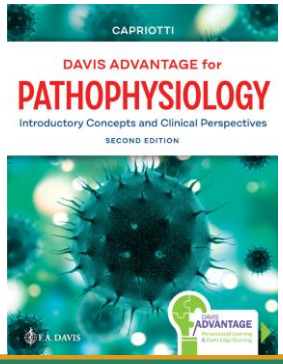


Chapter 6

Pain

1

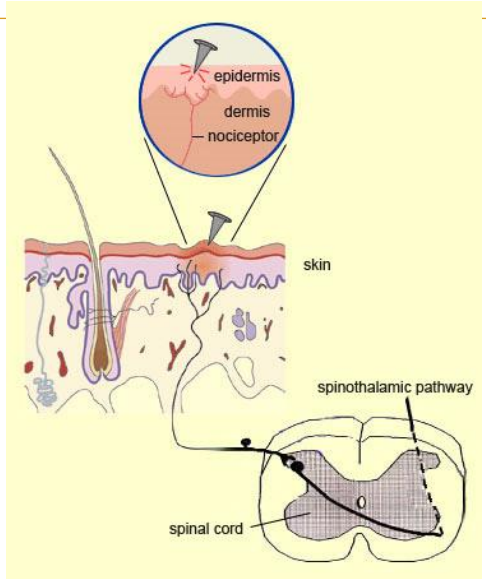
Epidemiology of Pain

- Protective mechanism
- Most common symptom for which people seek medical treatment
- Optimal pain management
  - Quicker rate of recovery
  - Better functioning
  - Fewer postoperative complications

2

Pain Overview

- Pain
  - Signal between periphery, spinal cord, and brain
- Simple reflex arc
  - Response at spinal cord level, does not involve brain
- Nociceptors
  - Pain nerves
- Spinal cord
  - Pain signals up to brain through ascending tract (spinothalamic tract)



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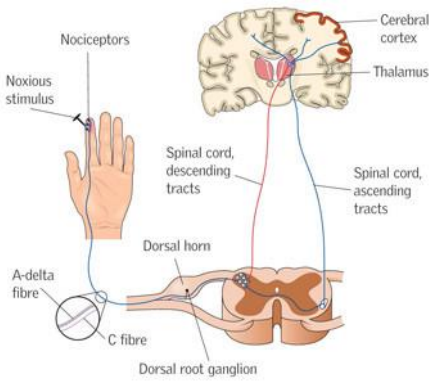
Pain Overview (continued)

- Brain
  - Sends outgoing signals to modify pain
  - Endorphins
- Neurotransmitters
  - Enhance or inhibit pain signals
  - Acetylcholine, GABA, serotonin, etc.



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Simple Reflex Arc

- Afferent neuron
  - Incoming signal to dorsal horn of spinal cord
- Interneuron
  - Connector
- Efferent neuron
  - Outgoing signal from anterior spinal cord
- Protective responses that do not involve brain input
- *Example:* patellar reflex

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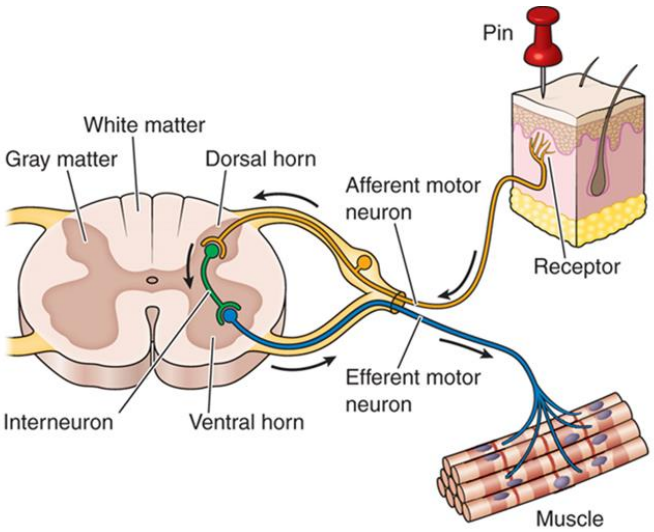
Simple Reflex Arc (continued)



