



Perioperative pain management

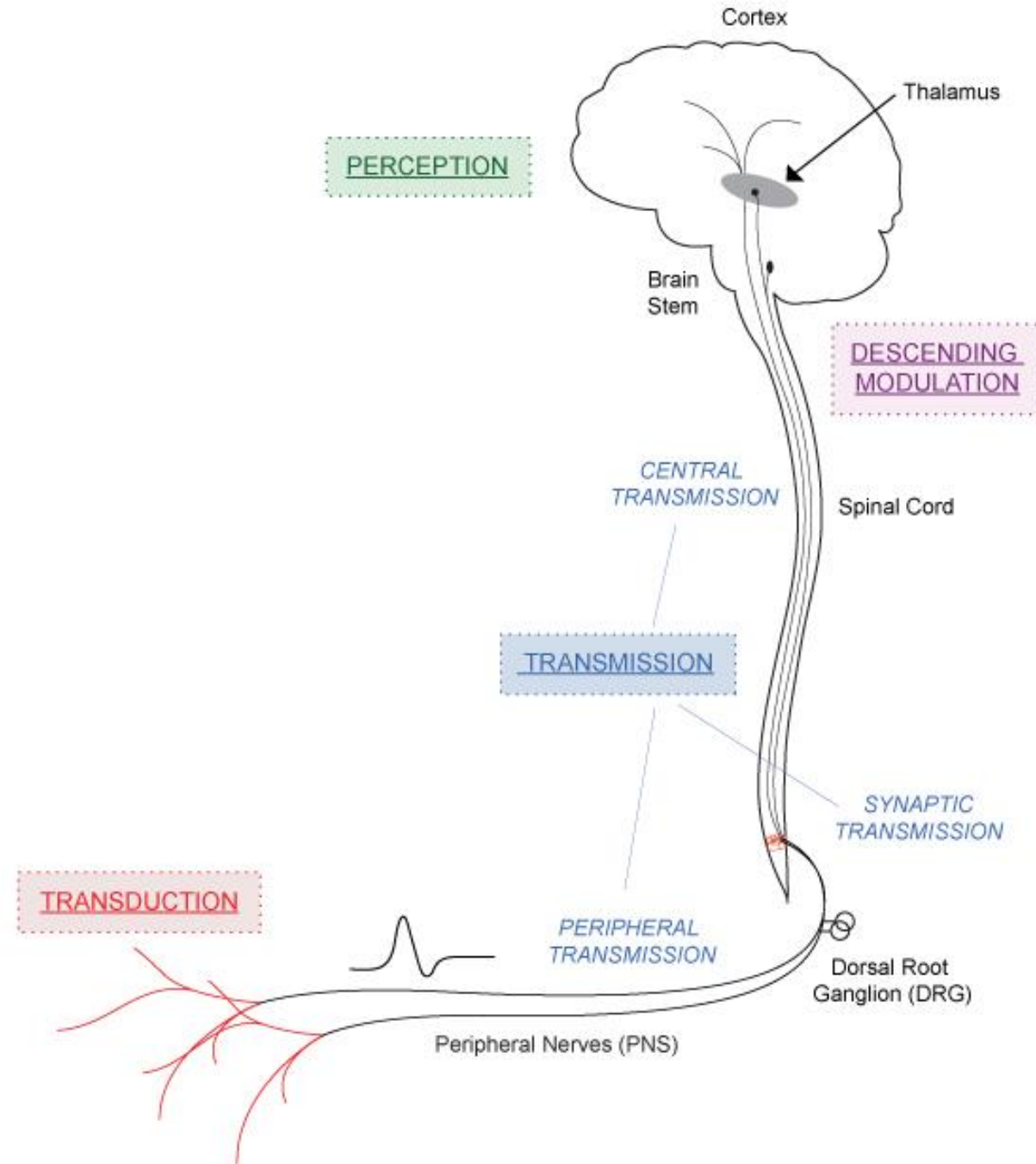
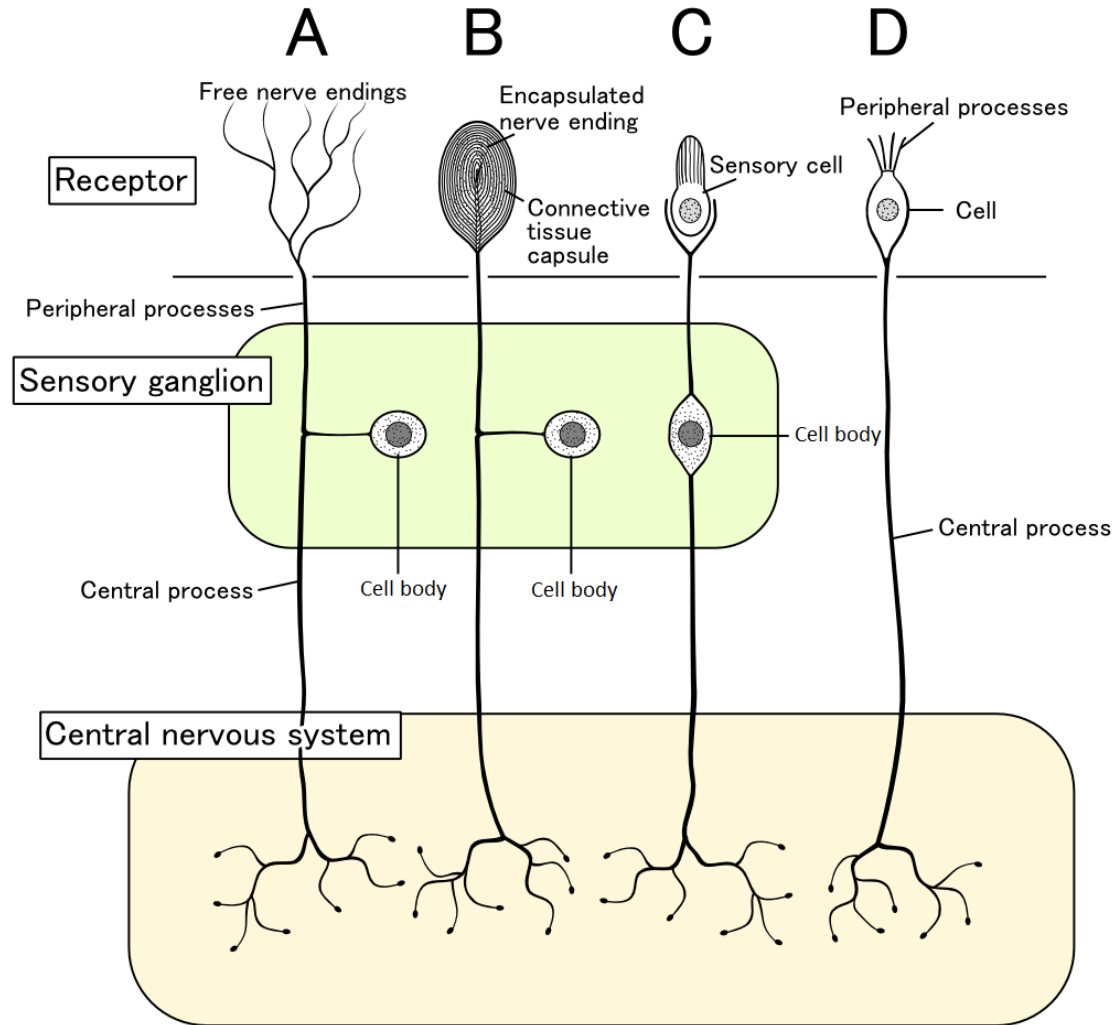
Kirill Lobastov

Introduction

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

IASP – International Association for the Study of Pain 2011

Nociceptive system



Pain Types

NOCICEPTIVE PAIN

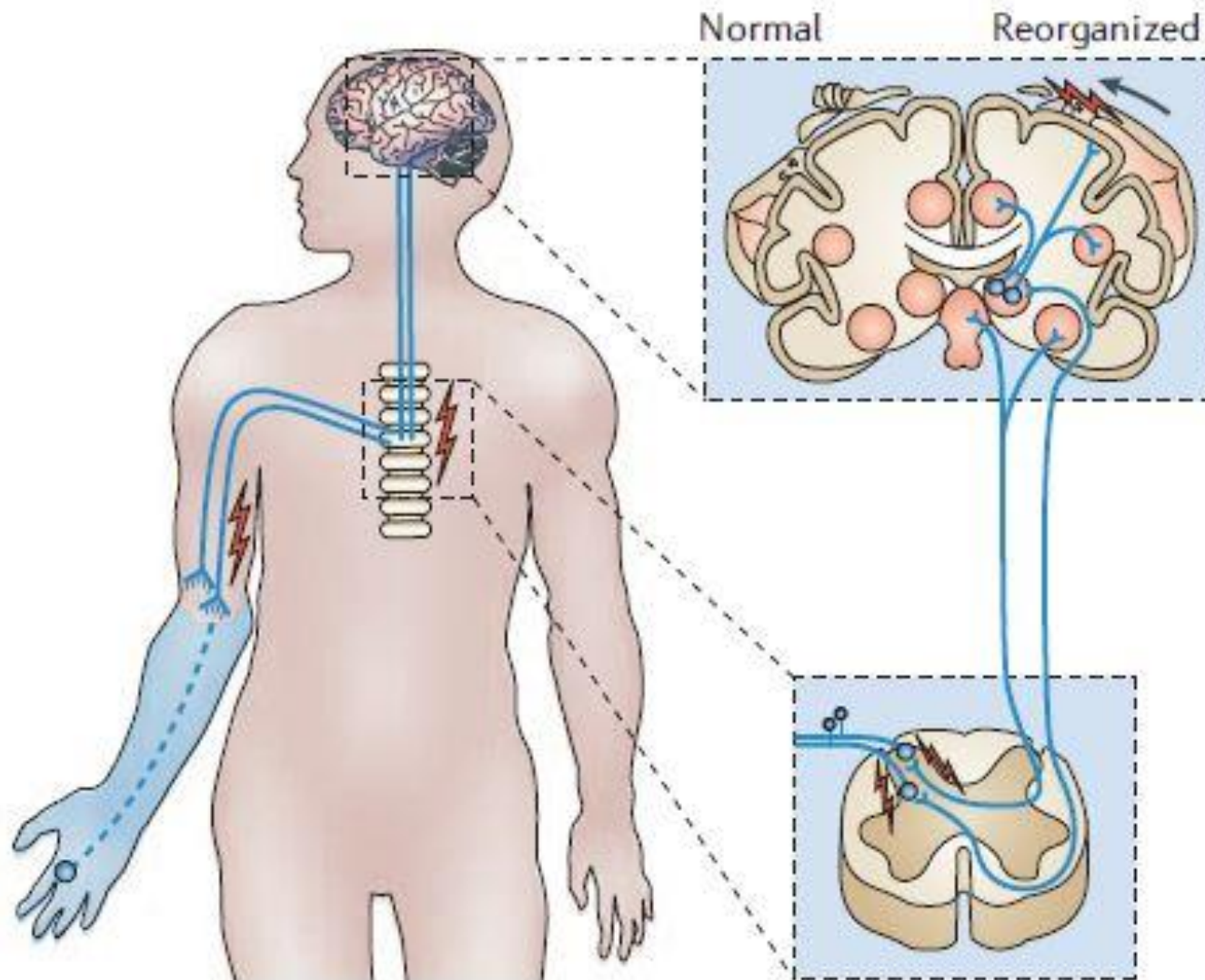
- Results from ongoing activation of mechanical, thermal, or chemical nociceptors
- Typically, opioid-responsive
- Pain related to mechanical instability

