Orthopaedics in Motion
Orthopaedic Pain and Pain Management
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Objectives

- Review etiology of acute orthopaedic pain, bone pain and postoperative pain
- Recognize common pharmacologic modalities for acute orthopaedic pain, both opioid and non-opioid
66 patients were surveyed and asked hypothetically how much money they would pay to prevent a given anesthetic outcome.

- Highest median dollar amount was for pain.
Risk Factors for Post-op Pain

- Very Old and Very Young experience less pain than middle aged
- Pre-op neurotic personalities
- Fear of Pain
Pain

- Pain is sensed by receptors known as nociceptors
  - Respond to mechanical, thermal, and chemical stimuli
- Two types of acute pain
  - Somatic
  - Visceral
Somatic Pain

- **Superficial:**
  - Input from skin, subcutaneous tissues, and mucous membranes
  - Well localized
  - Sharp, pricking, throbbing, or burning

- **Deep:**
  - Input from muscles, tendons, joints, and bones
  - Not as well localized
  - Dull, aching
Pain Pathway

- Noxious stimuli from periphery travels along nerve fibers (Aα, Aβ, Aδ, & C) to the Dorsal Horn in the spinal cord.
- In the spinal cord the impulse is transmitted from one neuron to another via a neurotransmitter in the synapse.
- The impulse then travels through the contralateral spinothalamic tract in the spinal cord to the thalamus.
Pain Pathway Con’t

- The pain impulse then travels through connections in thalamus and the cerebral cortex where it is then processed at higher levels of the brain.
Systemic Responses to Pain

- Cardiovascular
  - HTN
  - Tachycardia
  - Increased myocardial irritability
  - Increased SVR
  - Increased Cardiac output in most patients
Systemic Responses to Pain

- **Respiratory**
  - Increased Minute ventilation
  - More rapid shallow breaths ↓FRC

- **GI and Urinary**
  - Enhanced sympathetic tone decreases intestinal and urinary motility
  - Increased gastric acid secretion
  - Nausea/Vomiting
Systemic Responses to Pain

- **Endocrine**
  - Increased catabolic hormones and decreased anabolic hormones
  - Sodium and water retention $\rightarrow$ expansion of extracellular space
- **Hematological**
  - Increased platelet adhesiveness
  - Reduced fibrinolysis
Systemic Responses to Pain

- Immune
  - Predisposition to infection
- General
  - Anxiety
  - Sleep disturbances
Treatment of Acute Orthopedic Pain

- Multimodal
- Patient Specific
- Risks and Benefits
Enteral/Parenteral Analgesics

- COX Inhibitors
  - Salicylates, acetaminophen, NSAIDS
  - Inhibit Prostaglandin synthesis
  - Peripheral and Central Nervous system actions
  - Analgesic, antipyretic and anti-inflammatory properties
  - Orthopedic and Gynecological surgery responds well to these agents
- COX-1, COX-2
Enteral/Parenteral Analgesics

- COX Inhibitors
  - Selective COX-2 inhibitors have less GI side effects, lower toxicity, and do not inhibit platelet aggregation
  - Hepatic Metabolism and Renal excretion
  - ASA irreversibly inhibits platelet adhesiveness for 1-2 weeks. Other NSAIDS effects are reversible and last about 24-96 hours.
  - Ketorolac has been shown to reduce total Opioid dose by 1/3 depending on the type of surgery
Enteral/Parenteral Analgesics

- **Opioids**
  - Commonly combined with COX-inhibitors
  - Most Common oral: codeine, oxycodone, and hydrocodone
  - Common intravenous: fentanyl, morphine, hydromorphone, and meperidine
  - 4 major opioid receptors located in CNS and other tissues ($\mu$, $\kappa$, $\delta$, $\sigma$)
  - Intravenous Patient Controlled analgesia
Enteral/Parenteral Analgesics

- Opioids
  - Side effects:
    - Histamine release
    - Meperidine decreases cardiac contractility
    - Depressed ventilation (rate)
    - Sedation
    - Reduced peristalsis and delayed gastric emptying
Local Anesthetics

