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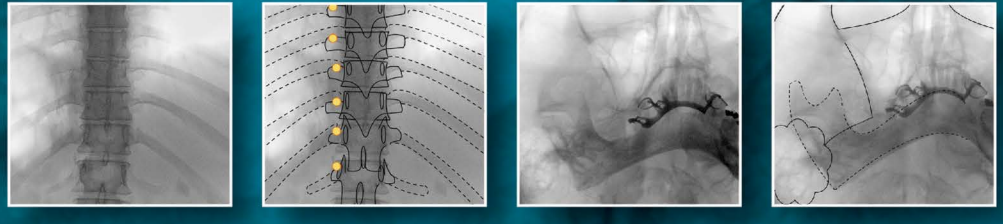
A Quick Reference Guide to Spinal and Peripheral Pain Procedures



Rudy Garza III

Co-Authors
Maxim S Eckmann
Rachel Yinfei Xu

Foreword
Maxim S Eckmann

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Terms/Abbreviations

- AP: Anteroposterior
- C1–C7: Cervical levels
- CESI: Cervical epidural steroid injection
- C MBB: Cervical medial branch block
- CRPS: Complex regional pain syndrome
- DR: Dorsal rami
- DRB: Dorsal ramus block
- DSA: Digital subtraction angiography
- ESI: Epidural steroid injection
- IAP: Inferior articular process
- L1–L5: Lumbar levels
- LBB: Lateral branch block
- LESI: Lumbar epidural steroid injection
- LM: Lateral mass
- L MBB: Lumbar medial branch block
- LOR: Loss of resistance
- MB: Medial branch
- MBB: Medial branch block
- NF: Neuroforamen
- PA: Posteroanterior
- PDPH: Post dural puncture headache
- PED: Pedicle
- PFNS: Preservative free normal saline
- RFA: Radiofrequency ablation
- S1–S5: Sacral levels
- SAP: Superior articular process
- SCS: Spinal cord stimulator
- SIJ: Sacroiliac joint
- SNRB: Selective nerve root block
- SP: Spinous process
- T1–T12: Thoracic levels
- TESI: Thoracic epidural steroid injection

- TFESI: Transforaminal epidural steroid injection
- TMBB: Thoracic medial branch block
- TON: Third occipital nerve
- TP: Transverse process
- UP: Uncinate process
- VB: Vertebral body

Chapter 2

Pharmacology

ANTICOAGULATION GUIDELINES

Anticoagulation guidelines have been described in Table 2.1.

- Table 2.1 is based upon the evidence-based guidelines published by the American Society of Regional Anesthesia and Pain Medicine, Third edition.

Table 2.1: Anticoagulation guidelines for interventional pain procedures

Drug	*Stopping medication before intermediate to high-risk procedure*	*Restarting medication after procedure*
Aspirin	Consider 6 days for high-risk procedure	24 hours
Apixaban (Eliquis)	3–5 days	24 hours
Clopidogrel (Plavix)	7 days	12–24 hours
Dabigatran (Pradaxa, Pradax, Prazaxa)	4–5 days 6 days if renal function impaired	24 hours
Enoxaparin (Lovenox) – Prophylaxis	12 hours	12–24 hours
Enoxaparin (Lovenox) – Therapeutic dose (1 mg/kg q12h or 1.5 mg/kg q day)	24 hours	12–24 hours
Heparin – IV vascular surgery	4 hours	2 hours 24 hours if was bloody
Heparin – SQ BID/TID prophylaxis	8–10 hours	2 hours
NSAIDs	5 half-lives	24 hours
Prasugrel (Efficient)	7–10 days	12–24 hours
Rivaroxaban (Xarelto)	3 days	24 hours
Ticagrelor (Brilinta, Brilique, Possia)	5 days	12–24 hours
Warfarin (Coumadin)	5 days AND normal INR	24 hours

(SQ: Subcutaneously; NSAIDs: Nonsteroidal anti-inflammatory drugs).

- The table is based upon the evidence-based multi-society guidelines ("Interventional Spine and Pain Procedures in Patients on Antiplatelet and Anticoagulant Medications: Guidelines From the American Society of Regional Anesthesia and Pain Medicine, the European Society of Regional Anesthesia and Pain Therapy, the American Academy of Pain Medicine, the International Neuromodulation Society, the North American Neuromodulation Society, and the World Institute of Pain," Regional Anesthesia & Pain Medicine: May/June 2015 - Volume 40 - Issue 3 - p 182–212)
- No recommendations were given regarding superficial nerve blocks in patients receiving superficial peripheral nerve blocks
- If an indwelling catheter is to be placed, refer to these guidelines for further guidance on how to plan medication dosing around placement and removal of a catheter.

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LOCAL ANESTHETICS

Mechanism of Action

- Two different classes: (1) ester and (2) amides.
- Blockade of voltage-gated sodium channels.

Pharmacodynamics/Pharmacokinetics[1]

Local anesthetic pharmacology have been described in Table 2.2.

