

Project: Ghana Emergency Medicine Collaborative

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Pharmacology of Pain Medications

Ghana Emergency Nurses Collaborative

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February 15, 2013

Critical Outcome

- Emergency nurse assesses, identifies, and manages acute and chronic pain within the emergency setting

Specific Outcomes

- Define the types of pain and complications of pain management
- Delineate pain physiology and mechanisms of addressing pain with medications
- Define the general assessment of the patient in pain
- Delineate the nursing process and role in the management of the patient with acute and chronic pain
- Apply the nursing process when analyzing a case scenario/patient simulation
- Predict differential diagnosis when presented with specific information regarding the history of a patient
- List and know the common drugs used in the emergency department to manage the painful conditions and conduct procedural sedation
- Consider age-specific factors
- Discuss medico-legal aspects of care of patients with pain related to emergencies

Medication Review

- Non-narcotic
- Narcotics
- Sedatives / anesthetics
- Local anesthetics

Non-Narcotic

- Acetaminophen
- Salicylates
- NSAIDs

Narcotic

- Codeine
- Fentanyl
- Hydromorphone
- Morphine sulfate
- Oxycodone

Sedatives / Anesthetics

- Diazepam
- Ketamine
- Lorazepam
- Midazolam
- Propofol
- Etomidate

Local Anesthetics

- Lidocaine
- Mepivacaine
- Procaine
- Tetracaine
- LET (lidocaine, epinephrine, tetracaine)
- EMLA cream

Considerations when deciding what type of pain therapy to choose?

- Pharmacological versus Non-pharmacological
- Curative relief or palliative relief
- Allergies
- Availability of medications

