Acute & Chronic Pain in Trauma Patients: Tools for Nursing

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ASSISTANT PROFESSOR

Objectives

Define pain

Identify the physiology of Pain signaling process

Review acute and chronic pain assessment

Explore strategies at reducing opioids in management of acute and chronic pain

Explore plans for chronic pain patients with acute pain events

How Do you define pain?

An unpleasant _____ and _____experience associated with actual or potential tissue damage or described in terms of such damage.

Pain is adaptive!

Harrison's Principles of internal medicine 19th ed

Acute

Acute pain is nociceptive pain associated with specific somatosensory stimuli, usually mechanical or inflammatory, and an identifiable peripheral injury or lesion.

(Schneiderhan et al., 2017)

Chronic Pain

Chronic pain is a complex, biologic, psychological, and social phenomenon that may be influenced by individual patient genetics, life experiences, and current circumstances.

The transition to chronic pain is generally defined as occurring at 12 weeks, on the assumption that the offending injury or lesion has healed.

Non-cancer pain, not rapidly progressing

Pain that persists beyond the usual recovery period

(Schneiderhan et al., 2017; Stanos et al., 2016)

Subacute pain?

CDC now recognizes Subacute pain

1-3 month period

Consequences of Uncontrolled pain

Physiologic

- CV changes with Oxygen/demand mismatch
- Decreased diaphragm function, increased respiratory complications
- Reduced GI motility
- Oliguria and urinary retention
- Atrophy
- Decreased ROM

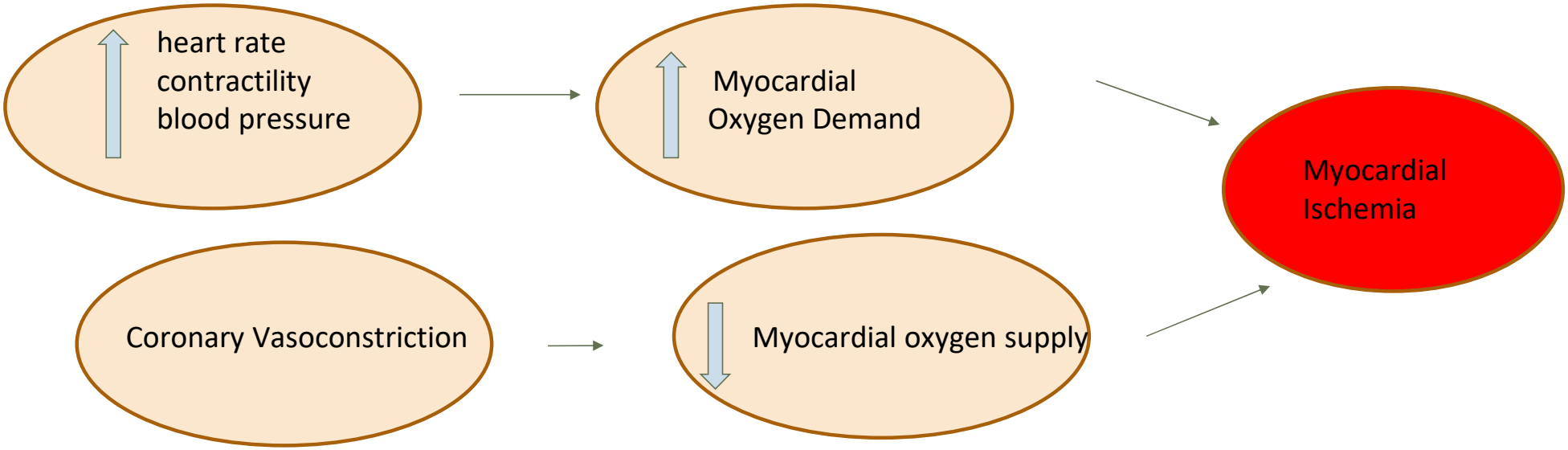
Institutional

- Increased Hospital LOS
- Decreased Patient satisfaction
- Longer time to PT milestones
- Readmissions
- Increased cost

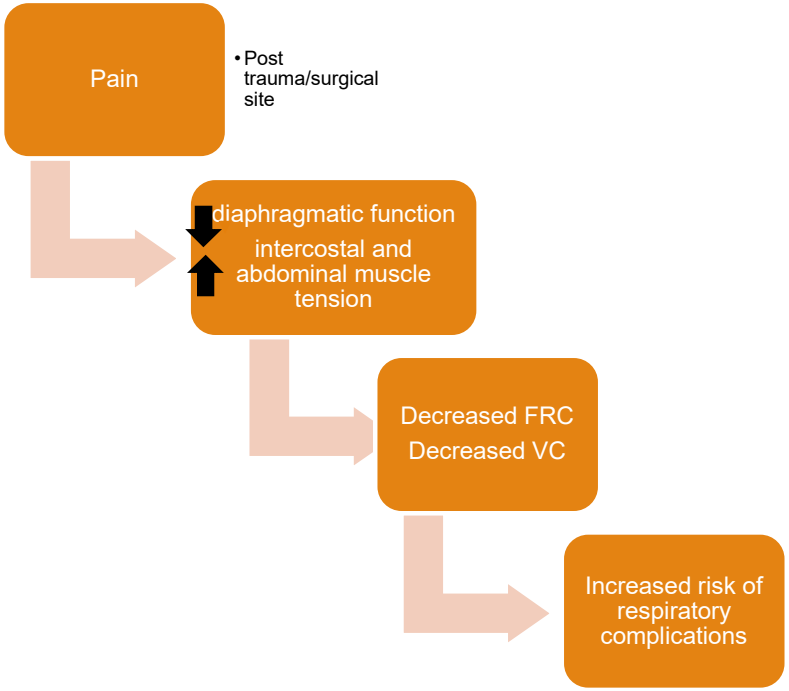
Lamplot J, W. E. (2014). Multimodal Pain management in Total Knee Arthroplasty : A Prospective Randomized Controlled Trial. *The Journal of Arthroplasty*, 329-334.

Consequences of uncontrolled pain

Cardiovascular:



Consequences of uncontrolled pain



Lamplot J, W. E. (2014). Multimodal Pain management in Total Knee Arthroplasty : A Prospective Randomized Controlled Trial. *The Journal of Arthroplasty*, 329-334.

Consequences of uncontrolled pain

GI: reduced motility, ileus, n/v

Renal: oliguria, urinary retention

Immune: impairment-> infection

Muscle: weakness, atrophy

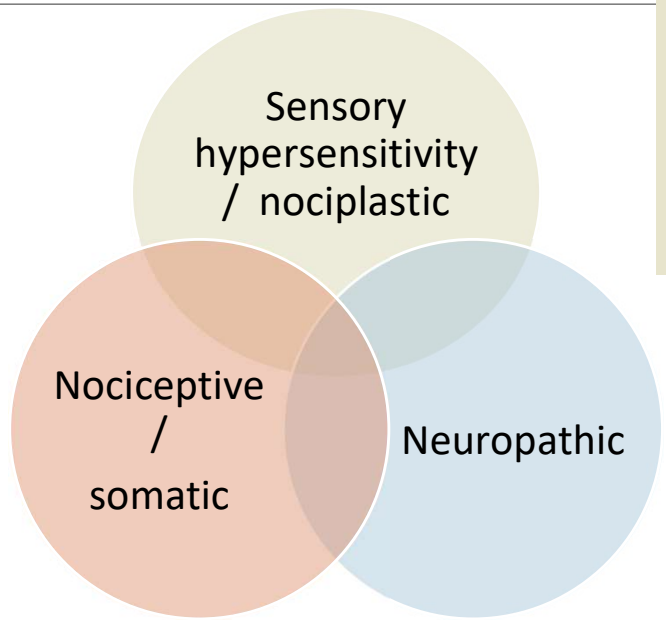
Psych: Anxiety, fear, depression

Impaired sleep: increased risk for delirium

Pain Types

Sensory/hypersensitivity/nociplastic
- Central disturbances in pain processing

- Examples:
  - Fibromyalgia
  - TMJ
  - IBS
  - Tension headache



Nociceptive
- Musculoskeletal

- Examples:
  - Oncological pain
  - Osteoarthritis
  - Rheumatoid Arthritis

Neuropathic
- damage/dysfunction to peripheral nerves

- Examples:
  - diabetic neuropathic pain
  - post herpetic neuralgia
    - Spinal injury
    - Chemo-induced neuropathy

