REGIONAL ANESTHESIA
Neuroaxial anesthesia: Spinal

- Injection of local anaesthesia through a small gauge needle inserted into a lumbar (usually L3-L4 or L4-L5) interspace until it reaches the subarachnoid space
- Produces temporary numbness and muscle relaxation. The anesthetic duration and dermatomal level of blockade can be adjusted by using different local anesthetics and adjusting baricity (density) and patient position
Neuroaxial anesthesia:

Epidural anesthesia

- Placement of a small gauge flexible catheter into the epidural space via a needle
- Repeat dosing of local anesthetic and adjunctive medications for prolonged intraoperative management is possible by leaving a catheter in the central neuraxial space for infusion for postoperative analgesia

- **Caudal anesthesia** is a form of epidural anesthesia, commonly used in children before surgery below the umbilicus as a supplement to general anesthesia and to control postoperative pain
Advantages

- Decrease incidence of DVT (vs general anesthesia)
- The sympatholytic effects of regional anesthesia reduce blood loss during pelvic or lower extremity surgery
- Postoperative analgesia
- No need for routine labs unless conditions dictate this
- Avoid GA complications
Complications

- Post-dural puncture headache
- Spinal hematoma
- Epidural abscess
Absolute Contraindications for Neuraxial Blockade

- Patient refusal
- Infection at the site of injection
- Coagulopathy
- Severe hypovolemia
- Increased Intracranial pressure
- Some severe heart diseases (severe aortic stenosis, severe mitral stenosis, ischemic hypertrophic sub-aortic stenosis)
Risk of Neuraxial Blockade with Aortic Stenosis/Ischemic Hypertrophic Sub-aortic Stenosis

Figure 4. Potential downward hemodynamic spiral

- Coronary perfusion
- Blood pressure
- Preload
- SVR
- Anesthetics
- Myocardial ischemia
- Cardiovascular collapse
- Ventricular dysfunction

SVR indicates systemic vascular resistance.
Severe Mitral Stenosis

- An abrupt decline in systemic vascular resistance may result in hypotension and reflex tachycardia.

- In MS, must avoid tachycardia. Tachycardia impairs ventricular filling, increases valvular gradient, exacerbates pulmonary congestion/hypertension.
Relative Contraindications

- Sepsis
- Uncooperative patients
- Pre-existing neuro deficits/neurological deficits
- Demyelinating lesions
- Stenotic valvular heart lesions (mild to moderate Aortic Stenosis/Ischemic Hypertrophic Sub-aortic Stenosis)
- Severe spinal deformities
Controversial

- Prior back surgery

- Inability to communicate with the patient

- Complicated surgeries that may involved prolonged periods of time to perform, major blood loss, maneuvers that may complicate respiration
Nerve block
<table>
<thead>
<tr>
<th>Esters</th>
<th>Amides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocaine, procaine, tetracaine, benzocaine</td>
<td>lidocaine, mepivacaine, prilocaine, bupivacaine</td>
</tr>
<tr>
<td>metabolized in the plasma via pseudocholinesterases</td>
<td>metabolized in the liver</td>
</tr>
<tr>
<td>Very stable in solution</td>
<td>unstable in solution</td>
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<tr>
<td></td>
<td>More allergic reactions</td>
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</tbody>
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Lipid solubility is an important characteristic. Potency is directly related to lipid solubility, because 90% of the nerve cell membrane is composed of lipid. Increased lipid solubility leads to faster nerve penetration and blockade of sodium channels.

Protein binding is related to the duration of action. The more firmly the local anesthetic binds to the protein of the sodium channel, the longer the duration of action.
All local anesthetics, with the exception of cocaine, are **vasodilators** via direct relaxation of peripheral arteriolar smooth muscle fibers.

Greater vasodilator activity of a local anesthetic leads to faster absorption and, thus, shorter duration of action.