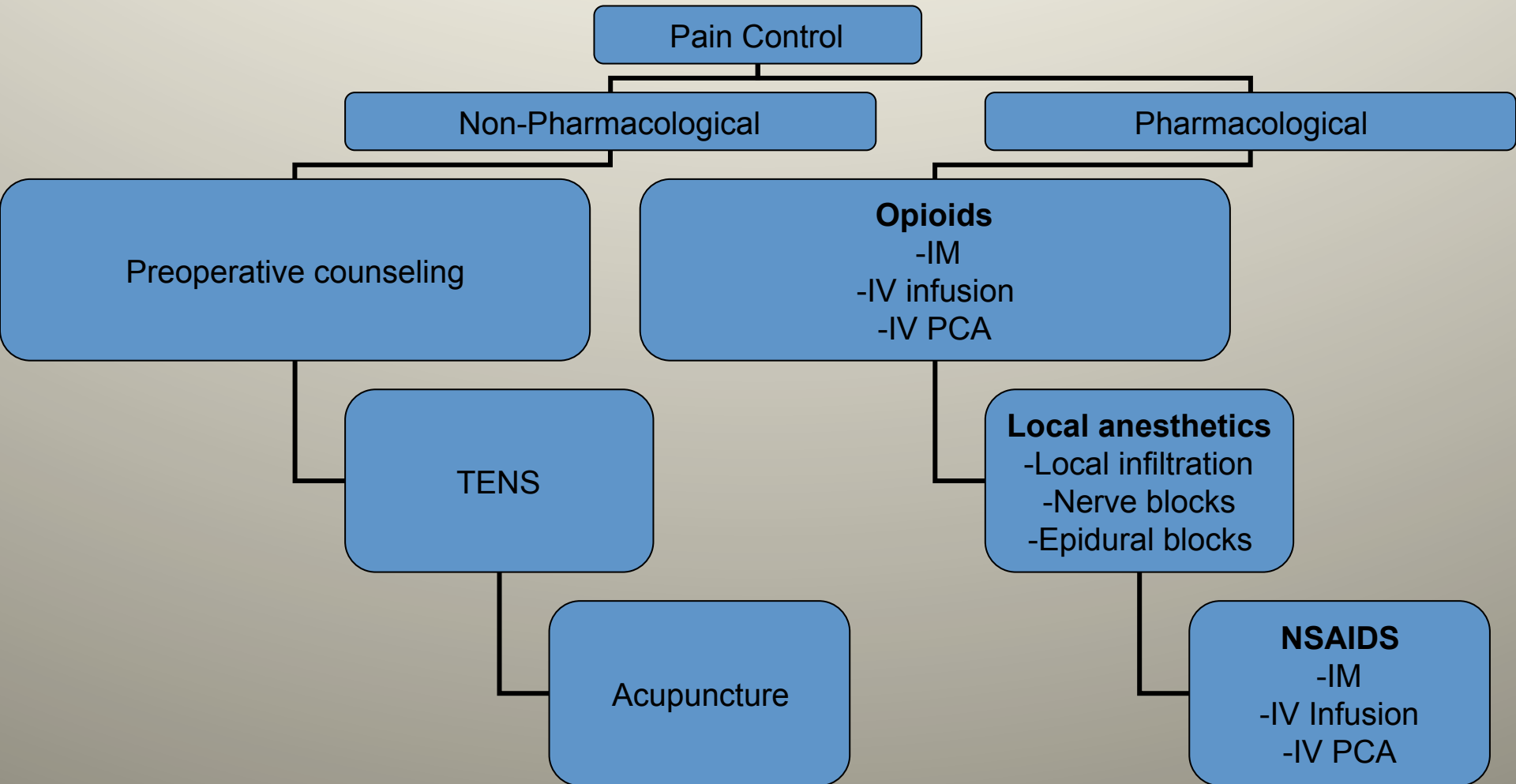


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Methods of Controlling Pain



Pharmacological Methods

- NSAIDS
 - Block synthesis of prostaglandins
 - Only suitable for mild to moderate pain