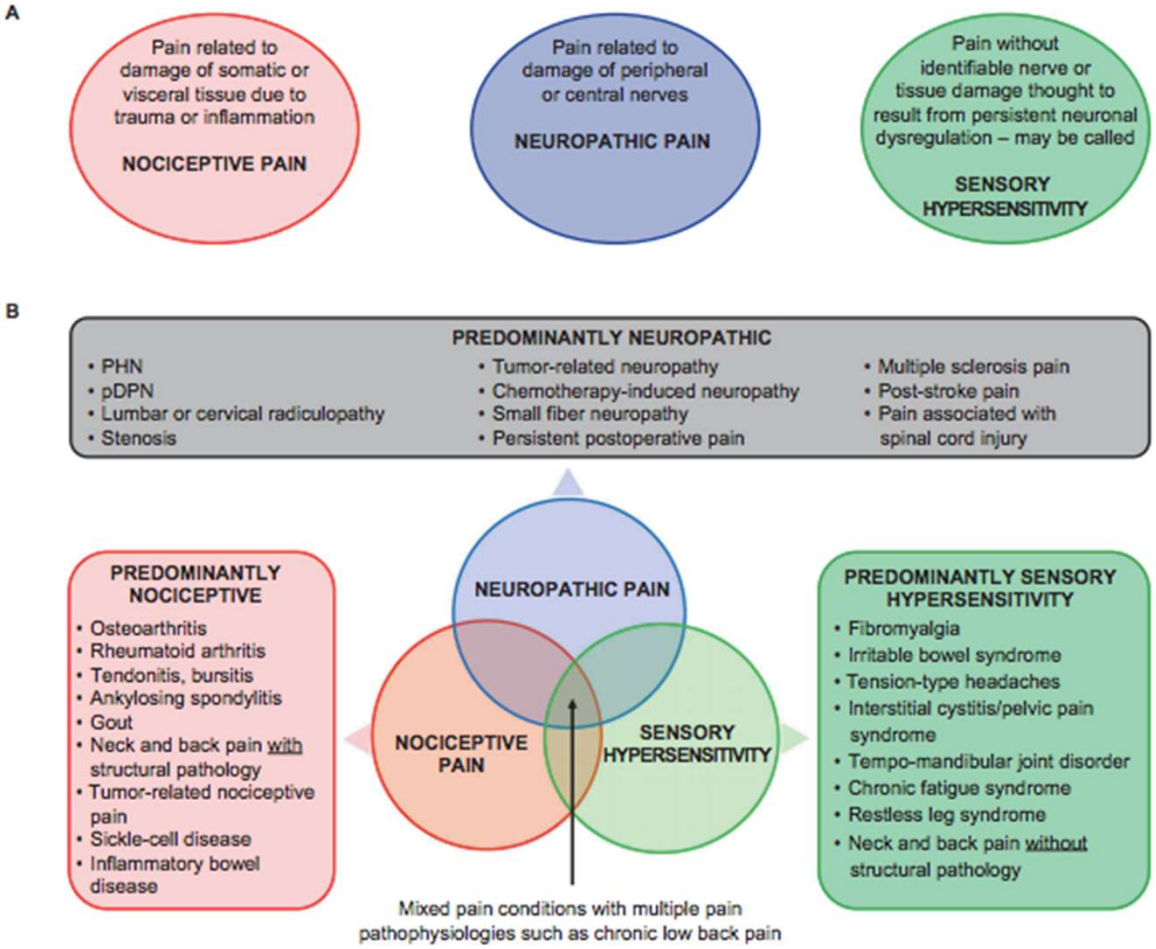


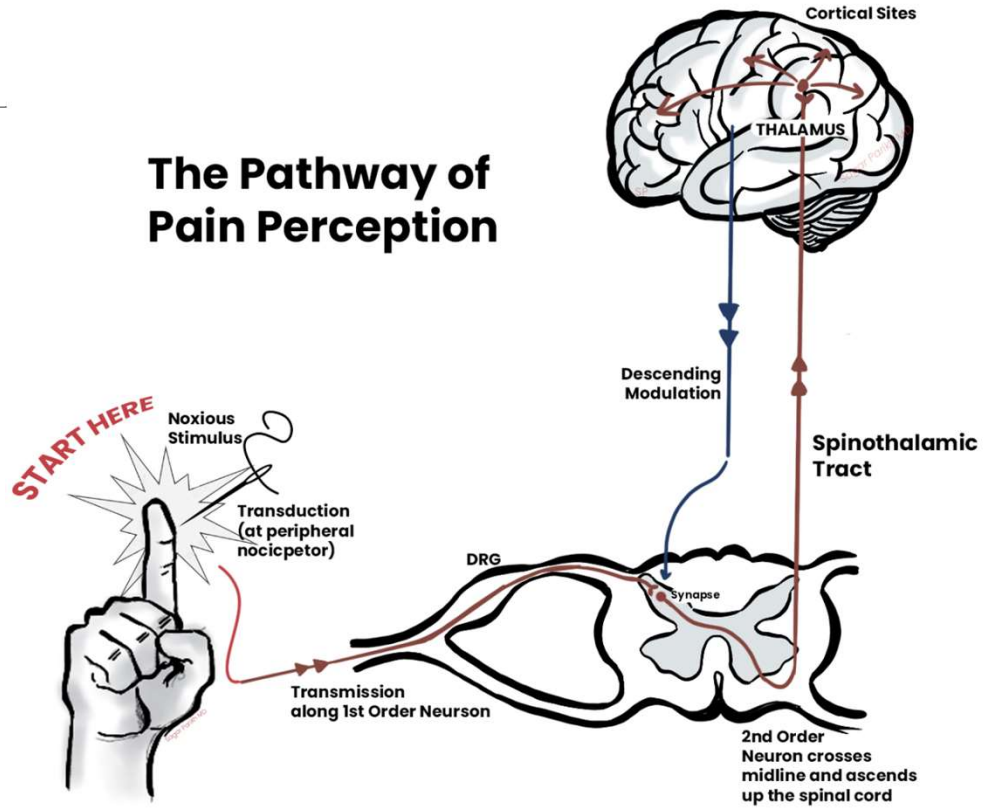
Figure 1. (A) The three main types of pain pathophysiology give rise to chronic pain conditions. (B) These types of pain may present separately or in combination to contribute to the overall pain experience.
PHN = postherpetic neuralgia; pDPN = painful diabetic peripheral neuropathy.

