Opioid Free Anesthesia
Orthopedic Trauma

Oklahoma Association of Nurse Anesthetists

Objectives

Opioid Crisis

Ortho Pain Pathways

Pharm Review

OFA & Ortho Trauma

Ref

Richard Wilson, DNAP, CRNA, FAANA
DreamMaker Anesthesia Services, LLC

Objectives

At the end of the presentation, the attendee will be able to:

1) Discuss the pain pathways associated with orthopedic trauma surgery.

2) Review medications used with OFA and their mechanism of action on receptors for pain.

3) Review results of orthopedic trauma cases managed with OFA.

Disclosure

I have no financial conflicts of interest to disclose

Some uses discussed may be off-label

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Definitions

Predictors

Opioid Crisis

By The Numbers

- Since 1999, nearly 650,000 deaths
- In 2020 there were 92,000 deaths
  - 30% increase from 2019
- On average, 90 people per day die
- Estimated 2 million addicted to opioids

Opioid Use Disorder Criteria

Risk Factors

Definitions

Misuse

Use of medication for purpose other than as directed or indicated (intent or harm doesn't matter)

Abuse

Use of an illegal drug or self-administration for non-medical intent (to alter consciousness)

Addiction

Primary and chronic disease involving brain reward, motivation and circuitry leading to relapses and improvement (fatal if untreated)

Tolerance

Exposure to drug leads to diminished effects over time

Physical Dependence

Abstinence syndrome occurs when drug is abruptly stopped

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Opioid Use Disorder Criteria

Risk Factors

Opioid-Use Disorder Criteria

1. Taken in larger amounts & longer time than intended

2. Desire but unsuccessful in cutting down or controlling opioid use

3. Significant time obtaining, using, or recovering from effects

4. Craving or strong desire to use

5. Recurrent use resulting in failure to meet major obligations

6. Continued use despite recurring social or personal problems caused

7. Stopping or reducing social, occupational or recreational activities due to use

8. Recurrent use even in physically hazardous situations

9. Continued use despite recognizing physical or psychological effects

10. Tolerance (needing more for same effect)

11. Withdrawal (physical symptoms associated)

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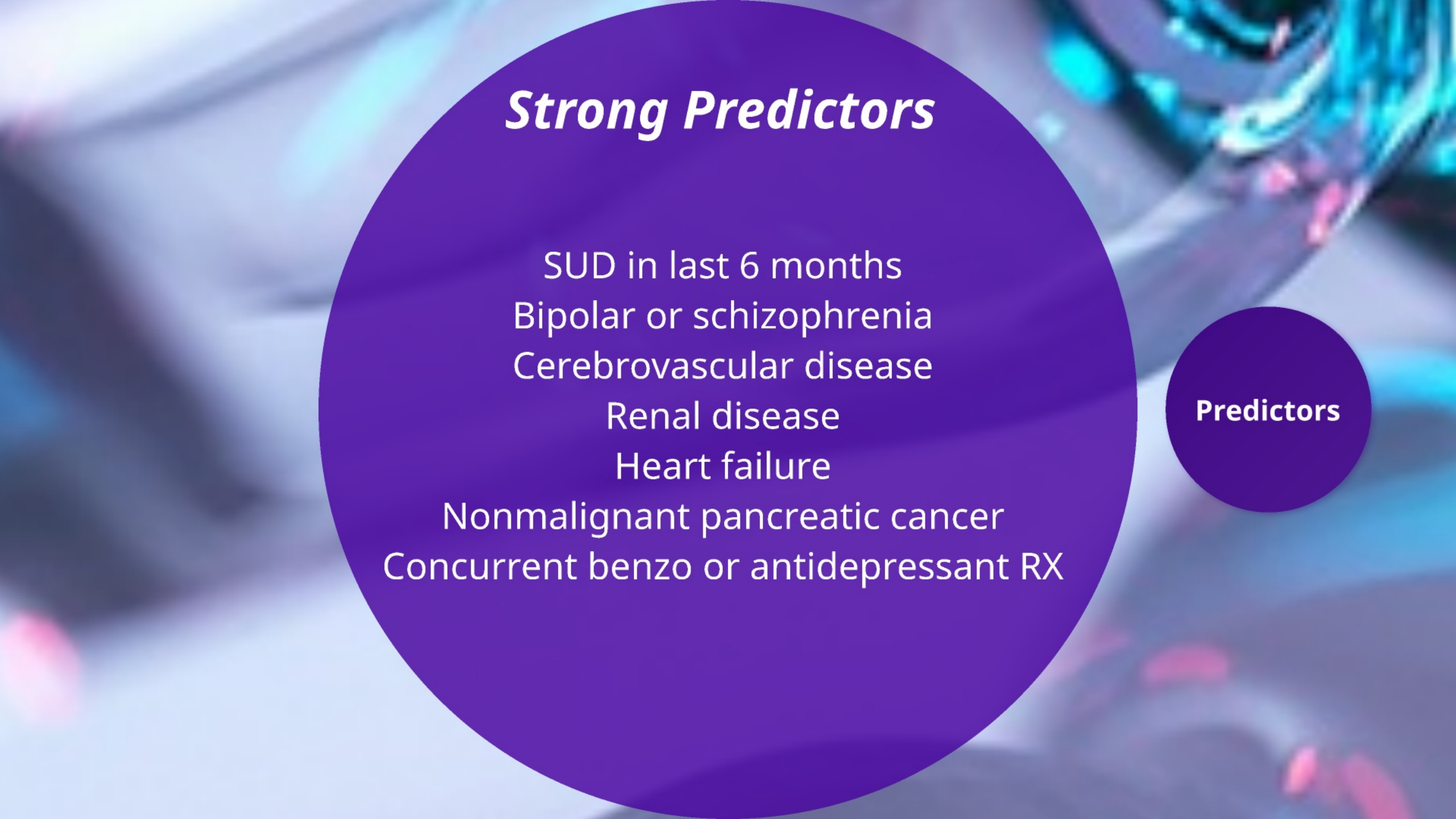
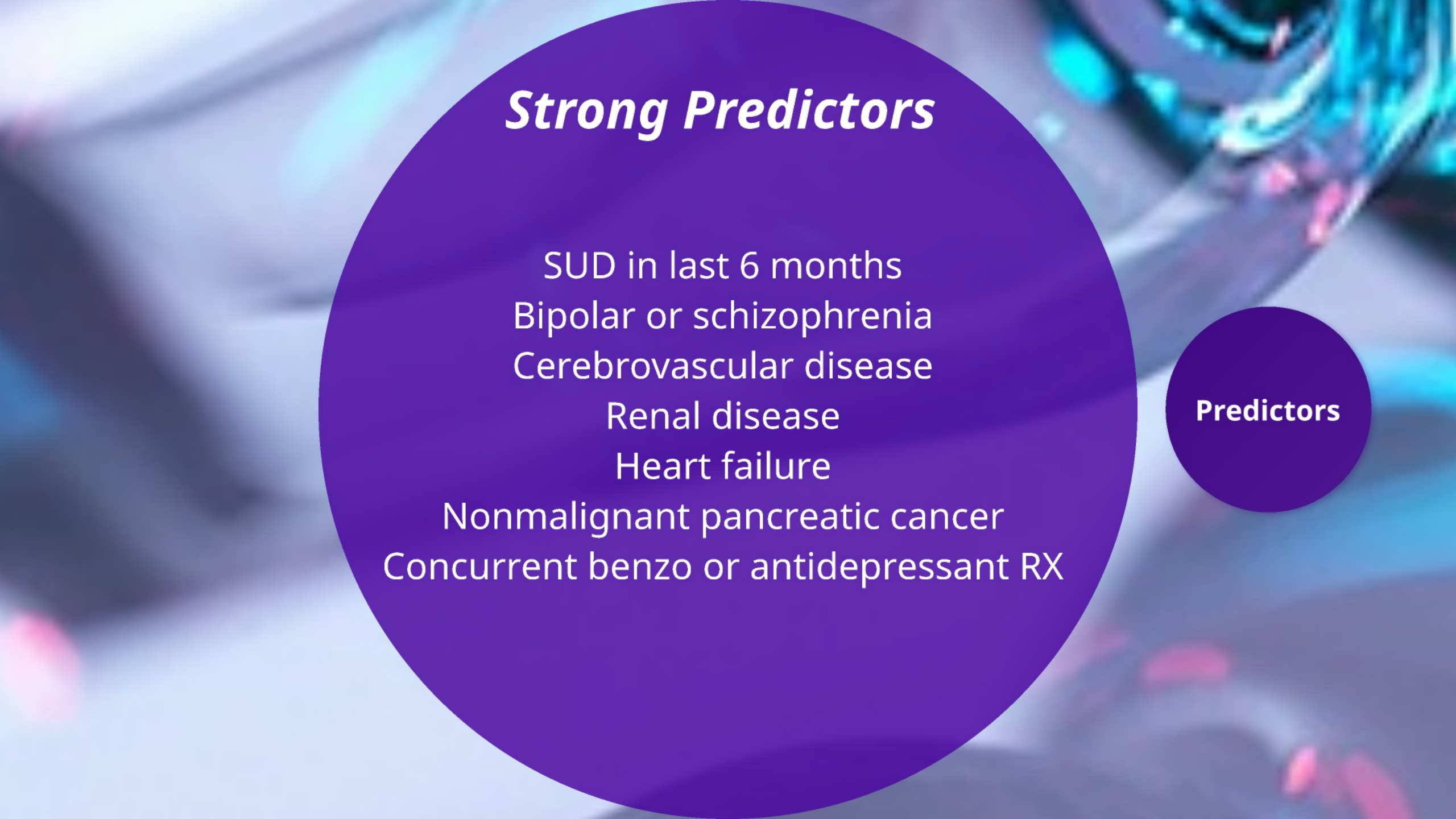
Risk Factors