NEUROPATHIC PAIN

- Spontaneous or evoked pain that occurs in the absence of ongoing tissue damage,
- Dysfunction of the nervous system
- Abnormality in the sensation or transmission
- Associated with medical conditions rather than tissue damage
- May be opioid-resistant
- Pain secondary to nerve root injury

PHANTOM PAIN

Phantom Pain



Central changes

- Unmasking
- Sprouting
- General disinhibition
- Map remodelling
- Loss of neurons and neuronal function
- Denervation
- Alterations in neuronal and glial activity
- Sensory-motor and sensory-sensory incongruence

Peripheral changes

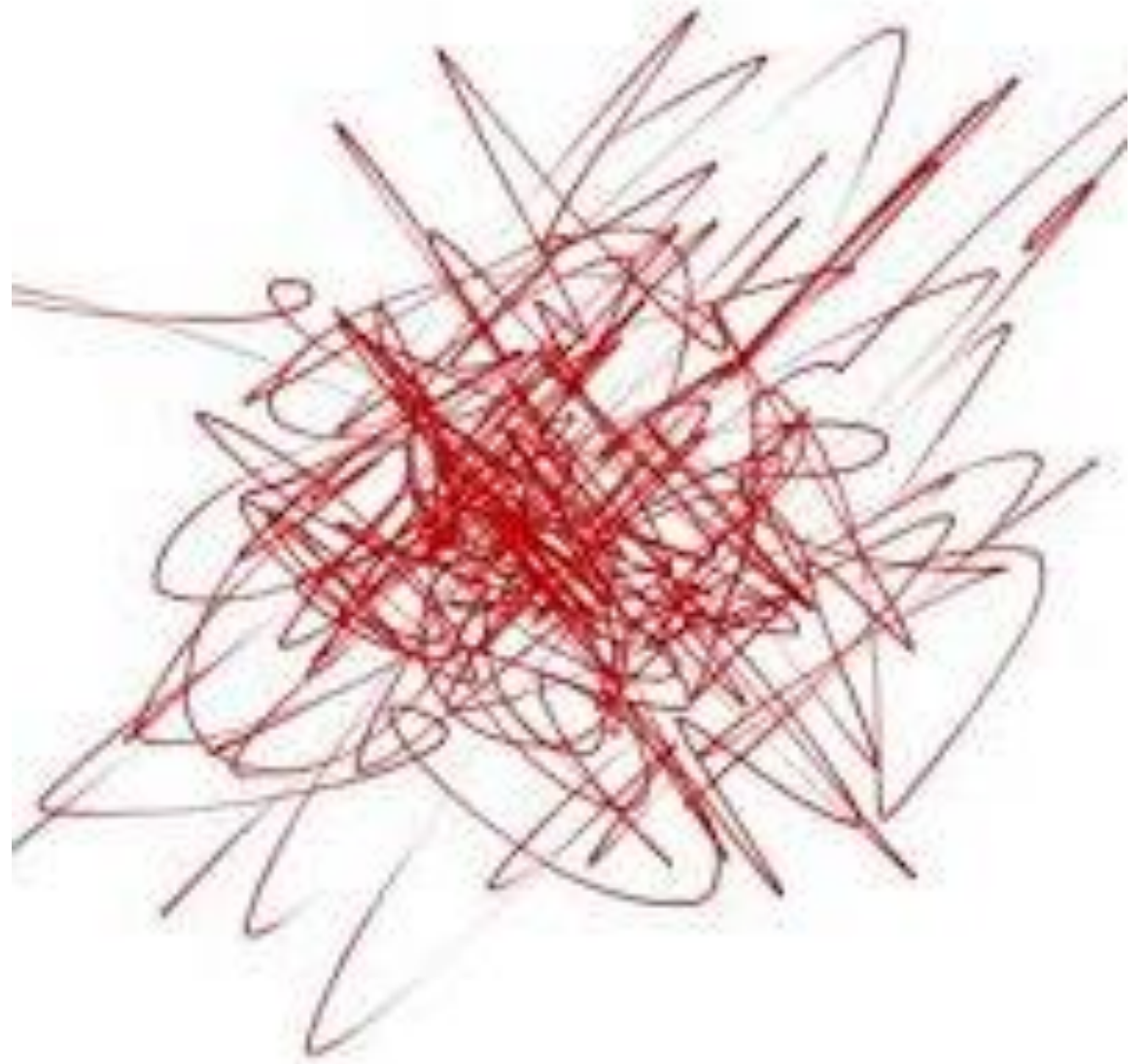
- Structural changes in neurons and axons
- Ectopic impulses
- Ephaptic transmission
- Sympathetic-afferent coupling
- Down- and upregulation of transmitters
- Alterations in channels and transduction molecules
- Selective loss of unmyelinated fibres

Time-based classification of pain

- **Acute**: short-term; usually due to nociception (tissue damage); resolves with healing.
- In back pain
 - Acute = <4 weeks
 - Sub-acute = 4-12 weeks
 - Chronic = >12 weeks
- **Chronic pain**: pain lasting > 3-6 months
- **Persisting pain**

Factors Influencing Pain

- Age
- Gender
- Culture
- Meaning of pain
- Attention
- Anxiety
- Fatigue
- Previous experience
- Coping style
- Family and social support



Causes of Acute Pain

- Post-operative
- Burns
- Trauma
- Infective / Inflammatory conditions
- Ischemic pain
- Visceral pain
- Obstetric / Labor

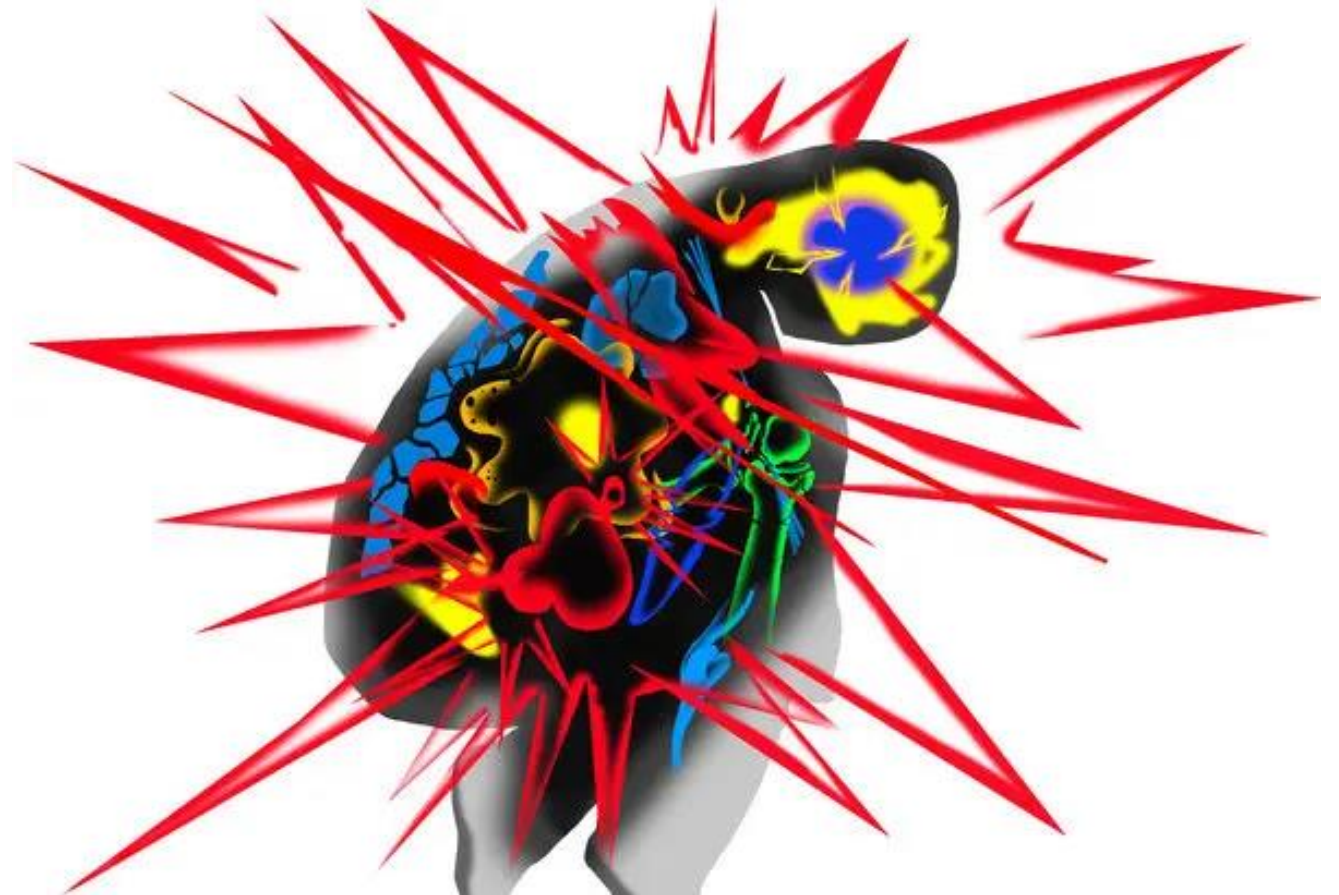


Causes of Post-Operative Pain

- Incisional skin and subcutaneous tissue
- Deep cutting, coagulation, trauma
- Positional nerve compression, traction & bed sore
- Intravenous site needle trauma, extravasation, venous irritation
- Tubes drains, nasogastric tube, endotracheal tube
- Respiratory from endotracheal tube, coughing, deep breathing
- Rehab physiotherapy, movement, ambulation
- Complication of surgery
- Others cast, dressing too tight, urinary retention