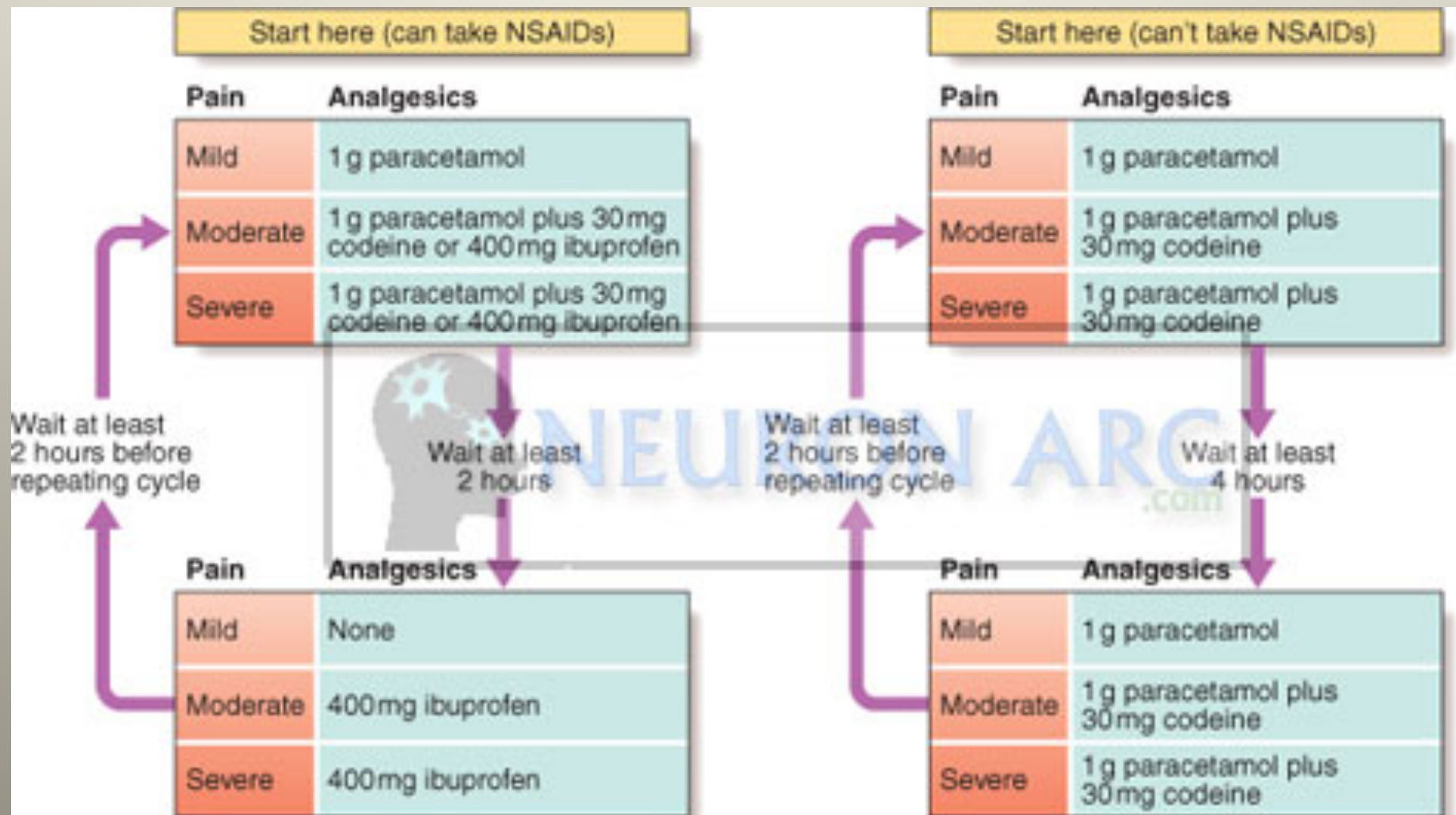
Pharmacological Methods

- Opioids:
 - Activate opioid receptors within the CNS
 - Reduce transmission of nerve impulses by modulation in the dorsal horn

Pharmacological Methods

- Local Anesthetics
 - Blocks the conduction of nerve impulses
 - Can be given with adrenaline because
 - Decreases absorption of local anesthetics allowing larger doses
 - Also acts on alpha 2 receptors which potentiates analgesic effect

Acute Pain Management



Acute pain management.

<http://www.neuronarc.com/>

Pathophysiology & Analgesics

Site of action	Analgesic/effect
<p>1. Nocioceptors in skin and subcutaneous tissues.</p> <p>- Stimulated by inflammatory substances (e.g., prostaglandins)</p>	NSAIDS – block pathways involved in the formation of inflammatory agents.
<p>2. A-beta fibers</p> <p>- Inhibits transmission of pain to higher centers.</p>	TENS stimulate A-beta fibers.
<p>3. Primary afferent neurons (A-delta, C fibers)</p> <p>- Transmit impulses from nociceptors to the spinal cord.</p>	Local anesthetics – block transmission of impulses along neurons
<p>4. Dorsal horn of spinal cord and higher centers.</p> <p>- Further relay/transmission of painful stimuli to the cerebral cortex.</p>	Opioids (morphine) – act as agonists at opioid receptors

How They Work

Mechanism of Action, Side Effects,
and Warnings

Mechanism of Action: NSAIDs

- NSAIDs
 - Traumatized cells release prostaglandins that sensitize primary afferent fibers
 - NSAIDs inhibit prostaglandin synthesis and interrupt the pain signal at the peripheral level
 - Ibuprofen
 - Ketorolac
 - Naproxen
 - Indomethacin

Adverse Effects: NSAIDs

- GI bleeding, ulceration
- Nephrotoxicity
- Blood dyscrasias
- Nausea
- Abdominal pain
- Dizziness
- Drowsiness

Warnings: NSAIDs

- Do NOT use with:
 - Third trimester of pregnancy
 - Hypersensitivity
 - Asthma
 - Severe renal/hepatic disease
- Maximum dose
 - Ibuprofen – max is 1200mg/day for adult and 40mg/kg/day for child

Non-Opioid Analgesics

Drug Name	Adult Dose	Pediatric Dose	Toxic Dose	Maximum Dose
Acetaminophen (Paracetamol)	325-650mg PO q 4-6 hours or 1000mg q 6-8 hours	>1 month: 10-15mg/kg PO q 4-6 hours >12 years: 325-650mg PO q 4-6 hours	-Loss of appetite - Nausea, vomiting, stomach pain -Sweating -Confusion -Weakness	1gm/dose or 4gm/day for adults
Aspirin (ASA)	650-975mg PO q 4h	10-15 mg/kg PO	- Reye's syndrome in children who then get flu or chickenpox. - Tinnitus - Toxic dose 150mg/kg	60mg/kg/day
Ibuprofen (Motrin)	600mg PO q6-8h	10 mg/kg PO q 6-8h	-GI irritation -Platelet dysfunction -Renal dysfunction -Bronchospasm	40mg/kg/day
Tramadol (Ultram)	50-100mg PO	Not approved	- May precipitate serotonin syndrome in SSRI patients	
Ketorolac (Toradol)	60mg IM/ dose 30mg IV/ dose	0.5 mg/kg IV q 6 h Max 120 mg/ day	-Same as for Ibuprofen -Plus decrease dose by one-half in elderly	

