"These pills will help you stay asleep. They change your dreams into Powerpoint presentations!"
Objectives

1. To identify clinical differences between injected steroids
2. To identify distinguishing properties and clinical concerns of common local anesthetics
3. To identify clinical concerns related to the use of injected contrast
4. To identify distinguishing properties of medications used to treat osteoporosis
5. To review interventional concerns related to the use of blood thinners
Steroids

organic compounds that contain four rings of carbon atoms
Steroids

Produced in the adrenal cortex - 3 Types

**Glucocorticoids** - regulate carbohydrate metabolism (Cortisol)

**Mineralocorticoids** - regulate the body levels of sodium and potassium (Aldosterone)

**Androgens** - actions are similar to that of steroids produced by the male gonads. (Testosterone)

Actions result from effects on gene expression
   - Delayed onset and long effect

Glucocorticoids are typically used in interventional pain management
Glucocorticoids

Suppress virtually every component of the inflammatory process

inhibits PLA₂
Glucocorticoids

Suppress virtually every component of the inflammatory process

inhibit $\text{PLA}_2$

reduce the formation of prostaglandins, which contribute to the inflammatory process.

decrease synthesis of interleukins and numerous other proinflammatory cytokines

suppress cell-mediated immunity

reduce complement synthesis

decrease production and activity of leukocytes (careful in sick patients).

Should appreciate the importance of introducing a needle into the injured area. The needle itself may provide drainage and a release of pressure and it may also mechanically disrupt the scar tissue in the muscle (trigger point injections/dry needling)
Mechanism of Action of Glucocorticoids

Dependent on structure

All therapeutic corticosteroids have a 21-carbon steroid skeleton, similar to hydrocortisone (cortisol).

Modifications to this skeleton selectively alter various properties of the resulting compound:

- the degree of anti-inflammatory activity
- metabolic consequences
- duration of activity
- protein-binding affinity
Mechanism of Action of Glucocorticoids

**Esterification** of the alcohol at C-21 **determines** the extent of **water/lipid solubility**

Monoacid, such as acetic acid, yields water-insoluble drugs (eg, methylprednisolone acetate) which are long-acting formulations when administered by the epidural, IM, SC, or intra-articular route.

Diacid, such as succinic acid, yields a hydrosoluble ester, due to the second acid function (eg methylprednisolone sodium succinate) allowing a salt to be formed.

Esters may also be used PO, but hydrolysis occurs in the lumen of the digestive tract (pancreatic esterase) and the free active moiety is absorbed; thus, a formulation may be long-acting when administered parenterally but short-acting when given orally (eg, prednisolone acetate).
Mechanism of Action of Glucocorticoids

Typically classified based on:

1. Relative glucocorticoid and mineralocorticoid potency
   a. Potency - the relative intensity of drug activity related to its concentration - should not be confused with efficacy

2. Duration of effect

*Compounds with the most potent glucocorticoid activity are also the most potent suppressors of the hypothalamic-pituitary-adrenal axis (HPAA).*
## Relative Potencies of Commonly Used Corticosteroids

<table>
<thead>
<tr>
<th>Compound</th>
<th>Relative Glucocorticoid Activity</th>
<th>Relative Mineralocorticoid Activity</th>
<th>Duration of Effect&lt;sup&gt;a&lt;/sup&gt; (Alcohol Form)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisol</td>
<td>1</td>
<td>1</td>
<td>S</td>
</tr>
<tr>
<td>Prednisone</td>
<td>5</td>
<td>0.8</td>
<td>I</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>5</td>
<td>0.8</td>
<td>I</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>5</td>
<td>0.5</td>
<td>I</td>
</tr>
<tr>
<td>Fludrocortisone</td>
<td>10</td>
<td>125</td>
<td>I</td>
</tr>
<tr>
<td>Isoflupredone</td>
<td>25</td>
<td>25</td>
<td>L</td>
</tr>
<tr>
<td>Triamcinolone</td>
<td>5</td>
<td>0</td>
<td>I</td>
</tr>
<tr>
<td>Triamcinolone acetonide</td>
<td>30</td>
<td>0</td>
<td>I</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>25</td>
<td>0</td>
<td>L</td>
</tr>
<tr>
<td>Betamethasone</td>
<td>25</td>
<td>0</td>
<td>L</td>
</tr>
<tr>
<td>Flumethasone</td>
<td>120</td>
<td>0</td>
<td>L</td>
</tr>
</tbody>
</table>

<sup>a</sup> S = short (~12 hr), I = intermediate (~24 hr), L = long (~48–72 hr)
Glucocorticoid Selection Criteria

Anatomic considerations - Location, location, location

Particulate vs. non-particulate

(triamcinolone, betamethasone acetate, and methylprednisolone) vs. (dexamethasone)

Risk of ischemic neurologic injury.