Causes of Chronic Pain

- Cancer pain
 - Cancer related
 - From cancer therapy
 - Cancer unrelated
- Non-cancer
 - Nociceptive
 - Neuropathic
 - Idiopathic



Adverse events of Pain

- Stress response - Hypothalamus-Pituitary-Adrenal axis:
 - Disturbed cytokine cascade
 - Impairment of immune function
 - Increased catabolism
 - Negative nitrogen balance
 - Pain chronicity
- Cardiovascular
- Respiratory
- Gastrointestinal
- Neuro-psychiatric
- Impairment of mobility
- Gait disturbances

Physiological effects of Pain

- Increased catabolic demands: poor wound healing, weakness, muscle breakdown
- Decreased limb movement: increased risk of DVT/PE
- Respiratory effects: shallow breathing, tachypnea, cough suppression increasing risk of pneumonia and atelectasis
- Renal effects: increased sodium and water retention
- Gut effects: decreased gastrointestinal mobility
- Cardiac effects: tachycardia and elevated blood pressure

Psychological effects of Pain

- Negative emotions: anxiety, depression
- Sleep deprivation
- Existential suffering: may lead to patients seeking active end of life.

Immunological effects of Pain

- Decrease natural killer cell counts
- Effects on other lymphocytes not yet defined

Why all this is vital?

- Pain is a miserable experience
- Pain increases sympathetic output
 - Increases myocardial oxygen demand
 - Increases BP, HR
- Pain limits mobility
 - Increases risk for DVT/PE
 - Increases risk for pneumonia, atelectasis
 - Secondary to splinting

Why Treat Pain?

- Basic human right!
- ↓ pain and suffering
- ↓ complications
- ↓ likelihood of chronic pain development
- ↑ patient satisfaction
- ↑ speed of recovery → ↓ length of stay → ↓ cost
- ↑ productivity and quality of life

Acute Pain Management Goals

- To provide patients with a level of pain control that allows them to actively participate in recovery
 - This level will be individual to each patient
- To minimize nausea and vomiting
- To minimize other side effects of analgesics
 - Sedation
 - Ileus
 - Weakness
 - Hypotension

Basic principles of pain management

- Good pain assessment
- Pain medications must be taken when the pain is first perceived
- Doses of pain medications are increased with the patient's report of pain
- Adjuvant medications are used for opioid non-responsive & neuropathic pain
- Non-pharmacologic approaches are always a part of any pain management protocol

Principles of Pain Assessment

- Assess and reassess
- Use methods appropriate to cognitive status and context
- Assess intensity, relief, mood, and side effects
- Use verbal report whenever possible
- Document in a visible place
- Expect accountability
- Include the family

Pain Assessment

- Location
- Intensity
- Onset
- Duration
- Radiation
- Exacerbation
- Alleviation



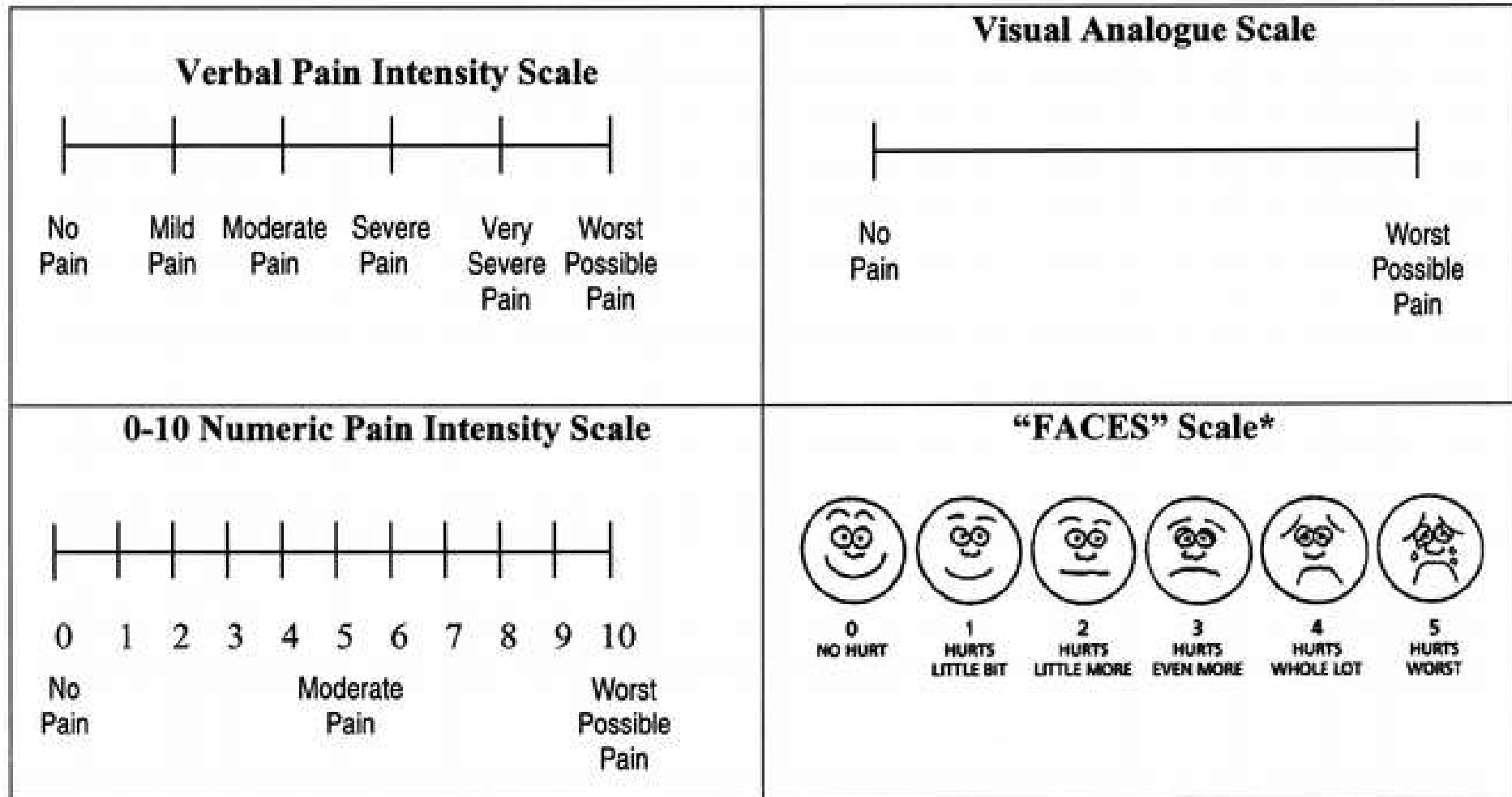
Pain Assessment Tools

- In adults: self report measurement scales, such as numerical scales
- In Pediatric patients:
 - Physiologic and behavioral indicators of pain (Infants, Toddlers, Nonverbal or Critically Ill Children)
 - Face scale (Age 3-10 years)
 - Visual analogue scales (Age 10-18)

Pain Assessment

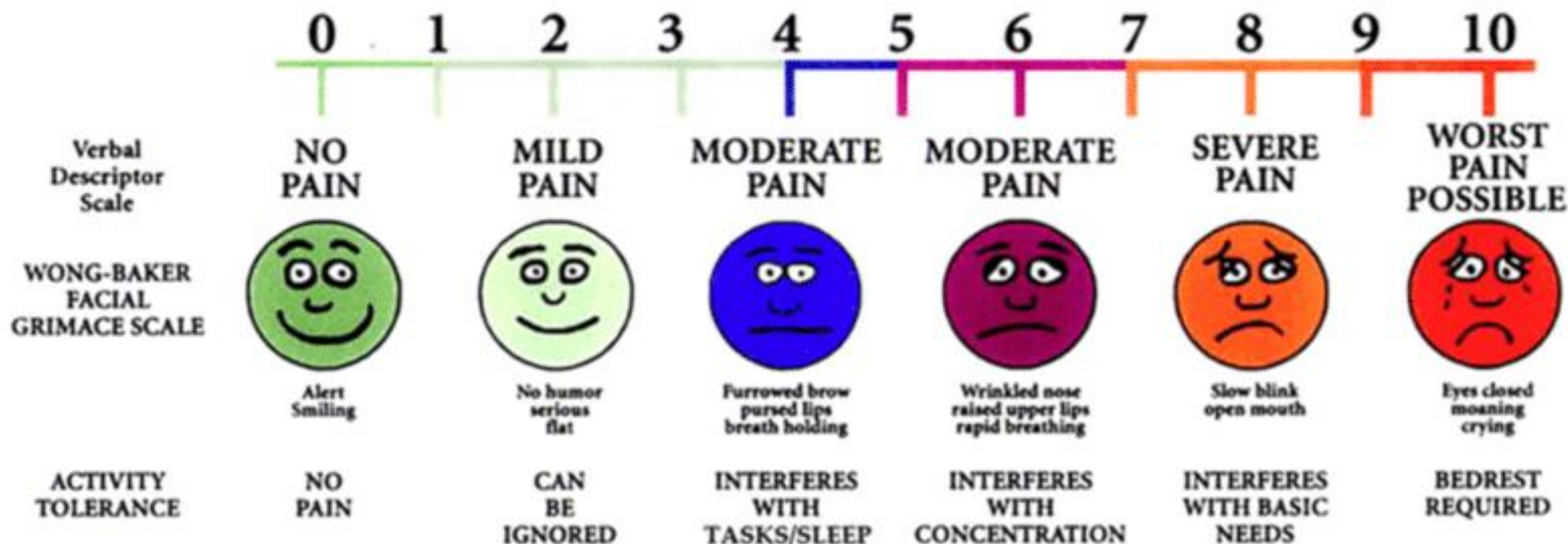
- Subjective:
 - Pain Scores:
 - Unidimensional for acute pain
 - VRS, VAS & NRS.
 - Facial expression.
 - Multidimensional for chronic pain
 - McGill & Pain Inventory.
- Objective:
 - Behavioral: refusal to move, cough & deep breath
 - Physiological: increased HR, RR, ABP, sweatiness & dilated pupils
 - Neuro-endocrinal: RBS, stress hormones

Scores and scales



UNIVERSAL PAIN ASSESSMENT TOOL

This pain assessment tool is intended to help patient care providers assess pain according to individual patient needs. Explain and use 0-10 Scale for patient self-assessment. Use the faces or behavioral observations to interpret expressed pain when patient cannot communicate his/her pain intensity.



