Multimodal Analgesia: Role of Regional Anesthesia Approaches

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Disclosure information

I have no financial relationships to disclose
The challenges in acute and postop pain management

• Uncontrolled pain in the postop period is associated with higher risk of undesirable adverse events
• Some patients present with challenging clinical situations (chronic pain, opioid-tolerance, substance use disorder, sensitivities to pain medications)
• Patients with medical problems such as OSA, metabolic and neurologic diseases

Consequences of inadequate pain control

- Acute pain causes potentially detrimental physiologic responses:
  - Tachycardia
  - Hypertension
  - Venous stasis
  - Hypercoagulability
  - Decrease alveolar ventilation
  - Hyperglycemia
  - Immunosuppression
  - Cognitive dysfunction
- Ultimately these can lead to increased morbidity
- Persistent post-surgical pain (PPP) or chronic postsurgical pain (CPSP)

Goals of analgesia

- Improve perioperative outcomes
- Achieve early mobilization
- Decrease postoperative complications
- Better address
  - genetic differences in pain medication metabolism
  - peripheral pain sensitization
  - central sensitization
  - ineffectiveness in pain control (tolerance and opioid induced hyperalgesia)

“Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage and described in terms of such damage.”

IASP (International Association for the Study of Pain)
Physiology of pain: 
Terms

• Nociception
  • the processing of noxious stimuli in the nervous system
  • allows the body the ability to sense potential harm

• Nociceptors
  • Highly sensitive sensory nerve endings of small myelinated and unmyelinated afferent nerve fibers. (A delta and C fibers).
  • Present in: skin, subcutaneous tissue, muscles, tendons, blood vessels, bones, organs and lining of body cavity
Physiology of pain:
Acute pain processing pathways

- **Transduction**: Pain is generated from local inflammation and nerve damage caused by trauma or temperature change. Cellular ion transfers generate an action potential.
- **Transmission**: Process in which the pain message moves from the peripheral nervous system to the dorsal horn, then along sensory tracts to the brain.
- **Perception**: The signals are sent up the spinal cord to the brain where they are perceived as pain.
- **Modulation**: Involves off-cells that inhibit pain-related information to the brain and on-cells that facilitate the transmission of pain-related signals to the brain.
Characterization of pain

- Nociceptive/inflammatory, and neuropathic
  - Nociceptive/inflammatory pain
    - results from stimulation of nociceptors in response to injury
  - somatic and visceral
- Neuropathic
  - pathophysiologic consequence of multiple changes in the PNS and CNS that occur after nerve injury
  - peripheral sensitization and central sensitization can occur
## Pain process and pharmacology

<table>
<thead>
<tr>
<th>Transduction</th>
<th>Transmission</th>
<th>Descending modulation</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local anesthetics</td>
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<td>Opioids</td>
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<tr>
<td>(topical)</td>
<td>(regional anesthesia)</td>
<td></td>
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<tr>
<td>NSAIDs, Cox 2</td>
<td>Opioids</td>
<td>Acetaminophen</td>
<td>NMDAr antagonists</td>
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<tr>
<td>inhibitors</td>
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<tr>
<td>Opioids</td>
<td>Alpha2-agonists</td>
<td>Cox 2 inhibitors</td>
<td>General anesthetic agents</td>
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<tr>
<td>Antihistamines</td>
<td>Gabapentinoids</td>
<td>SNRIs</td>
<td>Acetaminophen</td>
</tr>
<tr>
<td>Capsaicin</td>
<td>NMDAr antagonists</td>
<td></td>
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</table>

General Principles Regarding the Use of Multimodal Therapies

Recommendation 6

- The panel recommends that clinicians offer multimodal analgesia, or the use of a variety of analgesic medications and techniques combined with non-pharmacological interventions, for the treatment of postoperative pain in children and adults (strong recommendation, high-quality evidence).

Categories of multimodal approaches
Analgesic therapy concepts

- Based on rational combinations of optimal doses of different analgesics and different routes of delivery
- Provides a way to achieve safer and more effective, opioid-sparing pain management

- Use of multiple medications or more than are therapeutically necessary
- Using multiple medications from the same class or similar MOA
- Potentially inappropriate, excessive administration of medications

Why multimodal approach?

