Opioid Sparing Anesthesia

2/6/2021

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I have no actual or potential conflict of interest in relation to this presentation.

Objectives

- Define opioid sparing anesthesia
- Discuss pathophysiology of pain
- Discuss benefits of opioid sparing anesthesia
- Discuss medication regimens
- Brief overview of regional anesthesia

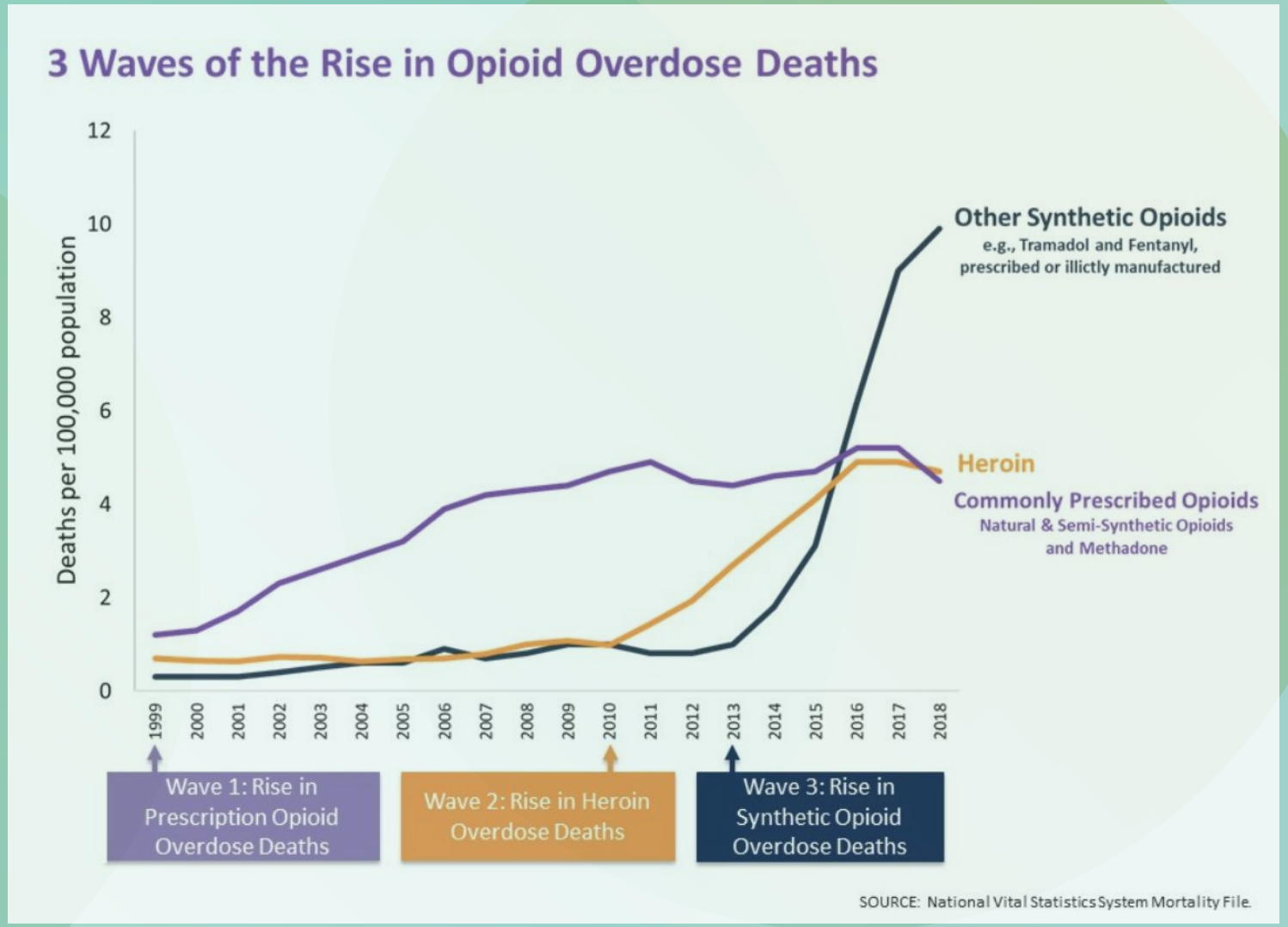
What is opioid sparing anesthesia?

- Goal of opioid sparing anesthesia (OSA) is to reduce negative impact of intraoperative opioid on patients' postoperative outcomes as well as the reduce negative effects of nociception effects intraoperatively.
- OSA is achieved through multimodal anesthesia
  - **Balanced technique of different analgesics**
  - **Regional anesthesia**
  - **Reduction of adverse effects of each analgesic**

(Beloeil, 2019)

Opioid Epidemic

- 1999-2018 **450,000** people died from opioid overdose; prescribed and illicit
- CDC describes 3 waves of the opioid epidemic
  - Prescription opioids
  - Rise in heroin
  - Other synthetic opioids
- **Perioperative opioids** have been associated with the opioid crisis
- Specifically for Crow Wing county, from 1999-2018, death rate from overdose was **9.7%**



(Beloeil, 2019, 2012 CDC,2020, Manchikanti et al.,)

Table 1. *Types of illicit drug use in the past month among persons aged 12 or older: Numbers in thousands, from 1998 to 2010.*

Drugs	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	12-Year % change from 1998 to 2010
Nonmedical Use of Psychotherapeutics[2,3]	2,477 (1.1%)	3,952 (1.8%)	3,849 (1.7%)	4,811 (2.1%)	6,287 (2.7%)	6,451 (2.7%)	6,110 (2.5%)	6,491 (2.7%)	7,095[b] (2.9%[b])	6,895[a] (2.8%[a])	6,224 (2.5%)	6,953 (2.8%)	6,967 (2.7%)	181%
Pain Relievers	--	2,621 (1.2%)	2,782 (1.2%)	3,497 (1.6%)	4,377 (1.9%)	4,693 (2.0%)	4,404 (1.8%)	4,658 (1.9%)	5,220 (2.1%)	5,174 (2.1%)	4,747 (1.9%)	5,257 (2.1%)	5,100 (2.0%)	NA
OxyContin*	--	--	--	--	--	--	325 (0.1%)	334 (0.1%)	276 (0.1%[a])	369 (0.1%)	435 (0.2%)	510 (0.2%)	564 (0.2%)	NA
Tranquilizers	655 (0.3%)	1,097 (0.5%)	1,000 (0.4%)	1,358 (0.6%)	1,804 (0.8%)	1,830 (0.8%)	1,616 (0.7%)	1,817 (0.7%)	1,766 (0.7%)	1,835 (0.7%)	1,800 (0.7%)	2,010 (0.8%)	2,160 (0.9%)	230%
Stimulants	633 (0.3%)	950 (0.4%)	788 (0.4%)	1,018 (0.5%)	1,303[b] (0.6%[b])	1,310[b] (0.6%[b])	1,312[b] (0.5%[b])	1,188[b] (0.5%[b])	1,385[b] (0.6%[b])	1,053 (0.4%)	904 (0.4%)	1,290 (0.5%)	1,077 (0.4%)	70%
Sedatives[3]	210 (0.1%)	229 (0.1%)	175 (0.1%)	306 (0.1%)	436[b] (0.2%[b])	294 (0.1%)	265 (0.1%)	272 (0.1%)	385 (0.2%[a])	346 (0.1%)	234 (0.1%)	370 (0.1%)	374 (0.1%)	78%
Marijuana and Hashish	11,016 (5.0%)	10,458 (4.7%)	10,714 (4.8)	12,122 (5.4%)	14,584 (6.2%)	14,638 (6.2%)	14,576 (6.1%)	14,626 (6.0%)	14,813 (6.0%)	14,448 (5.8%)	15,203 (6.1%)	16,718 (6.6%)	17,373 (6.9%)	58%
Cocaine	1,750 (0.8%)	1,552 (0.7%)	1,213 (0.5%)	1,667 (0.7%)	2,020 (0.9%)	2,281 (1.0%)	2,021 (0.8%)	2,397 (1.0%)	2,421 (1.0%)	2,075	1,855	1,637 (0.7%)	1,466 (0.6%)	-16%
TOTAL ILLICIT DRUGS[1]	13,615 (6.2%)	13,829 (6.3%)	14,027 (6.3%)	15,910 (7.1%)	19,522 (8.3%)	19,470 (8.2%)	19,071 (7.9%)	19,720 (8.1%)	20,357 (8.3%)	19,857 (8.0%)	20,077 (8.0%)	21,813 (8.7%)	22,622 (8.9%)	66%

-- Not available.
Note: 2002 to 2008 data is based on 2008 National Survey on Drug Use and Health Survey Report.
a Difference between estimate and 2008 estimate is statistically significant at the 0.05 level.b Difference between estimate and 2008 estimate is statistically significant at the 0.01 level.
1 Illicit Drugs include marijuana/hashish, cocaine (including crack), heroin, hallucinogens, inhalants, or prescription-type psychotherapeutics used nonmedically. Illicit Drugs Other
Than Marijuana include cocaine (including crack), heroin, hallucinogens, inhalants, or prescription-type psychotherapeutics used nonmedically. The estimates for Nonmedical Use of Psychotherapeutics, Stimulants, and Methamphetamine incorporated in these summary estimates do not include data from the methamphetamine items added in 2005 and 2006.
2 Nonmedical use of prescription-type psychotherapeutics includes the nonmedical use of pain relievers, tranquilizers, stimulants, or sedatives and does not include over-the counter drugs.
3 Estimates of Nonmedical Use of Psychotherapeutics, Stimulants, and Methamphetamine in the designated rows include data from methamphetamine items added in 2005 and 2006 and are not comparable with estimates presented in NSDUH reports prior to the 2007 National Findings report. For the 2002 through 2005 survey years, a Bernoulli stochastic imputation procedure was used to generate adjusted estimates comparable with estimates for survey years 2006 and later.
Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 1998 - 2010.
www.samhsa.gov/data/NSDUH/2k10NSDUH/2k10Results.pdf (170) Access date 2/22/2012

(Manchikanti ,2012)

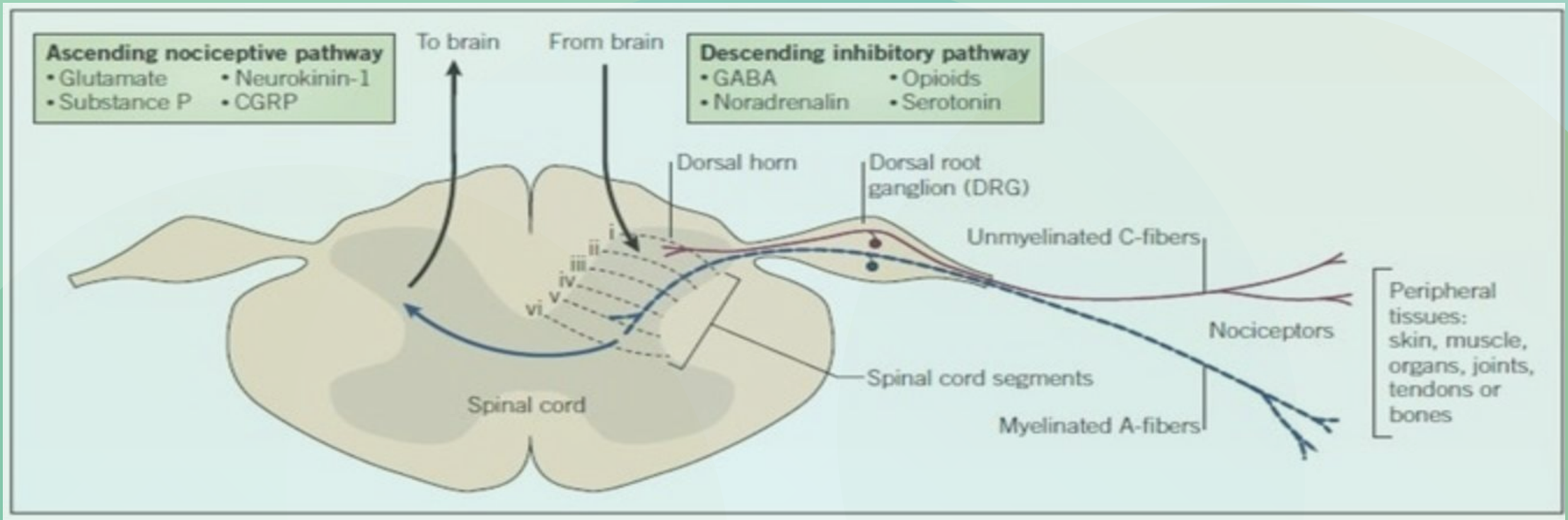
What is pain?