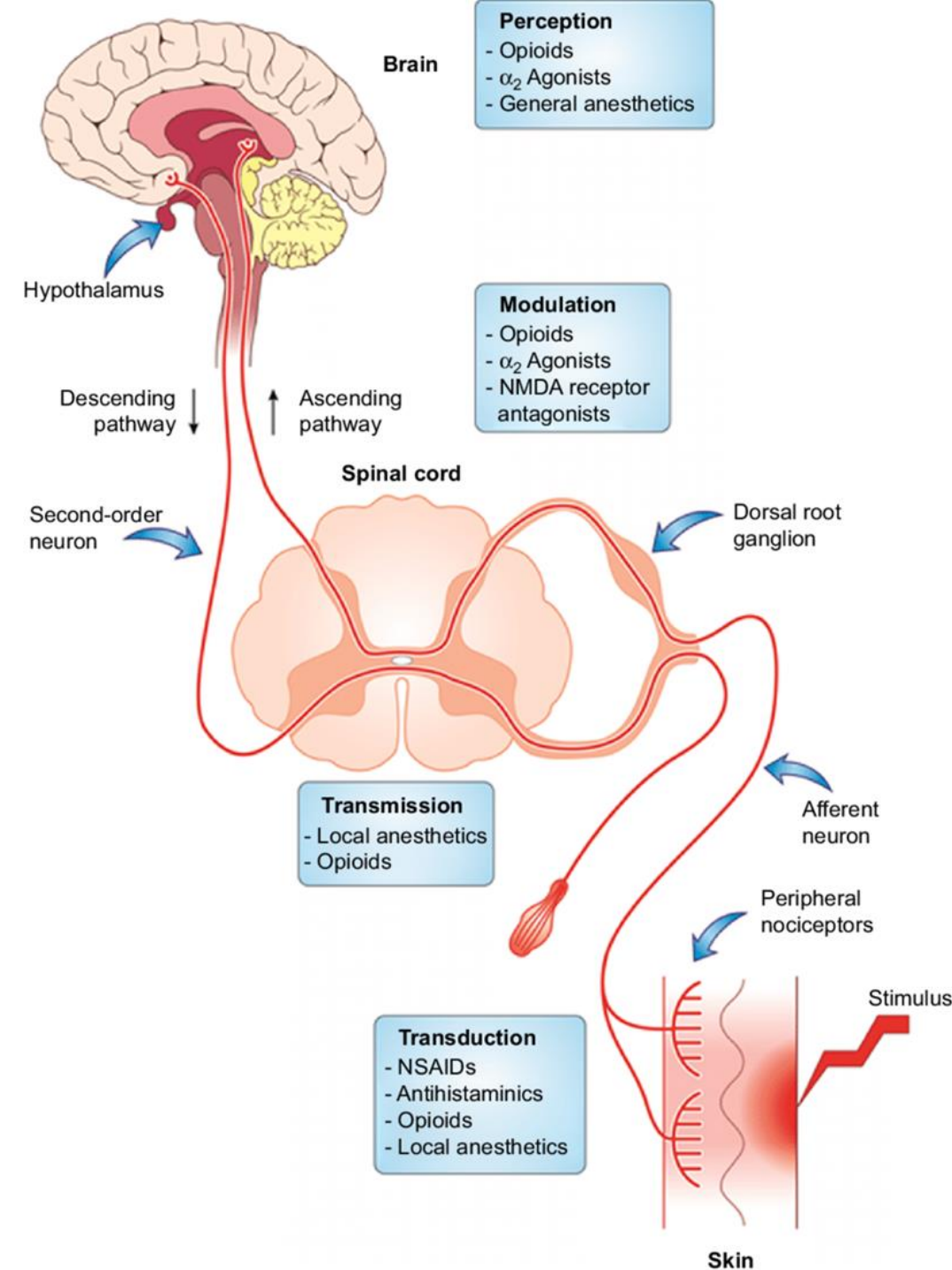
Pain Control Strategies

- Pharmacotherapy
- Anesthetic approaches
- Implantable devices
- Neurostimulation approaches
- Alternative approaches
- Surgical approaches
- Rehabilitative approaches
- Lifestyle changes
- Psychological approaches



Drug Strategies

- Non-opioid analgesics
 - Acetaminophen (paracetamol)
 - COX-3 inhibition in CNS without peripheral action
 - Central antipyretic and analgetic activity without anti-inflammatory action
 - NSAIDs
 - Non-selective COX-1 and COX-2 inhibitors
 - Selective COX-2 inhibitors
- Opioids
 - Weak opioids
 - Strong opioids
 - Mixed agonist – antagonists
- Adjuvants
 - Antidepressants
 - Anticonvulsants (Gabapentin)
 - Alfa-2 agonists (Dexmedetomidine)
 - Substance P inhibitors
 - NMDA inhibitors (Ketamine)
 - Local anesthetics
 - Others



Routes of Administration

- Oral
- Rectal
- Intravenous
- Intramuscular
- Transdermal
- Transmucosal
- Epidural
- Intrathecal

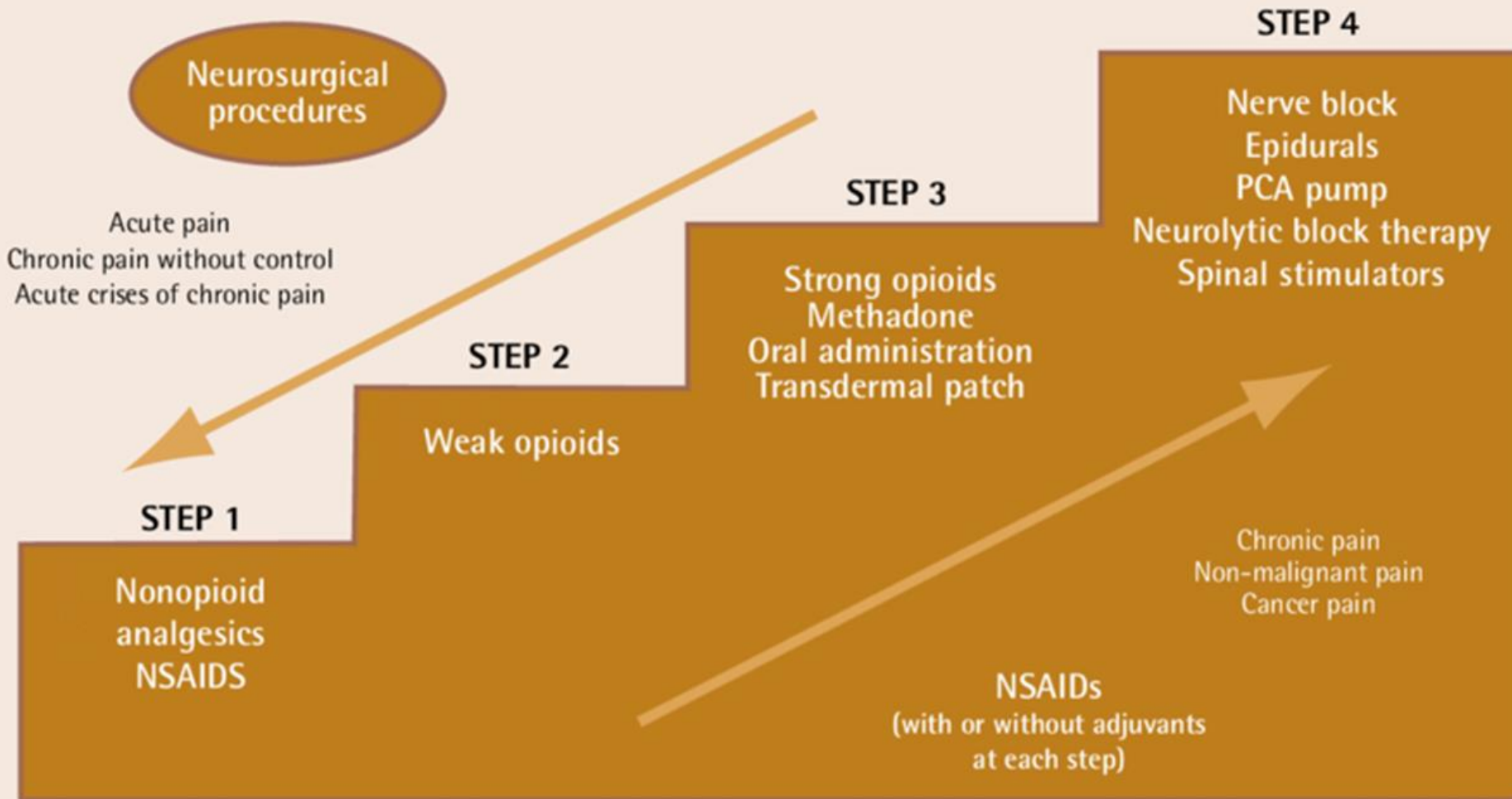


Non-Drug Strategies

- Alternative medicine:
 - Acupuncture
 - TENS
 - Cupping
 - Chiropractice
- Physical Therapy
 - Ice, heat, massage
- Exercise
- Psychological therapy
 - Cognitive-behavioral therapy
 - Relaxation techniques
 - Biofeedback
 - Hypnosis