- Inadvertent intra-arterial injection of particulate corticosteroid resulting in embolic spinal cord ischemia and paraplegia.
- All particulate corticosteroid preparations have been implicated in published case reports of paraplegia.
- Particle sizes larger than red blood cells (RBC) or form aggregates larger than red blood cells.
- Animal studies have shown CNS infarction with intra-arterial injection of particulate steroids.
- Dexamethasone, with particles smaller than RBCs on microscopic evaluation, has not been associated with any reports of paraplegia, and has not created neurologic complications in animal studies.
Glucocorticoid Selection Criteria - Risk of Ischemic Neurologic Injury
Two recent studies - Particulate vs Non-particulate

2013 ISIS Annual Scientific Meeting compared effectiveness of each type in lumbar TFESIs

Kennedy et al presented results from a randomized, double-blind, multi-center, prospective study comparing the efficacy of dexamethasone and triamcinolone.¹

No statistically significant differences in pain relief or surgical rates, but a significant difference was found in the total number of injections needed.

Dexamethasone group required more injections than the triamcinolone group.

El-Yahchouchi et al presented results of a retrospective observational study which found no evidence that dexamethasone is less effective than particulate steroids in lumbar transforaminal steroid injections performed for radicular pain with or without radiculopathy.²


Glucocorticoid Selection Criteria

Anatomic considerations - Location, location, location
- Particulate vs. non-particulate
  - (triamcinolone, betamethasone acetate, and methylprednisolone) vs. (dexamethasone)

Physiologic considerations - Diabetes, adrenal insufficiency

Frequency of administration - Based on both of the above.
- Use non-steroid based options if possible (RFA, etc)
Too Many Steroids?
Major adverse effects of corticosteroid therapy

- **Physiological**
  - Adrenal and/or pituitary suppression

- **Pathological Cardiovascular**
  - Increased blood pressure

- **Gastrointestinal**
  - Peptic ulceration exacerbation
  - Pancreatitis

- **Renal**
  - Polyuria
  - Nocturia

- **Central nervous**
  - Depression
  - Euphoria
  - Psychosis
  - Insomnia

- **Endocrine**
  - Weight gain, Glycosuria/hyperglycaemia, diabetes, impaired growth
  - Amenorrhoea

- **Bone and muscle**
  - Osteoporosis, Proximal myopathy and wasting, Aseptic necrosis of the hip, Pathological fractures

- **Skin**
  - Thinning, Easy bruising

- **Eyes**
  - Cataracts (including inhaled drug)

- **Increased susceptibility to infection**
  - (signs and fever are frequently masked), Septicaemia, Fungal
  - Infections, Reactivation of TB Skin (e.g. fungi)

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**CUSHING Syndrome**

**Background**
Cushing syndrome is caused by prolonged exposure to elevated levels of either endogenous glucocorticoids or exogenous glucocorticoids.
Local Anesthetics
Local Anesthetics

Interrupt neural conduction by inhibiting the influx of sodium ions.

Enter sodium channels and prevent them from assuming an active or “open” state.

Molecule consists of 3 components each of which contributes distinct properties to the molecule:

- **lipophilic aromatic ring** - lipid solubility
- **intermediate ester or amide chain** - basis for classification/determines the pattern of biotransformation. Esters are hydrolyzed by plasma esterases/amides in the liver.
- **terminal amine** - water solubility
Local Anesthetic Injection Concerns

Formulated as water soluble hydrochloride salts to be stable in solution but this form will not penetrate the neuron.

The time of onset of local anesthesia is predicated on the proportion of molecules that convert to lipid-soluble structure at physiologic pH (7.4).

Ionization constant (pKa) for the anesthetic predicts the proportion of molecules that exists in each of these states.

(By definition, the pKa of a molecule represents the pH at which 50% of the molecules exist in the lipid-soluble tertiary form and 50% in the quaternary, water-soluble form.)