Mechanism of Action: Anesthetics

- General anesthetics: Act on the CNS to produce tranquilization and sleep before invasive procedures
 - Propofol
 - Droperidol
 - Fospropofol
 - Fentanyl
- Local anesthetics: inhibit conduction of nerve impulses from sensory nerves
 - Lidocaine
 - Procaine

Adverse Effects: Anesthetics

- Dystonia
 - Sustained muscle contractions can cause twisting, repetitive motions, or abnormal postures
- Akathisia
 - Restless leg syndrome
- Flexion of arms
- Fine tremors
- Drowsiness
- Restlessness
- Hypotension
- Chills
- Respiratory Depression
- Laryngospasm

Warnings: Anesthetics

- General anesthetics should be used in caution with:
 - Elderly
 - Cardiovascular Disease (hypotension, bradydysrhythmia)
 - Renal/hepatic disease
- Local anesthetics should be used in caution during pregnancy



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Mechanism of Action: Opioids

- Opioids (systemic and intraspinal)
 - Bind to opioid receptors in the dorsal horn, inhibit release of neurotransmitters (such as substance P), and interfere with the relay of the pain signal across the neuronal synapse

Opioid Receptors

- Is a portion of a nerve cell to which an opioid or opioid-like substance can bind
 - Are located throughout the central nervous system at the spinal and supraspinal levels as well as in the periphery
 - Three receptor types
 - Mu
 - Kappa
 - Delta

Opioid Analgesic

- A morphine-like drug that attaches to an opioid receptor and produces analgesia by blocking substance P

Mu Receptor

- Mediates analgesia for most common opioid-agonist analgesics
- An **agonist analgesia** is an opioid that stimulates activity at an opioid receptor to produce analgesia but may also trigger physical dependence, tolerance, decreased GI motility, euphoria, sedation, and respiratory depression
 - Codeine
 - Fentanyl
 - Hydrocodone (Vicodin)
 - Hydromorphone (Dilaudid)
 - Meperidine (Demerol)
 - Methadone
 - Morphine
 - Oxycodone

Kappa Receptor

- Mediates analgesia and sedation but rarely affects respiratory drive or causes physical dependence

Delta Receptor

- Primarily mediates analgesia

Antagonist

- Blocks activity at mu and kappa opioid receptors by displacing opioid analgesics that are currently attached
- Most common antagonist is – naloxone (Narcan) – it is used to counteract the life-threatening side effects of the agonist opioids attached to the mu receptor sites

Mixed Agonist-Antagonist Analgesics

- Formulations that attach to both the kappa and mu receptor sites
- Provide analgesia at the kappa receptor site (agonist) but can simultaneously block activity (antagonist) at the mu receptor site

Endorphins

- A group of internally secreted opiate-like substances released by a signal from the cerebral cortex
- They attach to opioid receptors and block transmission of the pain signal
- Multiple factors affect their release, such as brief pain or stress, exercise, & massive trauma

Adverse Effects: Opioids

- GI symptoms (nausea, vomiting, anorexia, constipation, cramps)
- Light-headedness
- Dizziness
- Sedation
- Respiratory depression

Warnings: Opioids

- May worsen addiction
- Increase intracranial pressure
- Monitor patients with:
 - Severe heart disease
 - Hepatic/renal disease
 - Respiratory conditions
 - Seizure disorder

Opioids

Drug Name	Oral Dose	Duration (in hours)	Comments	Precautions
Morphine	30-60mg (0.5mg/kg)	3-5		-Respiratory depression -Hypotension -Sedation -Histamine Release
Codeine	30-100mg (2mg/kg)	4	-Poor analgesic -Good cough suppressant	-Constipation -Nausea & vomiting -Abuse potential
Hydromorphone (Diluadid)	2-6mg (0.02 – 0.1mg/kg)	2-4	-Available as suppository	-Euphoria

Opioids Continued....

