Postoperative Pain

National Survey Postoperative Pain

80% Pain

86% Moderate, Severe, Extreme

Postoperative Pain

• How Much Pain Is Acceptable After Surgery?
  – Audit Commission UK Recommendation 2002
    Severe Pain < 5%

Under Treating

• Underestimate
  – Opioignorance
  – Opiophobia

Opiophobia

“[T]he medical man who (from ignorance) withholds hypodermic medicine from a patient afflicted with cancer, is...totally without excuse”

Herber Snow 1890
Chief surgeon London Cancer Hospital

Under Treating

• Fear of Side Effects
• Abuse & Addiction
• Myths
  – Necessary
  – Natural & Unavoidable
  – Beneficial
“.....the Board will consider the inappropriate treatment of pain to be a departure from standards of practice and will investigate such allegations”

Model Policy for the Use of Controlled Substances for the Treatment of Pain
Federation of State Medical Boards of the United States, Inc. 2004

Pathophysiology of Postoperative Pain

Definition of Pain

"An Unpleasant Sensory and Emotional Experience Associated With Actual Or Potential Tissue Damage”

Classic Concepts Of Pain

• Descartes 1644 “Alarm Bell or Push Button” theory
• Muller 19th Century - Sensory nerves
• Von Frey late 19th Century- Cutaneous receptors
• Head 1920 - Pain center in thalamus
• Melzack & Wall 1962 - Gate Theory

Transduction and Transmission Pain Processing

• Peripheral
• Spinal
• Supraspinal

PERIPHERAL
Nociceptors
Free Nerve Endings

- Exteroceptors

- Interceptors

Modulation Pain Transduction

Pain Enhancing Mediators
“Peripheral Jungle”
- Bradykinin
- H+
- Histamine
- Prostaglandins
- Serotonin
- Adenosine
- Cytokines
- NGF

Afferent Nerve Fibers
First Order Neuron

- A fibers (large – myelinated)
  - Aα proprioception
  - Aβ (thick myelinated) light touch/hair movement
  - Aγ muscle spindles/tone

- Aδ (thinly myelinated)
  - somatic noxious stimuli sharp & well localized Laminae I

- B fibers (myelinated preganglionic autonomic)

- C fibers (small – unmyelinated)
  >50% visceral noxious stimuli
  diffuse burning – polymodal
  Laminae I & II

Spinal Rexed Laminae

SPINAL

SUPRASPINAL
Supraspinal Spinothalamic tract

Cortical Level

Descending Pathway

Modulation Pain Transmission Neurotransmitters

- **Excitatory**
  - Glutamate
  - Aspartate

- **Inhibitory**
  - Dopamine
  - Serotonin

- **Receptor**
  - NMDA receptor
  - Non-NMDA
  - mGluR (metabotropic)
  - Adenosine Triphosphate

- **Glycine**
  - Chloride linked strychnine sensitive
  - Strychnine-insensitive site on NMDA receptor

- **GABA**
  - GABA A
  - GABA B

- **Acetylcholine**
  - Muscarinic

Objectives

**Objectives**

- **Purpose**
  - Safety & Effectiveness
  - Reduce Adverse Outcome
  - Maintain Physical & Psychological Well Being
  - Enhance quality of life

**Objectives**

- Describe the pathophysiology of pain processing.
- Formulate a multimodal approach in the treatment of acute postoperative pain using pharmacological and non-pharmacological methods.
- Recommend and tailor pain management based on the needs of special populations (pediatric, elderly, chronic pain and obese patients)

**Objectives**

Objectives

- Purpose
  - Safety & effectiveness
  - Reduce Adverse Outcome
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  - Enhance quality of life

PRACTICE GUIDELINES

I. Institutional Policy
   • ongoing education & training

II. Preoperative evaluation

Preoperative Prediction Score for Postoperative Pain

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<th>Factor</th>
<th>Points</th>
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<td>Sex Female</td>
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<tr>
<td>Age &lt;30</td>
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<tr>
<td>Age 31-65</td>
<td>1</td>
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<tr>
<td>Age &gt;65</td>
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<tr>
<td>Preoperative Pain at surgical site</td>
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<tr>
<td>Moderate</td>
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<tr>
<td>None</td>
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<tr>
<td>Regular use of opioids</td>
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<tr>
<td>Regular use of anxiolytic/antidepressants</td>
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<td>&gt;120 minutes</td>
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<td>&lt;120 minutes</td>
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<tr>
<td>Obesity BMI</td>
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<tr>
<td>Preoperative Anxiety</td>
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<tr>
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</table>