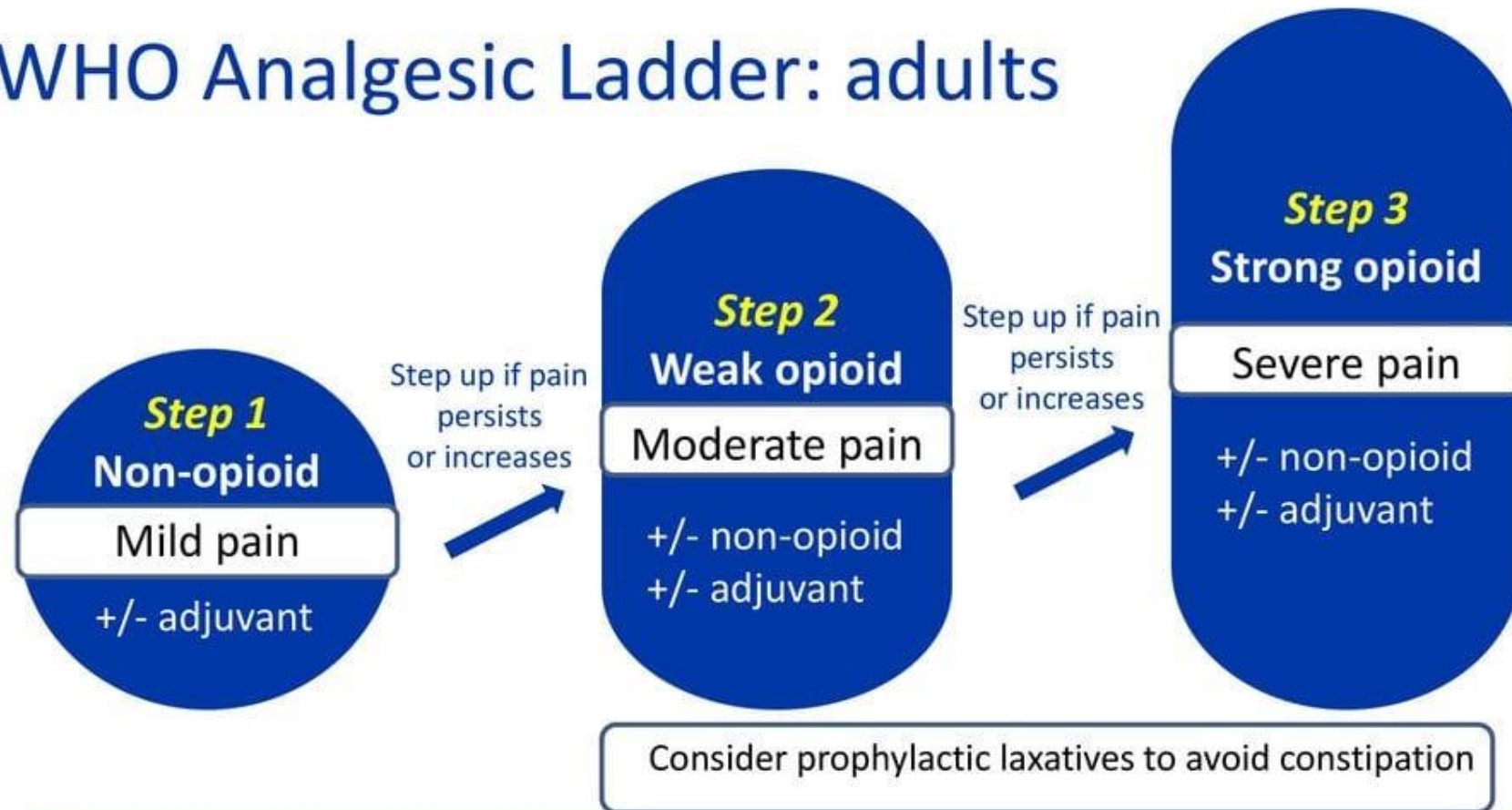


WHO Analgesic Ladder



NSAID—nonsteroidal anti-inflammatory drug, PCA—patient-controlled analgesia.

WHO Analgesic Ladder: adults



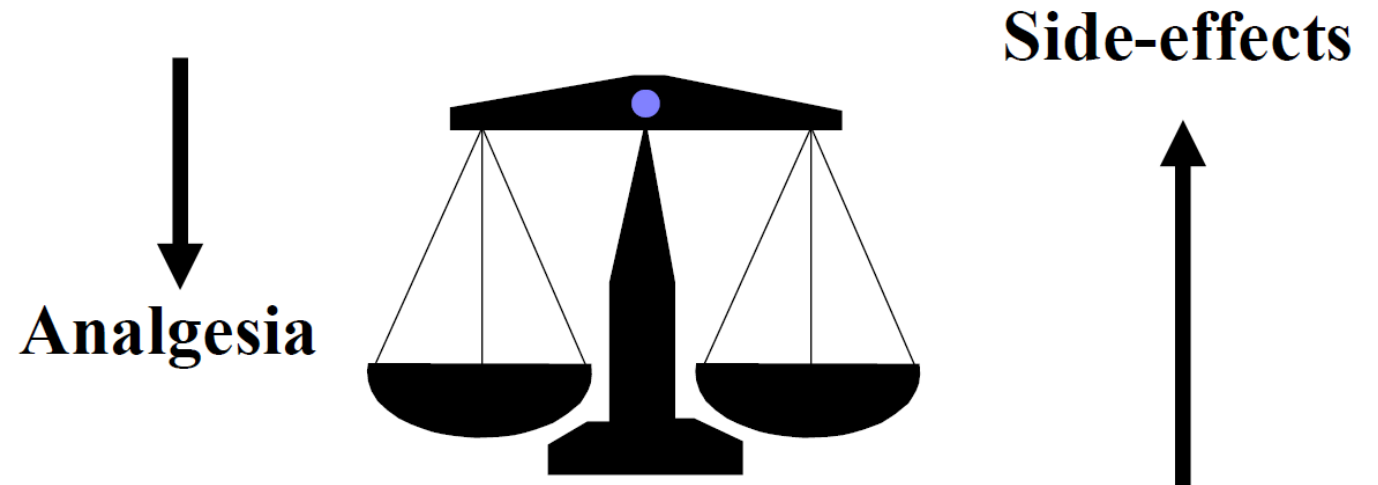
<i>Non-opioids</i>	ibuprofen or other NSAID, paracetamol (acetaminophen), or aspirin
<i>Weak opioids</i>	codeine, tramadol, or low-dose morphine
<i>Strong opioids</i>	morphine, fentanyl, oxycodone, hydromorphone, buprenorphine
<i>Adjuvants</i>	antidepressant, anticonvulsant, antispasmodic, muscle relaxant, bisphosphonate, or corticosteroid

Combining an opioid and non-opioid is effective, but do not combine drugs of the same class.

Time doses based on drug half-life ("dose by the clock"); do not wait for pain to recur

Multimodal Analgesia

- Using more than one drug for pain control
 - Different drugs with different mechanisms/sites of action along pain pathway
 - Each with a lower dose than if used alone
 - Can provide additive or synergistic effects
 - Provides better analgesia with less side effects (mainly opiate related)



Pre-emptive analgesia

- It is an antinociceptive treatment that prevents establishment of altered processing of afferent input, which amplifies postoperative pain
 - Central sensitization — persistent postinjury changes in the central nervous system that result in pain hypersensitivity
 - Central hyperexcitability — exaggerated and prolonged responsiveness of neurons to normal afferent input after tissue damage
- It has the potential to be more effective than a similar analgesic treatment initiated after surgery

Pre-emptive analgesia

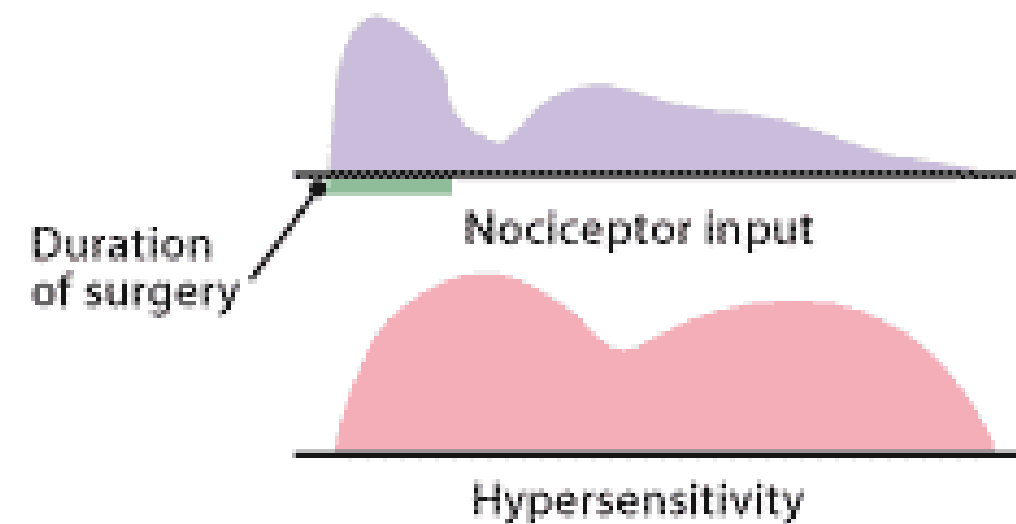
- Starts before surgery;
- Prevents the establishment of central sensitization caused by incisional injury (covers only the period of surgery);
- Prevents the establishment of central sensitization caused by incisional and inflammatory injuries (covers the period of surgery and the initial postoperative period)

Pre-emptive analgesia

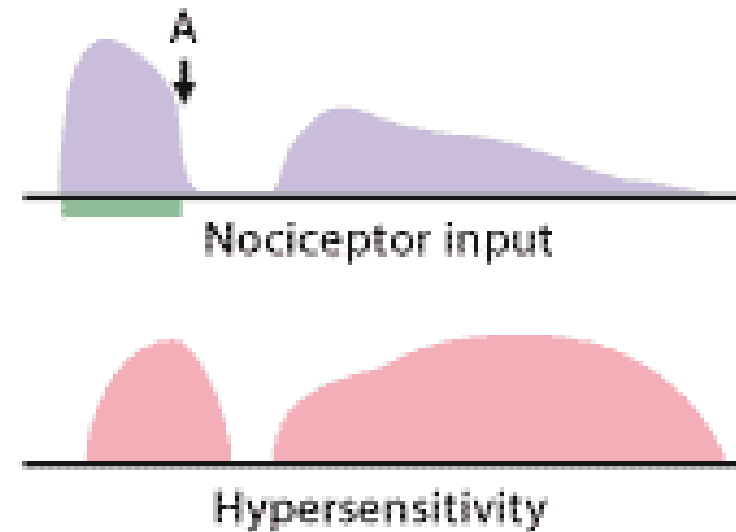
- Local anesthetic infiltration or nerve blocks
- Neuraxial local anesthetics
- Neuraxial opioids
- Systemic NSAIDs
- Intravenous or epidural ketamine or other NMDA-agonists