(Stanos et al., 2016)

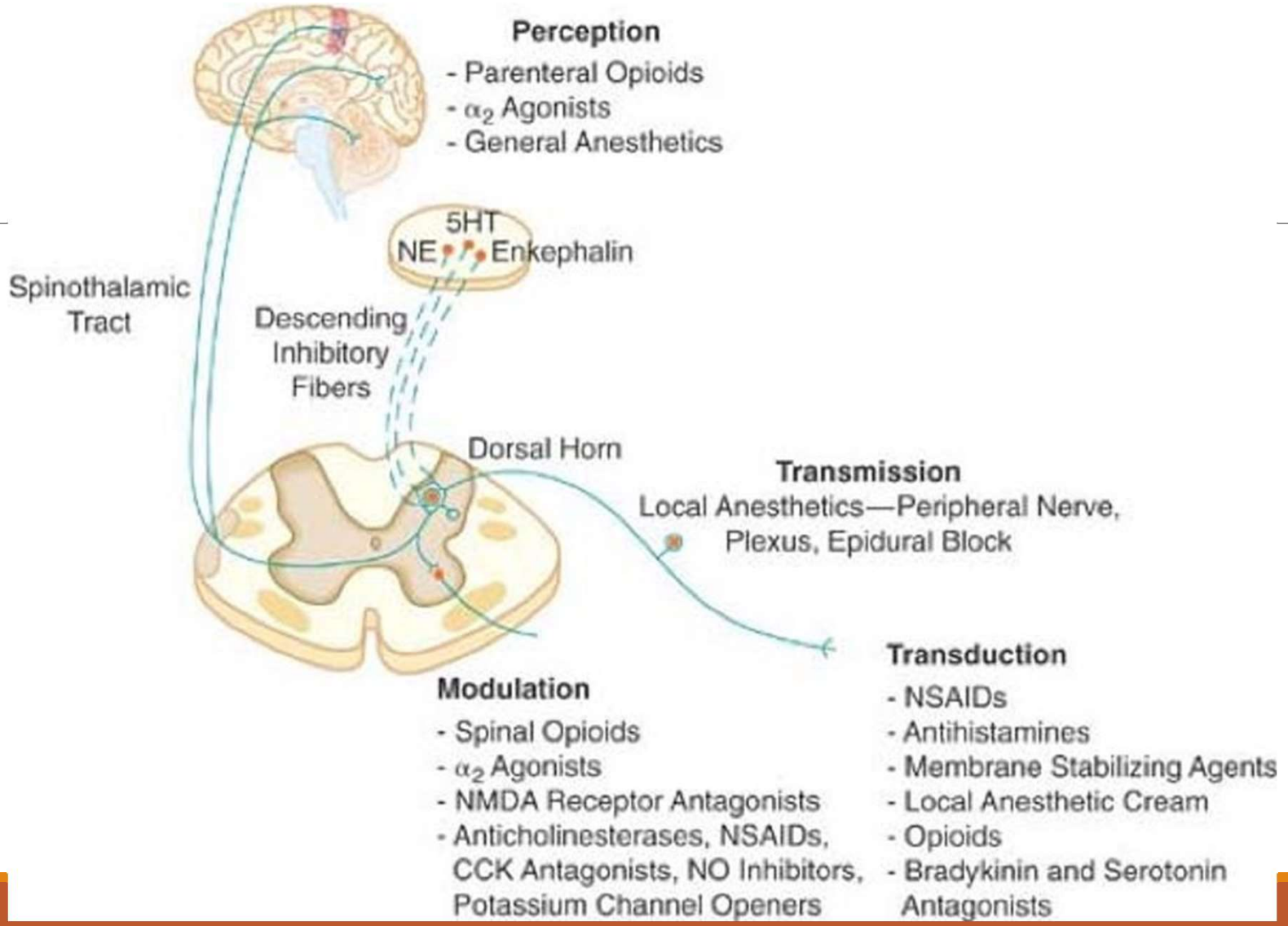
Patient pain descriptors/reported symptoms among the 3 types of pain:

Nociceptive pain	Neuropathic pain	Sensory hypersensitivity
• Sore • Throbbing • Dull • Tender • Aching • Cramping	• Hot • Burning • Electric shocks • Stabbing • Painful cold • Tingling • Prickling • Numbness • Pins and needles • Allodynia • Hyperalgesia	• Widespread pain with neuropathic pain qualities including allodynia and hyperalgesia • Fatigue • Non-restorative sleep • Cognitive dysfunction • Mood disturbance • Hypersensitivity to sensory input such as bright lights, loud noises, and smells.

(Stanos et al., 2016)



https://now.aapmr.org/pain-and-placebo-physiology/


Perception
- Parenteral Opioids
- α_2 Agonists
- General Anesthetics
5HT
NE
Enkephalin
Spinothalamic Tract
Descending Inhibitory Fibers
Dorsal Horn
Transmission
Local Anesthetics—Peripheral Nerve, Plexus, Epidural Block
Transduction
- NSAIDs
- Antihistamines
- Membrane Stabilizing Agents
- Local Anesthetic Cream
- Opioids
- Bradykinin and Serotonin Antagonists
Modulation
- Spinal Opioids
- α_2 Agonists
- NMDA Receptor Antagonists
- Anticholinesterases, NSAIDs, CCK Antagonists, NO Inhibitors, Potassium Channel Openers

Assessment of pain

Pain assessment

Numeric 1-10

Faces/Wong baker

Global pain scale

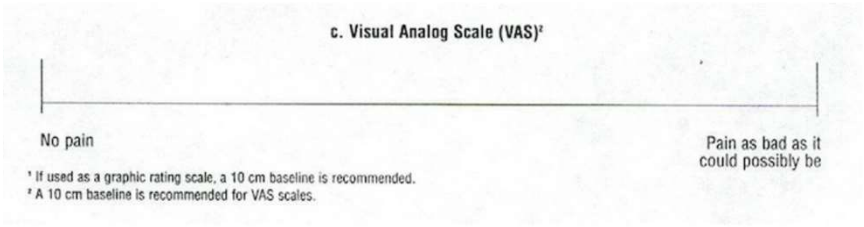
Visual analog score/color pain

CPOT

NVPS

Adult Non-Verbal Pain Scale (NVPS)

Categories	0	1	2
Face	No particular expression or smile.	Occasional grimace, tearing, frowning, wrinkled forehead.	Frequent grimace, tearing, frowning, wrinkled forehead.
Activity (movement)	Lying quietly, normal position.	Seeking attention through movement or slow, cautious movement.	Restless, excessive activity and/or withdrawal reflexes.
Guarding	Lying quietly, no positioning of hands over areas of body.	Splinting areas of the body, tense.	Rigid, stiff.
Physiology (vital signs)	Stable vital signs	Change in any of the following: * SBP > 20 mm Hg. * HR > 20/minute.	Change in any of the following: * SBP > 30 mm Hg. * HR > 25/minute.
Respiratory	Baseline RR/SpO_2 Compliant with ventilator	RR > 10 above baseline, or 5% ↓SpO_2 mild asynchrony with ventilator	RR > 20 above baseline, or 10% ↓SpO_2 severe asynchrony with ventilator



Pain assessment tools

Table 1. Behavioral Pain Scale

Indicator	Score	**Description**
Facial expressions	1	Relaxed
	2	Partially tightened
	3	Fully tightened
	4	Grimacing
Upper limb movements	1	No movement
	2	Partially bent
	3	Fully bent with finger extension
	4	Permanently retracted
Compliance with mechanical ventilation	1	Tolerating movement
	2	Coughing but tolerating ventilation most of the time
	3	Fighting ventilator
	4	Unable to control ventilation
Total score	__ of 12	

Data from: Young J, Siffleet J, Nikoletti S, Shaw T. Use of a behavioural pain scale to assess pain in ventilated, unconscious and/or sedated patients. *Intensive Crit Care Nursing*. 2006;22(1):32-39; Payen JF, Bru O, Bosson JL, et al. Assessing pain in critically ill sedated patients by using a behavioral pain scale. *Crit Care Med*. 2001;29(12):2258-2263; and Ahlers SJ, van der Veen AM, van Dijk M, Tibboel D, Knibbe, CAJ. The use of the Behavioral Pain Scale to assess pain in conscious sedated patients. *Anesth Analg*. 2010;110(1):127-133.