- Clinically, the order of loss of nerve function is a followed: (1) pain, (2) temperature, (3) touch, (4) proprioception, and (5) skeletal muscle tone.
- *Onset*: Determined by tissue pH, the pKa of the local anesthetic, and the amount of non-ionized drug available.
- *Duration*: Action depends on plasma and protein binding.
- *Potency*: It is related to lipid solubility.
- The uptake of local anesthetic from greatest to least as is follows: IV > tracheal > intercostal > caudal > paracervical > epidural > brachial plexus > sciatic > subcutaneous.
- Amino-amide local anesthetics are cleared form plasma by hepatic metabolism, primarily via oxidative dealkylation.
- Ester local anesthetics are metabolized by pseudocholinesterase and partially by red blood cell esterases.

Local Anesthetic Complications

- *Allergy to local anesthetics*:
  - ◊ Ester local anesthetics are metabolized to para-aminobenzoic acid (PABA), a known allergen.
  - ◊ Methylparaben, a preservative in both ester and amide local anesthetic solutions, is also metabolized to PABA
- *Central nervous system (CNS) toxicity*: Perioral numbness, metallic taste, light-headedness, visual and auditory disturbances, dizziness, paresthesia, unconsciousness, convulsions, coma, and respiratory depression.[2]

Table 2.2: Local anesthetic pharmacology.[4]

Agent	*Onset*	*Equipotency anesthetic concentration*	*Approximate anesthetic duration (min)*	*Recommended maximum single dose (mg/kg)*
Lidocaine (Xylocaine)	Intermediate	1	60–120	4 (7 with epi)
Mepivacaine (Carbocaine)	Intermediate	1	90–180	4 (7 with epi)
Ropivacaine (Naropin)	Slow	0.5	180–480	3
Bupivacaine (Marcaine)	Slow	0.25	180–480	3

(Epi: Epinephrine)

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- *Cardiovascular toxicity*: Hypotension, tachycardia, electrocardiography abnormalities (prolonged PR interval and QRS), and cardiac arrest.[2]
- *Intralipid 20% fat emulsion*:
  - ◊ Recommended dosage: 1.5 mL/kg bolus (repeated up to a total of 5 mL/kg), followed by infusion of 10 mL/min.[3]

STEROIDS

Mechanism of Action

Inhibiting prostaglandin synthesis, impairs the cell-mediated and humoral immune responses, and block nociceptive C fiber conduction.

Selection of Glucocorticoids

- Recommendations are based upon clinical experience and personal preference.
- Intra-articular injections—triamcinolone is more effective in pain reduction than other corticosteroids.[3]
- Transforaminal injections, head and neck and any other procedure where there is a high risk for an intravascular injection—use non-particulate steroids, i.e. dexamethasone and betamethasone
  - ◊ There is one questionable case report that documents adverse CNS effects from non-particulates during a transforaminal injection versus a complication resulting from vascular penetration, i.e. vasospasm, thrombus formation or a dissection[6]
  - ◊ Studies demonstrate no significant differences in pain reduction or the number of repeat injections with particulate compared with non-particulate transforaminal epidural steroid injection.[7]

Frequency of Injections

- Insufficient evidence to determine how many steroid injections one can receive in a year.
- North American Spine Society determined that for transforaminal epidural steroid injections (TFESIs):[8]
  - ◊ No more than two injections to achieve a beneficial response
  - ◊ Up to three injections in a 6-month period to reinstate and maintain benefit
    - ◆ Benefit—reduced pain and/or improved function, along with reduced need for other health care.
- More than four injections per year—an alternative treatment should be considered (i.e. surgical consult, changes in medication management).

Maximum Dose

- Previous research suggests triamcinolone dosage more than or equal to 3 mg/kg/year (administration route unspecified), or the equivalent, should be limited to prevent corticosteroid-induced bone loss.[9]
- Recent research suggests bone loss does not occur until the dose of triamcinolone, administered in the epidural space, is around 400 mg/year.

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Side Effects

- Alterations in skin pigmentation (avoid tracking of steroids when withdrawing the needle).
- Tendon rupture, cartilage damage, pericapsular calcification and bone mineral loss are all potential side effects that can worsen patient outcomes.[10]
- All long-acting glucocorticoids, with the exception of dexamethasone, contain preservatives. Intrathecal administration carries an increased risk for arachnoiditis.
- Patients with hemoglobin A1c levels greater than or equal to 7% have elevations in blood glucose that are higher and last longer (4–5 days) than patients with lower levels. There is no established "safe" cut off value for blood glucose levels prior to epidural administration of corticosteroids but, most practitioners utilize a cut off around 200 mg/dL.

Commercially Available Steroid Preparations

Commercially available steroid preparations have been given in Table 2.3.