Strong Predictors
SUD in last 6 months
Bipolar or schizophrenia
Cerebrovascular disease
Renal disease
Heart failure
Nonmalignant pancreatic cancer
Concurrent benzo or antidepressant RX
Predictors

Moderate Predictors

- Recurrent headaches
- Chronic pulmonary disease
- Sleep apnea
- Extended release & long action opioids
- Daily MSO4 equivalent >/= 100mg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Opioid Use Disorder Criteria

Risk Factors

Risk Factors

Misunderstanding between patient and provider

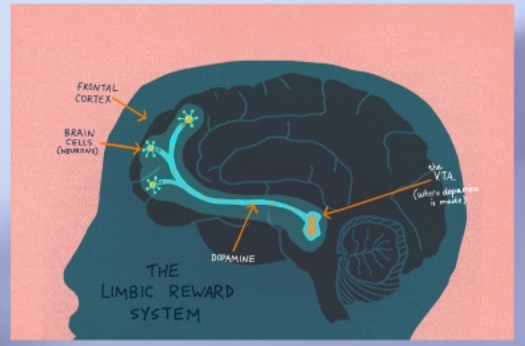
Unauthorized self-medication of pain, mood, or sleep disorders

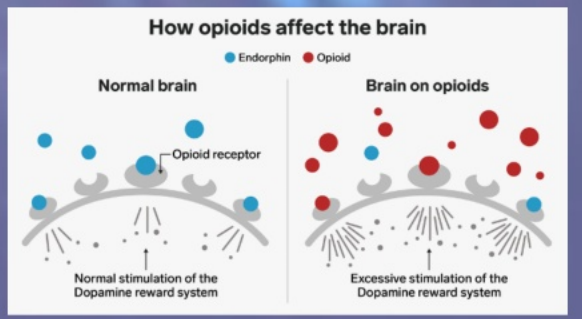
Desire to avoid abstinence syndrome symptoms

Desire for psychoactive reward

Compulsive use due to addiction

Diversion for financial gain





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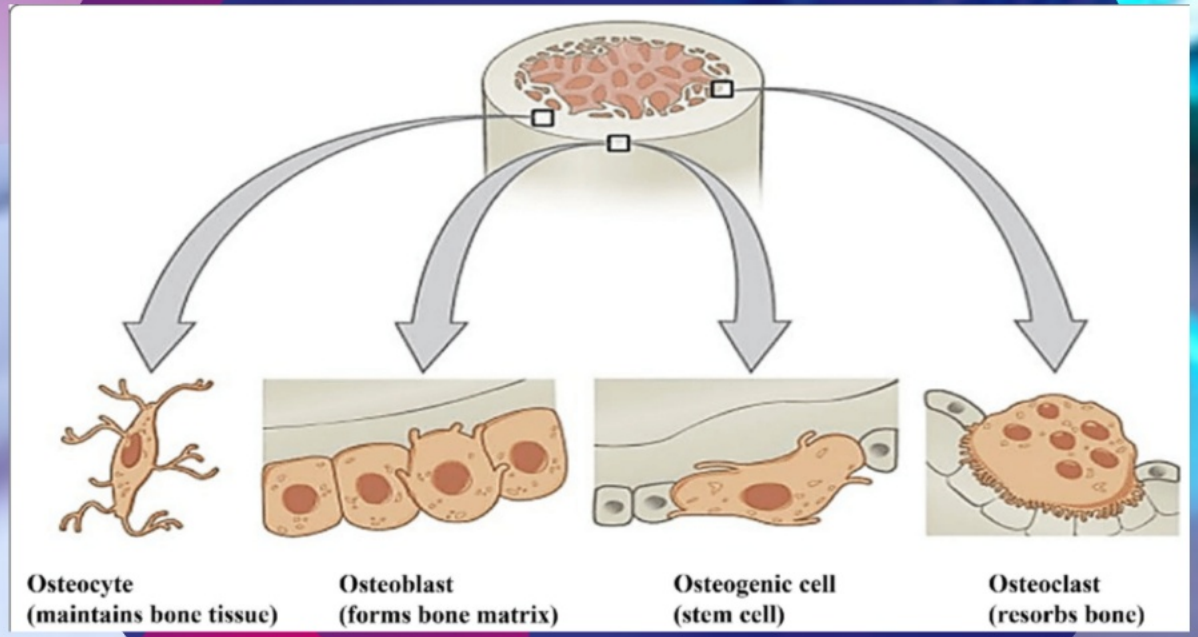
Nerve Fibers