- Pain- Conscious, unpleasant perception of noxious stimulus
- potential or actual tissue damage
  - Complex
  - Dynamic
  - Emotional
- **Perception is reality**

What is nociception?

- Nociception- nervous system response to noxious stimulation of receptors by mediators
  - Inflammatory Mediators: serotonin, norepinephrine, enkephalin, histamine, and peptides

(Answine, 2018, Beloeil, 2019).



Pain pathway: fiber review

- A delta vs c fiber
  - A delta are large mylenated: think fast sharp
  - C fibers are small unmyleninated: think dull diffuse

Ascending and Descending pathways

(Baribeault,2020)

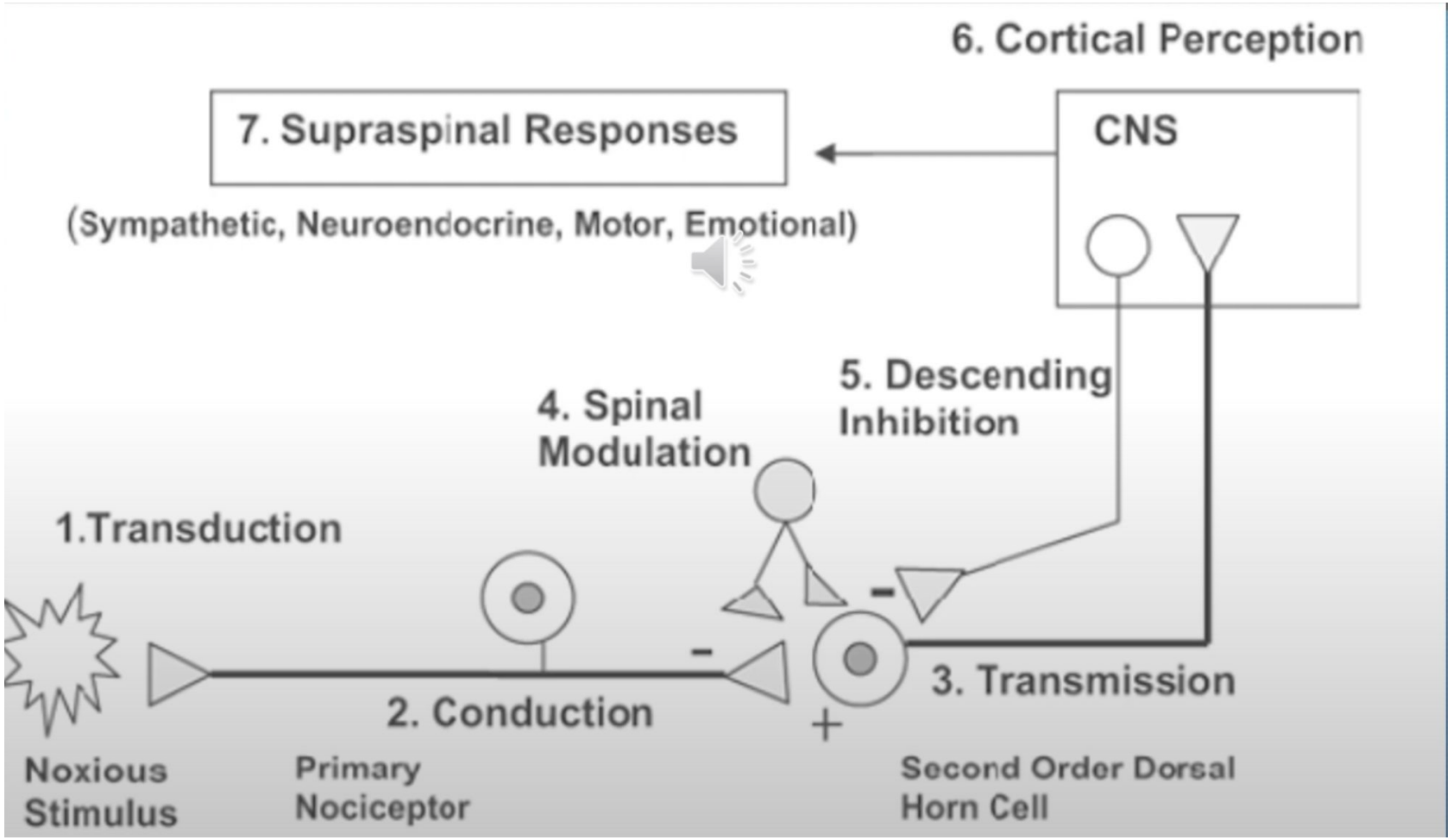
Pain Pathway

Transduction

Transmission

Modulation

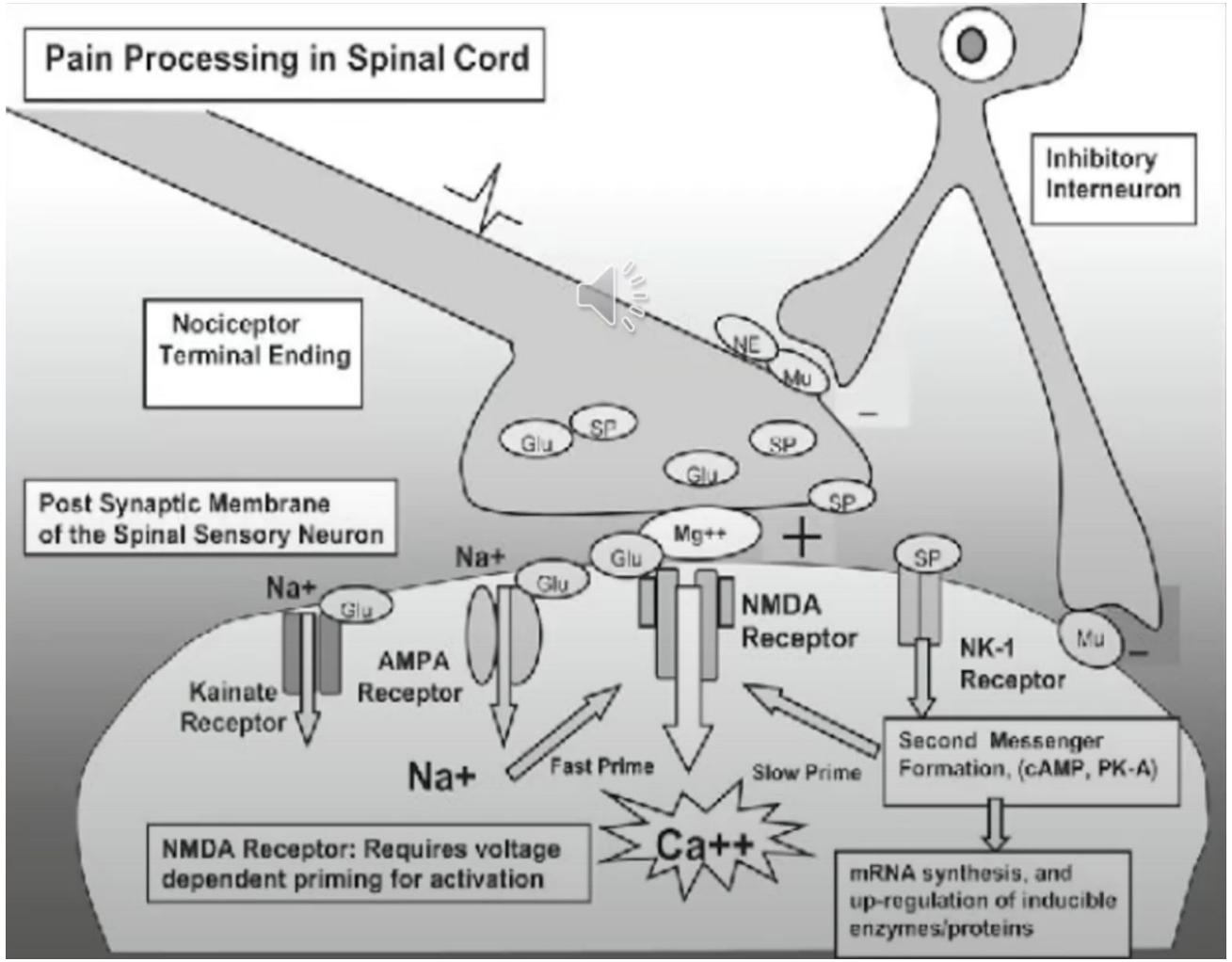
Perception



(Answine,2018, Baribeault,2020)

Receptor overview

- Sodium Channels
- NMDA receptor
  - Magnesium and glutamate
- AMPA
  - glutamate
- Mu
- Calcium
  - Role in pain transmission is to support the initiation of an action potential



(Answine,2018, Baribeault,2020)

Opioid mechanism of action

Opioid receptors located primarily in the brain and spinal cord regions

- transmission and modulation of pain.

Primarily act on mu, kappa and delta

Enhance outflow in the descending pathways

Directly inhibit transmission at the dorsal horn

Also interact with peripheral opioid receptors

	Mu_1	Mu_2	Kappa	Delta
Effect	-Analgesia -Euphoria -Low abuse potential -Miosis **-Bradycardia** **-Hypothermia** **-Urinary retention**	-Analgesia **-Depression of ventilation** **-Physical dependence** **-Constipation** (marked)	-Analgesia -Dysphoria -Sedation -Low abuse potential -Miosis -Diuresis	-Analgesia **-Depression of ventilation** **-Physical dependence** **-Constipation** (minimal)

(Kern,2018)