- Main action of Local anesthetics is to bind to the $\alpha$-subunit of the voltage-gated sodium channels from inside the cell preventing channel activation and impulse propagation.
- Different local anesthetics have different duration of actions.
- Additives may affect the onset time and duration of the local anesthetic.
Local Anesthetics

- Side Effects and Symptoms of Toxic Dose
  - Respiratory
    - Apnea/Respiratory failure
  - Neurological
    - Nerve damage
    - Signs/symptoms of Toxicity
  - Cardiovascular
    - Generally decrease myocardial automaticity
    - Signs/symptoms of Toxicity
Local Anesthetics

- Treatment of local anesthetic toxicity
  - Minor reactions may resolve on their own
  - Seizures can be treated with benzodiazepines, thiopental, and propofol
  - Cardiac arrest should be treated according to ACLS guidelines. Because of the lipophilic properties of local anesthetics, IV lipid therapy has been used in patients in cardiac arrest associated with toxicity.
  - Cardiopulmonary bypass should also be considered for patient in cardiac arrest not responding to initial treatments.
Peripheral Nerve Blocks

Pro:

- May provide better analgesia compared to systemic opioids
- Less sedation and respiratory depression
- May reduce morbidity and mortality
- May be able to avoid a general anesthetic
Peripheral Nerve Blocks

• Con:
  • Not every patient is a candidate
  • Risks associated with anatomic location of nerves being blocked
  • Risk for temporary and permanent nerve damage
  • May not set up completely
  • May unintentionally block additional nerves
Peripheral Nerve Blocks

- Upper extremity nerve anatomy
  - Brachial Plexus originates from C4-T1.
  - Nerve Roots → Trunks → Divisions → Cords → Main branches.
Peripheral Nerve Blocks
Peripheral Nerve Blocks

- **Interscalene Block**
  - Blocks at the level of the trunks of the brachial plexus
  - Superior for shoulder surgery and arm, but difficult to get ulnar nerve coverage
  - Risks

- **Supraclavicular Block**
  - Blocks at the level of distal trunks and divisions of the brachial plexus
  - Excellent anesthesia of entire arm including hand
  - Risks
Peripheral Nerve Blocks

- **Infraclavicular Block**
  - Blocks at the level of the cords of the brachial plexus
  - Good for elbow, distal arm, wrist and hand surgery
  - Risks

- **Axillary Block**
  - Blocks at the level of cords and main branches of the brachial plexus
  - Good choice for surgery of the elbow, forearm, and hand
  - Risks

- **Specific Nerve Block**
  - Radial, ulnar, and median nerves blocked with wrist block
Peripheral Nerve Blocks

- Lower extremity nerve anatomy
  - Lumbar plexus originates from T12-L4
  - Lumbosacral plexus originates from L4-S3
  - Femoral and Obturator nerves originate from L2-L4
  - Lateral Femoral nerve originates from L1-L3
  - Sciatic nerve originates from L4-S3
Peripheral Nerve Blocks

- Lumbar Plexus Block
  - Useful for surgeries involving the knee, anterior thigh and hip
  - Risks

- Femoral Nerve Block
  - Useful for surgeries involving thigh and knee
  - Risks

- Sciatic Nerve Block
  - Useful for surgeries involving hip, knee or distal lower extremity
  - Risks
Peripheral Nerve Block

- Popliteal Nerve Block
  - Useful for surgery of the foot and ankle
  - May want to perform Saphenous nerve block along with Popliteal nerve block.
  - Risks

- Ankle Block
  - Useful for surgeries of the distal foot
  - Individually blocking deep peroneal, superficial peronial, sural, posterior tibial, and saphenous nerve
  - Risks
Neuraxial Anesthesia

- Spinal
  - Dense block with excellent analgesia as well as anesthesia
  - Risks/Benefits
  - Contraindications
  - Intrathecal medications
  - Duration
Neuraxial Anesthesia

- Epidural
  - Provides good analgesia as well as anesthesia
  - Risks/Benefits
  - Contraindications
  - Epidural medications
Orthopedics in Motion

Questions?
Sources