Drug Name	Oral Dose	Duration (in hours)	Comments	Precautions
Hydrocodone (Vicodin, Lortab)	5-10mg	3-4	-Good cough suppressant -Fewer side effects than codeine & greater potency	-Greater abuse potential
Oxycodone (Percocet, Tylox)	5-10mg	3		-Euphoria -Abuse potential
Meperidine (Demerol)	250-300mg (1.5-2.0mg/kg)	2-3	-Toxicity from metabolite normeperidine	-Avoid with MAOI -Caution in renal & hepatic failure

Principles of Management of Pain

- Pre-emptive analgesia
- Balanced or combination analgesia
- Analgesia ladder

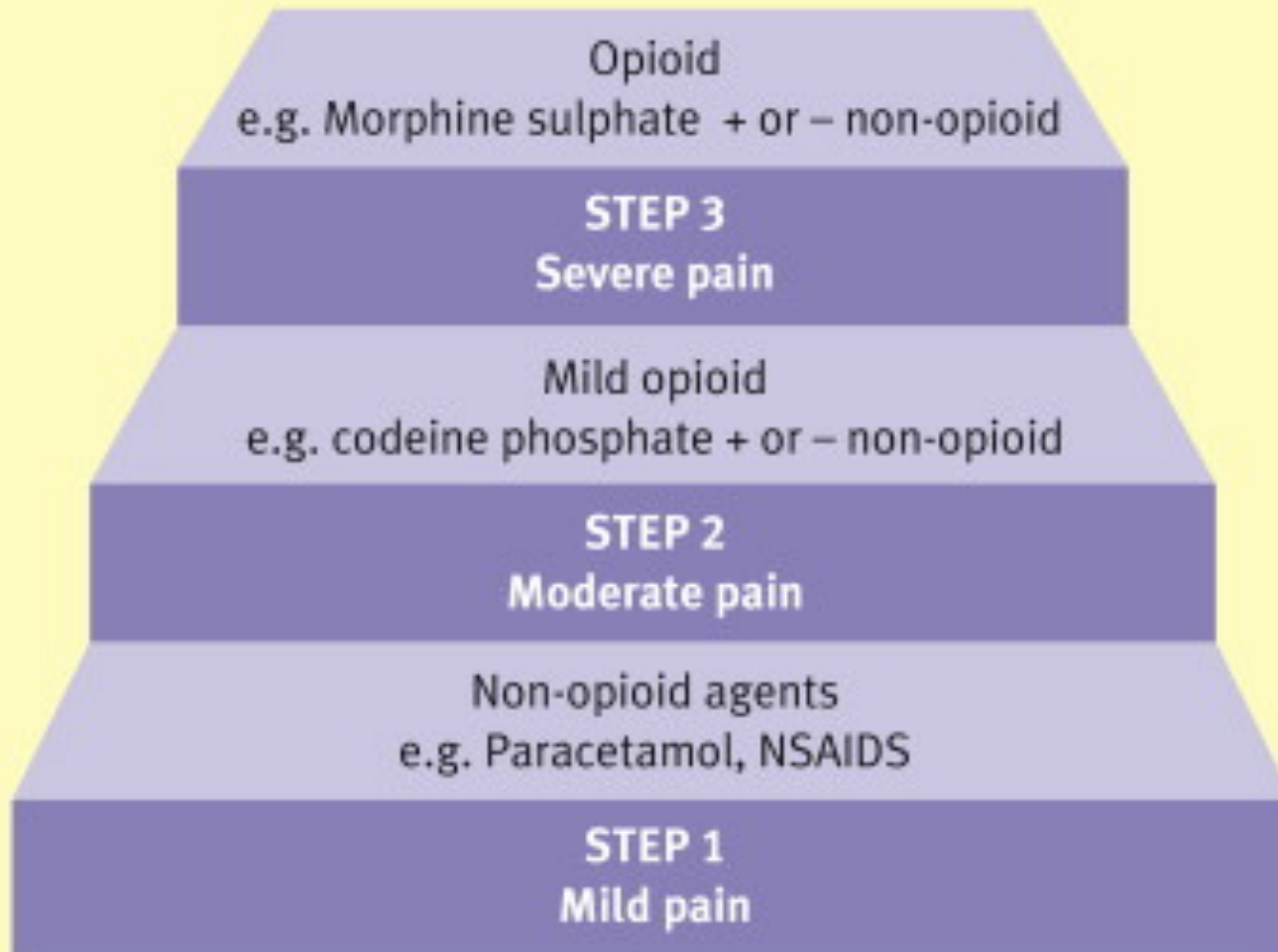
Pre-Emptive Analgesia

- Analgesia given prior to a procedure or problem to reduce pain
- Examples:
 - Procedural Sedation
 - Paracetamol and/or Ibuprofen (Motrin) given around the clock to reduce pain and swelling from an injury

Balanced Analgesia

- NSAIDS are used in conjunction with opioids
- Reduces amount of opioids
- Reduces side effects of opioids