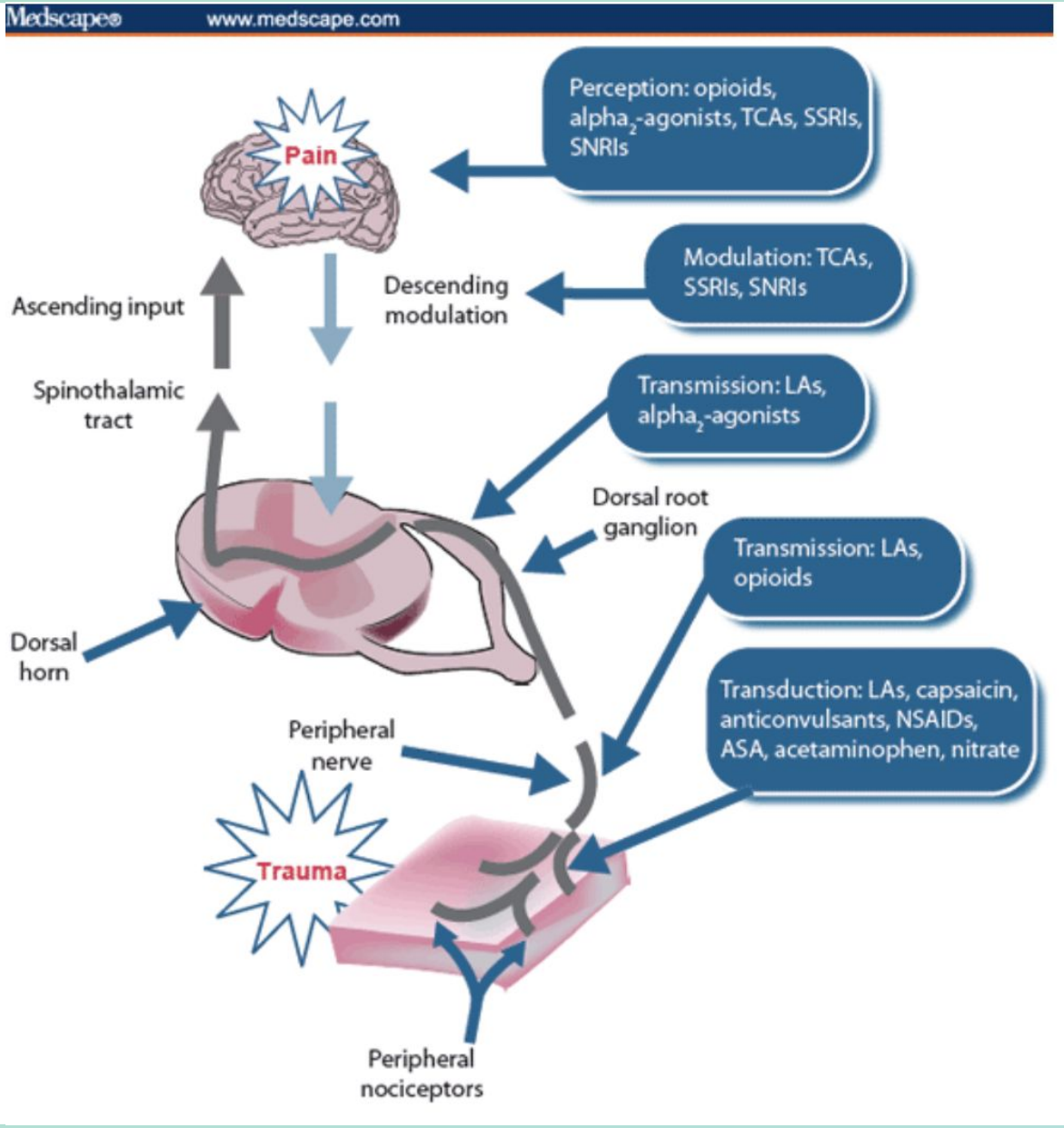
Benefits of OSA

- Elimination of opioids or reduction of opioid use results in a **reduction of adverse effects**.
  - Adverse effects such as, respiratory depression, airway obstruction, hyperalgesia, opioid tolerance, addiction, dependence, PONV, puritis, constipation and ileus, urinary retention, immune retention
- Supports hemodynamic stability
- Aids in post operative pain management
- Reduces wind up pain pathway activation

(Baribeault,2020)

Medications used in OSA

- NMDA antagonists (lidocaine, ketamine, magnesium sulfate)
- Sodium channel blockers (Local anesthetics (LA))
- Anti-inflammatory drugs (NSAID, dexamethasone, LA)
- Alpha-2 agonists (dexmedetomidine, clonidine)



(Medscape, 2020)

OSA medications

- Lidocaine: **blocks sodium channels**
  - inhibits actions by peripheral neurons that are excited by nociceptive stimuli.
  - Blocks NMDA receptors.
  - **Anti-inflammatory**

- Ketamine: **antagonizes NMDA receptors.**
  - **Prevents post-operative hyperalgesia.**
  - CV stability
  - Increased secretions
  - Subhypnotic dosing reduces risk of emergence delirium
    - Risk factors for delirium: increased age, female, >2mg/kg, psychiatric hx

(Beloeil, 2019)

OSA medications

- Magnesium Sulfate:

  antagonizes NMDA receptors.
  - CV stability
  - Bronchodilator
  - Reduce post operative shivering

- Anti-inflammatories:

  (**glucocorticoid**) reduce pro-inflammatory genes and increase anti-inflammatory
- **reduces PONV**
- (**Acetaminophen**) cox 3 inhibitor, provides anti-inflammatory effects
- **Analgesia**

(Beloeil, 2019)

OSA medications

- Dexmedetomidine: **alpha 2a agonist**
  - **sedation, hypnosis, anxiolysis**
  - sympatholysis
  - reduce shivering
  - inhibits substance P
  - Analgesia
  - No respiratory depression
- Esmolol- **selective beta 1 blocker**
  - appears to reduce hyperalgesia however studies not fully delineated
- Lyrica and neuronitn (gabapentinoids)- **reduces release of calcium and excitatory mediators**

(Beloeil, 2019)

Opioids

- Oxycodone: **binds to mu receptors**
  - Immediate action (10-15 mins), peak 0.5-1 hr, duration 3-6 hrs

- Tramadol: **binds to mu** receptor, inhibits NE and serotonin re-uptake
- Avoid with patients with seizure history (increased risk with SSRI, SNRI, TCAs, MAOIs)
- Onset 45min-1hr, duration 6 hours
- Avoid with breastfeeding moms and children

OSA Recap

- Initially slower wake up followed by less sedation
- Increased respiratory rate (30 rpm), this resolves normally suppressed by narcotics not to be mistaken as inadequate analgesia
- Less nausea
- Less pain and more responsive to opioids

Questions: OSA

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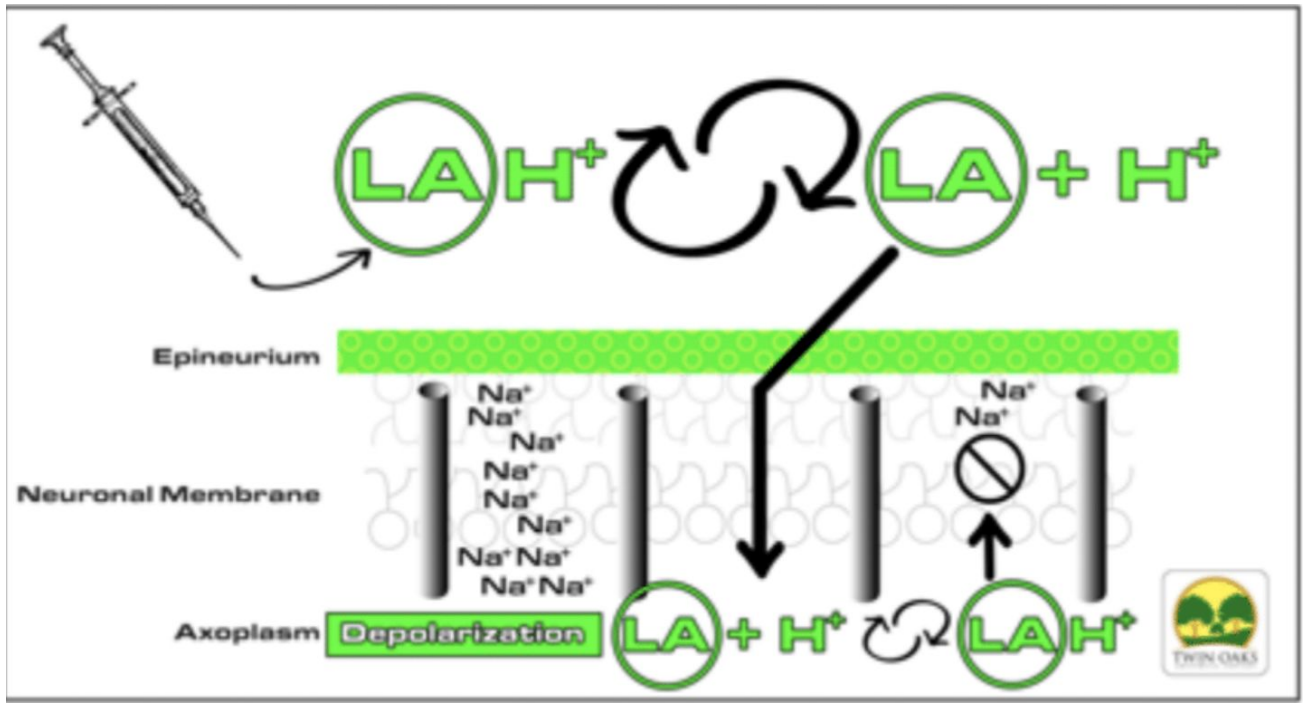
Regional Anesthesia

Benefits

- Improved pain management
- Decreased opioid use
- Reduced stress response
- Potential decrease in cancer spread
- Increased patient satisfaction

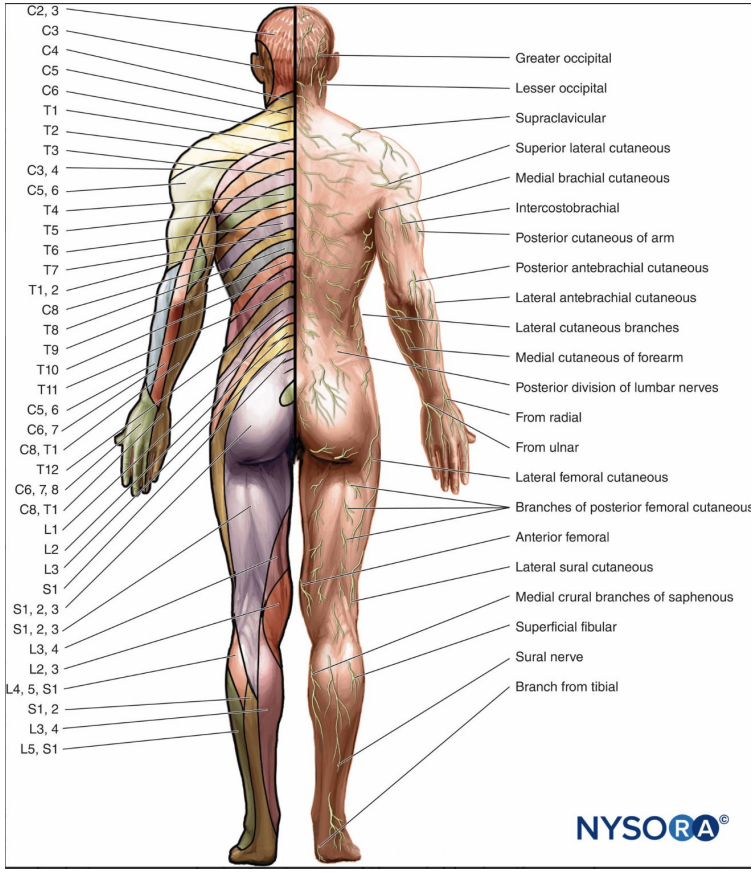
Local anesthetics mechanism of action

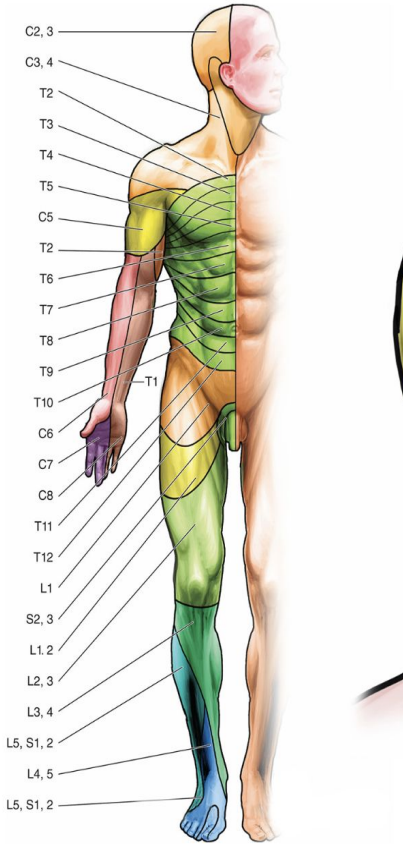
- Voltage gated sodium channel
  - Channel is maintained by ability to maintain a sodium gradient
- Non-ionized form of the local is allowed to pass through the membrane
- Once inside the cell, the local ionizes and subsequently de-activates sodium channel by slowing the rate of depolarization
- Keys to local function: hydrophobicity, protein binding and pKa