Fracture Pain

Bone Remodeling

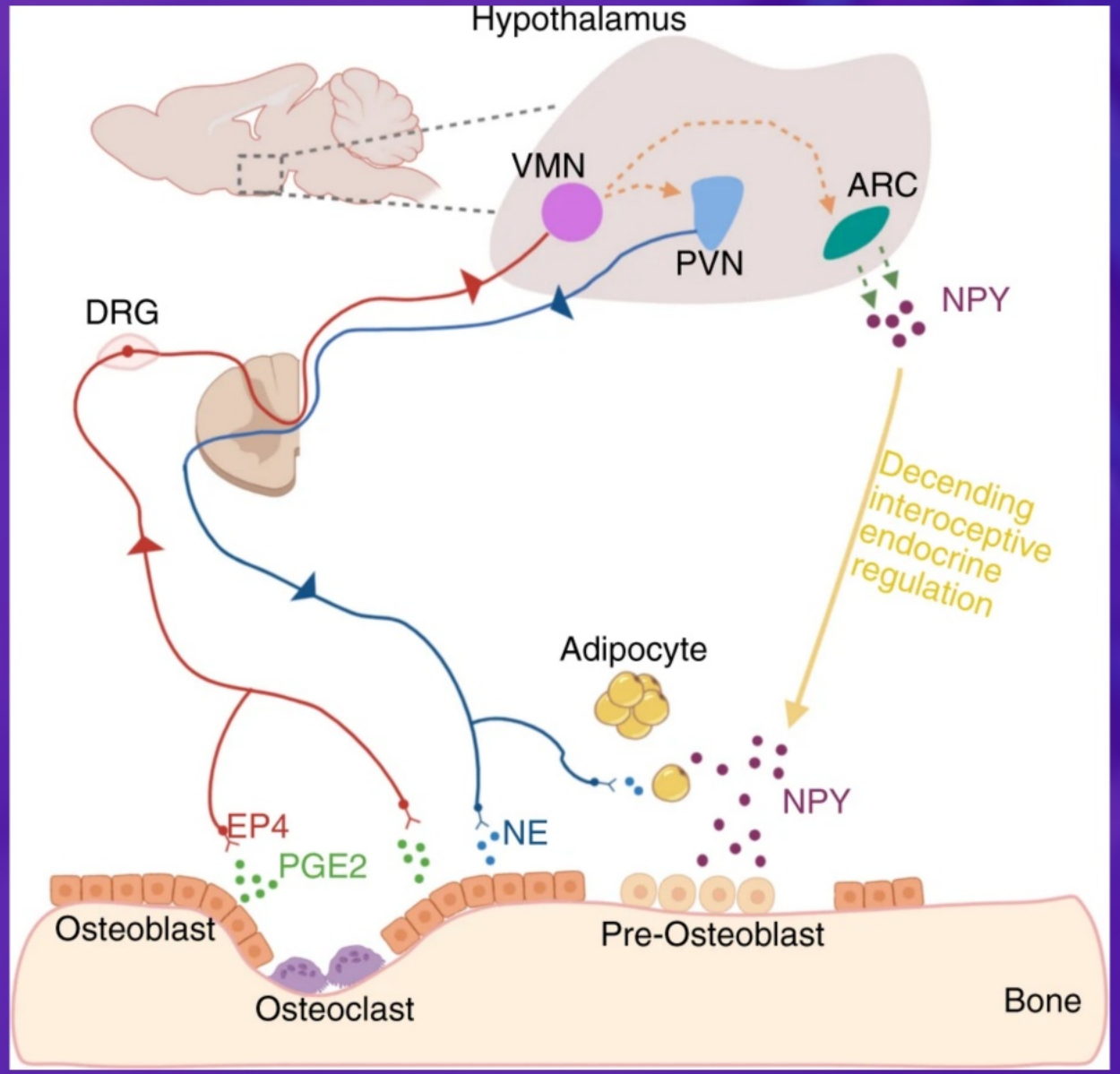


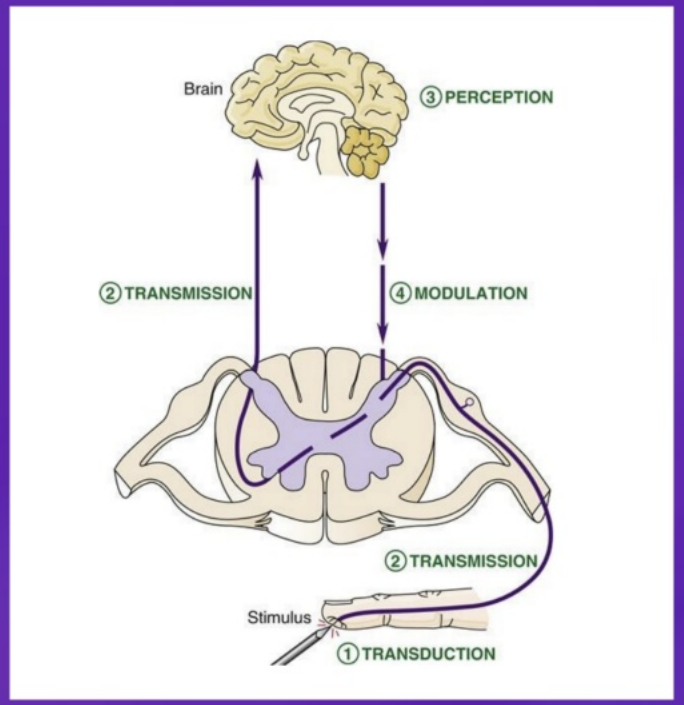
Sensory Innervation

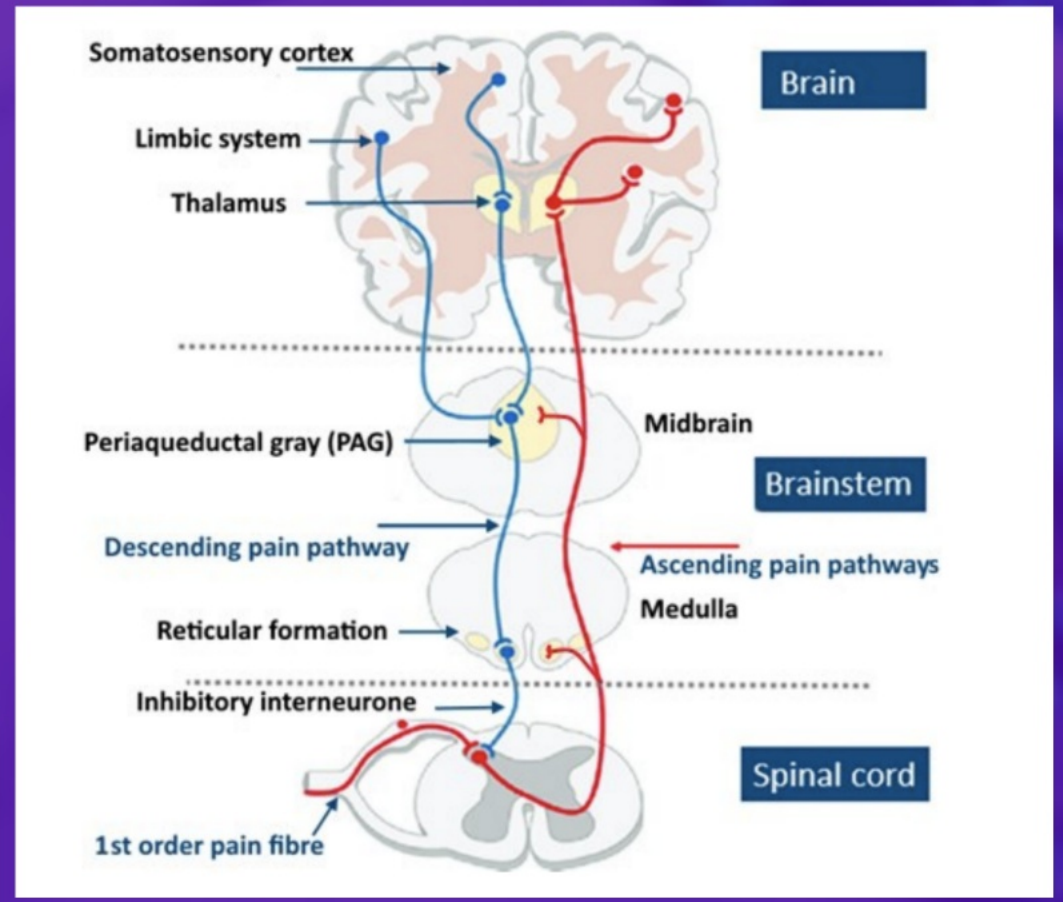
Bone Pain

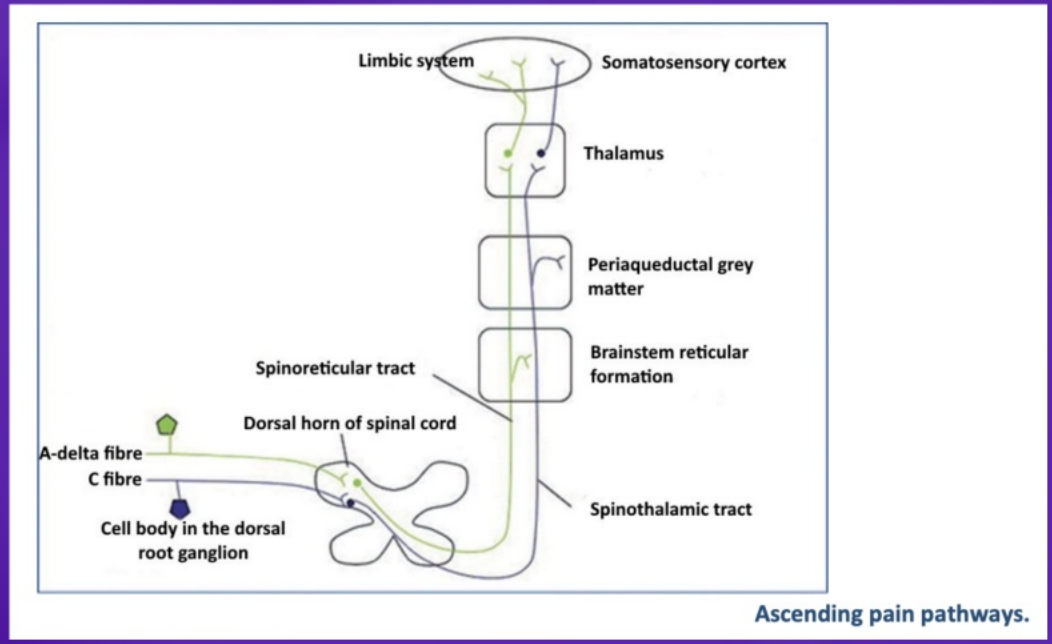
Nerve Fibers

Type	Myelinated	Size (mic)	Conducti velocity (m/sec)	Functions
A-fibers	yes			somatic
A - Alpha & beta	yes	8-20	40-120	Motor, pressure, touch, sensation
A- Gamma	yes	4-8	15-40	Muscle, spindle efferent
A-Delta	yes	2-4	5-15	Pain, temperature
B-fibers	yes	2-3	5-15	Autonomic preganglionic (sympathetic and parasympathetic)
C-fibers	no	0.5-2	0.5-1.5	Autonomic postganglionic, visceral pain