- optimizes pain relief
- reduce side effect burden
- provide synergistic/additive effects
- lower doses of each medication needed
- opioid sparing pain control
- prevents central sensitization

Nonpharmacologic
- Acetaminophen
- NSAIDs
- Adjuvants
- Regional Anesthesia

Potentiation

Steps for managing pain

• Preventive multimodal analgesia
  • Primary prevention of chronic pain
    • prevent acute pain
    • prevent or interfere with mechanisms involved in peripheral and central sensitization
  • pharmacologic and interventional therapies administered preoperative, intraoperative, and postoperative

• Secondary prevention of chronic pain
  • early identification of acute or subacute pain to prevent chronic pain
  • prevent central sensitization

Managing chronic postsurgical pain: strategies for prevention

• Mechanisms of acute pain resulting from surgical incision and associated tissue damage
  • Increased or heightened sensitivity of responsiveness to pain
  • Hyperalgesia
    • At the incision
    • Surrounding tissues in the region of the incision
• Prevention
  • adequate treatment of acute postoperative pain
  • protective anesthesia and analgesia

Pain management plan

Should be individualized
• Patient
• Mechanism of pain
• Location of pain
• Type of surgical approach
• Expected duration of pain
Management of postop pain guidelines

Use of Peripheral Regional Anesthesia

Recommendation 23
- The panel recommends that clinicians consider surgical site-specific peripheral regional anesthetic techniques in adults and children for procedures with evidence indicating efficacy (strong recommendation, high-quality evidence).

Recommendation 24
- The panel recommends that clinicians use continuous, local anesthetic-based peripheral regional analgesic techniques when the need for analgesia is likely to exceed the duration of effect of a single injection (strong recommendation, moderate-quality evidence).

Use of Neuraxial Therapies

Recommendation 26
- The panel recommends that clinicians offer neuraxial analgesia for major thoracic and abdominal procedures, particularly in patients at risk for cardiac complications, pulmonary complications, or prolonged ileus (strong recommendation, high-quality evidence).

Regional anesthesia

• Temporarily blocks nerve impulses to a certain intended area of the body, thus reducing pain
  • allows local anesthetics to be injected close to specific nerves involved in the surgical site
  • inhibits neural conduction from the surgical site to the spinal cord
  • decreases spinal cord sensitization
• Can provide analgesia superior to systemic opioids
• Use may reduce morbidity and mortality
Local anesthetics:
pharmacologic principles

• Block sodium channels in cell membranes
• Prevent influx of sodium ions into cells
  • Inhibits generation of the action potentials
  • Prevent transmission of nerve impulse along the axonal fiber
• Do not have a specific analgesic effect
  • Able to block all nerve conduction in sensory and motor fibers
  • Desensitize a specific part of the body to pain stimulus
• Sensory afferent fibers have longer action potential than motor neurons thus are more sensitive to lower concentrations of local anesthetics (LA)
Local anesthetics

- Decrease hormonal stress response and sympathetic responses during and after surgery
- Decrease incident pain
- Higher doses are used intraoperatively
- Reduction in dose postoperatively to reach differential motor-sensory block during the postop period
Nerve blocks

- Provide regional anesthesia or analgesia by temporarily interrupting the conduction of nerve impulses to a specific site or limb
- Single shot injection
  - done before or during surgery, sometimes after surgery
- Continuous catheter infusion
  - involves percutaneous insertion of an indwelling catheter in the proximity of the target peripheral nerve followed by local anesthetic administration via a catheter.
- Preferably placed preoperatively
Regional techniques

Peripheral nerve blocks
- upper extremity
- lower extremity

Truncal nerve blocks
- anterior, lateral and posterior chest area
- anterolateral and posterior abdominal wall

Neuraxial blocks
- intrathecal
- epidural

Common peripheral nerve blocks

**Upper extremity**
- Interscalene
- Supraclavicular
- Infraclavicular
- Axillary
- Suprascapular
- Wrist block

**Lower extremity**
- Sciatic
- Femoral
- Adductor canal
- Popliteal
- Saphenous
- Fascia iliaca
- Ankle

Common truncal nerve blocks

- **Truncal nerve blocks**
  - Transversus abdominus plane (TAP)
  - Iliohypogastric and ilioinguinal
  - Rectus sheath
  - Quadratus lumborum
  - Intercostal
  - Pectoralis
  - Thoracic paravertebral
  - Intercostal


Ultrasound probe

Antonakakis J., Ting, P. H., & Sites, B. Ultrasound-guided regional anesthesia for peripheral nerve blocks: An evidences-based outcome review. Anesthesiology Clinics 29(2). 179-191