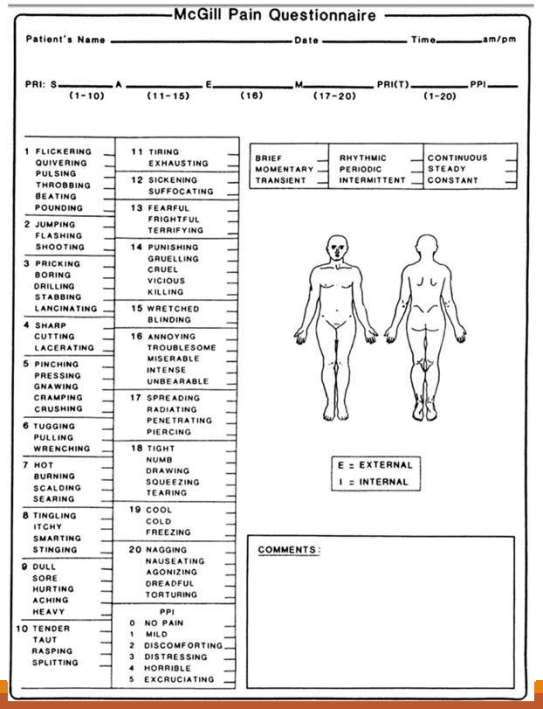
Table 3. Clinically Aligned Pain Assessment Tool

Question	**Response**
Comfort	• Intolerable • Tolerable with discomfort • Comfortably manageable • Negligible pain
Change in pain	• Getting worse • About the same • Getting better
Pain control	• Inadequate pain control • Effective, just about right • Would like to reduce medication
Functioning	• Can't do anything because of pain • Pain keeps me from doing most of what I need to do • Can do most things, but pain gets in the way of some • Can do everything I need to
Sleep	• Awake with pain most of night • Awake with occasional pain • Normal sleep

From: Topham D, Drew D. Quality improvement project: Replacing the numeric rating scale with a clinically aligned pain assessment (CAPA) tool. *Pain Manag Nurs*. 2017;18(6):363-371. Used with permission.

Pain rating scales - Chronic

McGill Pain Score



McGill Pain Questionnaire

Patient's Name _____ Date _____ Time _____ am/pm

PRI: S _____ A _____ E _____ M _____ PRI(T) _____ PPI _____
(1-10) (11-15) (16) (17-20) (1-20)

1 FLICKERING QUIVERING PULSING THROBBING BEATING POUNDING	11 TIRING EXHAUSTING	BRIEF MOMENTARY TRANSIENT	RHYTHMIC PERIODIC INTERMITTENT	CONTINUOUS STEADY CONSTANT
2 JUMPING FLASHING SHOOTING	12 SICKENING SUFFOCATING			
3 PRICKING BORING DRILLING STABBING LANCINATING	13 FEARFUL FRIGHTFUL TERRIFYING			
4 SHARP CUTTING LACERATING	14 PUNISHING GRUELLING CRUEL VICIOUS KILLING			
5 PINCHING PRESSING GNAWING CRAMPING CRUSHING	15 WRETCHED BLINDING			
6 TUGGING PULLING WRENCHING	16 ANNOYING TROUBLESOME MISERABLE INTENSE UNBEARABLE			
7 HOT BURNING SCALDING SEARING	17 SPREADING RADIATING PENETRATING PIERCING			
8 TINGLING ITCHY SMARTING STINGING	18 TIGHT NUMB DRAWING SQUEEZING TEARING			
9 DULL SORE HURTING ACHING HEAVY	19 COOL COLD FREEZING			
10 TENDER TAUT RASPING SPLITTING	20 NAGGING NAUSEATING AGONIZING DREADFUL TORTURING			
	PPI 0 NO PAIN 1 MILD 2 DISCOMFORTING 3 DISTRESSING 4 HORRIBLE 5 EXCRUCIATING			

E = EXTERNAL
I = INTERNAL

COMMENTS:

2016 Fibromyalgia Diagnostic Criteria

1. Widespread pain index (WPI) and symptom severity score (SSS)
   - WPI ≥ 7 and SSS ≥ 5 OR WPI 4-6 and SSS ≥ 9
2. Generalized pain: pain in 4/5 regions
3. Symptoms present ≥ 3 months

The fibromyalgia diagnosis can now be made irrespective of other diagnoses (you do not need to rule out all other conditions that could explain the symptoms, if criteria 1-3 are all met).

1. Widespread pain index (WPI)

In the past week, where have you had pain? (check all that apply)

Left upper region (1)	Right upper region (2)	Axial region (5)
☐ *L jaw*	☐ *R jaw*	☐ Neck
☐ L shoulder girdle	☐ R shoulder girdle	☐ Upper back
☐ L upper arm	☐ R upper arm	☐ Lower back
☐ L lower arm	☐ R lower arm	☐ *Chest*
		☐ *Abdomen*

Left lower region (3)	Right lower region (4)
☐ L hip (buttock/trochanter)	☐ R hip (buttock/trochanter)
☐ L upper leg	☐ R upper leg
☐ L lower leg	☐ R lower leg

Total: _____ WPI score (add up boxes checked, 0-19)
_____Number of regions checked (excluding items in italics); use this for criterion #2.

Symptoms Severity Score (SSS)

For each of the following, for the past week, rate

	0=No problem	1=slight or mild problem, often mild or intermittent	2=moderate, considerable problem, often present	3=severe, pervasive, continuous, life-disturbing
Fatigue	☐	☐	☐	☐
Waking unrefreshed	☐	☐	☐	☐
Cognitive symptoms	☐	☐	☐	☐

In the past week, have you been bothered by any of the following?

	0=No problem	1=Problem
Headaches	☐	☐
Pain or cramps in lower abdomen	☐	☐
Depression	☐	☐

Total SSS: _____(0-12)

Summary:

☐ **1. Criterion 1 is met if you have EITHER**
   - ☐ WPI ≥ 7 and SSS ≥ 5 OR
   - ☐ WPI 4-6 and SSS ≥ 9

☐ **2. Generalized pain: met if you checked pain in 4/5 regions (not including items in italics)**

☐ **3. Symptoms present ≥ 3 months**

Fibromyalgia is diagnosed if you meet all 3 criteria 1-3, independent of whether other diagnoses contribute to these symptoms. This is new: FMS diagnosis used to require that there be no other diagnosis to explain the findings.