Scores > 4 ↑ risk severe postoperative pain


Scores > 4 ↑ risk severe postoperative pain

PRACTICE GUIDELINES

III. Perioperative Preparation
IV. Perioperative Techniques
V. Multimodal Techniques
VI. Patient Subpopulation

Multimodal Analgesia

• Non-Pharmacological
  • Relaxation Therapy
  • Acupuncture
  • TENS
  • Imagery

• Pharmacological

• Interventional

Multimodal Analgesia

Non-Pharmacological

Imagery

Virtual Reality

Perception of Pain
Multimodal Analgesia
Pharmacologic

- NSAIDs
- Anticonvulsants
- Antidepressants
- Ketamine
- Opioids
- Alpha 2-agonists
- Dexamethasone

NSAIDs

- PRO’s
  - Works peripherally and spinal COX
  - Shown ↓ pain scores
  - Shown ↓ opioid-related side effects

- CON's
  - Renal function
  - Bone healing
  - Gastrointestinal bleeding
  - CVS risk

Total epidural drug consumption 42 hours postoperative less in rofecoxib group vs. placebo group
(mean [SD] 252.0 mL vs. 302.6 mL, respectively; P=.003)

Median pain score (VAS) 2.2 vs 3.5 for the rofecoxib group vs. the placebo group, respectively;
P=.002)

Multimodal Analgesia
Anticonvulsants

Multimodal Analgesia
Antidepressants
Multimodal Analgesia Ketamine

Perioperative ketamine (37 studies 2240 patients) reduced 24 hr PCA morphine consumption & PONV


Multimodal Analgesia Opioids

Frank Skorpen MD. 5th Research Forum of the EAPC Norway

IV vs. PCA

Adult PCA Regimens

• MORPHINE PCA: fixed or demand
  - 10 mg q 15 minutes (bolus) with 100 mg 4 hr lockout
  - Fixed 10 mg every 10 min. maintenance dose + 10 mg every 10 min. for pain
  - Fixed 10 mg every 10 min. maintenance dose + 10 mg every 10 min. for pain
  - Fixed 10 mg every 10 min. maintenance dose + 10 mg every 10 min. for pain

• REMIFENTANIL PCA:
  - 50 mcg q 15 minutes with 500 mcg 4 hr lockout
  - 40 mcg q 10 minutes with 200 mcg 4 hr lockout
  - 30 mcg q 10 minutes with 300 mcg 4 hr lockout

• DILDADID PCA:
  - 0.2 mg q 10 minutes with 40 mg 4 hr lockout
  - 0.3 mg q 10 minutes with 60 mg 4 hr lockout

Meta-analysis (55 studies, 2023 patients) PCA (vs. PRN opioids) provides superior postoperative analgesia and improves patient satisfaction


PCA Assessment

Multimodal Analgesia Interventional

• Neuraxial Blocks

• Peripheral Nerve Blocks
Epidural Analgesia

- Opioid
  - Fentanyl
  - Hydromorphone
  - Morphine
- Local Anesthetic
  - Bupivacaine
  - Ropivacaine
- \(\alpha\)-2 agonist
  - Clonidine

Neuraxial Opioids

- Opioids

PRO's
- ↓ Postoperative complications
- Pulmonary
- Gastrointestinal
- Cardiac

CON's
- Local Anesthetics
  - Hypotension
  - Motor Block
- Opioids
  - Pruritus
  - Urinary Retention
  - Nausea/Vomiting
  - Respiratory Depression (lipophilic/hydrophilic)

Side Effects

- Pruritus
  - Mechanism unclear (not Histamine related)
  - Rx: 5-HT3 receptor antagonists, agonist-antagonists

- Urinary Retention
  - Sacral spinal cord opioid receptors; Detrusor muscle relaxation; Increase maximal bladder capacity
  - RX: Agonist-antagonists, Foley

- Nausea and Vomiting
  - Secondary to systemic effect or cephalad migration of drug in CSF CTZ

- Respiratory Depression
Peripheral Nerve Blocks

- Peripheral Nerve Blocks/Catheters
  - Upper Extremity
    - Intercostal
    - Subclavicular
    - Infracavicular
    - Axillary
  - Lower Extremity
    - Femoral
    - Saphaneous
    - Sciatic
    - Popliteal
  - Other
    - Intercostal
    - Paraavertbral
    - TAP/Subcostal
    - Ilioinguinal/Iliohypogastric

Objectives

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- Formulate a multimodal approach in the treatment of acute postoperative pain using pharmacological and non-pharmacological methods.
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Acute Pain in Children

"Neonates and infants do not perceive pain because of immature peripheral and central nervous system"

FALSE !!!!