The pKa of all local anesthetics is >7.4 (physiologic pH), and therefore a greater proportion the molecules exists in the quaternary, water-soluble form when injected into tissue having normal pH of 7.4.

Acidic environment associated with inflamed tissues favors the quaternary, water-soluble configuration even further.

Leads to difficulty when attempting to anesthetize inflamed or infected tissues; fewer molecules exist as tertiary lipid-soluble forms that can penetrate nerves.
<table>
<thead>
<tr>
<th>FACTOR</th>
<th>ACTION AFFECTED</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>pKa</td>
<td>Onset</td>
<td>Lower pKa = more rapid onset of action, more RN molecules present to diffuse through nerve sheath, thus onset time is decreased</td>
</tr>
<tr>
<td>Lipid solubility</td>
<td>Anesthetic potency</td>
<td>Increased lipid solubility = increased potency</td>
</tr>
<tr>
<td>Protein binding</td>
<td>Duration</td>
<td>Increased protein binding allows anesthetic cations (RNH+) to be more firmly attached to protein located at receptor sites, thus duration of action is increased</td>
</tr>
<tr>
<td>Tissue diffusibility</td>
<td>Onset</td>
<td>Increased diffusibility = decreased time of onset</td>
</tr>
<tr>
<td>Vasodilator activity</td>
<td>Anesthetic potency and duration</td>
<td>Greater vasodilator activity = increased blood flow to region = rapid removal of anesthetic molecules from injection site, thus decreased anesthetic potency and decreased duration</td>
</tr>
</tbody>
</table>
# Table 1-4

**Dissociation Constants (pKₐ) of Local Anesthetics**

<table>
<thead>
<tr>
<th>Agent</th>
<th>pKₐ</th>
<th>Percent Base (RN) at pH 7.4</th>
<th>Approximate Onset of Action (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzocaine</td>
<td>3.5</td>
<td>100</td>
<td>—</td>
</tr>
<tr>
<td>Mepivacaine</td>
<td>7.7</td>
<td>33</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>7.7</td>
<td>29</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Prilocaine</td>
<td>7.7</td>
<td>25</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Articaine</td>
<td>7.8</td>
<td>29</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Etidocaine</td>
<td>7.9</td>
<td>25</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Ropivacaine</td>
<td>8.1</td>
<td>17</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Bupivacaine</td>
<td>8.1</td>
<td>17</td>
<td>5 to 8</td>
</tr>
<tr>
<td>Tetracaine</td>
<td>8.6</td>
<td>7</td>
<td>10 to 15</td>
</tr>
<tr>
<td>Cocaine</td>
<td>8.6</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>Chloroprocaine</td>
<td>8.7</td>
<td>6</td>
<td>6 to 12</td>
</tr>
<tr>
<td>Propoxycaaine</td>
<td>8.9</td>
<td>4</td>
<td>9 to 14</td>
</tr>
<tr>
<td>Procaine</td>
<td>9.1</td>
<td>2</td>
<td>14 to 18</td>
</tr>
<tr>
<td>Procainamide</td>
<td>9.3</td>
<td>1</td>
<td>—</td>
</tr>
</tbody>
</table>

## Table 4

### Comparative Table of LAs

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Trade Name</th>
<th>Relative Potency</th>
<th>Protein Binding (%)</th>
<th>pKₐ Value*</th>
<th>Lipid Solubility</th>
<th>Onset</th>
<th>Duration of Action (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procaine hydrochloride</td>
<td>Novocain</td>
<td>1</td>
<td>58</td>
<td>8.9</td>
<td>1.7</td>
<td>Moderate</td>
<td>30–60</td>
</tr>
<tr>
<td>Lidocaine hydrochloride</td>
<td>Xylocaine</td>
<td>2</td>
<td>55</td>
<td>7.8</td>
<td>25</td>
<td>Rapid</td>
<td>80–120</td>
</tr>
<tr>
<td>Bupivacaine hydrochloride</td>
<td>Marcaine</td>
<td>8</td>
<td>96</td>
<td>8.1</td>
<td>346</td>
<td>Longest (2–10 min)</td>
<td>180–360</td>
</tr>
<tr>
<td>Ropivacaine hydrochloride</td>
<td>Naropin</td>
<td>6</td>
<td>95</td>
<td>8.1</td>
<td>115</td>
<td>Moderate</td>
<td>140–200</td>
</tr>
</tbody>
</table>
Alkalination of local anesthetics

Commercially available acidic local anaesthetic solutions have a pH of typically 3.5 to 5.5

Basic solution can be added to a local anaesthetic solution immediately before injection to raise pH.