Considerations in Traumatic injury

Trauma in Pain

- Poor ability to quantify pain in poly trauma
  - improved quantification of pain could reduce over use of opioids

- Patient classifications with higher pain:
  - Middle aged patients when compared to extremes of ages
  - Penetrating injury - more statistically significant when surgical intervention is involved
  - Higher Injury Severity score is associated with higher pain
  - Isolated spinal injuries independent of surgical intervention

Pain Treatment

Non-Pharmacologic interventions

Table 6. Overview of Nonpharmacologic Pain Management

Therapy	Evidence Base in Trauma/Burn Care	Expertise Required	Associated Cost
Cognitive Strategies			
Animal-assisted therapy	Low	Moderate	Moderate
Cognitive behavioral therapy	Moderate[A,B]	Moderate	Low
Hypnosis	Moderate[C,D]	High	Moderate
Mindfulness	Low[B,C]	Moderate	Low
Music therapy	Moderate[C]	Low	Low
Virtual reality	High[D]	Low	High
Physical Strategies			
Acupuncture	Moderate[D,E]	High	High
Aromatherapy	Moderate[D,E]	Low	Low
Iontophoresis	Moderate[E]	High	High
Immobilization	Moderate[E]	Low	Low
Massage therapy	Moderate[A,D]	Moderate	Low
Temperature therapy (cold)	Low	Low	Low
Temperature therapy (heat)	Moderate[E]	Low	Low
Transcutaneous electrical nerve stimulation (TENS)	High[E]	Moderate	High
Ultrasound	Moderate[F]	High	High

Key: [A]Spinal cord injury, [B]Chronic pain, [C]Extremity/orthopaedic trauma, [D]Burn, [E]Perioperative/acute pain, [F]Muscle/tendon injury.

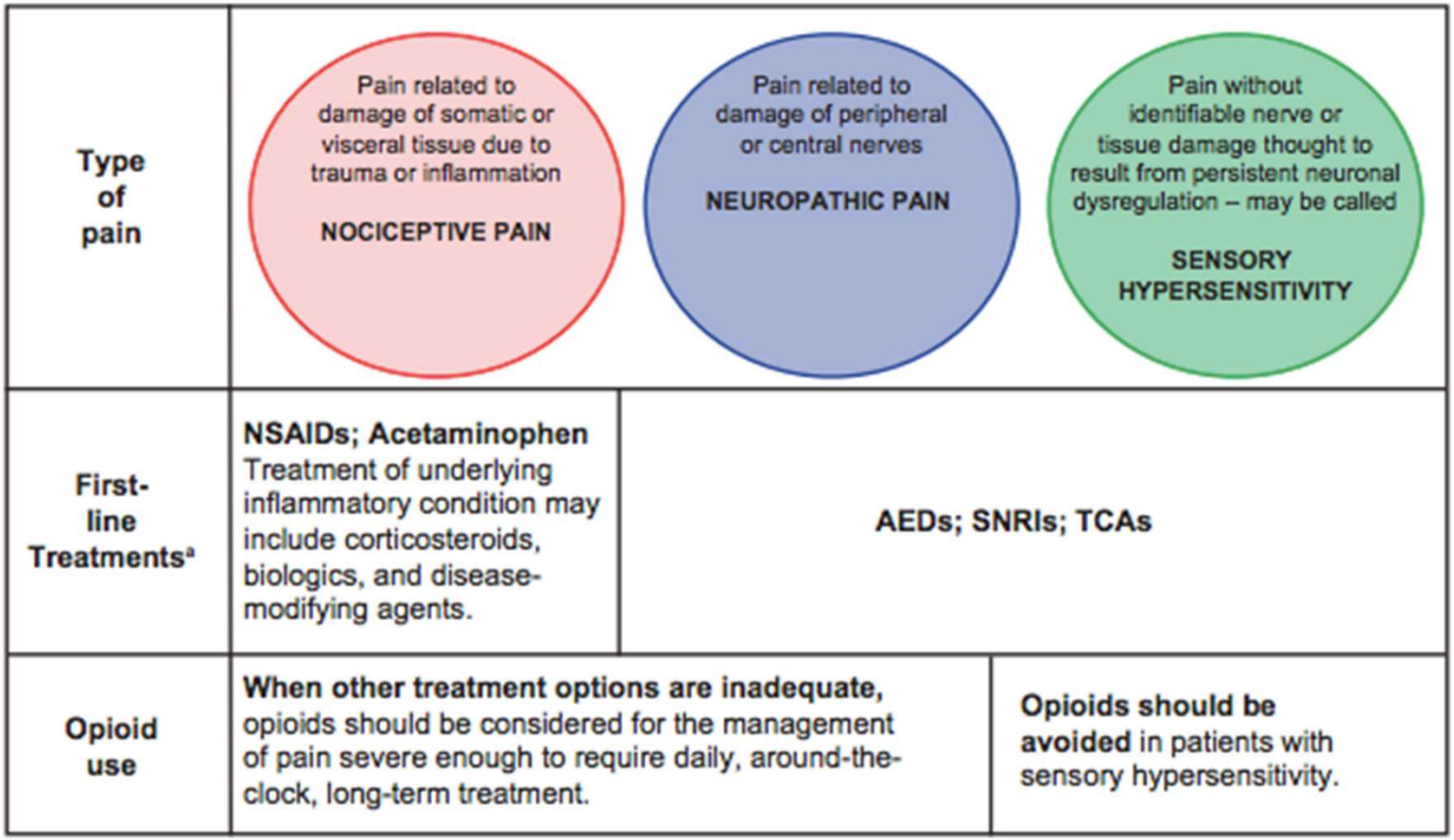


Figure 2. Recommended medication classes for the three types of pain pathophysiology.
[a]Based on strength of clinical evidence. NSAIDs = nonsteroidal anti-inflammatory drugs; AEDs = antiepileptic drugs; SNRIs = serotonin-norepinephrine reuptake inhibitors; TCAs = tricyclic antidepressants.

(Stanos et al., 2016)

Pharmacologic Analgesia: Nociceptive pain

APAP

Consistently demonstrates decreased opioid needs

Scheduled ideal
- Intravenous
- Often limited due to cost
- Occasional hypotension

Multiple formulations

Avoid in liver failure

Reduce dose in older adults and chronic liver disease

NSAIDS

Inhibit Cox – 1 and2-> prostaglandins

Decrease opioid requirements

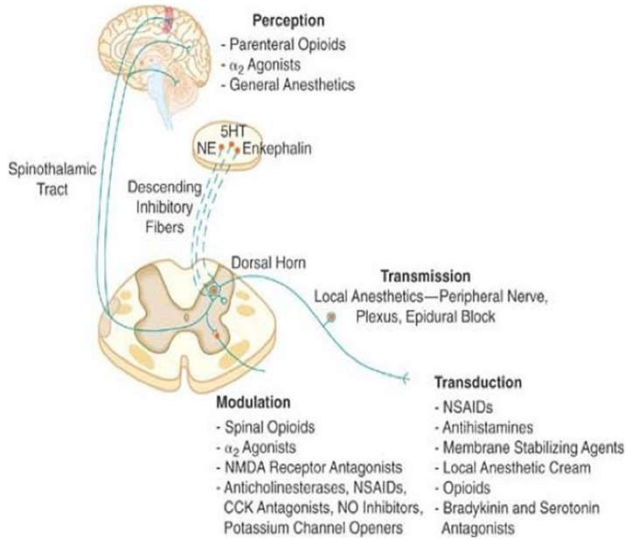
Risks
- GI bleeding
- AKI
- CV events
- Antiplatelet activity
- Frequently avoided in TBI
- Caution in Colorectal resection

What about NSAIDS and Fractures?