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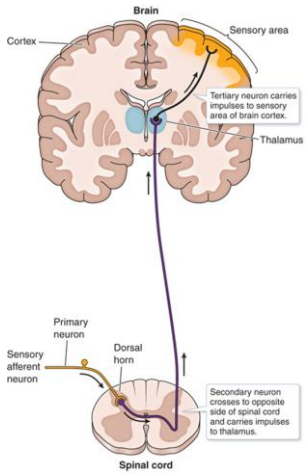
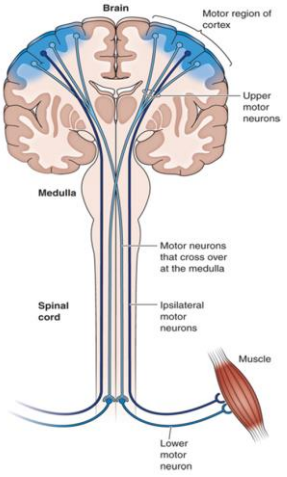
Spinal Cord—Brain Connection

- The brain *interprets* pain signals
- Spinothalamic tract
  - Primary ascending tract for pain signals from spinal cord to brain
- Corticospinal tract
  - Outgoing signals from the brain travel on this descending tract

Spinal Tracts





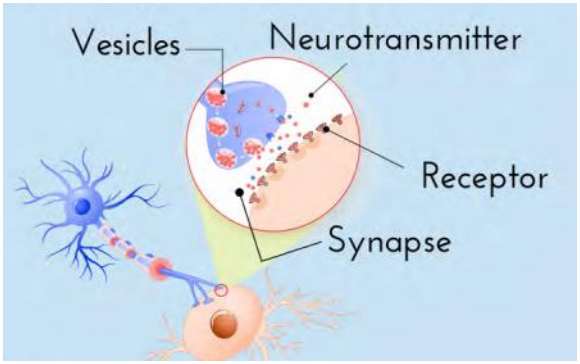
Nociception

- Response of nervous system to painful stimuli
- Nociceptors = pain receptors
- A-delta
  - Small, myelinated fibers that carry initial, acute signal of pain
- C fibers
  - Large, unmyelinated fibers that carry signals of dull, persistent pain

9

Neurotransmitters and Pain

- Excitatory *or* inhibitory
- Over 50 neurotransmitters involved with pain
- Pharmacological manipulation of neurotransmitters for pain management
  - *Example:* medications increase the level of the neurotransmitter, serotonin, to treat migraines



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Neurotransmitters and Pain (continued_1)

Neurochemicals	Action
Prostaglandins (from COX 1 enzymatic pathway)	Enhances inflammation, pain, edema
Interleukins	Enhances inflammation, pain, edema
Tumor necrosis factor	Enhances inflammation, edema, and pain and decreases appetite
Leukotrienes	Enhances inflammation, edema, and bronchospasm, particularly in asthma and allergy
Bradykinins	Enhances inflammation
Glutamate	Amplifies pain signal
Substance P	Amplifies pain signal
Enkephalins, endorphins	Inhibitory influence on pain; natural opioid

Neurotransmitters and Pain (continued_2)

Neurochemicals	Action
Acetylcholine	Inhibitory action on pain in the spinal cord
Gamma-aminobutyric acid	Inhibitory action on pain in the spinal cord and brain
Norepinephrine	Inhibitory action on pain in the spinal cord
Dopamine	Inhibitory action on pain in the spinal cord and brain
Serotonin	Conveys analgesic signals from the PAG area to the NRM of the brain (serotonin is diminished in migraine headache)

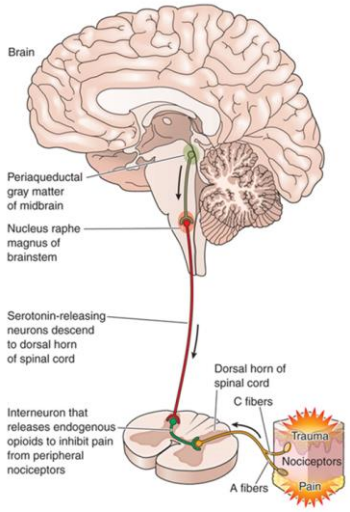
Endogenous Opioids

- Brain does not only receive pain signals
- Brain modifies pain information
- Brain produces endogenous opioids which blunt the sensation of pain
  - *Examples:* endorphins, enkephalins, dynorphinis

