Chapter 07
Fluids and Medications

Objectives

- Define the following terms: chronotrope, dromotrope, and inotrope.
- Identify the primary neurotransmitter for the sympathetic and parasympathetic divisions of the autonomic nervous system.
- Describe the location and effects of stimulation of alpha, beta, and dopaminergic receptors.
- Describe advantages and disadvantages associated with pediatric medication administration routes.

Objectives

- Define the terms pain, sedation, analgesia, amnesia, and anesthesia.
- Describe two tools that may be used to assess pain in the pediatric patient.
- Explain the importance of pain management.
- Describe techniques for nonpharmacologic management of pain in infants and children.
- Discuss common pharmacologic agents used in pain management and sedation.
Objectives

- Describe the levels of sedation/analgesia.
- Identify factors that may increase the risk of complications during sedation/analgesia.
- Explain the importance of post-sedation monitoring.

Review of the Autonomic Nervous System

NERVOUS SYSTEM

Central nervous system
  - Brain
  - Spinal cord

Peripheral nervous system
  - Somatic
  - Autonomic
    - Adrenergic (sympathetic)
    - Cholinergic (parasympathetic)
      - Alpha receptors
      - Beta receptors
Baroreceptor Reflex

ANS Innervation
Red = Sympathetic; Blue = Parasympathetic

Sympathetic Stimulation
- Norepinephrine
  - Neurotransmitter
  - Released when sympathetic nerve fibers are stimulated
  - Binds to receptor sites found in plasma membrane of cells
Sympathetic Receptor Sites

- Alpha
- Beta
- Dopaminergic

Sympathetic Receptor Sites

- Alpha receptor sites
  - Alpha-1
    - Located in vascular smooth muscle
    - Stimulation results in vasoconstriction
  - Alpha-2
    - Located in skeletal blood vessels
    - Inhibit release of norepinephrine

Sympathetic Receptor Sites

- Beta receptor sites
  - Beta-1
  - Beta-2
Sympathetic Receptor Sites

- Beta-1 receptor sites
  - One heart
  - Stimulation results in:
    - Increased heart rate
    - Increased force of contraction
    - Increased AV conduction velocity

Sympathetic Receptor Sites

- Beta-2 receptor sites (two lungs)
  - Located in:
    - Bronchiolar and arterial smooth muscle
  - Stimulation results in:
    - Relaxation of the bronchi
    - Vasodilation

Sympathetic Receptor Sites

- Dopaminergic
  - Located in the coronary arteries, renal, mesenteric, and visceral blood vessels
  - Stimulation results in dilation
Chronotropic Effect
- Refers to changes in heart rate
  - Positive chronotropic effect
    - Increased heart rate
  - Negative chronotropic effect
    - Decreased heart rate

Inotropic Effect
- Refers to changes in myocardial contractility
  - Positive inotropic effect
    - Increased contractility
  - Negative inotropic effect
    - Decreased contractility

Dromotropic Effect
- Refers to a medication’s effects on the conduction velocity of an impulse through the AV node
  - Positive dromotropic effect
    - Increased conduction velocity
  - Negative dromotropic effect
    - Decreased conduction velocity
Volume Expansion

Crystalloid Solutions

- Description
  - Isotonic solutions
  - Provide transient expansion of intravascular volume

- Examples
  - Normal saline
    - Contains sodium chloride in water
  - Ringer’s lactate
    - Contains sodium chloride, potassium chloride, calcium chloride, and sodium lactate in water

Colloid Solutions

- Contain molecules (typically proteins) that are too large to pass out of the capillary membranes
  - Remain in the vascular compartment
  - Draw fluid from the interstitial and intracellular compartments to expand the intravascular volume
Blood

- Indications
  - Correction of a deficiency or functional defect of a blood component that has caused a clinically significant problem
  - Severe acute hemorrhage

Blood

- Red blood cells (RBCs)
  - Most frequently transfused blood component
  - Reasons for administration
    * Increase oxygen-carrying capacity of the blood
    * Maintain satisfactory tissue oxygenation

Medication Administration
Routes of Medication Administration

- Medication routes used in the pediatric patient:
  - Oral
  - Transmucosal
  - Intranasal
  - Rectal
  - Pulmonary
  - Subcutaneous
  - Intramuscular
  - Intravenous
  - Intraosseous
  - Tracheal

Oral Medication Administration

- Advantages
  - Readily available route of administration
  - Patient acceptance; painless
  - Convenient, noninvasive
  - Does not generally require special equipment for administration
  - No risk of fluid overload, infection, or embolism as with IV medications

- Disadvantages
  - Requires functioning GI tract and sufficient GI tract for absorption to occur
  - Slow or erratic absorption following ingestion
  - Limited value in an emergent situation
  - Requires a responsive, cooperative patient with an intact gag reflex
  - May cause gagging or aspiration if administered too rapidly
Oral Medication Administration