Used with permission: J. Hutchins, 2017
Common regional nerve block modalities

- Single shot
- Continuous catheter infusion

Used with permission: University of Minnesota M-Health
Methods of delivery

Single shot

Continuous infusion

Used with permission: J. Hutchins, 2017

Used with permission: V. Chan, 2014 http://www.usra.ca/tapanatomy.php

Antonakakis J., Ting, P. H., & Sites, B. Ultrasound-guided regional anesthesia for peripheral nerve blocks: An evidences-based outcome review. Anesthesiology Clinics 29(2). 179-191
Thoracic paravertebral nerve block

Used with permission: Linda Le-Wendling, Julia DeLoach, Allison Haller and Barys Ihnatsenka, 2014
Paravertebral space

Used with permission: V. Chan, http://usra.ca/tpbanatomy.php
Neuraxial approaches

Epidural space

Intrathecal or subarachnoid space

Used with permission: Masood Rehman Moghul and Bassel El-Osta (2011)
Intrathecal

- Injection or catheter placement
- The dura is punctured
- CSF determines the correct space has been entered
- Methods: single shot, catheter, implanted device
- Dosing is approx. 1/100th of IV opioid

Used with permission from the University of Kansas Medical Center, 2014
- The catheter is inserted 2 or more cm beyond the needle tip
- Left in place for labor, or up to 3-5 days for postoperative pain
- Methods: single shot or catheter
- Dosing: approximately 1/10th the IV opioid dose

Used with permission from the University of Kansas Medical Center, 2014
Dermatome distribution

Used with permission: University of Minnesota M-Health
<table>
<thead>
<tr>
<th>Motor Strength Score</th>
<th>Description</th>
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<tbody>
<tr>
<td>5/5</td>
<td>Active movement against gravity and full resistance</td>
</tr>
<tr>
<td>4/5</td>
<td>Active movement against gravity and some resistance</td>
</tr>
<tr>
<td>3/5</td>
<td>Active movement against gravity</td>
</tr>
<tr>
<td>2/5</td>
<td>Active movement of body part when gravity is eliminated</td>
</tr>
<tr>
<td>1/5</td>
<td>Slight contraction</td>
</tr>
<tr>
<td>0/5</td>
<td>Total paralysis</td>
</tr>
</tbody>
</table>
Onset
• Sympathetic blockade usually occurs first
• Then block of nociception (pain) and sensation to temperature changes
• Motor block is the last to be complete

As the local anesthetic wears off
• Recovery of movement will come back first
• Then return of sensation to touch and pain
Benefits of regional anesthesia

• Provides site-specific analgesia
• Decreases stress response
• Decrease opioid requirements
  • regional anesthesia
  • use lower opioid doses via epidural/intrathecal route
• Diminished side effects
  • less nausea, vomiting, sedation and respiratory depression
• Potential for less general anesthesia when used during procedure
Regional anesthesia contra-indications

**Absolute**
- Patient refusal
- Allergy to local anesthetic

**Relative**
- Coagulation disorders
- Infection
- Uncorrected hypovolemia
- Increased intracranial pressure
- Unstable spine fractures
- Certain spinal or central neurologic disorders/preexisting neurologic deficit
- At risk requiring monitoring for compartment syndrome
## Potential complications

<table>
<thead>
<tr>
<th><strong>Peripheral/Paravertebral NERVE BLOCK</strong></th>
<th><strong>NEURAXIAL</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct nerve damage</td>
<td>Dural puncture “wet tap’ and PDPH</td>
</tr>
<tr>
<td>Unintentional intravascular injection</td>
<td>Unintentional intravascular injection</td>
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<tr>
<td>Catheter displacement</td>
<td>Catheter displacement</td>
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<tr>
<td>Catheter migration</td>
<td>Catheter migration</td>
</tr>
<tr>
<td>Pleural puncture, pneumothorax (brachial plexus, thoracic paravertebral)</td>
<td>Direct needle or catheter trauma</td>
</tr>
<tr>
<td>Injection or infusion of neurotoxic agent(s)</td>
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</tr>
<tr>
<td>Infection</td>
<td>Infection (local or general)</td>
</tr>
<tr>
<td>Local anesthetic systemic toxicity (LAST)</td>
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<tr>
<td>Hematoma formation</td>
<td>Epidural hematoma</td>
</tr>
</tbody>
</table>
Causes of epidural or IT space infection