Endogenous Opioid Release

- Periaqueductal gray matter (PAG) stimulation activates enkephalin-releasing neurons that project to nucleus rapine magnus (NRM)
- From NRM, serotonin-releasing neurons descend to dorsal horn of spinal cord
- Connect with interneurons in spinal cord that release endogenous opioids
- Opioids bind to and inhibit the incoming C and A-delta fibers signals

Endogenous Opioids (continued)

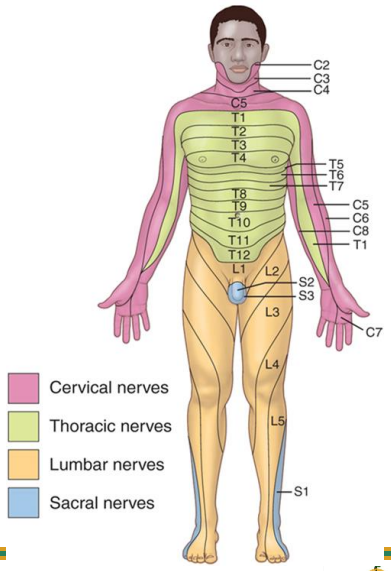


Sensitization

- Exaggerates excitement of pain nerve fibers
- Decreases pain inhibitory signals
- Pain mechanism may be altered in some individuals or in some disease states

Dermatomes and Myotomes

- Spinal nerves innervate the body in specific patterns
- Alterations in sensation or motor control can be "mapped" to specific spinal nerves based on location



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Pain Theory

- Gate Control Theory
  - Pain signals travel to and from brain
  - Pain is not necessarily proportional to injury
  - Does not adequately explain phantom pain

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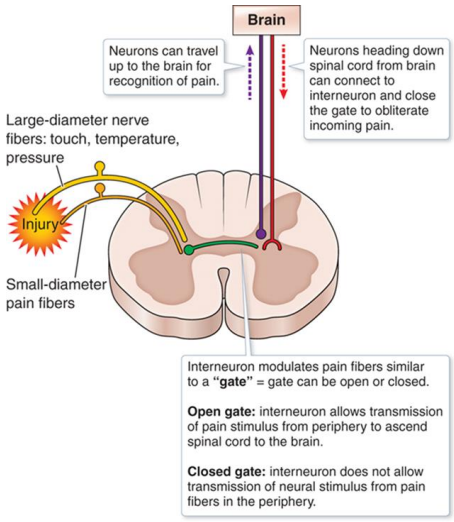
Steps of Gate Control Theory

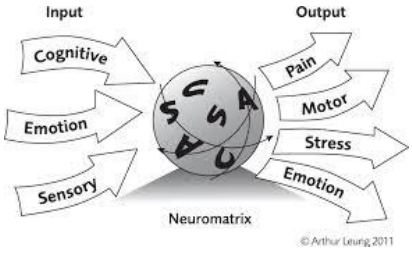
- Transduction
  - Painful stimuli into neuronal signals
- Transmission
  - Traveling of neuronal signal
- Modulation
  - Influence of other neurons on the pain signal: GATE
- Perception
  - Conscious awareness of the pain

Gate Control Theory



Pain: Neuromatrix Theory

- Can explain phenomenon such as phantom pain
- Pain is a multidimensional experience
- Pain generated from nerve impulses of the body-self neuromatrix located in the brain
  - Neuromatrix is genetically determined and develops from sensory input throughout a person's life
  - Brain can generate painful stimuli apart from nociceptive stimulation

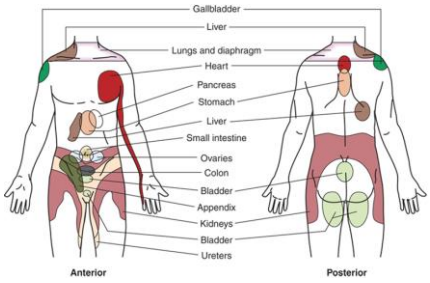


Types of Pain

- Acute
  - Lasts hours or days and resolves with healing
- Chronic
  - Beyond expected time; can be due to persistent inflammation; does not serve a biological or protective function
  - Chronic pain may become the patient's focus and profoundly affect quality of life
- Neuropathic
  - Injury or malfunction of nervous tissue
  - Burning, tingling, paresthesia (pins and needles)