Sodium bicarbonate (pH between 8-9)

Alkalination has potential advantages

- higher pH may result in less stinging pain being experienced by the patient
- pH of the injected solution closer to that of the body leading to more rapid drug diffusion and quicker onset
Local Anesthetic Systemic Toxicity

Dose-dependent depression of the central nervous system

Continuum of serum concentrations therapeutic at low levels or toxic at higher concentrations.

Convulsive seizures are the principal life-threatening consequence of local anesthetic overdose.
## Local Anesthetic Maximum Doses (Adults)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Formulation</th>
<th>Manufacturer's MRD</th>
<th>mg/kg (mg/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articaine</td>
<td>4% with epinephrine</td>
<td>N/A</td>
<td>7.0 (3.2)</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>Plain</td>
<td>300</td>
<td>4.4 (2.0)</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>Epinephrine 1 : 100,000</td>
<td>500</td>
<td>7.0 (3.2)</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>Epinephrine 1 : 50,000</td>
<td>500</td>
<td>7.0 (3.2)</td>
</tr>
<tr>
<td>Mepivacaine</td>
<td>Plain</td>
<td>400</td>
<td>6.6 (3.0)</td>
</tr>
<tr>
<td>Mepivacaine</td>
<td>With levonordefrin</td>
<td>400</td>
<td>6.6 (3.0)</td>
</tr>
<tr>
<td>Prilocaine</td>
<td>Plain</td>
<td>600</td>
<td>8.0 (3.6)</td>
</tr>
<tr>
<td>Prilocaine</td>
<td>With epinephrine</td>
<td>600</td>
<td>8.0 (3.6)</td>
</tr>
<tr>
<td>Bupivacaine</td>
<td>With epinephrine</td>
<td>90</td>
<td>—</td>
</tr>
</tbody>
</table>
Treatment of Local Anesthetic Toxicity

Seizures/Convulsions: GABA agonists, paralytics and airway management as needed

Hypotension: vasopressors

Cardiovascular collapse: 20% intralipid (4 mL/kg then 0.5 mL/kg/min, 1.5 mL/kg then 0.25 mL/kg/min)

Remember:

1. Bupivacaine binds more strongly to resting/inactivated Na channels as compared to lidocaine
2. Bupivacaine dissociates from Na channels during diastole more slowly than lidocaine.
Injected Contrast
Injected Contrast

- Helps localize precise anatomic locations
- May prevent aberrant spread of injectate
- May also reduce fluoroscopic time

Interventional pain vs. diagnostic and interventional radiology procedures (volumes differ)

Desirable properties include:

- Satisfactory radiopacity
- Stability
- Pharmacological inertness
- Minimum sensitization
Injected Contrast Classification

Broadly classified as **positive** contrast agents and negative contrast agents.

- **Positive contrast agents** absorb x-rays and produce a darker shadow on fluoroscopy.
- **Negative contrast agents** are more transparent to x-rays than body tissue and produce a lighter shadow on the fluoroscopic screen - air, oxygen, nitrogen etc.

Positive agents most often used in Interventional Pain Management
Injected Contrast Classification

All are based on organic iodine compound

Further classified chemically as ionic and non-ionic

Non-ionic:

- more hydrophilic/less neurotoxic
- lower osmolality
- produce fewer side effects

The recommended limit for iodine is 3gm per day
## Commonly used iodinated contrast agents

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Iodine Content</th>
<th>Osmolality</th>
<th>Osmolarity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ionic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diatrizoate (Hypaque 50)</td>
<td>Ionic Monomer</td>
<td>300</td>
<td>1550</td>
<td>High Osmostic</td>
</tr>
<tr>
<td>Metrizoate (Isopaque Coronar 370)</td>
<td>Ionic</td>
<td>370</td>
<td>2100</td>
<td>Low Osmostic</td>
</tr>
<tr>
<td>Ioxaglate (Hexabrix)</td>
<td>Ionic</td>
<td>320</td>
<td>580</td>
<td></td>
</tr>
<tr>
<td><strong>Non-Ionic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iopamidol (Iovue 370)</td>
<td>Non-ionic monomer</td>
<td>370</td>
<td>796</td>
<td></td>
</tr>
<tr>
<td>Iohexol (Omnipaque 350)</td>
<td>Non-ionic</td>
<td>350</td>
<td>884</td>
<td></td>
</tr>
<tr>
<td>Iodixanol (Visipaque 320)</td>
<td>Non-ionic dimer</td>
<td>320</td>
<td>290</td>
<td>Iso Osmostic</td>
</tr>
</tbody>
</table>
Injected Contrast Clinical Concerns