Pre-emptive analgesia

A. Surgical and postsurgical afferent input

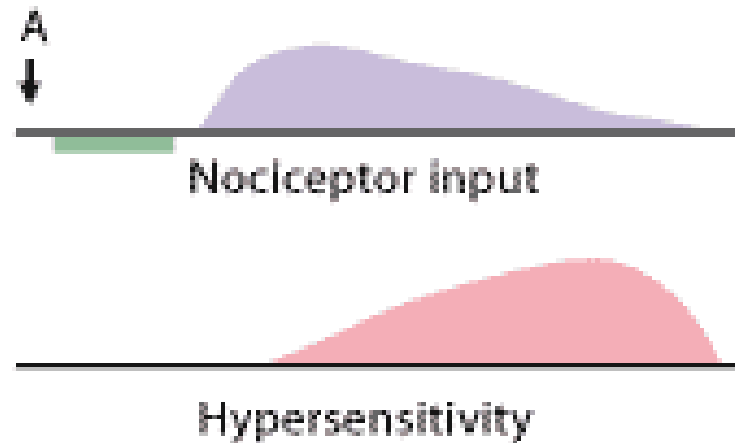


B. Postsurgical analgesia

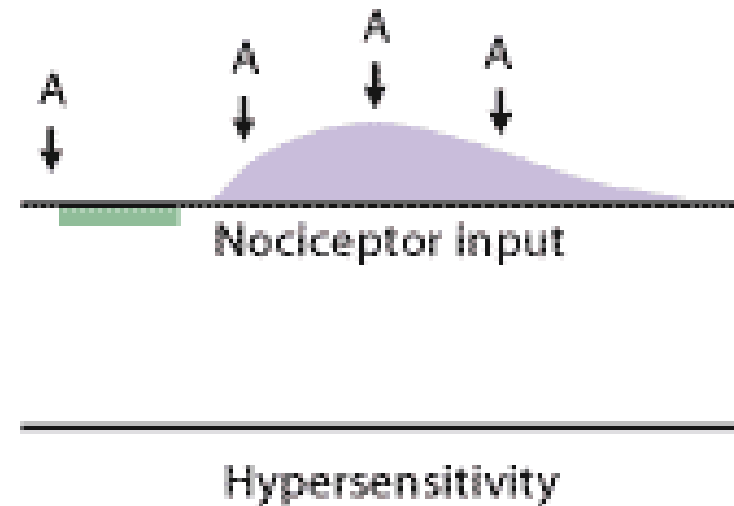


Pre-emptive analgesia

C. Presurgical analgesia

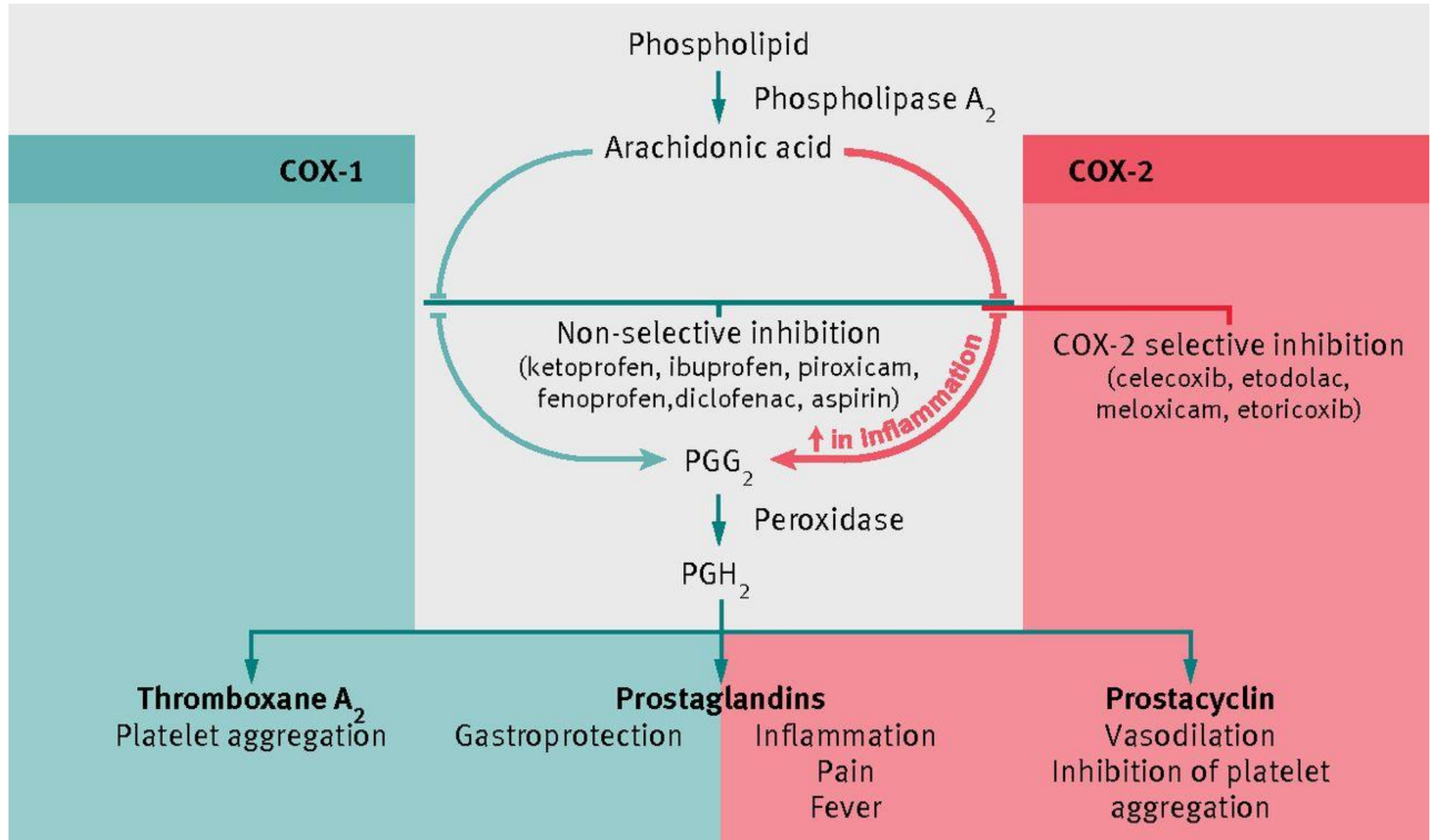


D. Presurgical and postsurgical analgesia



Acetaminophen

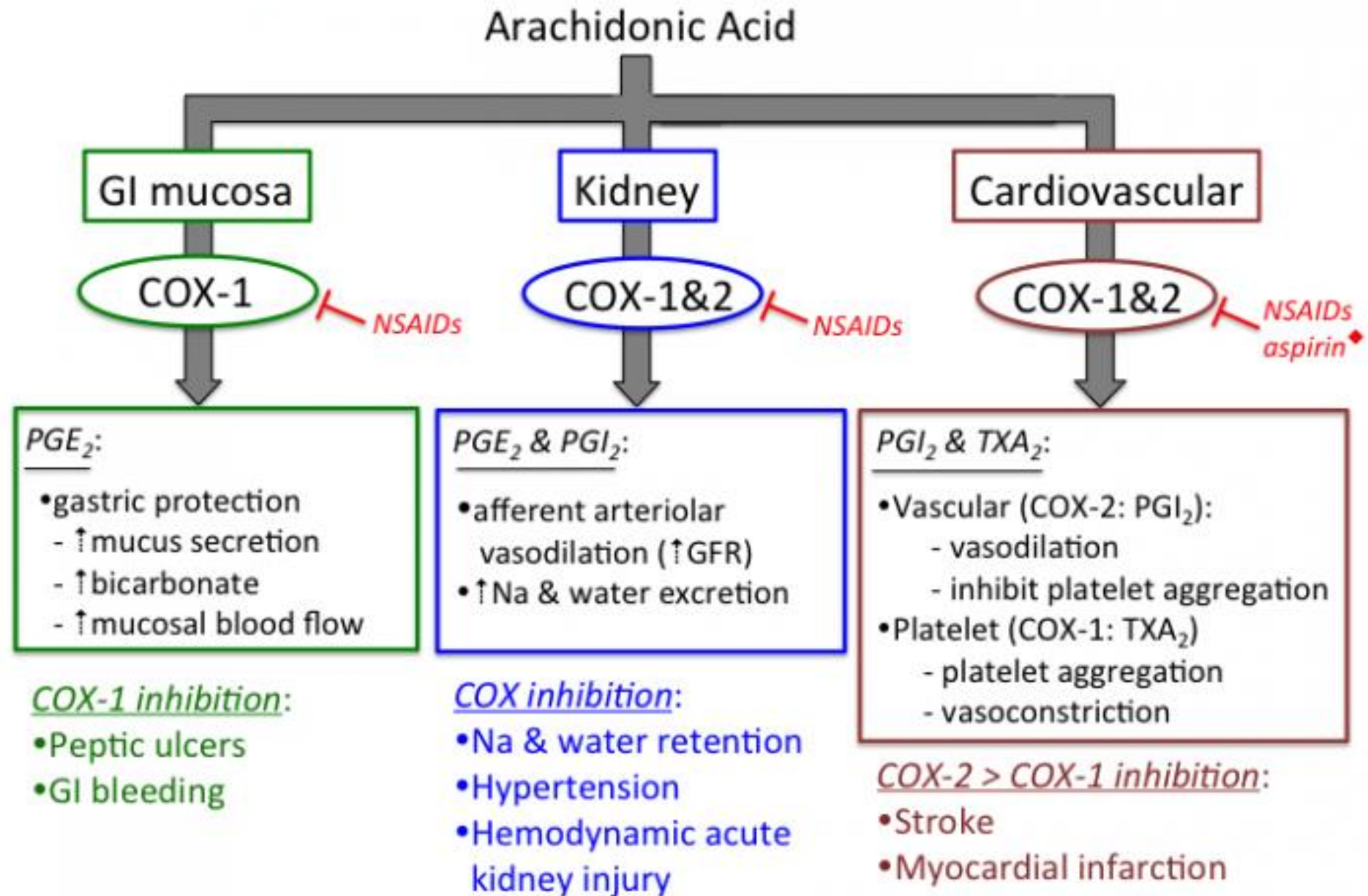
- First-line treatment if no contraindication
- Mechanism: thought to inhibit prostaglandin synthesis in CNS (COX-3)
→ analgesia, antipyretic
- Typical dose: 650 to 1000 mg
- Max dose: 4 g / 24 hrs from all sources
- Warning: ↓ dose / avoid in those with liver damage