CONTRAST AGENTS

- Iodine based radiopaque agent: Ionic:
  - ◊ High-osmolarity contrast media (HOCM):
    - ◆ Causes severe irritation and more likely to cause vasodilatation, increased capillary permeability, and mast cell degranulation
    - ◆ Hence more likely to cause an allergic reaction
  - ◊ Not commonly used in pain practices
- Nonionic—iohexol (Omnipaque) and iopamidol (Isovue)
  - ◊ Low-osmolarity contrast media (LOCM)—although still hyperosmolar compare to serum
  - ◊ Dose based upon the iodine concentration, standard dose for pain procedures—between 200 mg and 300 mg/dL
  - ◊ Omnipaque can be used for intrathecal use, Isovue is not Food and Drug Administration (FDA) approved
  - ◊ Four- to fivefold reduction in all reactions compared to HOCM.

Table 2.3: Commercially available steroid preparations.

Drug	*IM dose (mg)*	*Approximate equivalent dose*	*Relative glucocorticoids (anti-inflammatory)*	*Relative mineralocorticoid (Na retention)*	*Half-life (hours)*
Triamcinolone acetonide (Kenalog)	40–80	4	5	0	12–36
Betamethasone (Celestone)	9	0.6	25	0	36–72
Methylprednisolone (Depomedrol)	40–80	4	5	0.5	18–36
Dexamethasone acetate (Decadron)	4–8	0.75	25	0	36–54

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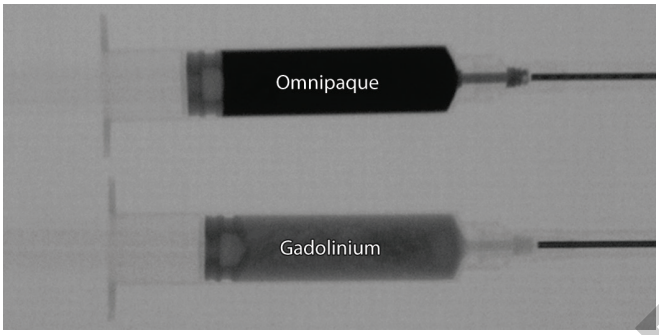

Fig. 2.1: Gadolinium produces a dispersal pattern that is less distinct than iodinated contrast media.

Gadolinium (OptiMARK) (Fig. 2.1)

- Alternative contrast media used for patients with a true history of an allergic reaction to nonionic contrast.
- Not FDA approved for intrathecal use.
- Not proven safer than the iodinated contrast agents and should be limited to 3 mL. Paramagnetic properties, hence also called MRI contrast.

Adverse Reactions

- Ninety percent of adverse reactions with nonionic contrast materials are anaphylactoid.
- *Mild reactions*: Localized hives, itching, rhinorrhea, mild nausea and vomiting, coughing, and lightheadedness.
- *Moderate reactions*: Generalized hives, mild bronchospasm, swelling, and hypotension.
- *Severe reactions*: Severe hypotension, severe bronchospasm, aseptic meningitis, arachnoiditis (seen in both iodinated contrast and gadolinium), seizures, and death.
- Medical myth-allergies to shellfish = allergies to iodine[11]
  - ◊ Patients are allergic to the protein in shellfish and not iodine.

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- Target Angles—a consolidated reference of the initial approach to pain procedures



Rudy Garza III MD was born and raised in San Antonio, Texas, USA. He received his medical degree from the University of Texas at Galveston and completed his residency and fellowship at UT Health San Antonio. Dr Garza is dual board certified in Anesthesiology and Pain Medicine. Following his fellowship, he was appointed a faculty position in the Department of Anesthesiology at UT Health San Antonio. Each year, he helps train over 40 anesthesia residents and six pain fellows. Dr Garza has won numerous awards for his clinical and educational achievements, presented at multiple society meetings, and has authored several chapters for Anesthesiology and Pain Medicine textbooks.

His motivation for writing this book was based on the lack of a single resource that comprehensively discusses pain procedures other than spine. He wrote this book not only thinking about the physician but also nurses, radiology technicians and medical assistants, so that any one of them has the tools to easily perform or assist in navigating through any pain procedure.



Maxim S Eckmann MD received his Bachelors of Science Degree in Biomedical Engineering in 1998 from Texas A & M University and later his Doctor of Medicine Degree from Baylor College of Medicine in 2003. He completed his residency training in Anesthesiology at the University of Michigan in 2007, and then went on to complete his Pain Medicine Fellowship at the University of Texas Health Science Center at San Antonio (UTHSCSA) in 2008. He then joined the faculty at UTHSCSA, becoming the director of the Pain Medicine Fellowship in 2011 as well as the Medical Director of the primary pain clinic. He now serves as Executive Medical Director of Pain Medicine for his division, overseeing an inpatient and outpatient clinical enterprise that reaches multiple hospital systems, and has attained the rank of Associate Professor in Anesthesiology.



Rachel Yinfei Xu MD is an Interventional Pain Management Physician in San Antonio, Texas where she completed her fellowship training. Prior to that, she completed a physical medicine and rehabilitation residency at Mount Sinai School of Medicine in New York City. Dr Xu emphasizes a multidisciplinary approach to help her patients maximize function, independence and quality of life. She is also the co-author of "Musculoskeletal Pain Conditions: A Comprehensive Guide", which is scheduled for publication in the fall of 2017.

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