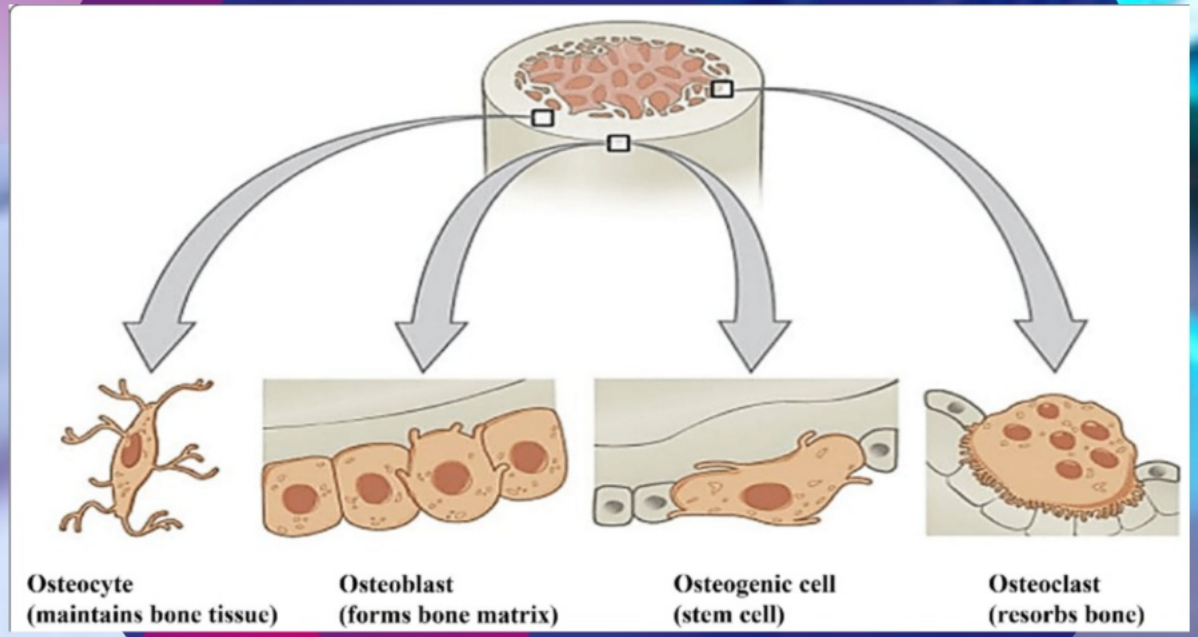


Ascending pain pathways.

Nerve Fibers

Fracture Pain

Bone Remodeling



Sensory Innervation

Bone Pain

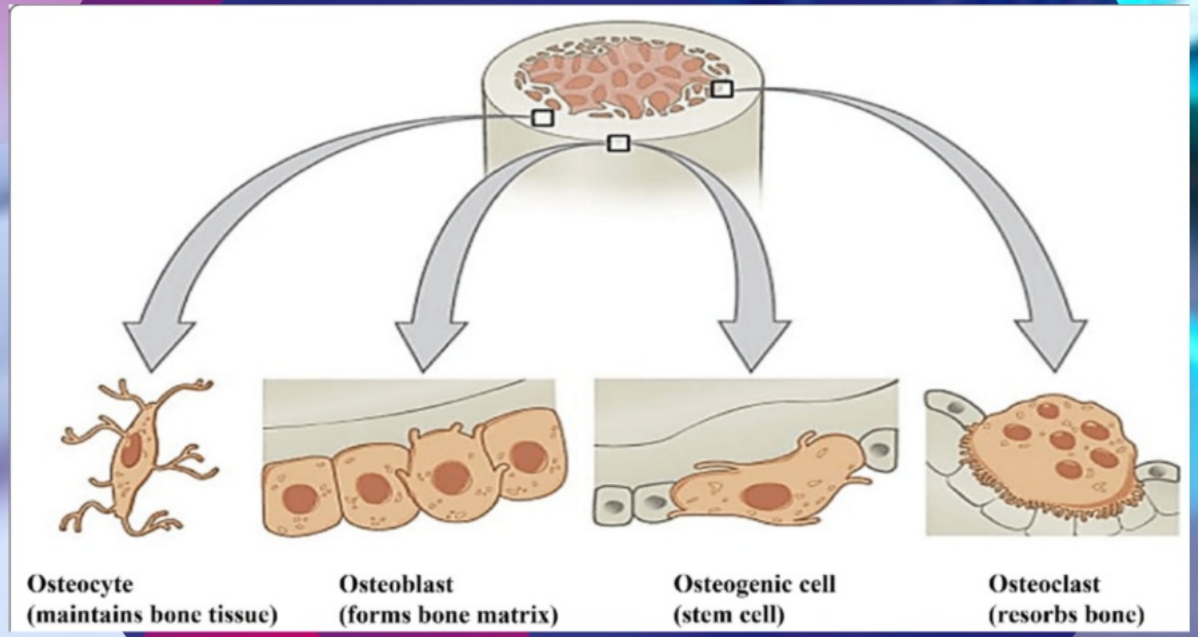
Sensory Innervation

- Primarily osteoclasts involved in skeletal pain and sensory innervation
- During resorption, osteoclasts secrete protein leading to acidic environment
- Acidic environment is noxious stimuli for nociceptive nerves
- Acid activates nocicpetive sensory neurons
- Activation of sensory nerves can promote blood vessel growth leading to nerve growth
- Role of osteoblasts less well defined and more likely affect afferent nervous system