Analgesia Ladder



Route of Administration of Pharmacological Therapies for Pain

Oral

- Time to onset of analgesia is longer and titration is difficult
 - First-pass hepatic metabolism may inactivate as much as 80% of an oral opioid dose
- Patients who are vomiting will not be able to retain the drug long enough for absorption to occur

Injectable

- IV
 - Shortest time to onset of pain relief
- IM
 - Pain at injection site
 - Drug uptake is variable, depending on the patient's peripheral circulation

Transmucosal

- Uniform absorption from the skin
- Usually well-tolerated by patients
- Not often used for acute pain – more for chronic pain management

Rectal

- Only available for hydromorphone (Dilaudid)
- Allows for transmucosal absorption without the first-pass effect
- However, absorption is variable
- Patients may object to this route

Opioid Time to Peak Effect

Route of Administration	Time to Peak Effect
Oral	60 minutes
IM/SQ	30 minutes
IV	10 minutes

Equianalgesic Chart for Commonly Prescribed Opioids

Drug	Parenteral Dosage	Oral Dosage
Codeine	130 mg	200 mg
Fentanyl	100 µg	NA
Hydromorphone (Dilaudid)	2 mg	7.5 mg
Levorphanol (Levo- Dromoran)	2 mg	4 mg
Meperidine (Demerol)	100 mg	300mg
Methadone (Dolophine)	10 mg	20 mg
Morphine	10 mg	30 mg
Oxycodone (OxyContin)	NA	15 mg

Patient-Controlled Analgesia (PCA)

- A pump used with an IV infusion to administer pain medications for patients with acute or chronic pain who are able to communicate, understand explanations, and follow directions
- *Nurses Roles:*
 - Assess vital signs and pain level
 - Explain the use of the pump
 - Collaborate with the physician, patient, and family about dosage, lockout interval, basal rate, and amount of dosage on demand
 - Assist the patient to use the PCA pump

A Quick Note on Some Chronic Pain Treatments

Mechanism of Action: Antidepressants

- Antidepressants
 - Inhibit reuptake of serotonin, a neurotransmitter, into neuronal fibers, which makes less serotonin available to relay the pain signal across the synapse; primarily indicated for neuropathic pain

Mechanism of Action: Noradrenergic Agonists

- Noradrenergic agonists
 - Attach to α_2 noradrenergic receptors in the dorsal horn of the spinal cord and modulate ascending pain signal

Review Question

- Decreased doses of opioids should be utilized in elderly patients because:
 - a. They don't eat as much so their medication needs are decreased
 - b. They don't feel pain
 - c. They have slower metabolism of analgesics

Answer

- **c. They have slower metabolism of analgesics**
 - They also may have decreased sensation to pain because of changes associated with aging BUT they still feel pain

Review Question

- Describe the first step in pain management according to the WHO ladder and how the medication works to decrease pain.

Answer

- NSAIDs
 - Traumatized cells release prostaglandins that sensitize primary afferent fibers; NSAIDs inhibit prostaglandin synthesis and interrupt the pain signal at the peripheral level

Review Question

- Describe the side effects of opioids and what should be monitored during therapy.

Answer

- Sedation
 - Monitor level of consciousness during treatment
- Respiratory Depression
 - Monitor respiratory rate and regularity during treatment

Review Question

- What is the best mode of delivery for pain medications (IV, PO, IM)?

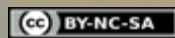
Answer

- **Depends**
- Oral – longer time to onset but can be continued out of the hospital
- IV – shortest time to onset
- IM – pain at injection site and variable uptake but may be used for a patient without an IV site

Case Review

- Discuss a nursing care plan and appropriate pain management for the following scenario:
 - An 88 year old man appears at the A & E with complaints of severe abdominal pain. He has not taken in anything by mouth for the last four hours due to the pain and is waiting for further evaluation as to what might be causing the pain. His temp is 38.0°C, Pulse is 105, Respirations are 24, B/P is 132/90.
 - **Assessment:** General assessment for pain would include what indicators? What are some special considerations for this patient?
 - **Nursing diagnosis:** What is your nursing diagnosis?
 - **Plan/Intervention:** What type of nursing plan would you implement? What type of pain medications should be initiated at this time?
 - **Evaluation:** How often would you follow-up with patient? What risks/complications would you be looking for?

Questions



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