- Spontaneous infection
- Hematogenous spread during bacteremia
- Poor aseptic technique
- Skin, soft tissue infection

- The longer a catheter is left in, the greater the risk of infection
**Epidural and IT infection vs hematoma**

**EPIDURAL or IT INFECTION**
- Constant diffuse back pain or tenderness
- Pain or paresthesia during bolus injection
- Decreased pain relief without presence of decrease in analgesic
- Sensory and/or motor deficit
- Bowel or bladder dysfunction may be present
- Fever may or may not be present
- Epidural abscess can cause spinal cord compression or sepsis, or paralysis
- Abscess is confirmed on MRI or CT and neurology consult recommended

**EPIDURAL HEMATOMA**
- Increasing diffuse back pain or tenderness or pain or paresthesia on epidural injection
- Bowel or bladder dysfunction may be present
- Sensory or motor deficit may develop with increasing size of hematoma
- Report any of these symptoms immediately for further workup
- Hematoma is confirmed on MRI or CT and neurology consult is recommended
Local anesthetic systemic toxicity (LAST)

- Rare, but potentially life threatening complication
- Most common cause is inadvertent intravascular administration, hepatic or renal insufficiency
- Early symptom detection is important for timely intervention
- Early symptoms: circumoral numbness and tingling, tinnitus, metallic taste, dizziness and anxiety
- Later symptoms: muscle twitching, shaking, increased anxiety, seizure, bradycardia, hypotension, arrhythmia and ultimately cardiac arrest

LAST management

ASRA checklist for LAST:

• Supportive Measures
  • Airway management
  • Seizure suppression
  • ACLS

• Lipid emulsion 20%
  • Bolus of 1.5mL/kg IV over 1 minute (~100mL)
  • Continuous infusion 0.25mL/kg/min (~18mL/min)
  • Repeat if necessary

Anticoagulant use with neuraxial and perineuraxial approaches

• Concurrent anticoagulation is a primary risk factor for epidural hematoma.
• A procedural checklist is strongly recommended for clinicians, taking into consideration pharmacologic principles and shared decision-making and consideration of procedural risks.
• Periprocedural management of anticoagulants and antiplatelet medications should be utilized.

Anticoagulant use with peripheral nerve blocks

• Spontaneous hematoma has been reported in patients who took anticoagulants
  • the anesthesiologist must discuss risk and benefits of the block with the pt and the surgeon, and provide close follow up care.
• Diagnosis includes:
  • pain (flank, groin, psoas)
  • tenderness in the area
  • fall in hgb/hct
  • fall in BP
  • sensory and/or motor deficit.
• Definitive diagnosis made by CT
  • US may also be helpful tool

• Decreasing inpatient length of stay and emphasis to outpatient care
• Enhanced Recovery
  • Multimodal care pathways designed to achieve early recovery after surgical procedures
  • Components of enhanced recovery programs
    • Preoperative counseling
    • Optimization of nutrition
    • Avoidance of perioperative fasting
    • Minimally invasive approaches
    • Standardized anesthetic and analgesic regimens
  • Postoperative care to enhance recovery and function
  • Defined discharge criteria/patient education
Preoperative assessment

• Many of our surgical patients are seen preoperatively
• Advantages
  • Pt gets to know the facility and ask questions about their upcoming surgery
  • Opportunity for providers and pharmacists to ask questions
  • Pt provides important information that will impact their care
  • Develop a preoperative pain management plan
  • Pt receives preoperative counseling and education
• Evidence-based approaches
  • Perioperative care is best when planned in the preoperative process
  • Discussed with the patient
  • Use multidisciplinary strategies
  • Use multimodal approaches
  • Assess and adjust medications and pain management plan as needed
  • Ongoing monitoring of outcomes
PCSS-O is a collaborative effort led by American Academy of Addiction Psychiatry (AAAP) in partnership with: Addiction Technology Transfer Center (ATTC), American Academy of Neurology (AAN), American Academy of Pain Medicine (AAPM), American Academy of Pediatrics (AAP), American College of Physicians (ACP), American Dental Association (ADA), American Medical Association (AMA), American Osteopathic Academy of Addiction Medicine (AOAAM), American Psychiatric Association (APA), American Society for Pain Management Nursing (ASPMN), International Nurses Society on Addictions (IntNSA), and Southeast Consortium for Substance Abuse Training (SECSAT).

For more information visit: www.pcss-o.org
For questions email: pcss-o@aaap.org

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