Nerve Fibers

Fracture Pain

Bone Remodeling



Sensory Innervation

Bone Pain

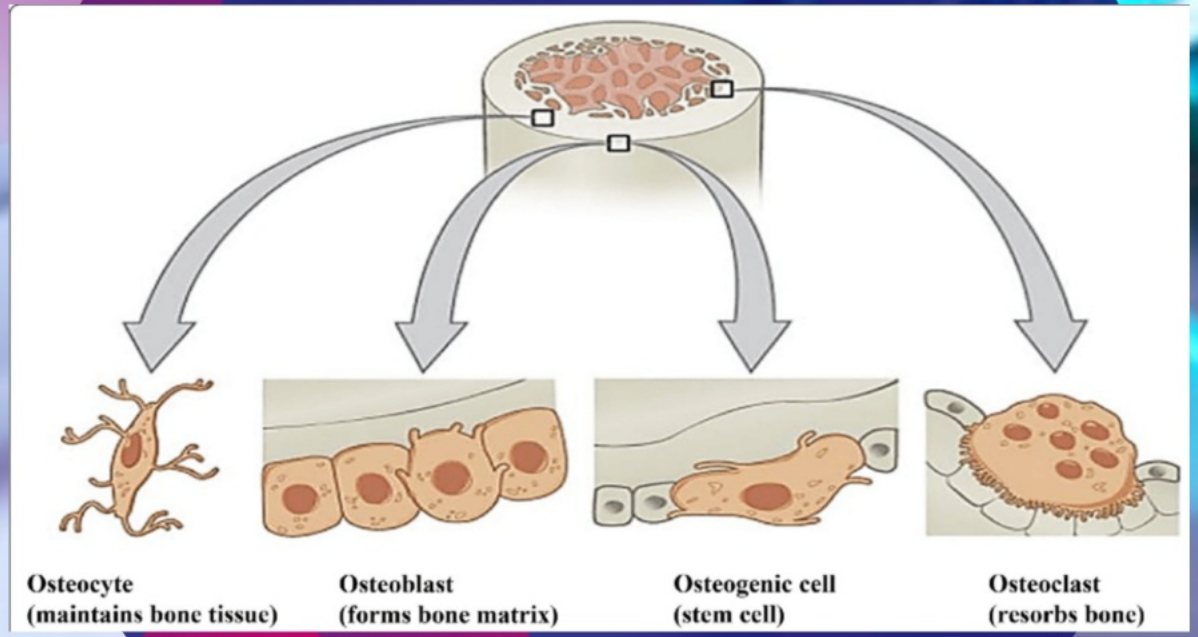
Fracture Pain

- Mediated by nerves innervating the bone
- Movement or pressure can cause sharp pain
- DRG neurons are A-delta (thin myelinated) and C (unmyelinated) fibers
- Mechanosensitive
- Generate discharge immediately after injury lasting for hours
- Can sensitize neurons in CNS
- Pro-inflammatory cytokines released from fracture and attract circulating immune and inflammatory cells (local inflammation)
- Pro-inflammatory cytokines exacerbate pain responses
- Changes in the microenvironment promotes osteoclasts and bone resorption
- Ectopic sprouting of sensory and sympathetic nerve fibers can occur
- Central sensitization and maladaptive changes can lead to chronic pain

Nerve Fibers

Fracture Pain

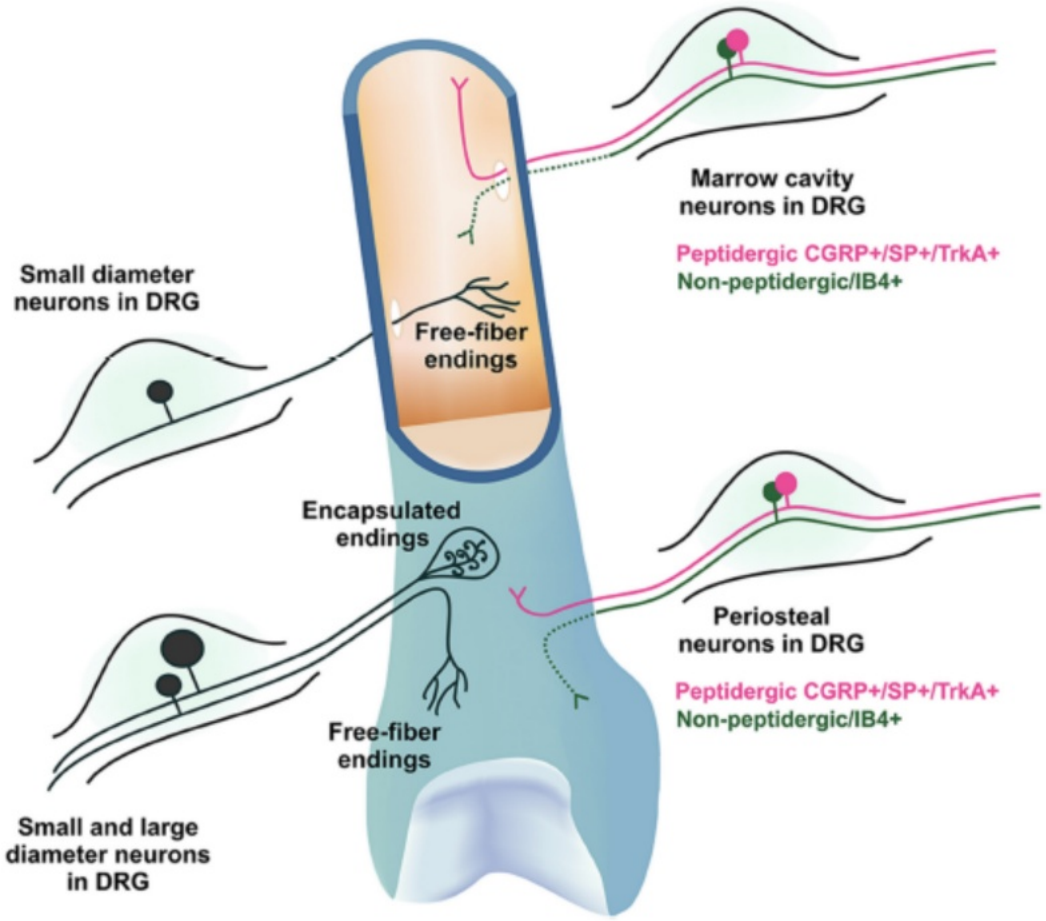
Bone Remodeling



Sensory Innervation

Bone Pain

Bone Pain

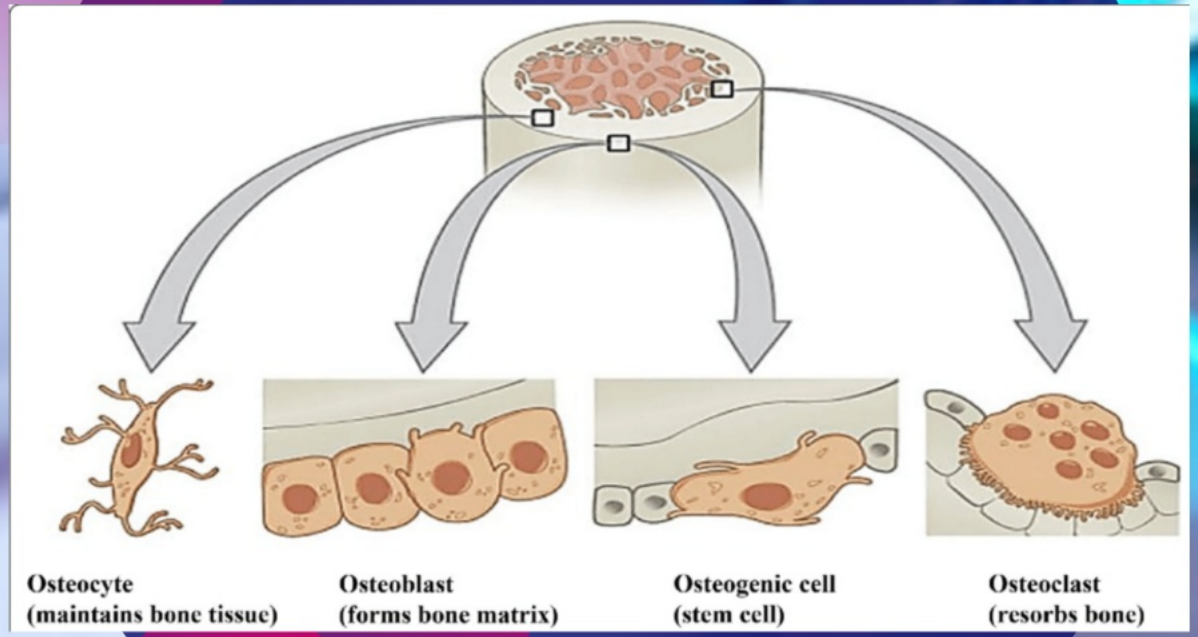


- Primary afferent neurons innervate bone
- Have morphology and phenotype consistent with role in nociception
- Fibers innervating mineralized bone, bone marrow and periosteum are sensory and autonomic
- DRG of primary afferent neurons are small myelinated and unmyelinated expressing various markers or nociceptive neurons