(Kline, 2020)

Dermatomes





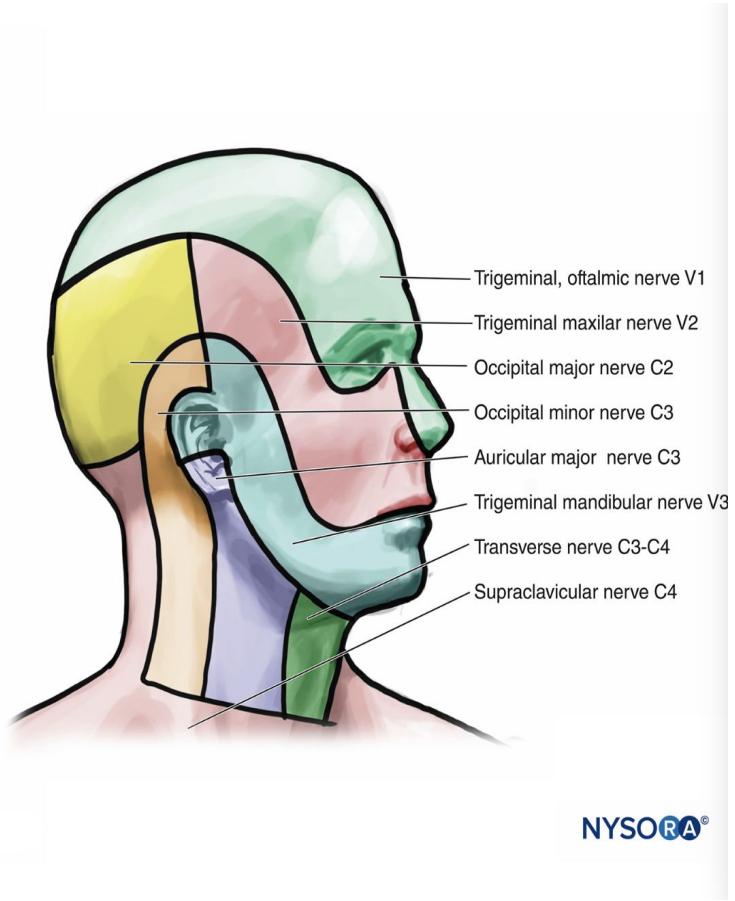


FIGURE 5. *a, b: Dermatomes, anterior.*

(NYSORA, 2020)

LA Classes

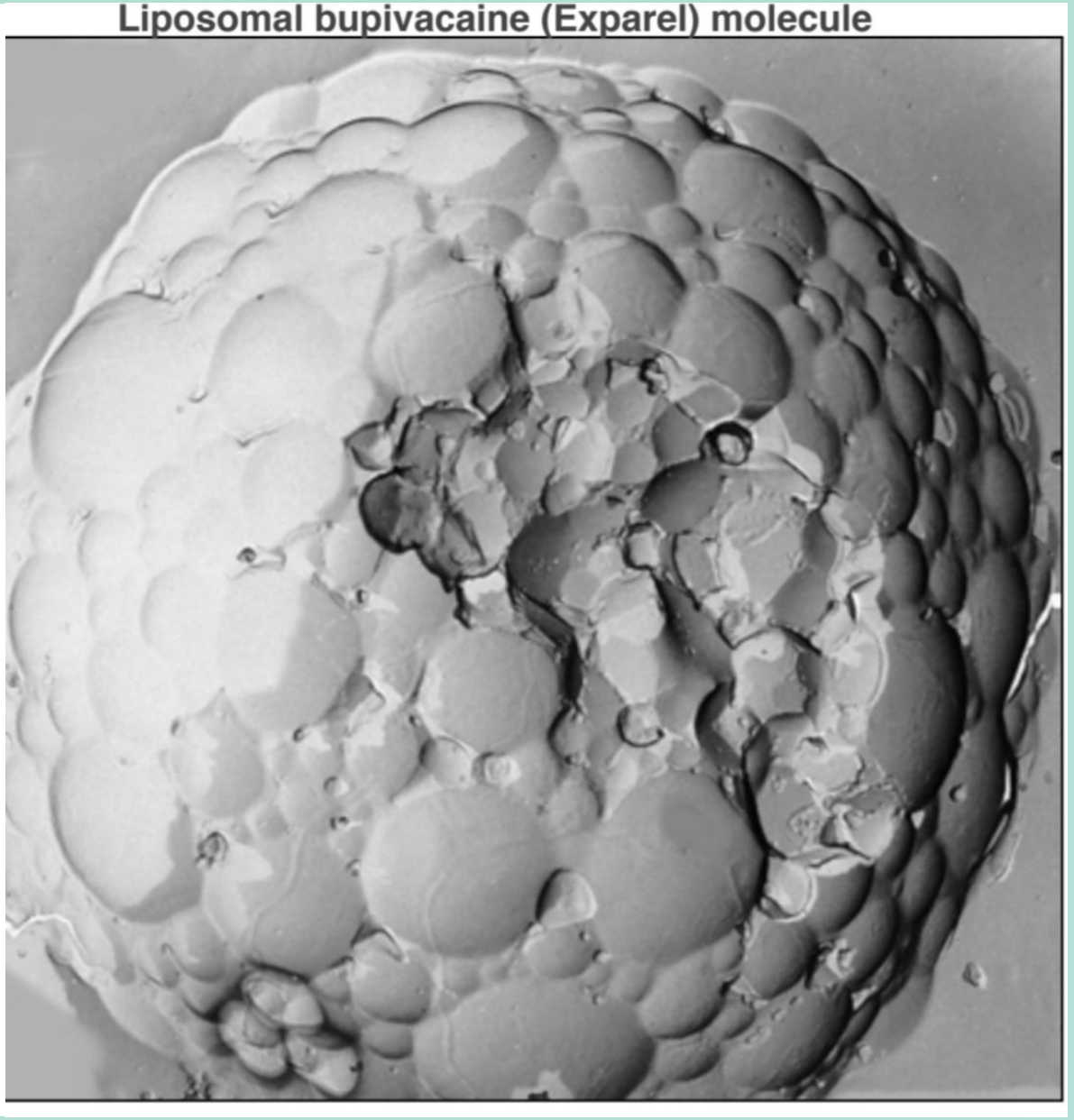
- Ester
  - Quickly metabolized in the blood
  - Higher risk for allergic reaction due to PABA metabolites
- Amides
  - Metabolized by the liver

Classification	Potency	Onset	Duration after Infiltration (min)	Maximun Single Dose for Infiltration (adult, mg)
Esters				
Procaine	1	Slow	45-60	500
Chloroprocaine	4	Rapid	30-45	600
Tetracaine	16	Slow	60-180	100 (topical)
Amides				
Lidocaine	1	Rapid	60-120	300
Mepivacaine	1	Slow	90-180	300
Bupivacaine	4	Slow	240-480	175
Etidocaine	4	Slow	240-480	300
Prilocaine	1	Slow	60-120	400
Ropivacaine	4	Slow	240-480	200

(Kern, 2018)

Exparel

- Marcaine is encapsulated by 3 layers of microspheres
- Delayed release of Marcaine, prolonged duration of block
- Onset is roughly 1 hour
- Sensory blockade, not motor blockade



(Kline, 2020)

Nerve stimulator basics

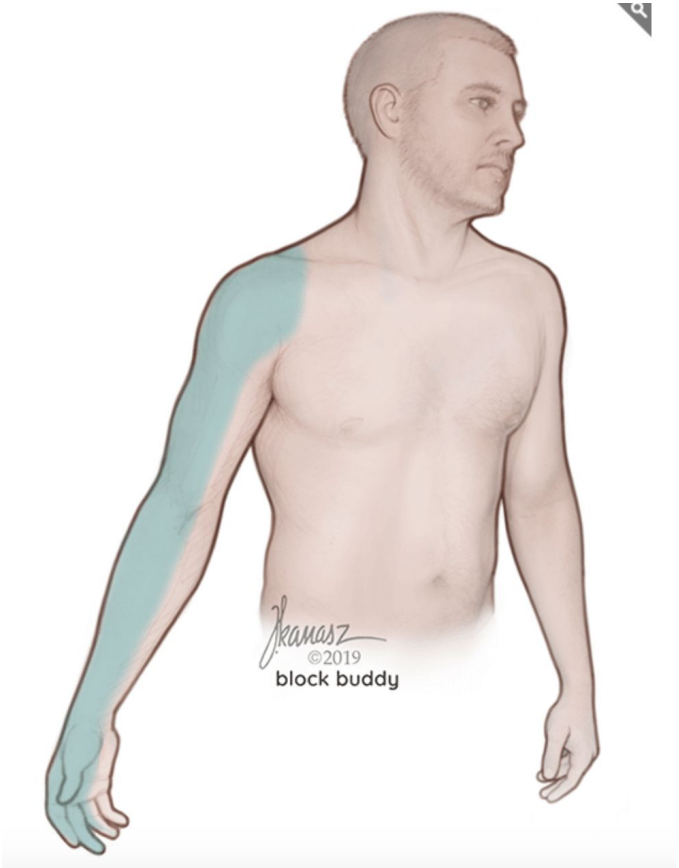
- Purpose is to ensure needle is not placed intraneural
- Stimulator should be set from 0.2 mA to 1mA
- Strong nerve twitch should be lost at less than 0.4 mA

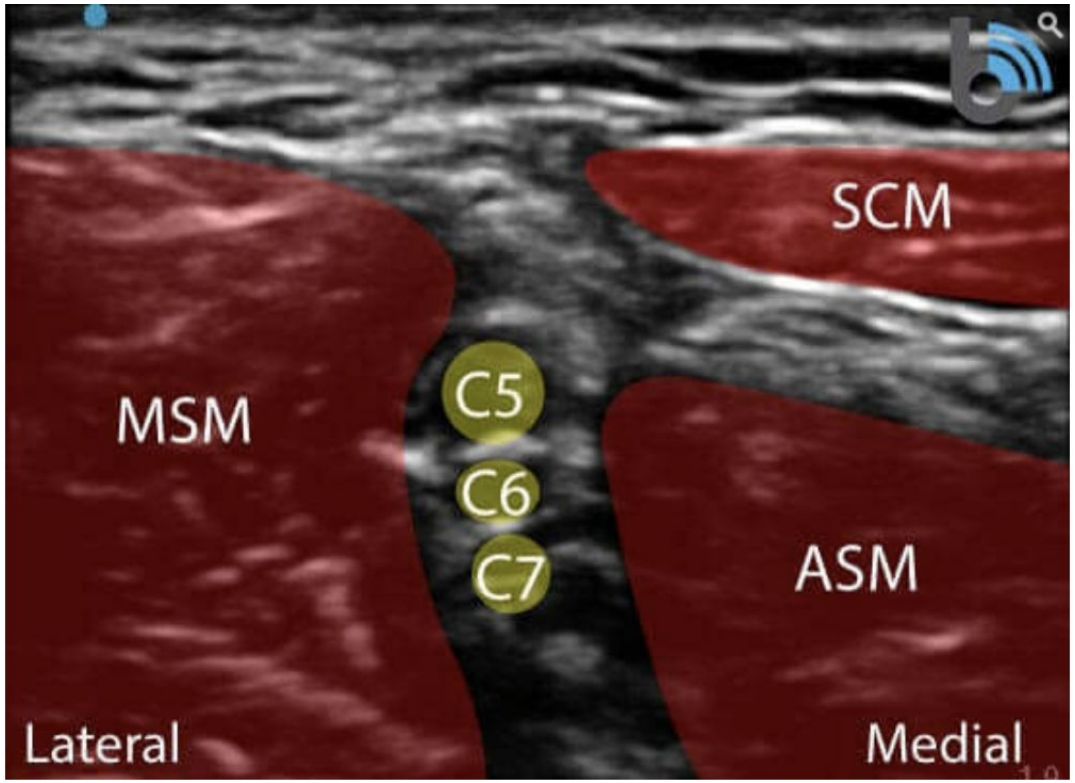
(Kline, 2020)