A detailed history of allergies or previous administrations of contrast agents should be elicited prior to the procedure. A history of allergic reaction to iodine containing foods such as seafood is not necessarily a contraindication to using contrast. The predictive value of specific allergies, such as those to shellfish or dairy products, is unreliable\textsuperscript{1-2}. A significant number of health care providers continue to inquire specifically into a patient’s history of “allergy” to seafood, especially shellfish\textsuperscript{3}. There is no evidence to support the continuation of this practice\textsuperscript{3-4}. Most forms of atopy result in a 2 to 3x likelihood of contrast reaction compared with non-atopic patients.

Atopy refers to the genetic tendency to develop allergic diseases such as allergic rhinitis, asthma and atopic dermatitis (eczema). Atopy is typically associated with heightened immune responses to common allergens, especially inhaled allergens and food allergens.

Medications for Osteoporotic Compression Fractures
Medications for Osteoporotic Compression Fractures

Many FDA approved medications for osteoporosis.

Fall into two groups:

- Antiresorptives
  - Bisphosphonates
  - Calcitonin
  - Biologics/MAB
  - estrogen therapy or hormone therapy (not discussed)
  - estrogen agonists/antagonists (not discussed)

- Anabolics
Medications for Osteoporosis - Anti-resorptives

Bisphophonates

Increase bone mineral density by slowing down the rate at which osteoclasts absorb bone.

Side effects depend on how they’re taken.

Pill side effects include:

- Pain in the chest and/or esophagus
- Difficulty swallowing

IV (Zoledronic acid/Reclast) side effects include:

- Fever
- Muscle and/or joint pain
Medications for Osteoporosis - Anti-resorptives

Bisphosphonates - Clinical concerns

Hypocalcemia can worsen. Correct hypocalcemia prior to use. Adequately supplement patients with calcium and vitamin D.

Anaphylaxis, including fatal events, has been reported.

Renal toxicity may be greater in patients with underlying renal impairment. Do not administer BONIVA injection to patients with severe renal impairment (creatinine clearance less than 30 mL/min). Monitor serum creatinine prior to each dose.

Osteonecrosis of the jaw (ONJ) has been reported.

Severe Bone, Joint, and/or Muscle Pain may occur, consider discontinuing use if symptoms occur.
Medications for Osteoporosis - Anti-resorptives

Bisphophonates

**Alendronate (Fosamax):** Both men and women can take it. Indicated in steroid-induced osteoporosis. Taken orally.

**Ibandronate (Boniva):** Only women can take it. It specifically helps lower your risk of a spinal fracture. This medication can be taken either orally or through IV every 3 months.

**Risedronate (Actonel):** Both men and women can take it. Has indication for steroid-induced osteoporosis.

Multiple dosing strategies ranging from 5 milligrams (mg) once a day to 150 mg tablet once a month

**Zoledronic acid (Reclast):** Only women can take it. This medication is taken via intravenous (IV) infusion.

Treatment of postmenopausal osteoporosis: a single 5 mg infusion once/year

Prevention of postmenopausal osteoporosis 5 mg every two years
Medications for Osteoporosis - Anti-resorptives

Calcitonin

Calcitonin is a hormone which is naturally produced in the thyroid. Calcitonin is a powerful inhibitor of osteoclastic activity.

Only women who are at least five years past menopause can take calcitonin.

Men can take it if testosterone levels are normal or osteoporosis doesn’t improve with replacement.

May also help with pain, though occasionally causes back pain.

Administered as a nasal spray.

Side effects include:

- Nasal irritation
Medications for Osteoporosis - Anti-resorptives

Biologics

Denosumab (Prolia/Xgeva) was approved in 2010

Treats osteoporosis in men and post-menopausal women

Works by inhibiting the RANK Ligand protein

RANKL is involved in bone breakdown

When blocked, bones aren’t broken down as quickly, thereby increasing bone strength and density.