- Do not administer oral medications in solid form (i.e., pills, capsules, tablets) to young children because of the danger of aspiration
- A tuberculin syringe (needle removed) is ideal for administering liquid medications of 1 mL or less

Transmucosal (Sublingual, Buccal) Medication Administration

- Advantages
  - Readily available route of administration
  - Ease of administration
  - Painless
  - Rapid onset of action
- Examples
  - Sedatives

- Disadvantages
  - Requires a responsive, cooperative patient with an intact gag reflex
  - Unsuitable for very young patients who may not understand your instructions
  - Limited number of medications that can be administered via this route
  - Variable absorption
Transmucosal (Sublingual, Buccal) Medication Administration

- Mucosal surfaces typically have a rich blood supply, allowing rapid drug transport to the systemic circulation.

Intranasal Medication Administration

- Advantages
  - Easy to administer
  - Rapid, reliable onset of action
  - Relatively painless
  - Obviates need for painful injections

- Examples
  - Fentanyl, midazolam, steroids

Intranasal Medication Administration

- Disadvantages
  - Some medications (e.g., midazolam) are associated with a burning sensation and lacrimation when administered intranasally
  - Limited number of medications that can be administered via this route
  - May cause gagging or aspiration if administered too rapidly

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Rectal Medication Administration

- **Advantages**
  - Route is always available
  - More easily accessible route during active seizures than IV route
  - Rapid absorption
  - Relatively painless

- **Examples**
  - Anticonvulsants, antipyretics, antiemetics, analgesics, sedatives

- **Disadvantages**
  - Limited number of medications that can be administered via this route
  - If the rectum is not empty when the medication is inserted, drug absorption may be delayed, diminished, or prevented
  - Most children dislike this route of administration

Pulmonary (Inhaled) Medication Administration

- **Advantages**
  - Painless
  - Ease of administration
  - Rapid onset of action

- **Examples**
  - Oxygen, bronchodilators, nitrous oxide, steroids, antibiotics, antivirals
Pulmonary (Inhaled) Medication Administration

- Disadvantages
  - Limited use with respiratory failure
  - Medications used are limited to those with actions on or absorption through the respiratory tract

Subcutaneous (SubQ) Medication Administration

- Advantages
  - Readily available route
  - Allows delivery of a variety of medications
  - Less painful than IM injection

- Examples
  - Heparin, morphine, insulin, some vaccines, epinephrine, allergy desensitization, hormone replacement

- Disadvantages
  - Painful; creates fear and anxiety in children and may cause a child to deny pain in order to avoid further injections of analgesics
  - Inconvenient, time consuming
  - Requires technical expertise to perform
  - Volume of medication that can be delivered is limited to 0.5 to 1.0 mL (maximum of 1 mL in all age groups)
  - Slower onset and lower peak effects than IV administration
  - Can cause local tissue injury and nerve damage if improper technique used
Subcutaneous (SubQ) Medication Administration

- Common SubQ sites
  1. Lateral aspect of upper arms
  2. Abdomen from costal margins to iliac crests
  3. Anterior thighs

Intramuscular Medication Administration

- Advantages
  - Readily available route
  - Allows delivery of a variety of medications

- Examples
  - Antibiotics, some vaccines, sedatives, analgesics

- Disadvantages
  - Painful, creates fear and anxiety in children and may cause a child to deny pain in order to avoid further injections of analgesics
  - Erratic absorption may cause discontinuous levels of analgesia
  - Requires technical expertise to perform
Intramuscular Medication Administration

- Grasp the muscle between your thumb and index finger to isolate and stabilize it

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IM Injection Sites in Children

- Vastus lateralis

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IM Injection Sites in Children

- Ventrogluteal
**IM Injection Sites in Children**

- **Dorsogluteal**

**IV Medication Administration**

- **Advantages**
  - Rapid onset of action for medications administered via this route
  - Route is easily accessible
  - Control over the level of the drug in the blood
  - Particularly useful for resuscitation medications and fluids

- **Examples**
  - Antiarrhythmics, sedatives, analgesics, antibiotics
IV Medication Administration

- Disadvantages
  - Painful
  - Limits patient mobility
  - Time consuming
  - Requires technical expertise to perform

Tracheal Medication Administration

- Advantages
  - Permits delivery of lipid-soluble medications into the pulmonary alveoli and systemic circulation via lung capillaries

- Disadvantages
  - Limited number of medications that can be administered via this route
  - Medication absorption may be negatively affected by the presence of blood, emesis, or secretions in the trachea or tracheal tube
  - No fluid resuscitation possible via this route
Tracheal Medication Administration

- Use this route for medication administration during resuscitation efforts if a tracheal tube is in place but IV or IO access is not available
- Tracheal medications should be diluted with approximately 5 mL of sterile NS