Upper Extremity Blocks

Interscalene

- Indications: shoulder and upper arm surgery
- Phrenic nerve involvement possible
- Horners syndrome

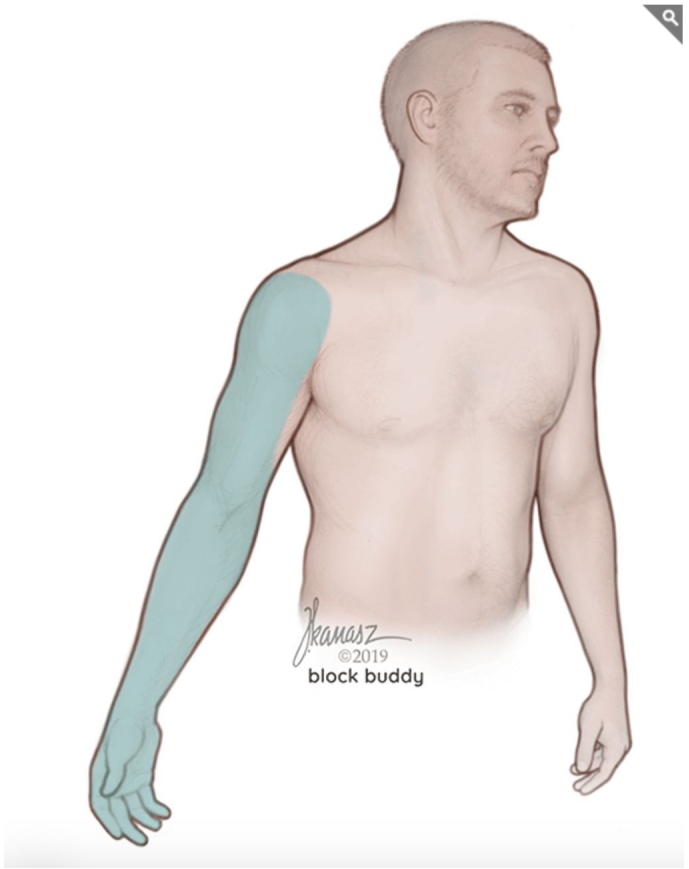


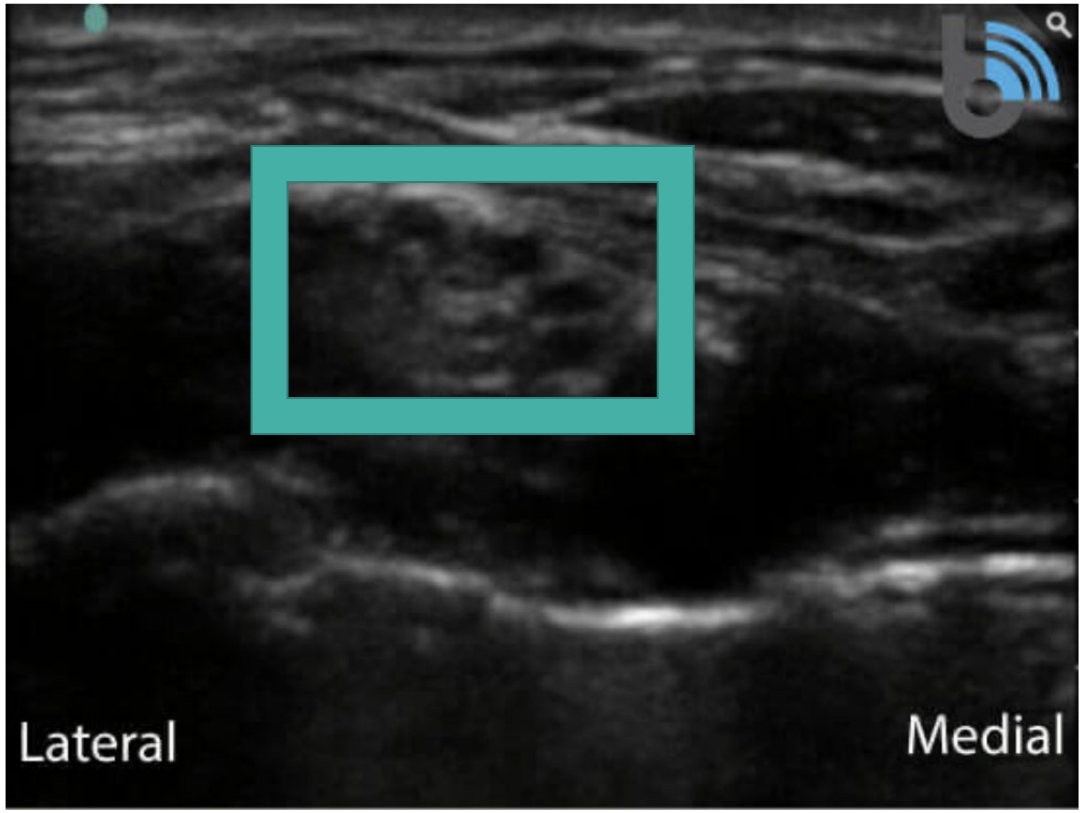


(Molter & Urigel, 2021)

Supraclavicular

- Indications: lower arm surgery
- Decreased risk of phrenic nerve involvement and horners syndrome

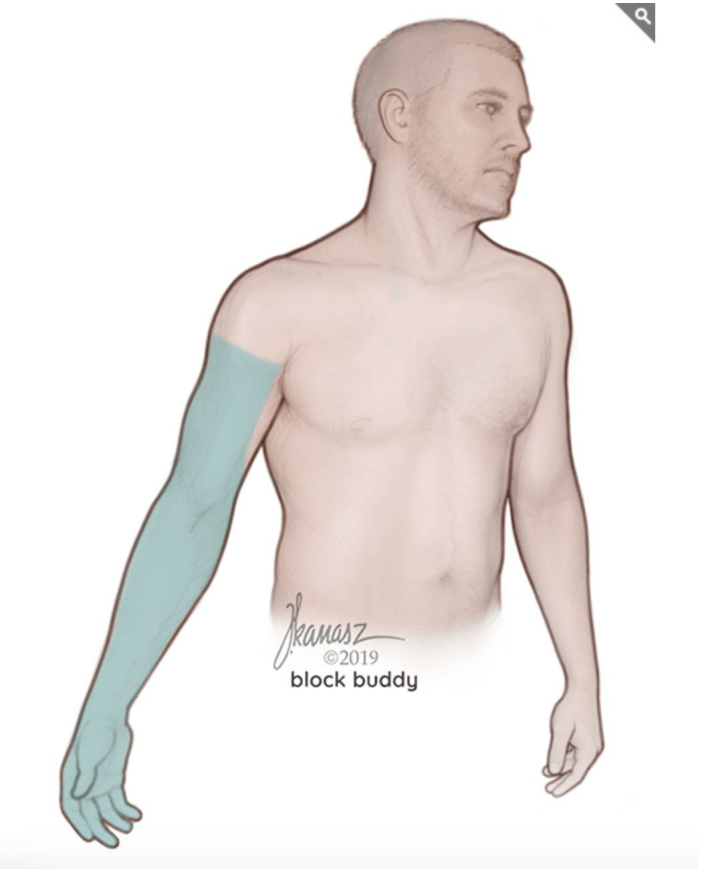


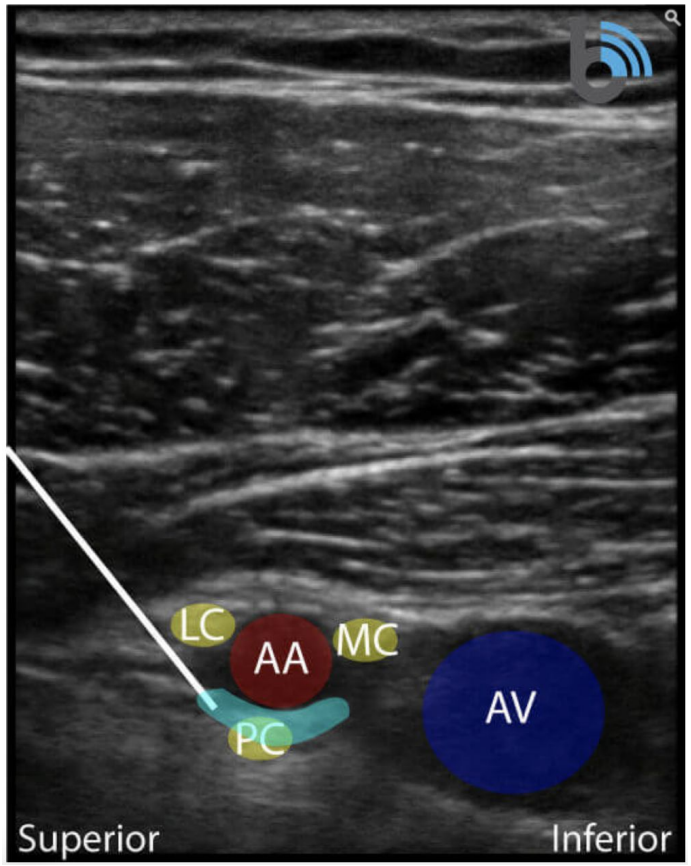


(Molter & Urigel, 2021)

Infraclavicular

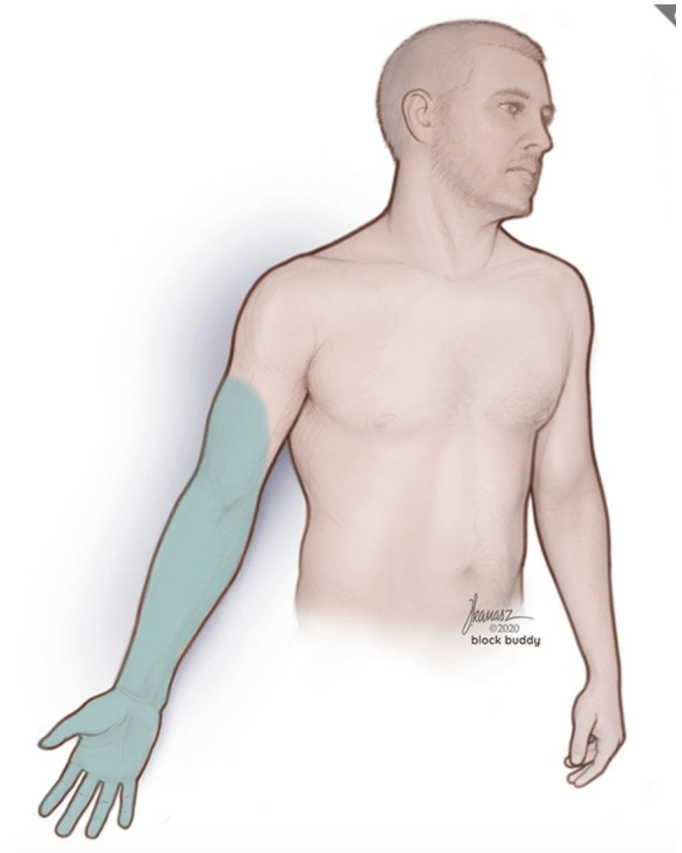
- Indications: lower arm surgery
- Misses intercostalbrachial nerve
- Potential risk of pneumothorax