Nerve Fibers

Fracture Pain

Bone Remodeling



Sensory Innervation

Bone Pain

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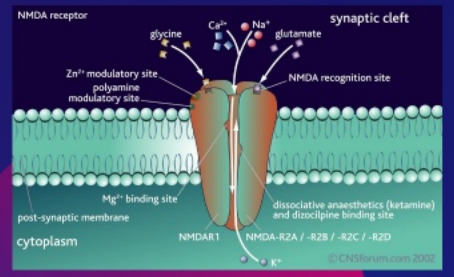
Opioid Free Anesthesia Pharmacology Review

Lidocaine (peripheral)

- Antiarrythmic, local anesthetic
- Blocks voltage-gated Na + channels
- 2mg/min
- Treat centrally mediated pain



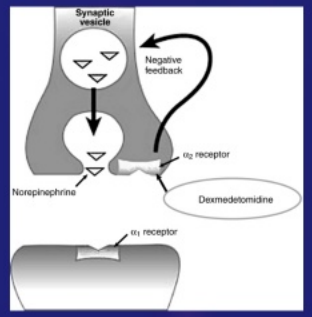
Ketamine (central)

- NMDA receptor antagonist
- Antidepressant effects
- 0.5mg/kg bolus
- 4mcg/kg/min initial gtt rate

Opioid Free Anesthesia Pharmacology Review

Dexmedetomidine (central)

- Alpha-2 agonist
- Dose dependent sedation, analgesia, sympatholysis and anxiolysis
- 0.5mcg/kg bolus
- 0.2-0.6mcg/kg/hr



Magnesium (central)

- Important in neurotransmission
- Nociceptive action is NMDA antagonist
- 10mg/kg/hr

Opioid Free Anesthesia Pharmacology Review

Esmolol

- Cardioselective *B*-1
- Rapidly metaboized
- Treat sympathetic stimulation
- 30mg boluses

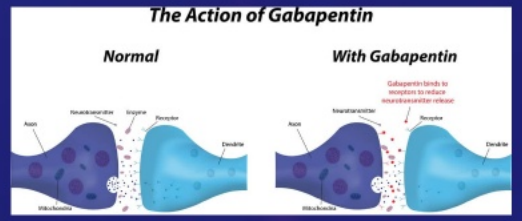
Acetaminophen (peripheral)

- Inhibits synthesis of prostaglandins in CNS
- 1000mg po preop
- Duration 4-6hrs

Opioid Free Anesthesia Pharmacology Review

Gabapentin (central)

- Depresses neuronal excitability
- Inhibits inflammatory mediators
- 300mg po preop



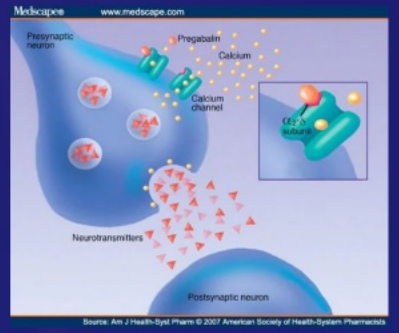
Celebrex (peripheral)

- COX-2 inhibitor
- Inhibits prostaglandin synthesis
- Targets pain and inflammation
- 400mg for acute pain

Opioid Free Anesthesia Pharmacology Review

Lyrica (central)

- Acts on voltage dependent calcium channels
- Decreases glutamate and substance P release
- 75mg po preop



Regional Anesthesia (peripheral)

- Blocks nerve conduction
- Choice of block depends on surgical site
- Preop vs. postop
- Catheter vs. single shot

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OFA

My Technique

Case #1

Lidocaine 2mg/kg/hr
Ketamine 5mcg/kg/min
Magnesium 10mg/kg/hr
Dexmedetomidine 0.4mcg/kg/hr

McLott Mix

Lidocaine 2% 10ml
Ketamine 30mg
Magnesium 1gm
Dexmedetomidine 40mcg

Fill syringe with IV fluid for total volume of 50mL
Infuse at 0.5ml/kg/hr (IBW or AdjBW)

Case #2

Case #3

Additional Resources

Effort

Comfortable Patient

Happy Hospital Exec

OFA

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Case #2

Case #3

Additional Resources

My Technique

Preop

- 1gm acetaminophen po
- 400mg Celebrex po
- Lyrica ?
- 40mg dexmedetomidine IV over 10 min

Induction

- 30mg ketamine IV
- 40-100mg lidocaine IV
- 1-2mg/kg propofol IV
- 35-50mg Rocuronium IV/ or 120-200mg Succ IV
- Esmolol prn

Technique (cont)

My Technique (cont)

Maintenance

- 4mcg/kg/min ketamine
- 2mg/min lidocaine
- 0.4 - 0.6 mcg/kg/hr dexmedetomidine
- Esmolol bolus prn
- NDMR bolus or infusion (titrate to effect)

Emergence

- Ketamine 2mcg/kg/min IV 60min before case complete then D/C 30min before case complete
- Dexmedetomidine D/C 30min before case complete
- Lidocaine D/C at extubation
- Ketorolac 30mg
- Dilaudid bolus prn after SV (analgesia)

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OFA

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Case #2

Case #3

Additional Resources

PMH

Anesthesia

Case #1

Preop Diagnosis: femoral fracture

Planned Procedure: ORIF treatment of intertrochanic femoral fracture with intramedullary implant

Planned Surgical Time: 3-3.5hrs

Height/Weight = 63in/220lbs

Labs = nothing remarkable

Anesthesia Times

Postop

Past Medical History

Acquired hypothyroidism
Arthritis
Bicipital tendonitis of right shoulder

Depression
Mitral valve prolapse
Shoulder pain, right
Vitamin D deficiency

Allergic rhinitis
Atrial fibrillation (HCC)
Closed displaced intertrochanteric fracture of right femur (HCC)
Hyperlipidemia
Preoperative examination
Trauma

PMH

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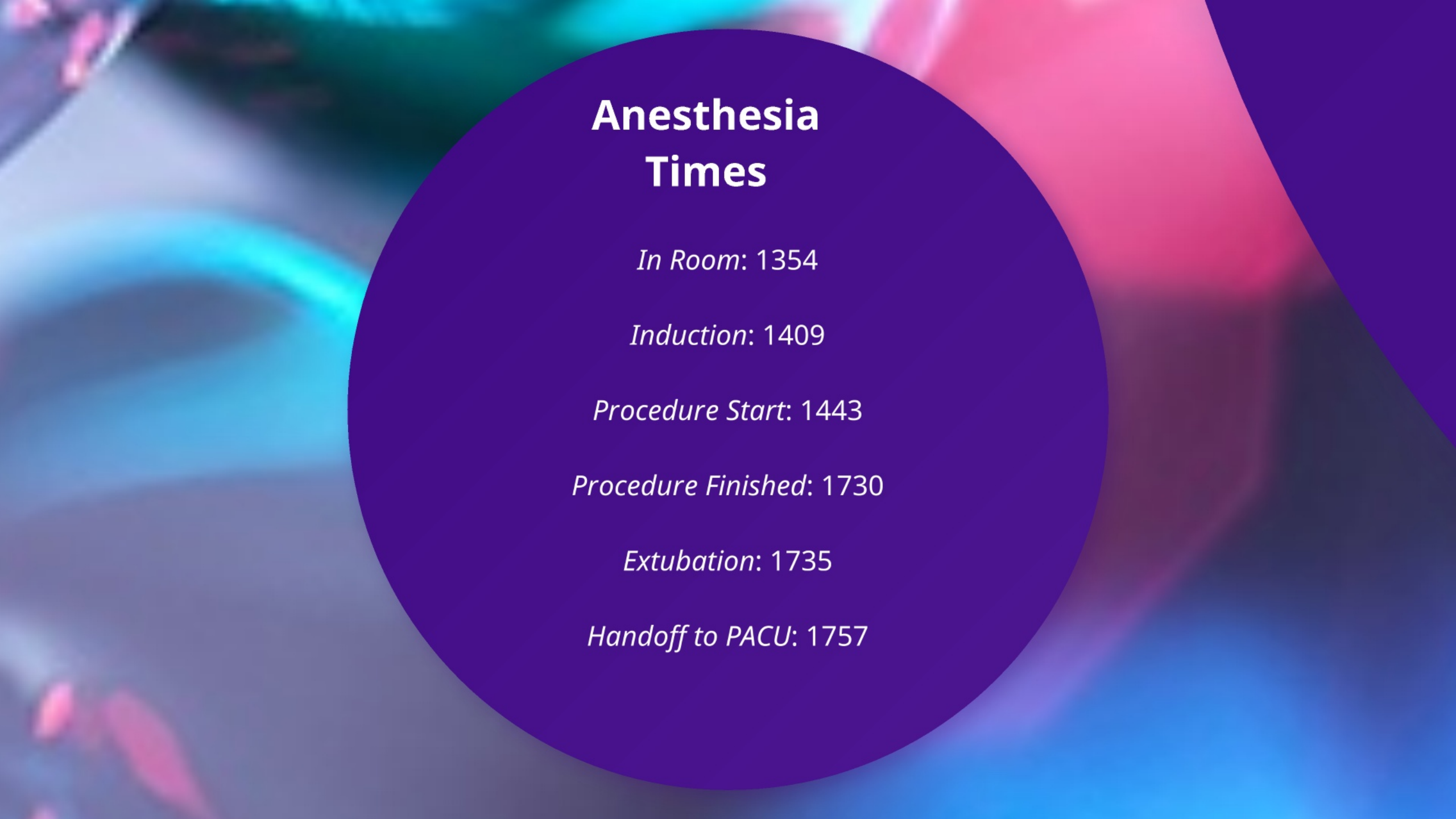