Typically used if someone has suffered a fracture, not for preventive.

SQ injection every 6 months - not self-administered.
Medications for Osteoporosis - Anabolics

Promote rapid bone formation.

Teriparatide (Forteo) is a synthetic form of parathyroid hormone

The only FDA-approved anabolic.

Promotes bone growth and increases bone density

Both men and women can take it

Self-administered in a daily SQ injection

Connected to a rare form of bone cancer when given in high doses in animal studies

Approved for use of no more than two years.
Medications for Osteoporotic Fractures - PMMA

**Methyl methacrylate** (MMA) is an organic compound with the formula $\text{CH}_2=\text{C(CH}_3\text{)COOCH}_3$. This colourless liquid, the methyl ester of methacrylic acid (MAA) is a monomer produced on a large scale for the production of poly(methyl methacrylate) (PMMA).
Medications for Osteoporosis - PMMA

1. Fractured Vertebra
2. Insert Instrument
3. Inflate Balloon Tamp
4. Fill with a "support cast"
Interventional Concerns of Blood Thinners
Interventional Concerns of Blood Thinners

Oral Anticoagulants in Coagulation Cascade

Warfarin

Rivaroxaban

Apixiban

Dabigatran

Anticoagulants Protein C, S
Epidural Hematoma
<table>
<thead>
<tr>
<th>Anticoagulant</th>
<th>Recommendations to minimize risk of hematoma following regional analgesic/anesthetic procedures*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventional Concern of Blood Thinners</td>
<td>Anticoagulant type</td>
</tr>
<tr>
<td>Heparin (unfractionated) intravenous</td>
<td>1.5–2 hours</td>
</tr>
<tr>
<td>Heparin SQ BID ≤ 10,000 U/d</td>
<td>1.5–2 hours</td>
</tr>
<tr>
<td>Heparin SQ TID ≥ 10,000 U/d</td>
<td>1.5–2 hours</td>
</tr>
<tr>
<td>Enoxaparin (Lovenox) QD prophylaxis (0.5 mg/kg) (40 mg daily)</td>
<td>3–6 hours</td>
</tr>
<tr>
<td>Enoxaparin (Lovenox) BiD prophylaxis (0.5 mg/kg) (30 mg BiD)</td>
<td>3–6 hours</td>
</tr>
<tr>
<td>Enoxaparin BiD therapeutic dose (≥0.5 mg/kg)</td>
<td>3–6 hours</td>
</tr>
<tr>
<td>Warfarin (Coumadin)</td>
<td>20–60 hours</td>
</tr>
<tr>
<td>Aspirin</td>
<td>6 hours</td>
</tr>
<tr>
<td>Clopidogrel (Plavix)</td>
<td>6–8 hours</td>
</tr>
<tr>
<td>Ticlopidine (Ticlid)</td>
<td>4–5 days</td>
</tr>
<tr>
<td>Prasugrel (Effient)</td>
<td>7–8 hours</td>
</tr>
<tr>
<td>Ticagrelor (Brilinta)</td>
<td>7–8.5 hours</td>
</tr>
<tr>
<td>Abciximab (ReoPro)</td>
<td>0.5 hour</td>
</tr>
<tr>
<td>Eptifibatide (Integrillin)</td>
<td>1–2.5 hours</td>
</tr>
<tr>
<td>Tirofiban (Aggrastat)</td>
<td>2 hours</td>
</tr>
<tr>
<td>Bivalirudin (Angiomax), lepirudin, desirudin</td>
<td>0.5–3 hours</td>
</tr>
<tr>
<td>Argatroban</td>
<td>35–40 minutes</td>
</tr>
<tr>
<td>Dabigatran (Pradaxa)</td>
<td>12–15 hours</td>
</tr>
<tr>
<td>Fondaparinux (Arixtra)</td>
<td>17–21 hours</td>
</tr>
<tr>
<td>Rivaroxaban (Xarelto)</td>
<td>5–9 hours</td>
</tr>
<tr>
<td>Apixaban (Elquis)</td>
<td>10–15 hours</td>
</tr>
</tbody>
</table>
Many concerns related to medications in interventional pain management

Often interventions may be viable options to other therapies, preferable to high dose opioids

Can be utilized in conjunction with surgical referral - diagnostic vs therapeutic