Considerations in Pediatric Medication Administration

- Use a length-based resuscitation tape to determine the correct dosage for medication administration or fluid resuscitation in children
Pediatric Medication Administration

- Check each medication at least three times before administering it:
  1. When removing it from its storage container (i.e., drug box, code cart)
  2. When preparing it for administration
  3. At the patient’s side before administering it

- Question any medication dosage that is outside the normal range

- Using age-appropriate language, explain to the child (and parents) why a medication is necessary

- Children should always be praised for cooperating in taking their medications
Pain Management and Sedation

Pain Assessment

- Pain should be assessed in all patients
- Methods used for assessment will vary according to age
  - Facial expression is most consistent behavioral indicator of pain in infants
- Reassessment is essential

Pain Assessment

- QUESTT:
  - Question the child
  - Use pain rating scales
  - Evaluate behavior and physiologic changes
  - Secure parents’ involvement
  - Take cause of pain into account
  - Take action

Pain Assessment

- Wong-Baker FACES Pain Rating Scale
- To use this scale, point to each face using the words to describe the pain intensity.
- Ask the child to choose the face that best describes his or her own pain and record the appropriate number.

<table>
<thead>
<tr>
<th>Category</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>No particular expression or smile</td>
<td>Occasional grimace or frown, withdrawn, resistant</td>
<td>Frequent to constant quivering chin, clenched jaw</td>
</tr>
<tr>
<td>Legs</td>
<td>Normal position or relaxed</td>
<td>Uneasy, restless, tense</td>
<td>Kicking, or legs drawn up</td>
</tr>
<tr>
<td>Activity</td>
<td>Lying quietly, normal position, moves easily</td>
<td>Squeezing, shifting back and forth, tense</td>
<td>Arched, rigid or jerking</td>
</tr>
<tr>
<td>Cry</td>
<td>No cry (awake or asleep)</td>
<td>Moans or whimpers; occasional complaint</td>
<td>Crying steadily, screams or sobs, frequent complaints</td>
</tr>
<tr>
<td>Consolability</td>
<td>Content, relaxed</td>
<td>Resistant to occasional touching, hugging, or being talked to, distractible</td>
<td>Difficult to console or comfort</td>
</tr>
</tbody>
</table>

Sedation

- Sedation may be used to:
  - Help control anxiety or fear
  - Combat effects of toxic ingestions or withdrawal syndromes
  - Promote sleep
  - Decrease physical activity, metabolism, or oxygen consumption
  - Provide amnesia during procedures and neuromuscular paralysis
  - Facilitate management of mechanical ventilation

Peds Pearl

- Analgesics used to manage severe pain usually cause sedation, but most sedatives do not provide analgesia.

Sedation

- If a procedure is not painful, a sedative is typically used.
- If pain is expected, analgesics are used, usually in conjunction with a sedative.
- When selecting medications, consider the duration of action of the sedatives/analgesics and the duration of procedure.
Levels of Sedation/Analgesia

- Minimal sedation/analgesia
  - Anxiety reduction; cognitive function and coordination may be impaired
  - Protective reflexes present
  - Able to maintain patent airway independently and continuously
  - Able to respond appropriately to verbal command (e.g., "Open your eyes")
  - Ventilatory and cardiovascular functions intact

- Moderate sedation/analgesia
  - Minimally depressed level of consciousness
  - Protective reflexes present; able to maintain patent airway independently and continuously
  - Spontaneous ventilation is adequate
  - Able to respond purposefully to verbal command (e.g., "Open your eyes"), either alone or accompanied by light tactile stimulation
    - Reflex withdrawal from a painful stimulus is NOT considered a purposeful response
  - Cardiovascular function is usually maintained
Levels of Sedation/Analgesia

- General anesthesia
  - Drug-induced state of unconsciousness
  - Unable to maintain patent airway independently
  - Not arousable, even by painful stimulation
  - Ability to maintain ventilatory function independently is often impaired
  - Cardiovascular function may be impaired

Patient Monitoring and Documentation

- Patient monitoring
  - Should begin before medications are administered
  - Should continue until the patient returns to his or her presedation level and recovery is complete

- The following must be monitored and documented:
  - Vital signs
  - Monitor and document
    - Every 5 to 10 min during minimal and moderate sedation/analgesia
    - At least every 5 min during deep sedation/analgesia
  - Medications
    - Names, dosages, route, time, effects of administration
  - Sedation level and level of consciousness
Patient Monitoring and Documentation

- The following must be monitored and documented:
  - Airway patency, work of breathing, respiratory pattern
  - Any adverse effects
    - Apnea
    - Hypoxia
    - Tachycardia or bradycardia
    - Hypotension
    - Emesis
  - Any necessary interventions and resolutions

Questions?