Anesthesia Times

In Room: 1354

Induction: 1409

Procedure Start: 1443

Procedure Finished: 1730

Extubation: 1735

Handoff to PACU: 1757

PMH

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Labs = nothing remarkable

Anesthesia Times

Postop

Anesthesia

Preop

- 40mcg dexmedetomidine

Induction

- Lido (80mg), Prop (130mg), Roc (30mg), Ketamine (30mg)

Maintenance

- Lido 2mg/min
- Ketamine 4mcg/kg/min
- Dexmedetomidine 0.4mcg/kg/hr
- NMB boluses titrated to effect

Emergence

- Neostig (5mg), Glyco (0.8mg)

PONV

4mg Ondansetron (induction)
10mg dexamethason

Opioid

NONE

Vasopressors

Phenylephrine 560mcg
Ephedrine 20mg
Vasopressin 2 units

PMH

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Labs = nothing remarkable

Anesthesia Times

Postop

Postop

VSS on arrival to PACU

- 98/51 (BP), 65 (HR), 25 (RR), 100% SaO2

Meds in PACU

- Ketamine (10mg)

Meds on Floor for 1st 36hrs

Oxycodone (10mg) @ 2004
Cyclobenzapine (5mg) @ 2005

PMH

Anesthesia

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Fill syringe with IV fluid for total volume of 50mL
Infuse at 0.5ml/kg/hr (IBW or AdjBW)

Case #2

Case #3

Additional Resources

PMH

Anesthesia

Case #2

Preop Diagnosis: Type III open fracture of tibia and fibula

Planned Procedure: Removal of external fixator left lower extremity and ORIF of left lower extremity

Planned Surgical Time: 2.5hrs

Height/Weight = 71in/185lbs

Labs = nothing remarkable

Anesthesia Times

Postop

Past Medical History

Type III open fracture of left tibia and fibula
Right wrist pain
Closed fracture of head of left radius with routine healing
Closed fracture of right distal radius
Closed fracture of fifth metatarsal bone of left foot with routine healing

PMH

Anesthesia

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Preop Diagnosis: Type III open fracture of tibia and fibula

Planned Procedure: Removal of external fixator left lower extremity and ORIF of left lower extremity

Planned Surgical Time: 2.5hrs

Height/Weight = 71in/185lbs

Labs = nothing remarkable

Anesthesia Times

Postop

Anesthesia Times

In Room: 0715

Induction: 0727

Procedure Start: 0754

Procedure Finished: 1138

Extuabation: 1143

Handoff to PACU: 1152

PMH

Anesthesia

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Planned Surgical Time: 2.5hrs

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Anesthesia Times

Postop

Anesthesia

Preop

- 40mcg dexmedetomidine

Induction

- Lido (100mg), Prop (150mg), Roc (50mg), Ketamine (30mg)

Maintenance

- Lido 2mg/min
- Ketamine 4mcg/kg/min
- Dexmedetomidine 0.3mcg/kg/hr
- Vec gtt titrated to effect

Emergence

- Neostig (5mg), Glyco (0.8mg)

PONV

4mg ondansetron (induction)
4mg odansestron (emergence)

Opioid

0.25mg hydromorpone (1132)
0.25mg hydromorpone (1152)

Vasopressors

Phenylephrine (320mcg)
Ephedrine (40mg)

PMH

Anesthesia

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Anesthesia Times

Postop

Postop

VSS on arrival to PACU

- 103/61 (BP), 75 (HR), 8 (RR), 100% SaO2

Meds in PACU

- Ketamine (20mg), hydromorphone (1.5mg)
- Met discharge criteria from PACU at 1307

Meds on Floor

Hydromorphone	*Oxycodone (5mg)*
NONE	9/8 (1539)
	9/8 (2133)

Convereted to ketorolac POD1 @ 0625

Discharged home on POD1

PMH

Anesthesia

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Postop

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Dexmedetomidine 40mcg

Fill syringe with IV fluid for total volume of 50mL
Infuse at 0.5ml/kg/hr (IBW or AdjBW)

Case #2

Case #3

Additional Resources

PMH

Anesthesia

Case #3

Preop Diagnosis: Right femur nonunion fracture

Planned Procedure: Repair nonunion or malunion femur distal to head and neck with autologous iliac bone graft