Pharmacologic Analgesia: Nociceptive Pain

Opioids

- Modulate pain signaling in ascending and descending pathways
- Side Effects
  - Respiratory and CNS depression
  - Delay of ROBF
  - Risk of ileus
  - Concern for chronic opioid use
- Factors increasing risk for OD/SUD
  - Family or personal history of SUD or OD
  - Depression
  - Age (OD risk)
  - Underlying renal, hepatic or pulmonary dysfunction



Pharmacologic Analgesia: Nociceptive Pain: Opioids

Opioid use for LBP is correlated to long term opioid use

- 1-13%
- Odds increases with longer duration of initial exposure
- OR 2.08 for long term opioid use with 1-140 MME provided
- OR 6.14 for long term opioid use with >450 MME prescription

- https://www.oregonpainguidance.org/opioidmedcalculator/

Webb, Bradley & Spears, J. & Smith, Langan & Malkani, Arthur. (2015). Periarticular injection of liposomal bupivacaine in total knee arthroplasty. Arthroplasty Today. 1. 10.1016/j.artd.2015.09.001.

Opioids and patient education

Table 1
Equianalgesic conversion.

Drug	Administration	Dose (mg)	Conversion factor	PO morphine equivalent dose (mg)
Morphine	PO	10	1	10
	IV	10	3	30
Hydromorphone	PO	10	4	40
	IV	10	20	200
Hydrocodone	PO	10	1	10
Oxycodone	PO	10	1.5	15
Tramadol	PO	10	0.25	2.5

PO, oral; IV, intravenous.

Multimodal approach to pain management in setting of trauma reducing MME

Patient education associated with decreased opioid use

Harvin et al 2021, Karamchandani, K et all 2022; Kay, A et all 2022; Colloca 2022

Pharmacologic Analgesia: Nociceptive Pain: Opioids

Routes
- Enteral preferred

Escalating pain?
- May require escalating opioids
- Opioid rotation

Extended-release Opioids
- Avoid in acute pain
- Not indicated in most trauma
- More commonly in cancer related pain

OUD in traumatic pain

Check all that apply	
	Opioids are often taken in larger amounts or over a longer period of time than intended.
	There is a persistent desire or unsuccessful efforts to cut down or control opioid use.
	A great deal of time is spent in activities necessary to obtain the opioid, use the opioid, or recover from its effects.
	Craving, or a strong desire to use opioids.
	Recurrent opioid use resulting in failure to fulfill major role obligations at work, school or home.
	Continued opioid use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of opioids.
	Important social, occupational or recreational activities are given up or reduced because of opioid use.
	Recurrent opioid use in situations in which it is physically hazardous
	Continued use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by opioids.
	*Tolerance, as defined by either of the following: (a) a need for markedly increased amounts of opioids to achieve intoxication or desired effect (b) markedly diminished effect with continued use of the same amount of an opioid
	*Withdrawal, as manifested by either of the following: (a) the characteristic opioid withdrawal syndrome (b) the same (or a closely related) substance are taken to relieve or avoid withdrawal symptoms

https://www.asam.org/docs/default-source/education-docs/dsm-5-dx-oud-8-28-2017.pdf

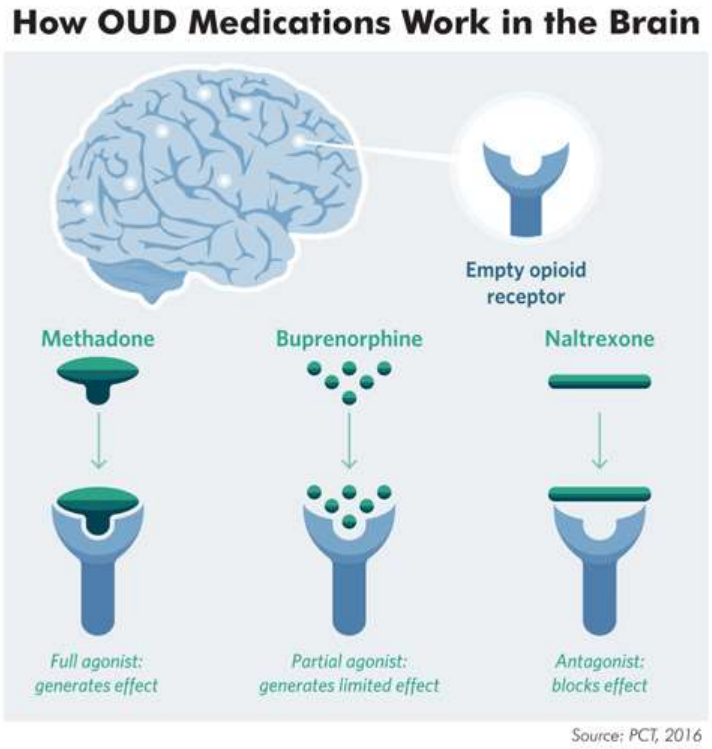
Buprenorphine

Partial mu agonist

Higher receptor affinity compared to other opioids

Analgesic effect

- Greater potency compared to morphine



Culshaw, J. , Philpott, C. , Reinstatler, K. , Bradshaw, P. , Brizzi, M. , Makley, A. & Droege, M. (2022). 1555: EVALUATION OF ACUTE PAIN MANAGEMENT IN TRAUMA PATIENTS ON HOME BUPRENORPHINE. *Critical Care Medicine, 50* (1), 781-781. doi: 10.1097/01.ccm.0000812544.38918.29.

Medication	Dosing			Precautions (P), Contraindications (CI), and Considerations[A]
	Maintenance Dose	Routes of Administration	Maximum Suggested Dose/ Duration[A]	
N-methyl D-aspartate (NMDA) Antagonists				
Ketamine	0.3 mg/kg (bolus) 0.1 mg/kg/ hr (infusion)	IV, IM, IN	0.5 mg/kg/ dose (bolus) 1 mg/kg/hr	• Acute psychosis, cerebrovascular accident (CVA), cardiac decompensation (CI) • Dose based on ideal body weight if obese • Dependence potential • Monitor for emergence reactions
Magnesium	30–50 mg/kg	IV	Limited evidence to guide	• Heart block or myocardial damage (CI) • Renal dysfunction (P) • Bolus dose associated with hypotension, flushing
α_2-receptor agonists				
Clonidine	0.1 mg q8h	PO	2 mg/day	• Hemodynamic instability (P) • Hypotension and bradycardia common with dexmedetomidine bolus, development of hypotension, and bradycardia with infusion may limit its use • Sedating • Require taper if on longer than 7 days
Dexmedetomidine	0.4 mcg/kg/ hr (infusion) ±1 mcg/ kg (bolus)	IV	1.4 mcg/kg/hr	

Medication	Dosing			Precautions (P), Contraindications (CI), and Considerations[A]
	Maintenance Dose	Routes of Administration	Maximum Suggested Dose/ Duration[A]	
Local Anesthetics				
Lidocaine	1.5 mg/kg (bolus) 5% patch q24h	IV, topical	200 mg/dose (IV) 3 patches/day	• Heart block (CI, intravenous product) • Monitor for local anesthetic systemic toxicity with IV product • Limited evidence for topical formulations
Opioids				
Fentanyl	IV: 25-50 mcg q30-60min CI: 50 mcg/hr	IV	200 mcg/hr	• All opioids confer risk of addiction and life-threatening respiratory depression • Extended-release preparations are not intended for acute pain • Fentanyl may accumulate in lipid stores with prolonged use
Hydromorphone	PO: 2 mg q4h IV: 0.4 mg q3h CI: 0.5 mg/hr	PO, IV	PO: 10 mg/dose IV: 1 mg/dose CI: 3 mg/hr	
Morphine	IV: 2 mg q3h	PO, IV	10 mg/dose	
Oxycodone	5 mg q4h	PO	20 mg/dose	
Tramadol	50 mg q4h	PO	400 mg/day	