Sources of Pain

- Cutaneous
- Deep somatic
  - Ligament, tendons
  - Dull, poorly localized pain
- Visceral
  - Deep organs
- Referred
  - Pain occurs at a distance from actual pathology
- Phantom
  - Amputated part of body



Pain Assessment

- 5th vital sign
- Pain is subjective
- Variability among patients
  - Nonverbal and verbal expressions may vary
- Distinguishing features of pain
  - Can aid in diagnosis
  - *Example:* peripheral arterial disease causes leg cramps

Pain Assessment (continued)

- OLD CART
  - **O**nset: When did the pain begin?
  - **L**ocation: Where does it hurt? Can you point to where it hurts?
  - **D**uration: How long does it last?
  - **C**haracteristics: What does it feel like?
  - **A**ggravating factors: Does anything make it worse?
  - **R**elieving factors: Does anything make it better?
  - **T**reatment: Did anything make it better (pain medication, ice, heat)?

Diagnosis

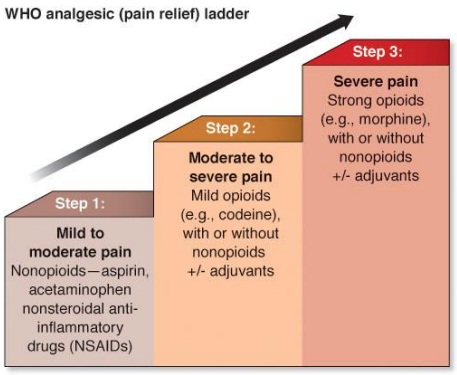
- Pain severity may be assessed using reliable scale
- May also use:
  - Blood tests
  - Nerve conduction studies
  - Electromyography
  - Nerve injection
  - Imaging tools

Treatment

- Three classes
  - Opioids
  - Nonopioids
  - Adjuvant mediations
    - Two products belonging to same category should not be used simultaneously

Treatment (continued)

- WHO Step Analgesic Ladder



Opioids

- Considered a controlled substance
- Morphine is prototypical opioid
  - Produces analgesia, euphoria, and sedation
- Most effective when given before pain onset
- Can cause respiratory depression
- Additional side effects of opioids: constipation, nausea, dizziness, physical dependence

Common Opioids

- SCHEDULE II
  - Morphine (MS Contin®, Roxanol®)
  - Codeine (Vicodin®)
  - Hydromorphone (Dilaudid®)
  - Meperidine (Demerol®)
  - Methadone (Dolophine®, Methadose®)
  - Oxycodone (Oxycontin®, Percocet®, Endocet®, Roxicodone®, Roxicet®)
  - Fentanyl (Duragesic, Oralet®, Actiq®, Sublimaze®, Innovar®)
  - Tapentadol
- SCHEDULE III
  - Buprenorphine (Suboxone®, Subutex®)
- SCHEDULE IV
  - Tramadol

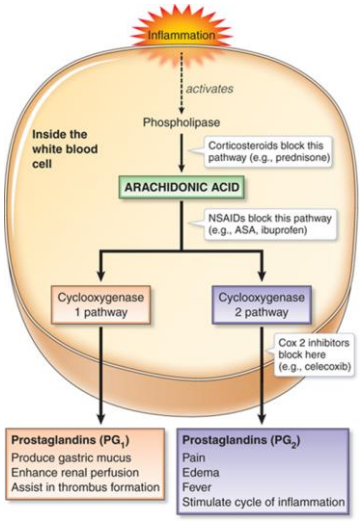
Complications of Opioid Use

- Substance abuse
  - Screener Opioid Assessment for patients with pain
- Addiction
- Tolerance
- Withdrawal
  - Buprenorphine
    - Used to wean patients from opioids
  - Naloxone
    - Helps counter the effects of opioid overdose