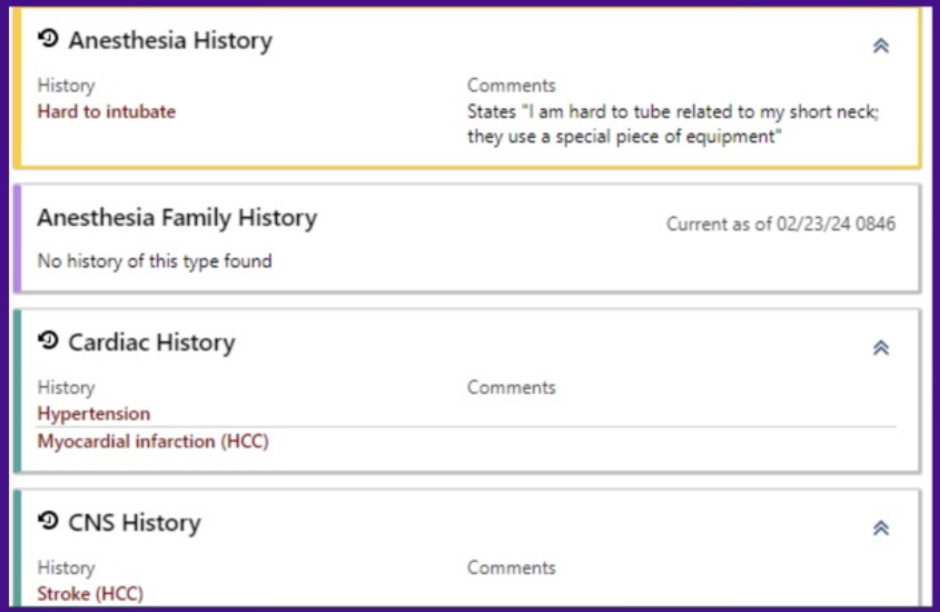
Planned Surgical Time: 120min

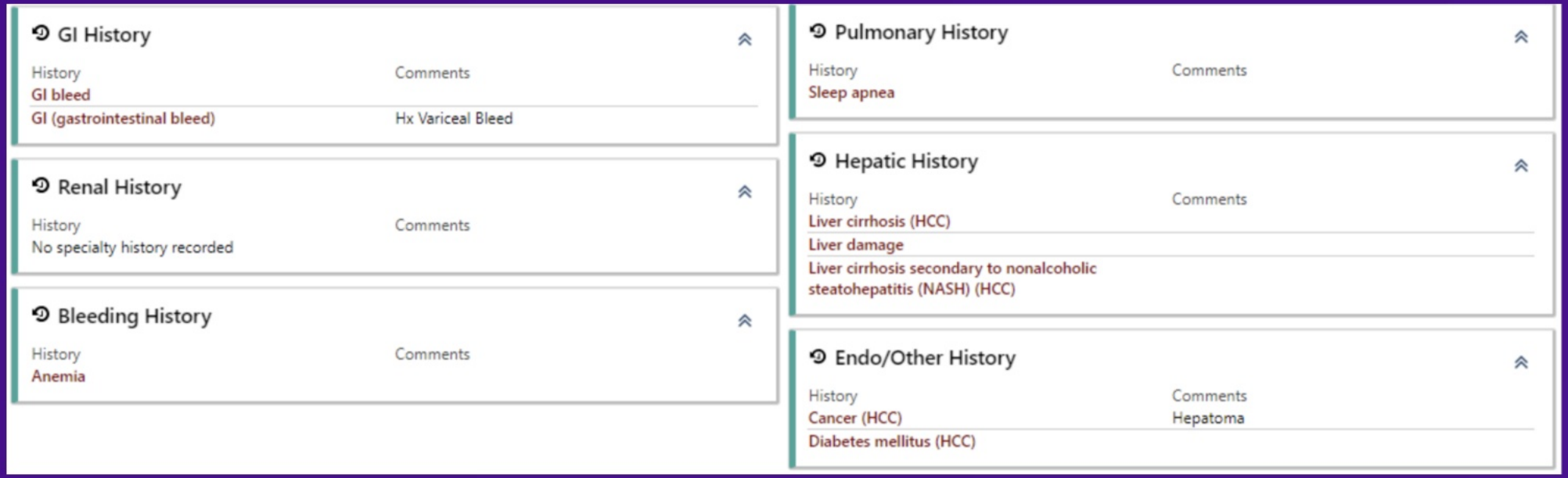
Height/Weight: 70in/98kg

Labs: H/H = 9.1/27
Albumin = 2.9 (low)

Anesthesia Times

Postop


Anesthesia History
History
Hard to intubate
Comments
States "I am hard to tube related to my short neck; they use a special piece of equipment"
Anesthesia Family History
Current as of 02/23/24 0846
No history of this type found
Cardiac History
History
Hypertension
Myocardial infarction (HCC)
Comments
CNS History
History
Stroke (HCC)
Comments


GI History
History
GI bleed
GI (gastrointestinal bleed)
Comments
Hx Variceal Bleed
Renal History
History
No specialty history recorded
Comments
Bleeding History
History
Anemia
Comments
Pulmonary History
History
Sleep apnea
Comments
Hepatic History
History
Liver cirrhosis (HCC)
Liver damage
Liver cirrhosis secondary to nonalcoholic steatohepatitis (NASH) (HCC)
Comments
Endo/Other History
History
Cancer (HCC)
Diabetes mellitus (HCC)
Comments
Hepatoma

PMH

Anesthesia

Case #3

Preop Diagnosis: Right femur nonunion fracture

Planned Procedure: Repair nonunion or malunion femur distal to head and neck with autologous iliac bone graft

Planned Surgical Time: 120min

Height/Weight: 70in/98kg

Labs: H/H = 9.1/27
Albumin = 2.9 (low)

Anesthesia Times

Postop

Events

Date	Time	Event
2/23/2024	0815	Ready for Procedure
	0846	Patient Verification
	0846	Patient In Room
	0846	Anesthesia Start
	0847	Start Data Collection
	0848	Pre-Induction Verification
	0852	Induction
	0855	Intubation
	0904	Anesthesia Ready
	0919	Procedure Start
	0921	Incision Start
	1036	Procedure Conclusion Begin
	1045	Reversal
	1051	Procedure Finish (Closed)
	1054	Extubation
	1058	Stop Data Collection
	1058	Patient Out of Room
	1107	Anesthesia Stop
	1107	Post-Op Handoff

0919	Procedure Start
0921	Incision Start
1036	Procedure Conclusion Begin
1045	Reversal
1051	Procedure Finish (Closed)

1051	Procedure Finish (Closed)
1054	Extubation
1058	Stop Data Collection
1058	Patient Out of Room
1107	Anesthesia Stop
1107	Post-Op Handoff

PMH

Anesthesia

Case #3

Preop Diagnosis: Right femur nonunion fracture

Planned Procedure: Repair nonunion or malunion femur distal to head and neck with autologous iliac bone graft

Planned Surgical Time: 120min

Height/Weight: 70in/98kg

Labs: H/H = 9.1/27
Albumin = 2.9 (low)

Anesthesia Times

Postop

Preop
2mg midazolam

Induction
100mg lidocaine, 150mg propofol, 50mg rocuronium, 15mg ketamine

Maintenance
Lidocaine gtt 2mg/min
Ketamine 15mg bolus
Isoflurane 0.8-1.1 ET concentration
NMB boluses titrated to effect
20mcg dexmedetomidine

Emergence
Neostigmine 5mg, Glycopyrrolate 0.8mg

Opioid
0.5mg hydromorphone

PONV
5mg dexamethasone
4mg ondasetron

Vasopressors
20mg ephedrine

PMH

Anesthesia

Case #3

Preop Diagnosis: Right femur nonunion fracture

Planned Procedure: Repair nonunion or malunion femur distal to head and neck with autologous iliac bone graft

Planned Surgical Time: 120min

Height/Weight: 70in/98kg

Labs: H/H = 9.1/27
Albumin = 2.9 (low)

Anesthesia Times

Postop

Meds Received

Discharged to home

PMH

Anesthesia

Case #3

Preop Diagnosis: Right femur nonunion fracture

Planned Procedure: Repair nonunion or malunion femur distal to head and neck with autologous iliac bone graft

Planned Surgical Time: 120min

Height/Weight: 70in/98kg

Labs: H/H = 9.1/27
Albumin = 2.9 (low)

Anesthesia Times

Postop

OFA

My Technique

Case #1

Lidocaine 2mg/kg/hr
Ketamine 5mcg/kg/min
Magnesium 10mg/kg/hr
Dexmedetomidine 0.4mcg/kg/hr

McLott Mix

Lidocaine 2% 10ml
Ketamine 30mg
Magnesium 1gm
Dexmedetomidine 40mcg

Fill syringe with IV fluid for total volume of 50mL
Infuse at 0.5ml/kg/hr (IBW or AdjBW)

Case #2

Case #3

Additional Resources

Additional Resources

SOFA

The Society for Opioid Free Anesthesia

OFA

My Technique

Case #1

Lidocaine 2mg/kg/hr
Ketamine 5mcg/kg/min
Magnesium 10mg/kg/hr
Dexmedetomidine 0.4mcg/kg/hr

McLott Mix

Lidocaine 2% 10ml
Ketamine 30mg
Magnesium 1gm
Dexmedetomidine 40mcg

Fill syringe with IV fluid for total volume of 50mL
Infuse at 0.5ml/kg/hr (IBW or AdjBW)

Case #2

Case #3

Additional Resources

Opioid Free Anesthesia
Orthopedic Trauma

Oklahoma Association of Nurse Anesthetists

Objectives

Opioid Crisis

Ortho Pain Pathways

Pharm Review

OFA & Ortho Trauma

Ref

Richard Wilson, DNAP, CRNA, FAANA
DreamMaker Anesthesia Services, LLC

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This Stuff is GOOOOOOOD!

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