Regional Anesthesia: Peripheral Nerve Blocks

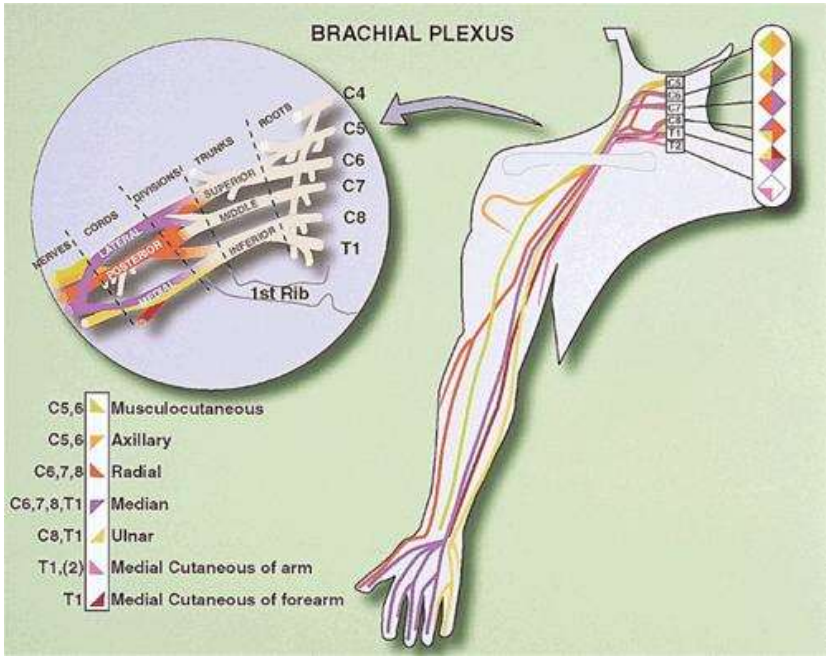
- Single Shot
- Indwelling catheter

Indications

limb surgery
traumatic injury/sutures/wound repair
Rib fractures/surgical site pain

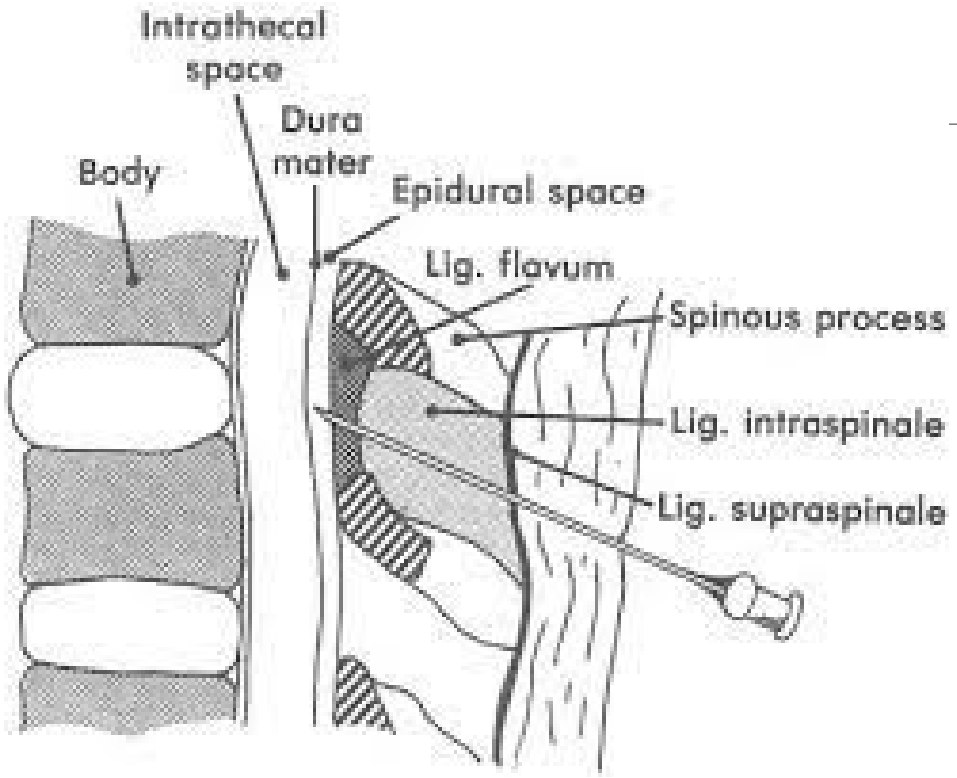
Contraindications

Allergy
nerve injury
risk for compartment syndrome
Infection
inability to communicate



Folino TB, Mahboobi SK. Regional Anesthetic Blocks. [Updated 2022 Jul 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK563238/

Regional Anesthesia: Neuraxial



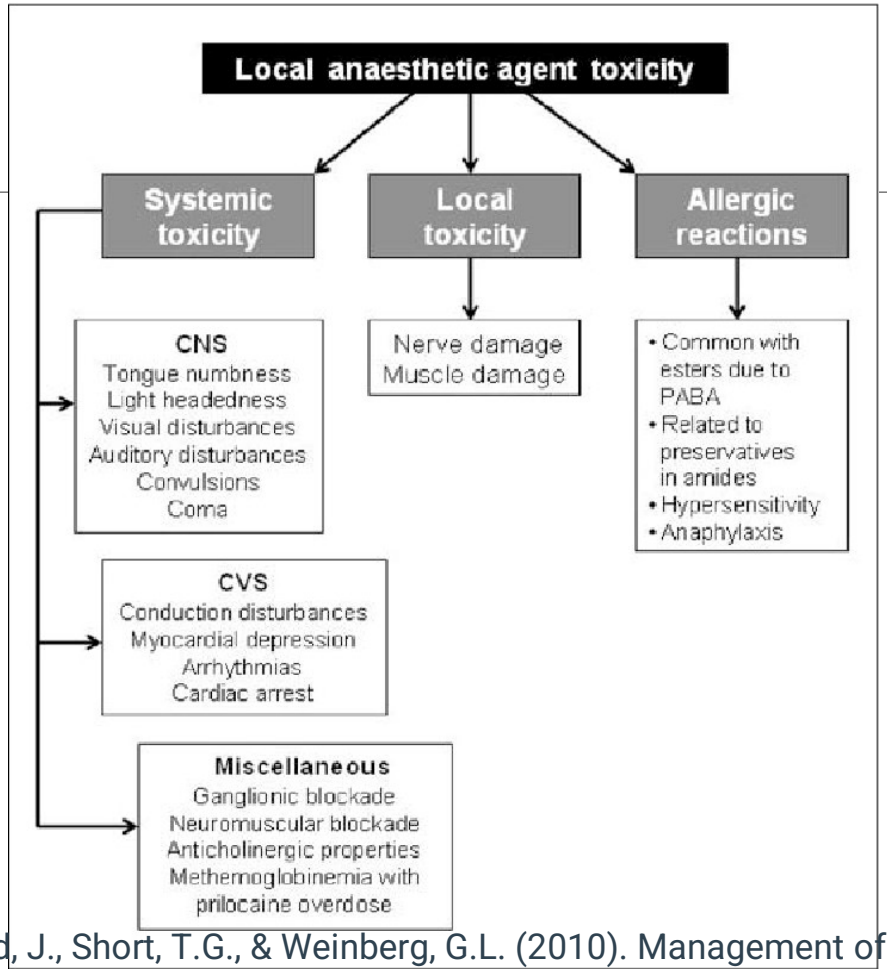
Intrathecal vs Epidural

Indications

- Thoracic/abdominal/pelvic surgery
- Rib fractures
- Abdominal/pelvic/lower extremity trauma

Contraindications

- Allergy to local anesthetic
- Spinal injury
- Coagulopathies



Cave, G., Harrop-Griffiths, W.A., Harvey, M., Meek, T., Picard, J., Short, T.G., & Weinberg, G.L. (2010). Management of severe local anaesthetic toxicity.

