placebo-controlled study
  - Less spontaneous and evoked pain in lamotrigine group

- Ketamine
  - Clear evidence that NMDA receptor plays role in central pain

± Not statistically significant

Central Pain Management

• Serotonin reuptake inhibitors
  o Trazodone
  o Tricyclic antidepressants (amitriptyline)

• Opioids
  o Intrathecal > oral
  o Combination with clonidine

Injury Type – Traumatic Brain Injury

• Reported prevalence of pain: 18 to 95%
• Most frequently reported pain: headache, musculoskeletal pain, spasticity, and facial pain
• Management
  o Non-opioid analgesics (butalbital/caffeine/APAP or NSAIDs)
  o Selective serotonin reuptake inhibitors
  o Steroids
  o Muscle relaxants

Non-pharmacologic Interventions

- Early mobilization
- Stabilization of injuries
- Cool/warm compresses
- Patient comfort measures
- Acupuncture
- Cognitive/psychological interventions
- Transcutaneous Electrical Nerve Stimulation
Clinical Pearls

• Trauma exerts pervasive effects on multitude of body systems -> ↑ morbidity & mortality
• Routine assessment EARLY in admission is critical!
• Take advantage of non-pharmacologic interventions
• Use multi-modal pain treatment modalities targeting specific type of injury

INDIVIDUALIZE regimens to meet patient needs!
Test Question #1

Which of the following is NOT associated with adequate pain control?

A. Earlier mobilization
B. Decreased morbidity & mortality
C. Decreased incidence of post-traumatic stress disorder
D. Decreased lung complications
E. All of the above are associated with adequate pain control
Test Question #1

Which of the following is NOT associated with adequate pain control?

A. Earlier mobilization
B. Decreased morbidity & mortality
C. Decreased incidence of post-traumatic stress disorder
D. Decreased lung complications
E. All of the above are associated with adequate pain control
Test Question #2

Which term is used to describe the long-term changes in central nervous system that leads to chronic pain?

A. Peripheral sensitization
B. Somatic pain
C. Visceral pain
D. Neuroplasticity
E. None of the above
Test Question #2

Which term is used to describe the long-term changes in central nervous system that leads to chronic pain?

A. Peripheral sensitization  
B. Somatic pain  
C. Visceral pain  
D. Neuroplasticity  
E. None of the above
Test Question #3

Which of the following agents is the best treatment option for traumatic pain?

A. Systemic opioids
B. Intrapleural bupivacaine
C. Epidural with bupivacaine & fentanyl
D. NSAIDs
E. None of the above – a multi-modal regimen is the best approach
Test Question #3

Which of the following agents is the best treatment option for traumatic pain?

A. Systemic opioids
B. Intrapleural bupivacaine
C. Epidural with bupivacaine & fentanyl
D. NSAIDs
E. None of the above – a multi-modal regimen is the best approach
References

References

“Of pain you could only wish one thing: that it should stop. Nothing in the world was so bad as physical pain. In the face of pain there are no heroes.”

- George Orwell, 1984
Session Code:

1. Write down the course code. Space has been provided in the daily program-at-a-glance sections of your program book.

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