NSAIDs

- Also, first-line treatment
- Mechanism
 - Block cyclooxygenase (COX) enzyme → ↓ prostaglandin synthesis
 - COX-2 → Prostaglandins → pain, inflammation, fever
 - COX-1 → Prostaglandins → gastric protection, hemostasis
- Warnings: ↓dose / avoid if
 - GI ulceration
 - Bleeding disorders / Coagulopathy
 - Renal dysfunction
 - High cardiac risk – COX-2 inhibitors
 - Asthma
 - Allergy

NSAID Side Effects:



♦ Low dose aspirin irreversibly inhibits platelet COX-1

Pharmacology of non-opioid analgesics

Non-opioids are used in multimodal analgesia to reduce risks associated with opioids and enhance analgesic effects.

Medication	Onset (min)	Peak effect (min)	Duration (min)	Notes
Dexmedetomidine	5-10	25	240	• Easily titrated
I.V. acetaminophen	15	30	240-360	• Used at end of surgery • Contraindicated in patients with liver disease
Ketorolac	30	45-60	240-360	• Used at end of surgery • Caution in patients with bleeding issues
Ketamine	0.5-1	5	30-60	• May cause postoperative delirium • Adjunct for patients with chronic pain • Bronchodilator

Opioids

- Key Points:
 - Centrally acting on opioid receptors
 - No ceiling effect
 - High dose/response variability in non-opiate users
 - Previous dependence creates a challenge in acute on chronic pain management cases
 - Balancing safety and efficacy can be difficult
 - Side effects may limit reaching effective dose



Side Effects

- Nausea / Vomiting
- Sedation
- **Respiratory depression**
- Pruritus
- Constipation
- Urinary retention
- Ileus
- Tolerance



Pharmacology of commonly used opioids

These commonly used opioids have a range of onset, peak effect, and duration times.

Medication	Onset (min)	Peak effect (min)	Duration (min)	Potency (compared to morphine)	Notes
Fentanyl	2	5	30-60	100x	• Easily titrated
Morphine	5-10	15-20	120-240	N/A	• Causes histamine release • Use caution in patients with renal failure
Hydromorphone	10-15	20-30	120-180	5-8x	• Greater safety margin than morphine

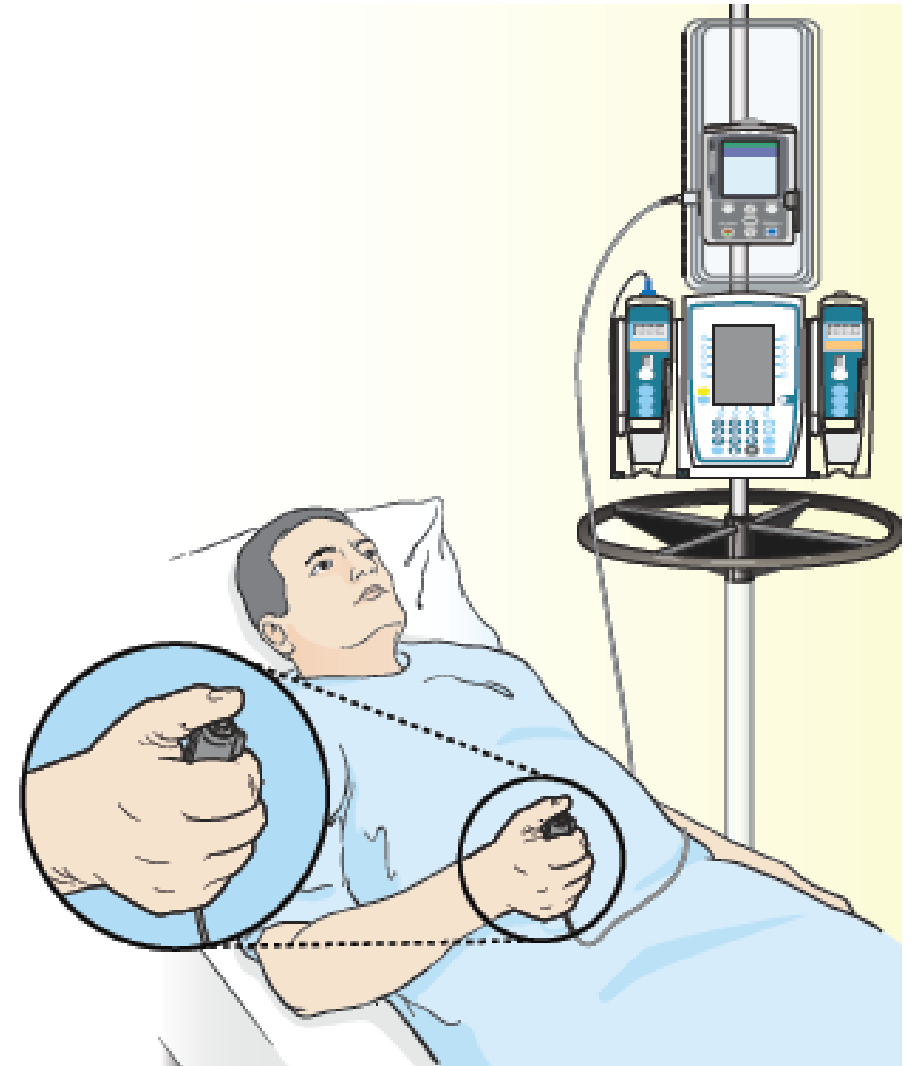
Pharmacology of less commonly used opioids

Except for meperidine, less commonly used opioids are limited to administration only during surgery.

Medication	Onset (min)	Peak effect (min)	Duration (min)	Potency (compared to morphine)	Notes
Sufentanil	2	5	30-60	1,000x	• Used only during surgery
Remifentanil	1.5	1.5	9-18	100x	• Used only during surgery
Alfentanil	1-2	1-2	30	10x	• Used only during surgery
Meperidine	1-2	5-7	120-240	0.1x	• Histamine release • Active metabolite (normeperidine) increases risk for seizures • Weak opioid • Restricted to postoperative shivering and patients with morphine/hydromorphone allergy

Opioid's patient-controlled analgesia (PCA)

- Allows patient to reach their own minimum effective analgesic concentration (MEAC)
- Rapid titration (Morphine 1mg IV every 5 min)
- Better analgesia and less side effects than IM



Gabapentin

- Anti-epileptic drug, also useful in:
 - Neuropathic pain, postherpetic neuralgia, complex regional pain syndrome
- Blocks voltage-gated Ca channels in CNS
- Additive effect with NSAIDs
- Reduces opioid consumption by 16-67%
- Reduces opioid related side effects
- Drowsiness if dose increased too fast

Management of Side Effects

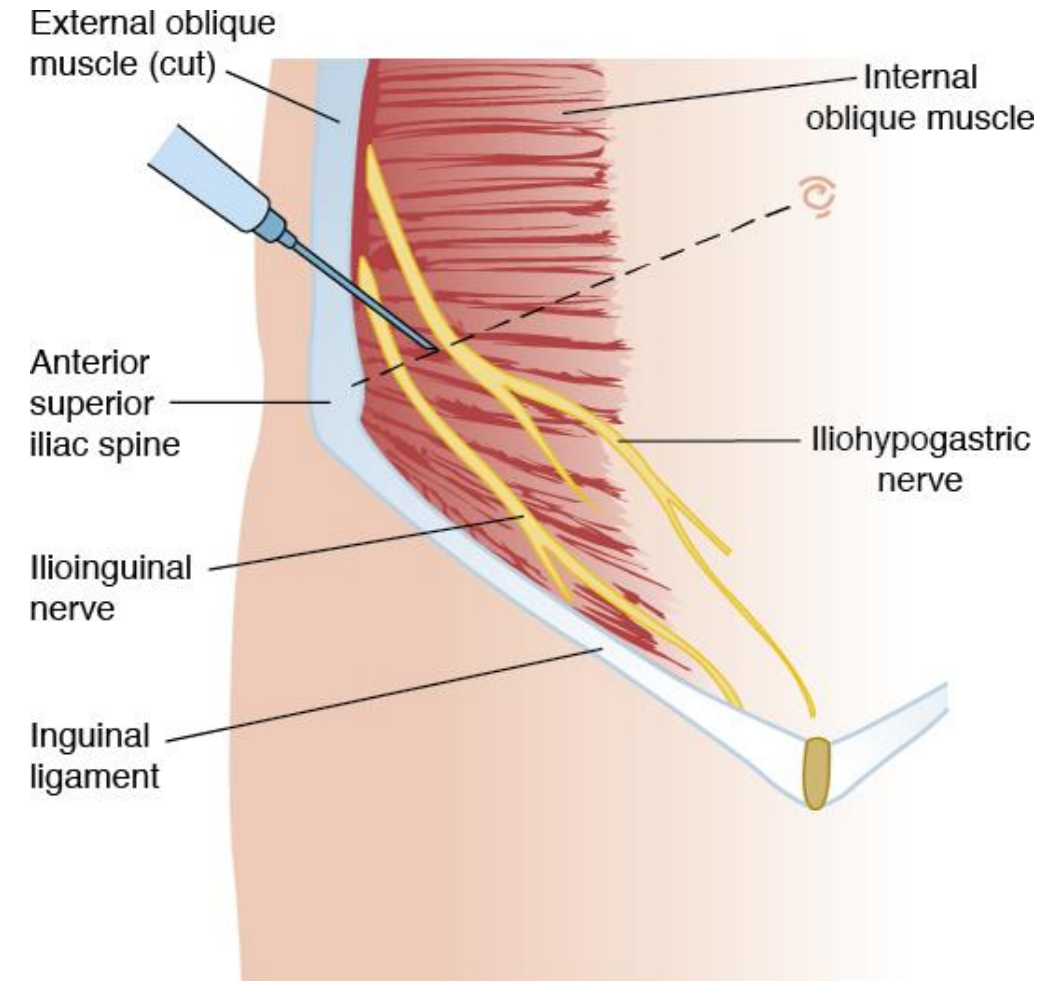
- Nausea / Vomiting
 - Ondansetron (Zofran)
 - Dimenhydrinate (Gravol)
 - Metoclopramide (Maxeran)
 - Changing medication(s) / ↓ dose
- Pruritus
 - Diphenhydramine (Benadryl)
 - Changing medication(s) / ↓ dose