Lidocaine infusion

Peripheral and Central properties

Modifies neuronal response in the dorsal horn

Decreases spinal synaptic response

Anti-Proinflammatory properties

Lidocaine infusion

Colorectal surgery
- Post op infusion 2 mg/min for 24 hours
- Reduce pain scores 2 days post op, reduce opioid needs

Prostatectomy
- 1.5 mg /kg bolus pre op followed by 2 or 3 mg/min infusion
- No opioid consumption difference
- Reduced pain scores and earlier ROBF

Inflammatory markers post op
- Variety of studies with varying pain and opioid consumption changes
- Show reduced inflammatory markers following infusion

Benzon 2018

Intravenous Lidocaine for the Management of Traumatic Rib Fractures
(INITIATE Program of Research)

Traumatic rib fractures (TRFs) are common with a 10% incidence in all trauma patients and are associated with significant morbidity and mortality. Adequate analgesia is paramount for preventing pulmonary complications and death.

A single-centre, double-blind, **randomized control trial** comparing IV lidocaine plus usual analgesics to placebo infusion plus usual analgesics for 72-96 hours was conducted for adult trauma patients diagnosed with two or more TRFs requiring hospital admission.

36 patients were enrolled, 17 per arm to evaluate the primary outcome: mean pain score at rest and with movement, as measured on the Visual Analog Scale (VAS). The study was powered to detect a 20% reduction in pain scores.

Comparison of the mean VAS pain scores demonstrated **significant pain reduction with movement** in the lidocaine group compared to placebo (7.05 ±1.72 vs 8.22 ±1.28, p=0.042). Although pain scores at rest were reduced in the lidocaine group, this difference was not statistically significant (3.37 ± 2.00 vs 3.82 ±1.97, p=0.519).

Overall, these results demonstrate that **lidocaine has a beneficial analgesic effect** in patients with TRFs, particularly during the critical period of mobility, which could reduce negative outcomes of this injury pattern.

Patton P et al. Intravenous Lidocaine for the Management of Traumatic Rib Fractures (INITIATE Program of Research). *Journal of Trauma and Acute Care Surgery*. December 2021 [doi]

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RESEARCH ARTICLE

Intravenous lidocaine as a non-opioid adjunct analgesic for traumatic rib fractures

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Ketamine

NMDA antagonist and NA channel blocker

Half life 80-180 minute

Pain reduction

Reduced opioid consumption

Ketamine

Does not:

- Cause respiratory depression
- Suppress Cardiovascular function
- Depress the laryngeal protective reflexes

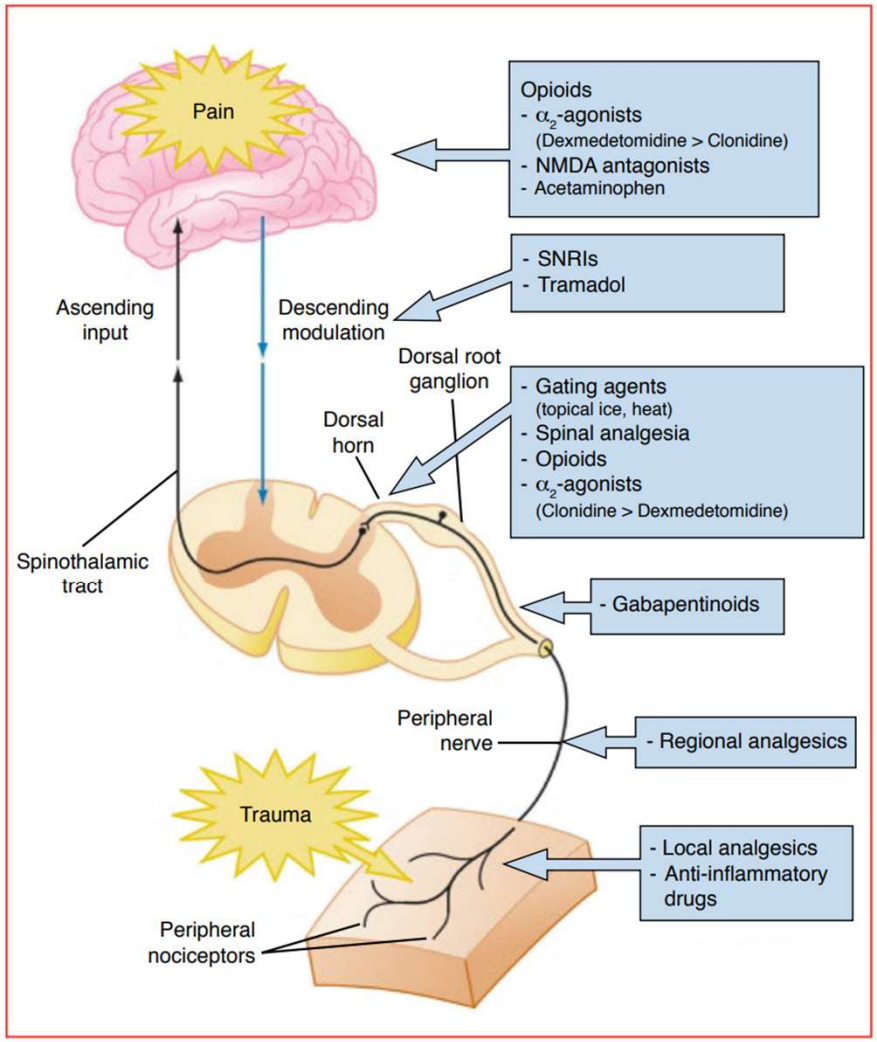
Side Effects:

- Post operative malaise
- Accumulation of metabolites
- Development of tolerance
- Cardiovascular excitation
- Psychotomimetic effects

Ketamine

Protocols vary

- Low dose infusion (o.1 mg/kg) 96 hours perioperatively (Chumbley et al)
  - 48 hour reduction in pain (at rest) compared to standard care (multimodal) in Thoracotomy
  - Significantly less opioid consumption
- Low dose ketamine post operatively (spinal surgery) (Macintyre et al, Benzon et al)
  - 1 mg/kg bolus followed by 83 microgram/kg/hr
  - Reduced opioid use in opioid tolerant patients
  - Some studies show improved pain for > 1 year post operatively
- Post operative in amputation
  - 0.5mg mg/kg bolus and infusion
  - Did not reduce morphine consumption or decrease stump allodynia
- Ketamine + epidural post op in colorectal surgery
  - Less PCA needs
  - Less opioid consumption up to 3 months later



Summary

Pain is complex and multifactorial

Acute on chronic pain or acute pain in the setting of substance use can be more complex to manage

Multimodal pain strategies can reduce opioid consumption without negative impact on pain scores

Ketamine can be opioid sparing

Continuation of pre-injury opioid use disorder treatment is imperative to pain management

Non-pharmacologic interventions can be useful in pain management; more typically in chronic pain than acute

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