To counteract this vasodilatation, epinephrine is often included in local anesthetic solutions.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Onset</th>
<th>Maximum Dose</th>
<th>Duration</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>(with Epinephrine)</td>
<td>(with Epinephrine)</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>Rapid</td>
<td>4.5 mg/kg (7 mg/kg)</td>
<td>120 min (240 min)</td>
</tr>
<tr>
<td>Mepivacaine</td>
<td>Rapid</td>
<td>5 mg/kg (7 mg/kg)</td>
<td>180 min (360 min)</td>
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<tr>
<td>Bupivacaine</td>
<td>Slow</td>
<td>2.5 mg/kg (3 mg/kg)</td>
<td>4 hours (8 h)</td>
</tr>
<tr>
<td>Ropivacaine</td>
<td>Medium</td>
<td>2-3 mg/kg</td>
<td>3 hours (6 h)</td>
</tr>
<tr>
<td>Levobupivacaine</td>
<td>Medium</td>
<td>2.0 mg/kg or 400mg in 24 hrs</td>
<td>4-6 hours (8-12 h)</td>
</tr>
<tr>
<td>Procaine</td>
<td>Slow</td>
<td>8 mg/kg (10 mg/kg)</td>
<td>45 min (90 min)</td>
</tr>
</tbody>
</table>
Additional drugs with LAs

- **Epinephrine**: It is used to decrease the absorption of the local anesthetic from tissues to decrease potential toxicity (in vascular areas) and prolong the duration of the block.

- Side effects include tachycardia and arrythmias.

- **Sodium bicarbonate** is used to decrease onset time of the local anesthetic effect. Because local anesthetic molecules must be in the uncharged, basic form to cross the nerve membrane and decrease the painful injection (render the acidic LA solution into body PH).
Technique of injection

- **Always aspirate before injecting** (prevents inadvertent direct intravascular injection of the local anesthetic, which leads to an abrupt rise in serum levels and may precipitate an adverse reaction)

- **Using the smallest needle possible** decreases the pain of injection.

- **Warming the local anesthetic solution**

- **Injecting slowly**, both decrease patient discomfort, since much of the discomfort is produced by rapid distention of tissues by the volume of the local anesthetic solution
Advantages of Peripheral Nerve Blocks

- Improved patient satisfaction
- Less immunosuppression
- Less nausea and vomiting
- No malignant hyperthermia
- Patient who is hemodynamically unstable or too ill to tolerate a general anesthetic
Local adverse effects

- Pain, ecchymosis, hematoma formation, infection
- Transient or chronic paresthesia
- Nerve damage and laceration
Systemic adverse effects

- Systemic effects usually occur when blood concentrations of local anesthetic increase to toxic levels or inadvertent intravascular injection.

- Adding a vasoconstrictor (e.g., epinephrine) can reduce the systemic absorption of an anesthetic.
CNS

- Light headedness, tinnitus, circumoral numbness, a metallic taste, or double vision, drowsiness or slurring speech and may develop nystagmus
- At higher levels of anesthetics, anxious and develop fine tremors, grand mal seizure
- Finally, generalized CNS depression leading to hypoxia, acidosis, and respiratory arrest
Cardiac

- Local anesthetics decrease the rate of depolarization of cardiac tissue (the use of lidocaine in treatment of ventricular arrhythmias)

- At higher concentrations, amplitude of the cardiac action potential is decreased, and the velocity of conduction is reduced

- At toxic doses, the negative inotropic effects of local anesthetics may lead to bradycardia, ventricular fibrillation, or asystole.

- Other cardiovascular effects include hypotension, which occurs via the direct vasodilating effects of local anesthetics on peripheral arteriolar smooth muscle
Hypersensitivity Reactions

- Most reactions to local anesthetics are actually caused by anxiety, panic attack, vasovagal responses, or accidental intravascular injection.

- True allergic reactions occur in fewer than 1% of all reactions to local anesthetics.
Contraindications to Peripheral Nerve Block

- Pediatric patients, combative patients, demented patients
- Bleeding disorders or patients on anticoagulants
- Local sepsis
- Pre-existing peripheral nerve neuropathies
Examples

- **Brachial plexus block**: (neck, infraclavicular, subclavicular, axillary approach)

- **Intercostal nerve block**: breast surgery, thoracotomy, video assisted thoracoscopy, chest tube placement, and upper abdominal procedures

- **Paravertebral block**: breast or thoracic surgery, management of postoperative pain (following chest procedures), and management of pain due to rib fractures
- Ilioinguinal and iliohypogastric nerve block: open inguinal hernia repair
- **Interscalene block** is used for surgery of the shoulder and proximal upper extremity
- **Ankle block** (superficial and deep peroneal, posterior tibial, and sural nerves and one cutaneous branch of the femoral nerve (saphenous nerve))
- **Wrist block** (median, ulnar, radial n)
- **Digital nerve block**
Intravenous regional anesthesia (IVRA) or Bier block anesthesia

- is a common technique for surgical procedures on extremities where the LA is injected IV

- Exanguination (forces blood out of the extremity), followed by the application of pneumatic tourniquet then injecting the LA IV.