Developmental Time Line

Limited Data

WHO calls for targeted research on pharmacological treatment of persisting pain in children

Clinical Studies Needed

- Long term safety data prolonged use of NSAIDs & Acetaminophen
- Head-to-head comparison of strong opioids; effectiveness, adverse effects, feasibility
- Efficacy & safety of intermediate potency opioids children <12
- Dose conversion between opioids in different age groups
- Adjuvant medicines for neuropathic pain

Pain Assessment Tools

- Insufficient orders
- Parents reluctance
- Insufficient time to pre-medicate prior to procedures
- Low priority by medical staff
Pain Treatment Modalities

Pharmacological

- Non Opioids
  - Acetaminophen
  - NSAIDs
- Opioids

Acetaminophen (PO, PR)

- initial dose 45mg/kg followed by oral 10-15mg/kg or rectal 20 mg/kg q4-6hrs
- total daily dose not exceed 100mg/kg children; 75mg/kg infants; 60mg/kg term & preterm >32 weeks; 40mg/kg <32 weeks

Acetaminophen IV

- Dosage
  - PO: do not exceed 40 mg/kg/day
  - IM/IV: 0.5 mg/kg; do not exceed 30 mg/dose IM or 15mg/dose IV (approved for >2 years of age)

Caution

- Neonates and young infants
  - Immature liver conjugation & renal filtration = metabolism and excretion ↓
  - Immature blood brain barrier = ↑ concentration in brain
  - Decreased plasma protein binding = ↑ free fraction of drug in blood
  - Decreased ventilatory response to hypoxia and hypercapnea = hypoventilation

Patient Controlled Analgesia

- PCA
- NCA
- PrCA

Interventional

- Neuraxial Blocks
- Peripheral Nerve Blocks

Interventional

- PRO’s
  - ↓ opioid associated side effects
- CON’s
  - Local anesthetic ↓ seizure threshold
  - Decrease protein binding
  - ↑ serum levels local anesthetic = ↑ risk of toxicity

Local Anesthetics

- Single shot
  - Lidocaine 5 mg/kg (with epinephrine 7 mg/kg)
  - Bupivacaine 3 mg/kg
  - Ropivacaine 3 mg/kg
- Infusion
  - Children & Infants; Bupivacaine or Ropivacaine
    - Neonates; 0.2-0.25 mg/kg/hr
  - Neonates; 0.2-0.25 mg/kg/hr

Intralipid

- 1.5 ml/kg bolus followed by 0.25 ml/kg/min infusion
Acute Postoperative Pain in Elderly

2000 to 2030, elderly population will increase from 10% to 20%

Fail to Report pain

- Healthcare providers “too busy”
- Stoic—should tolerate pain
- Fear of addiction

Pain Assessment Functional Pain Scale

Special Considerations

- Perception of Pain Altered
  - Structural
  - Biochemical
  - Functional
- Cognitive Impairment
- Physiological
  - Volume of Distribution
  - Hepatic Function
  - Renal Function
Hepatic & Renal Dysfunction

Special Considerations

- Gastrointestinal
  - Constipation: Buprenorphine & Fentanyl < Morphine & Oxymorphone

- Central Nervous System
  - Opioid neurotoxicity; hallucinations, confusion, loss cognition

Special Considerations

- Drug Interactions
  - 45% patients >65 years old take 5 or more different drugs/week and 12% take 10 or more
  - Poly-pharmacy: USA $1 million/annually adverse drug reactions; 28% events occurred with CV drugs, opioids, antidiabetic & anticoagulants

Acute Postoperative Pain in Chronic Pain

- 116 million American adults suffer from Chronic Pain

- $635 billion/year of medical treatment and lost productivity

Opioid Non-Responsiveness
Opioid Non-Responsiveness

Elmofty D. Opioid-Induced Hyperalgesia, Tolerance and Chronic Postsurgical Pain; a Dilemma Complicating Postoperative Pain Management. ASA 2013.

Treatment Options
Opioid Non-Responsiveness

Acute Postoperative Pain in Obese

Treatment Goals for Obese Patients

Early Mobilization
↓ DVT, Pressure sores, Respiratory complications

High Risk For OSA
Special Considerations

• Postoperative Pain Management
• Oxygenation
• Patient Positioning
• Monitoring

Where We Are Headed

Genetics of Pain

Absence of Pain

Genetics of Pain

Genetic Variation

• CYP2D6
  – Codeine
  – Tramadol
• OPRM1
• PTGS2

Professor Jeffrey Mogil
Dept. of Psychology and Centre for Research
Pain McGill University Canada

Melanocortin-1 Receptor Gene Variants

Genetics of Pain

Evidence-Based Genetic Approach to Pain Management

“The reign of pain is mainly the brain”