Nonopioid Analgesics

- Acetaminophen (Tylenol)
- NSAIDs
  - Aspirin, ibuprofen, naproxen, celecoxib
  - Block prostaglandin (PG) synthesis by inhibiting cyclooxygenase (COX) enzymes
    - COX-1: gastric mucus production
      - Use of medications that inhibit COX-1 can affect GI mucosa
    - COX-2: inflammation
      - Celecoxib is selective for COX-2

Cyclooxygenase Pathway



Adjuvant Medications

- Used to amplify analgesic effect of pain medication
- Antidepressants
  - Can increase serotonin, norepinephrine, dopamine
- Local anesthetics
  - Prevent nerve depolarization
- Injected corticosteroids
  - Anti-inflammatory
- Anticonvulsants
  - Help with neuropathic pain
- Topical pain relievers
  - Lidocaine, capsaicin, NSAIDs
- Cannabinoids
  - Potential to help manage pain in some disorders

Nonpharmacological Pain Management

- Nursing interventions
- Physiotherapy
- Occupational therapy
- Acupuncture
- Transcutaneous electrical nerve stimulation (TENS)
- Guided imagery
- Intradiscal electrochemical therapy
- Botulinum neurotoxin
- Psychological counseling

Cancer Pain

- Common
- May be intermittent or chronic
- Tumors can cause pain by placing pressure on adjacent structures
- Inflammatory mediators and enzymatic destruction of tissues
- Chemotherapy and radiation therapy
- Bone pain often occurs with metastatic cancers

Spinal Nerve Radiculopathy

- Spinal nerve impingement
- Lumbosacral area
  - Often affecting sciatic nerve leading to “sciatica”
  - Pain radiates down the leg with numbness and tingling of foot
- Cervical radiculopathy: spinal nerve impingement in neck area
  - Numbness in hand and fingers

Diabetic Peripheral Neuropathy

- Both sensory and motor nerves are affected
  - High glucose levels cause cellular damage
  - Structural breakdown of nerves
- Loss of pain sensation may allow for further wounding undetected by patient
  - Assessment of extremity health is important part of diabetic care

Complex Regional Pain Syndrome (CRPS)

- Chronic, progressive disorder
- Severe pain, edema, discoloration of injured area
- Unknown cause
- Associated with dysfunction of autonomic nervous system
- Combined treatment of physical therapy, pain medications, and occupational therapy

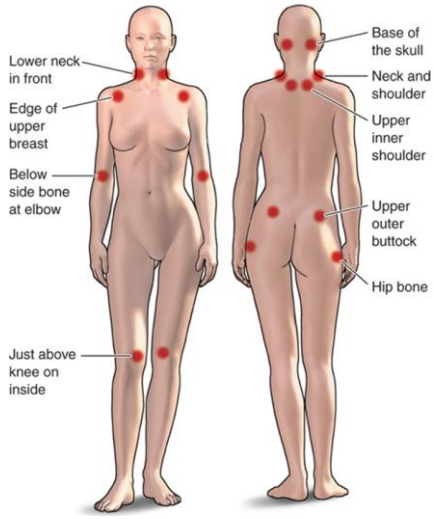
Postherpetic Neuralgia

- Varicella zoster "chickenpox"
- Remains dormant along nerves after infection
- Reemerges as "shingles" (renamed "herpes zoster" when in an adult)
- Commonly produces acute, vesicular, and linear rash along specific nerve
- Painful

Fibromyalgia

- Pain presents at specific, exact tender points
  - Diagnosis requires pain in 11 of 18 specific sites
- Linked to depression, fatigue, headaches, anxiety
- More common in women
- Joints are not affected

Fibromyalgia (continued)



Trigeminal Neuralgia

- Stabbing pain in facial area, arising from trigeminal nerve
- Very severe, lasting from a few seconds to minutes
- Pain can be triggered by touch, sounds, brushing teeth, eating, drinking
- Anticonvulsants and muscle relaxers can lessen pain and rate of attacks

Headaches

- Tension
  - Stress and tension
- Cluster
  - Severe, unilateral, periorbital pain
  - Sharp, stabbing pain
  - Tearing of eyes common
- Migraine
  - More common in women
  - Due to cerebral perfusion issues
  - Serotonin stimulants may help