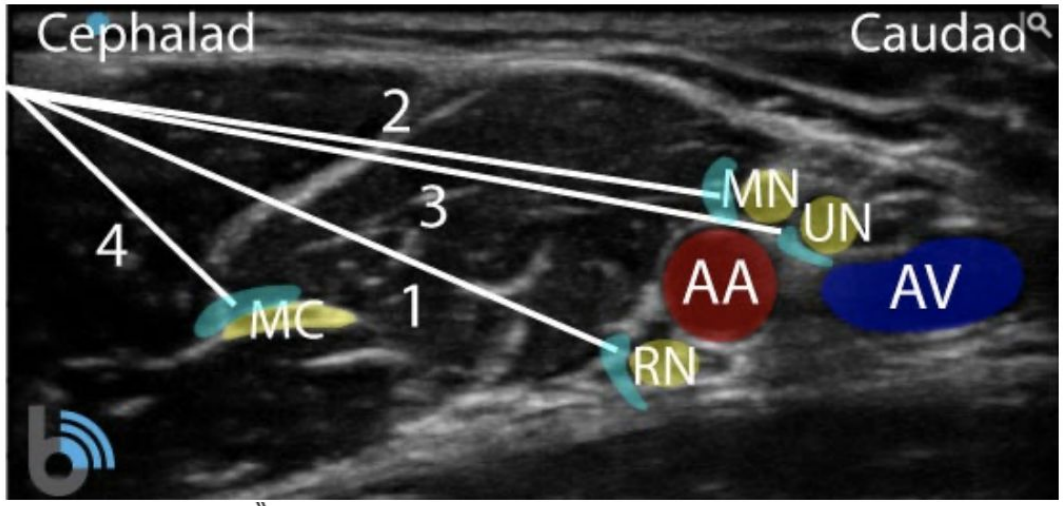


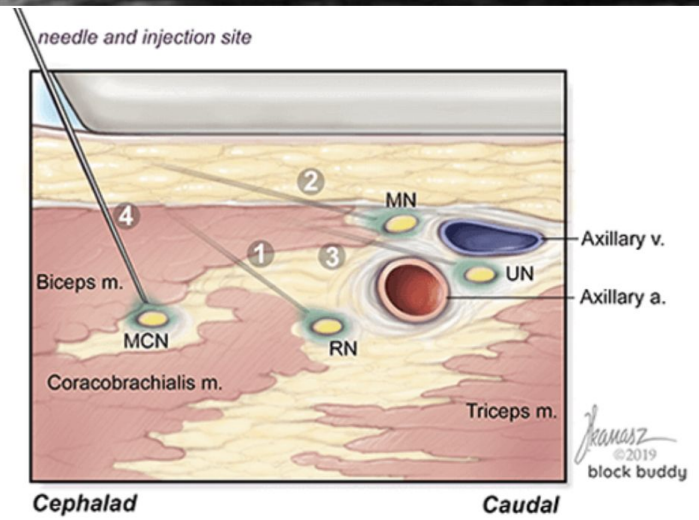
(Molter & Urigel, 2021)

Axillary



- Indications: lower arm surgery



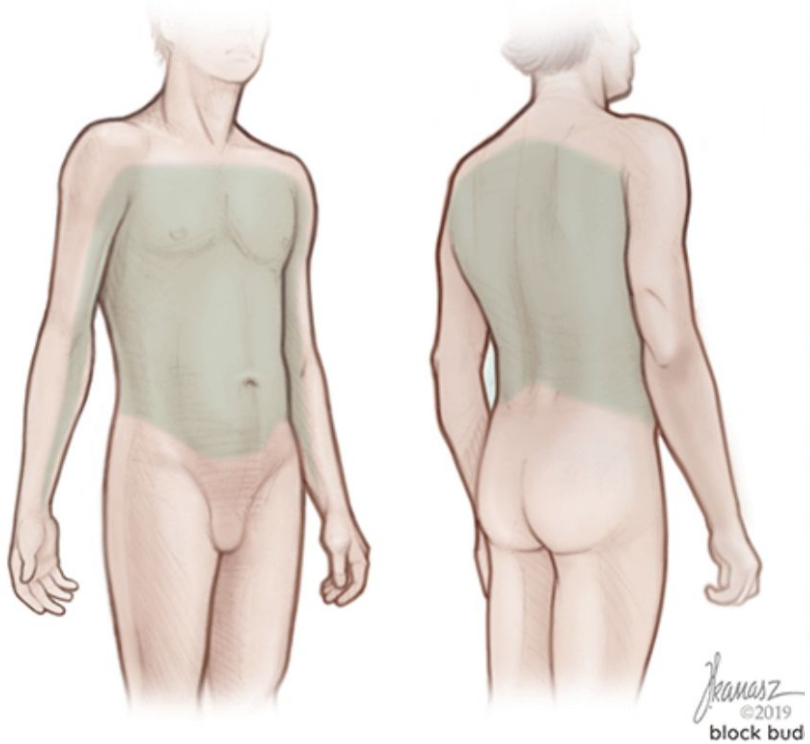


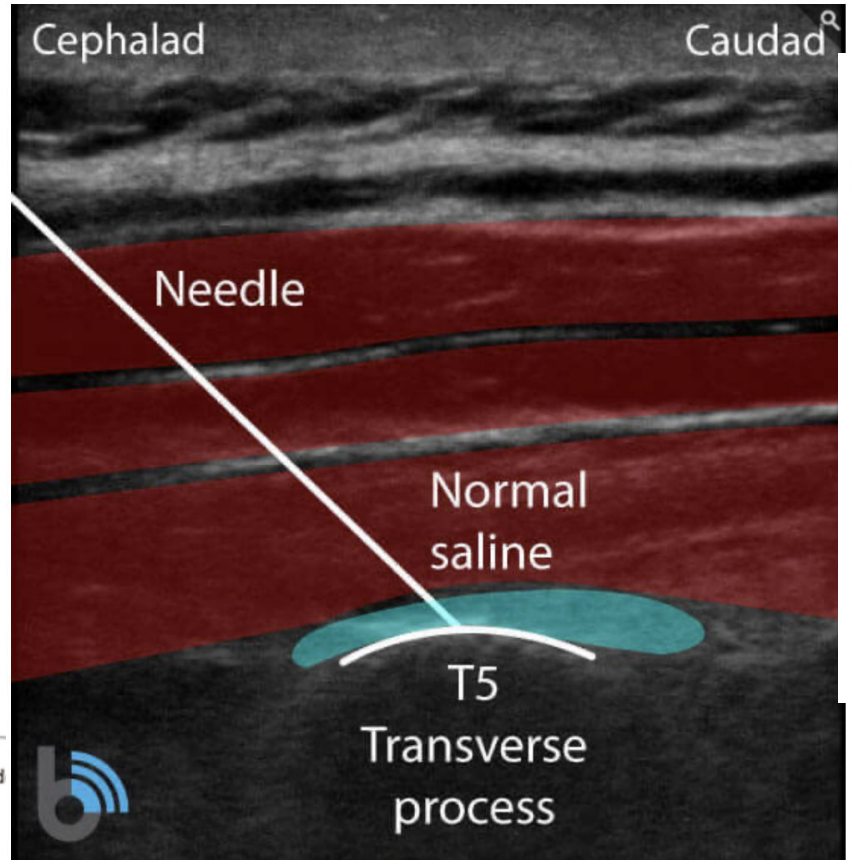
(Molter & Urigel, 2021)

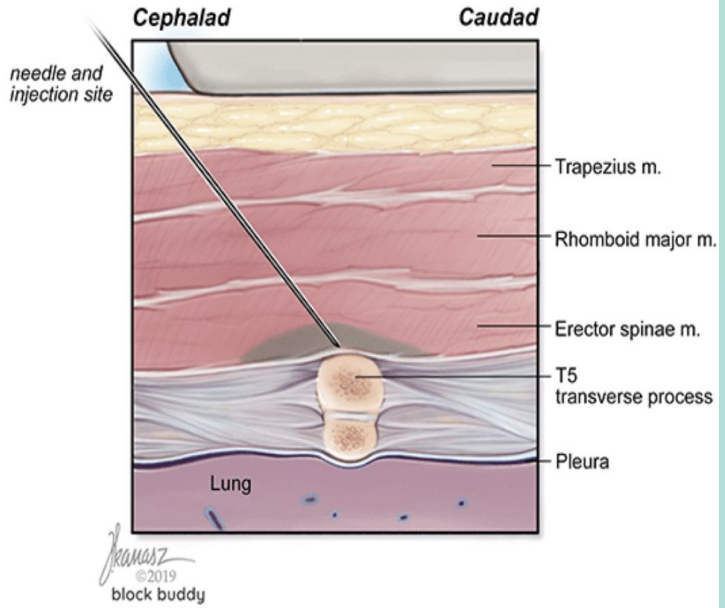
Truncal Blocks

Erector Spinae (ESP)

- Indications: large breast surgeries, belly cases
- Somatic and visceral coverage



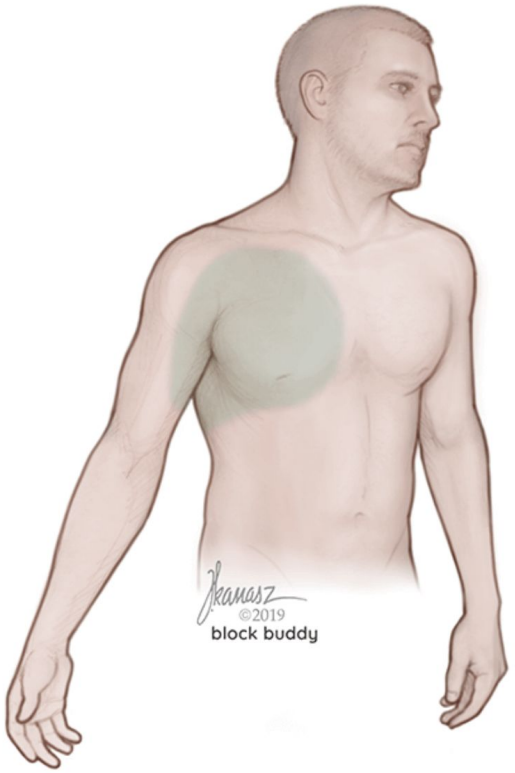


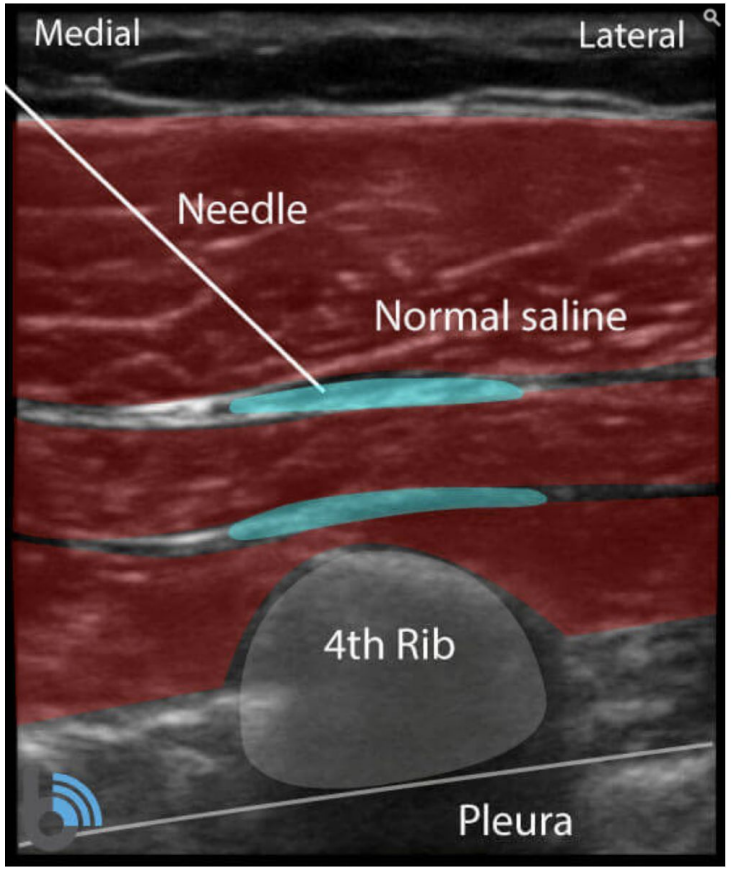


(Molter & Urigel, 2021)