Regional Anesthesia

- Involves blockade of nerve impulses using local anesthetics (LA)
- LA bind sodium channels preventing propagation of action potentials along nerves
- Wide variety of LA with different characteristics:
 - i.e. Novocain (ether) – very fast onset, very short duration, allergy
 - ie. Lidocaine (amide) – fast onset, short duration of action
 - ie. Bupivacaine (amide) – slow onset, longer duration

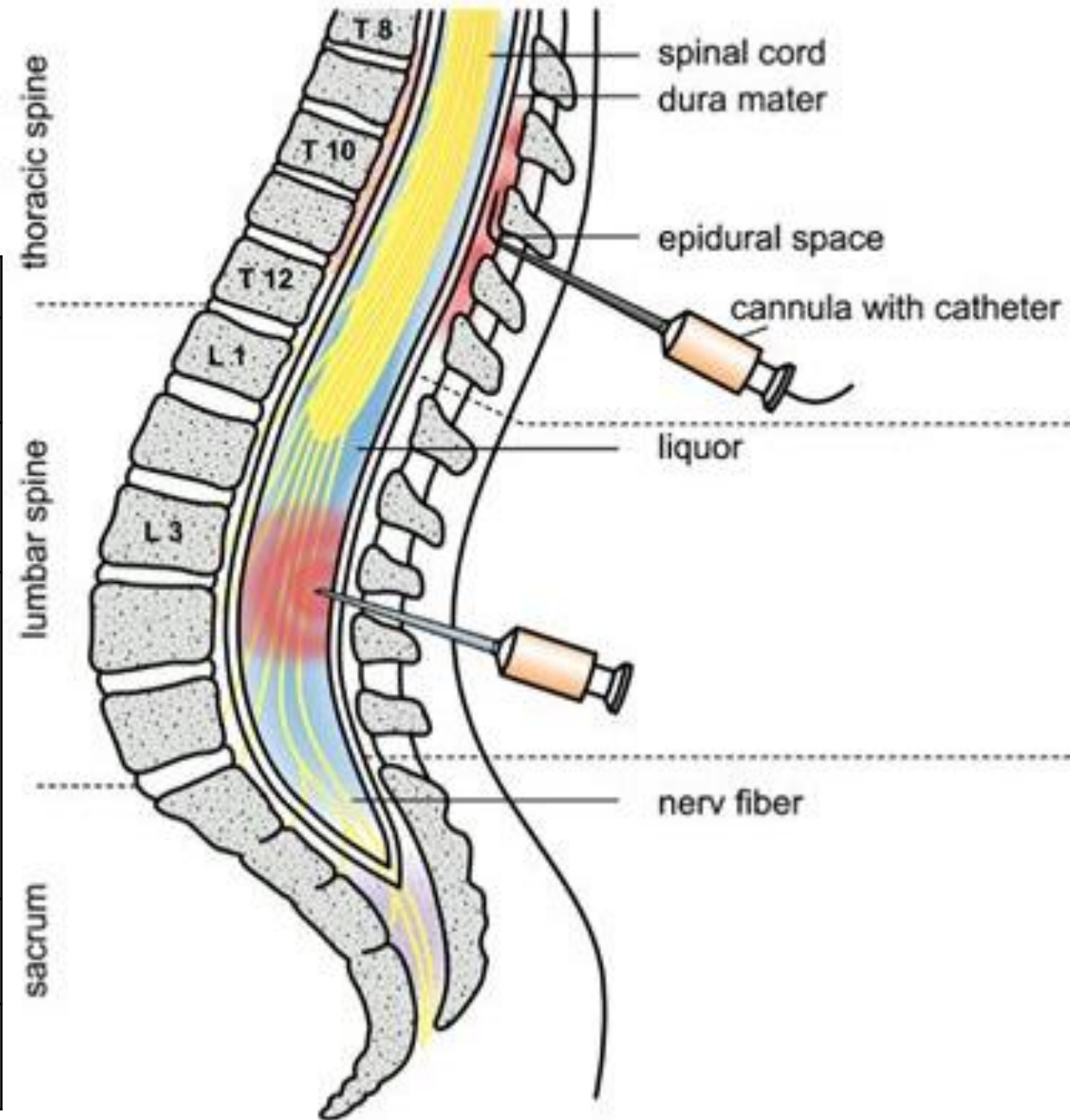
Regional Anesthesia

- Peripheral Nerve Blocks
 - Upper Limb: Brachial plexus
 - Lower Limb: femoral, sciatic, popliteal, ankle
 - Abdomen: transverse abdominis plane (TAP) blocks
 - Thoracic: paravertebral, intercostal blocks
- Use of Ultrasound Imaging has revolutionized peripheral nerve blockade
 - Safety?
 - Accuracy / Improved Success
 - Efficiency



Neuraxial Techniques

Spinal (subarachnoid) anesthesia	Epidural anesthesia
The universal level of puncture at L3-L4	Different sites of puncture according to the treatment zone
Anesthetic solution mixed with liquor	Anesthetic solution spreads through epidural space to neighbor segments
Transfer with liquor according to the relative density • Hypobaric solution comes up • Isobaric solution stays at puncture zone • Hypobaric solution comes down	Spreading depends on the volume of solution
Block spinal nerve root lower zone of puncture	Block spinal nerve root at the site of puncture
Can be used only for lower parts of the body	Can be used on each part of the body (neck?)



Benefits of epidural analgesia

- Superior analgesia in open abdominal procedures & specifically in colorectal surgery
- Reduce incidence of paralytic ileus
- Blunt surgical stress response
- Improves dynamic pain relief
- Reduces systemic opiate requirements
- Facilitates early oral intake, mobilization and return of bowel function when part of fast-track protocols

Contraindications to Neuraxial Blockade

Absolute:

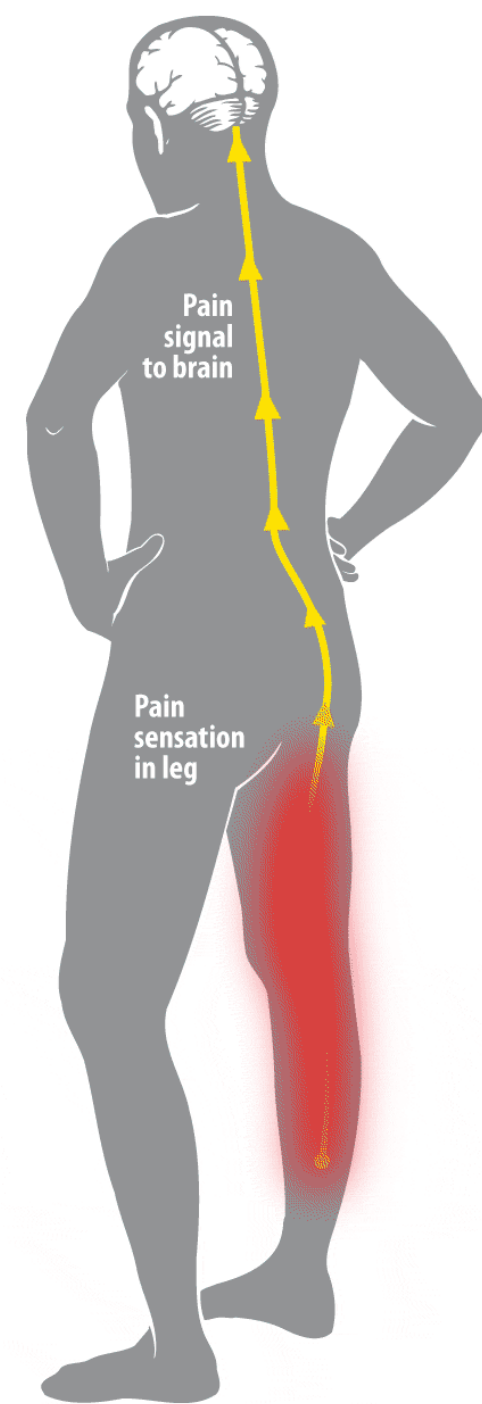
- Patients' refusal or allergy to LA
- Uncorrected hypovolemia
- Infection at insertion site
- Raised intracerebral pressure
- Coagulopathy

Relative:

- Uncooperative patient
- Fixed cardiac output states
- Systemic infection/sepsis
- Unstable neurological disease
- Significant spine abnormalities or surgery

Spinal cord stimulation

- Spinal cord stimulation therapy masks pain signals before they reach the brain.
- Spinal cord stimulators consist of thin electrodes and a small, pacemaker-like battery pack.
- The electrodes are placed in the epidural space, and the generator is placed under the skin, usually near the buttocks or abdomen.
- Spinal cord stimulators allow patients to send the electrical impulses using a remote control when they feel pain.
- Both the remote control and its antenna are outside the body.
- Some SCS devices use a low-frequency current to replace the pain sensation with a mild tingling feeling called paresthesia.
- Other SCS devices use high-frequency or burst pulses to mask the pain with no tingling feeling. A paresthesia-free setting is an option on most devices.



Summary

- Accurate pain assessment
- Make sure to continue or account for patient's pre-hospital pain regimen
- Use Multimodal pain management
- Discharge pain management plan