PECS I and II

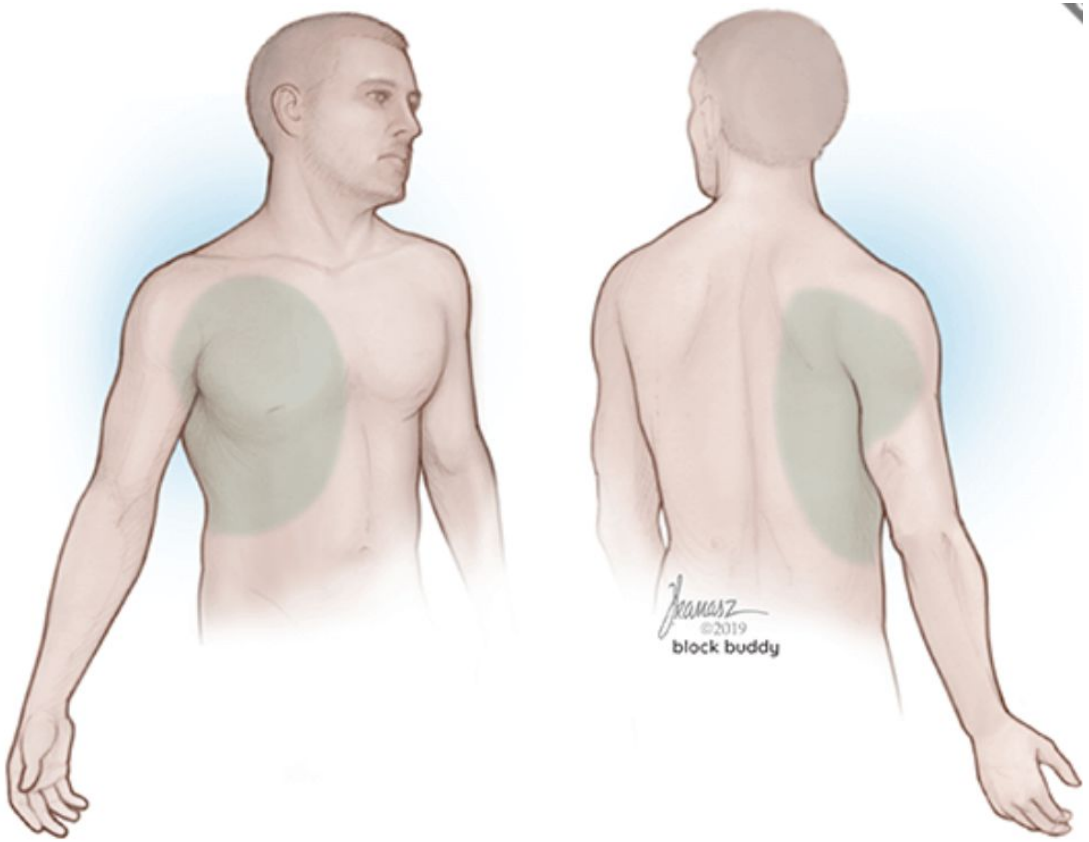
- Indications: breast surgery
- Doesn't reliably cover axilla



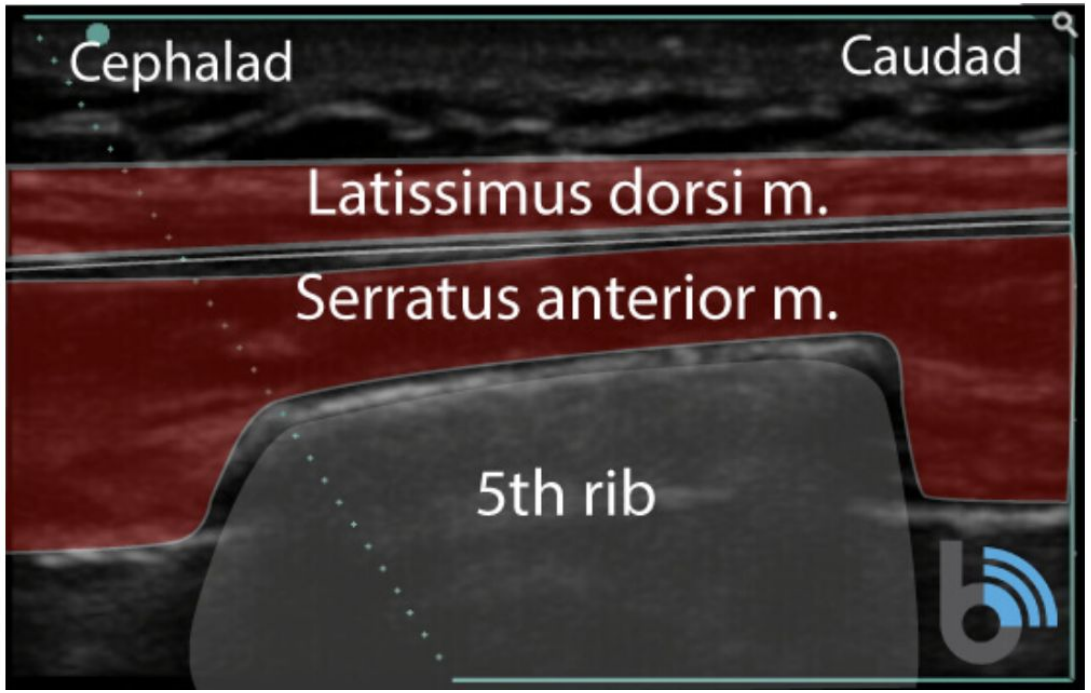


(Molter & Urigel, 2021)

Serratus plane



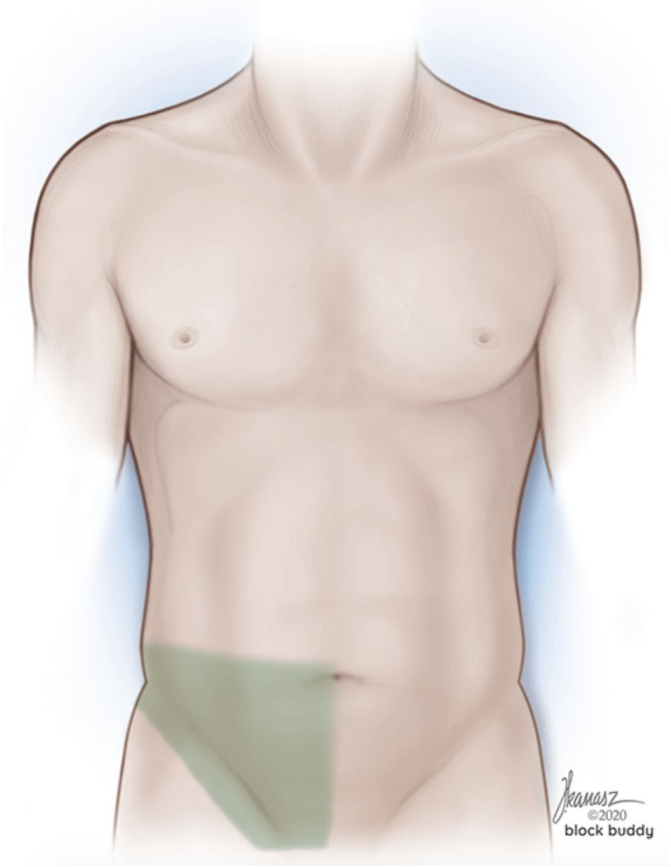
- Indications: breast surgery
- Provides axillary coverage

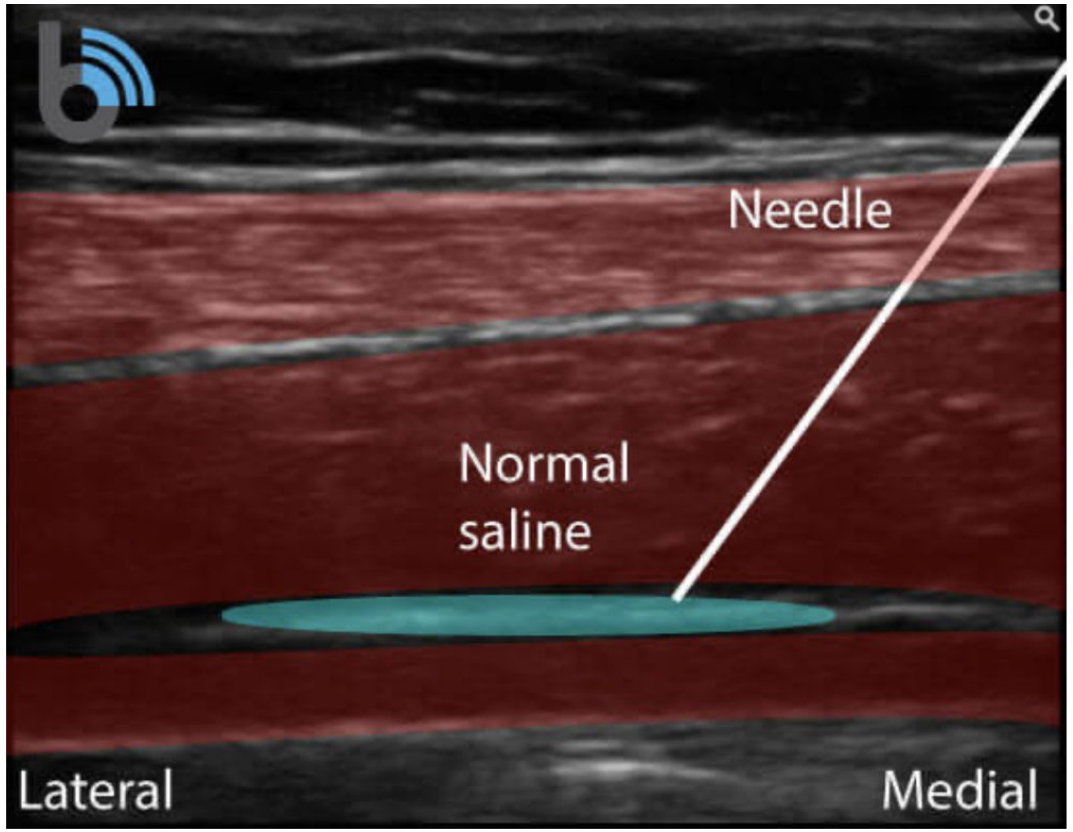


(Molter & Urigel, 2021)

TAP

- Indications: abdominal surgery, c-sections
- Generally done bilaterally



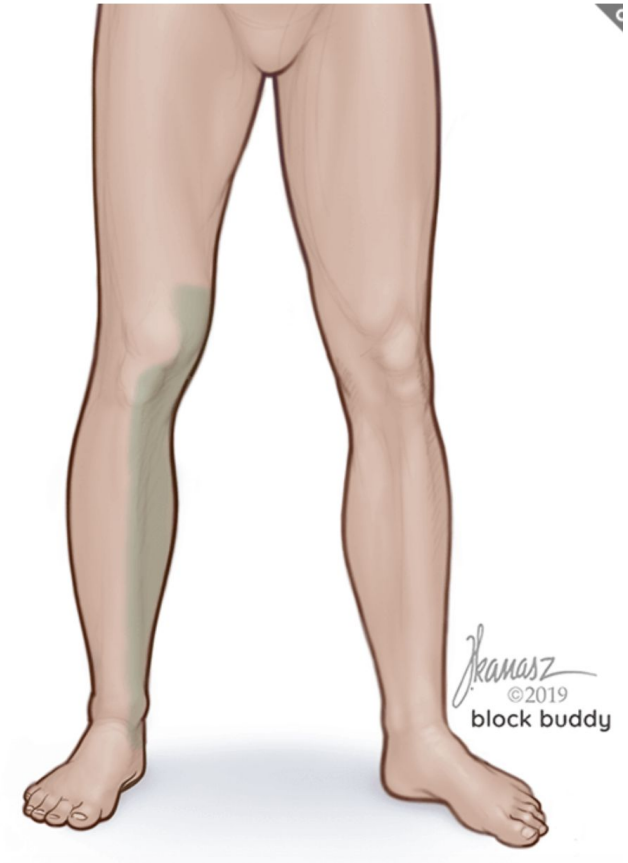


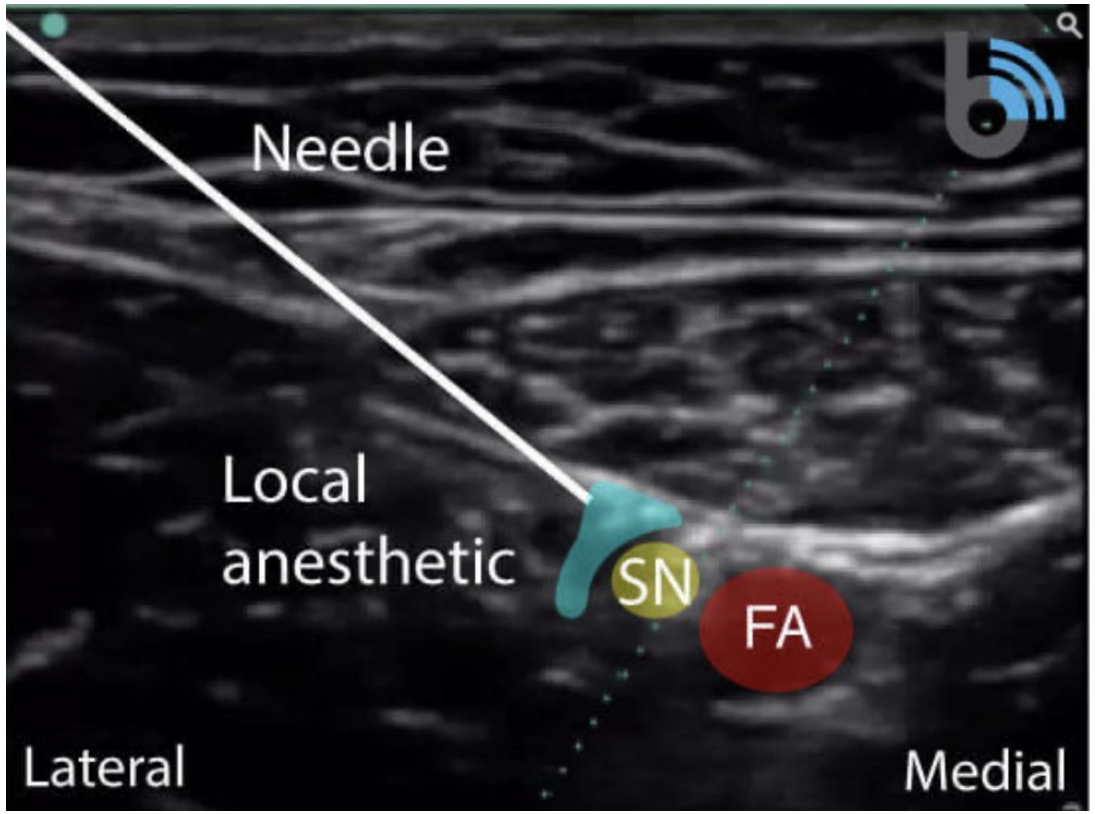
(Molter & Urigel, 2021)

Lower Extremity Blocks

Adductor Canal

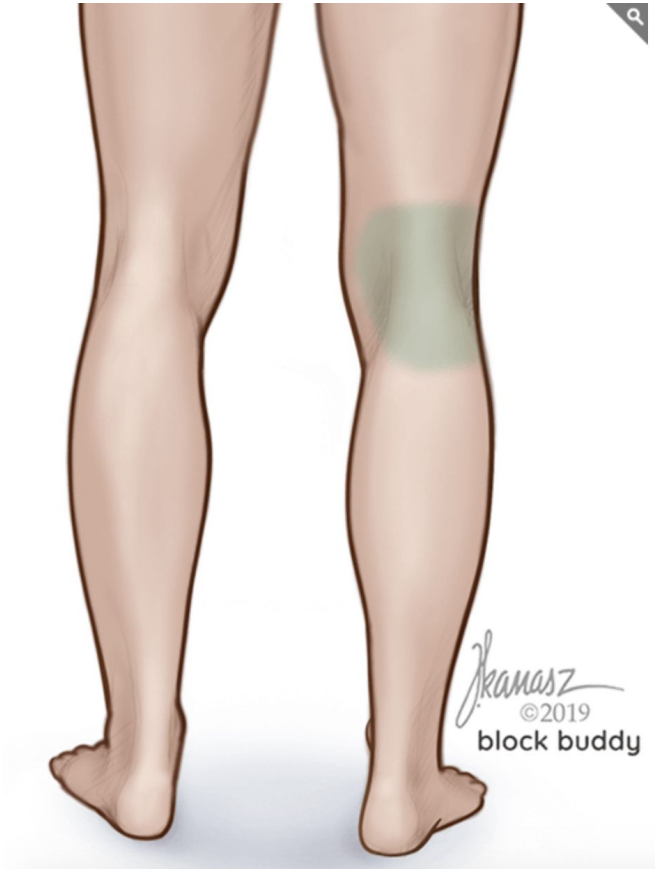
- Indications: adjunct with other blocks
- Covers medial aspect of leg

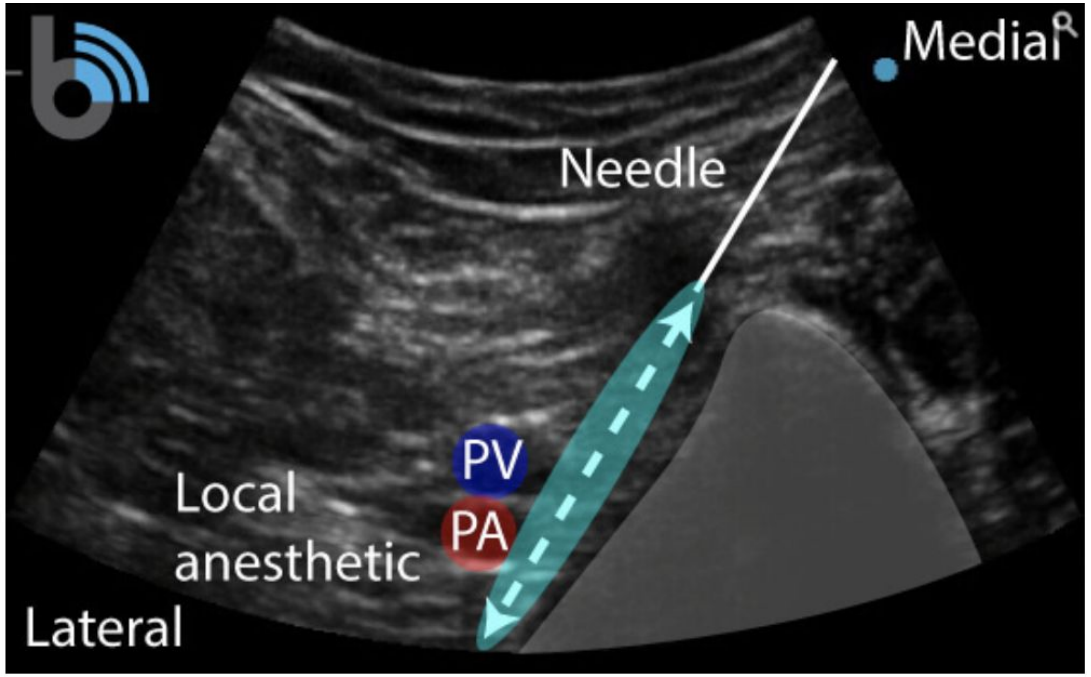




IPACK

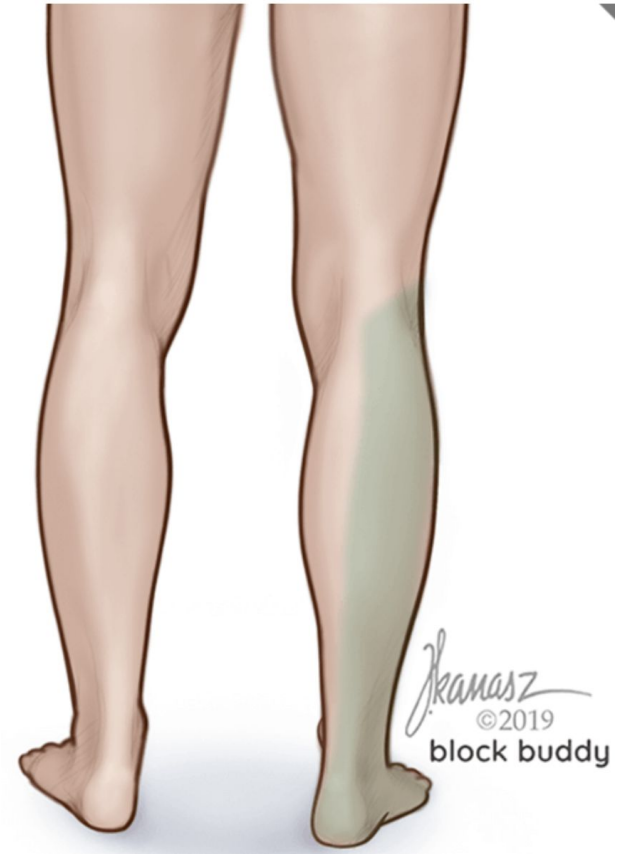
- Indications: adjunct in knee surgery

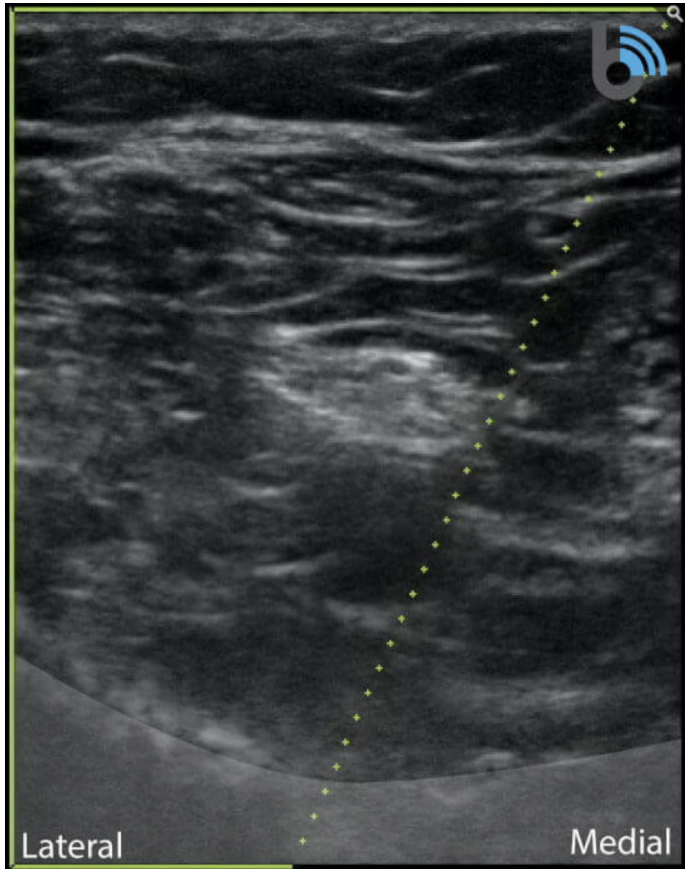




Popliteal

- Indications: lower leg surgery
- Provides lateral coverage





Questions: Regional Anesthesia

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