INFRACLAVICULAR NERVE BLOCK

Surgical Specialty:	Pediatric Pain/Regional Anesthesia
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Background:

- General Considerations
  - The infraclavicular nerve block (ICB) is performed below the clavicle at the level of the brachial plexus cords and provides reliable anesthesia over the elbow, forearm, and hand. [1,2]

  - At this location, the cords of the brachial plexus are found below the clavicle near the axillary artery. [1,2]
  - This technique provides motor, sensory, and autonomic blockade, with a duration of action of up to 8-24 hours, depending on the type and dose of local anesthetic and added adjuvants.
  - In comparison to interscalene and supraclavicular block, the ICB avoids phrenic nerve involvement and has a lower risk of pneumothorax and Horner's syndrome.[3]
  - The ICB may be more challenging to perform secondary to the deep nature of the plexus at this level, requiring a more acute angle of needle insertion.[3]

  - The ICB is superior for a catheter-based technique as the muscles of the chest wall allow for more anchoring support to prevent catheter migration, as opposed to the more superficial locations of the interscalene and supraclavicular nerve blocks.
  - In pediatric patients, ICB is ideal for surgical procedures involving the elbow, forearm, and hand. It is most commonly selected for intra/postoperative analgesia but is occasionally employed as a surgical block in lieu of general anesthesia (GA). [1,2]
  - This block may be performed under ultrasound guidance (USG) or via landmark or nerve stimulation-based techniques; however, the use of USG is highly recommended and will be the focus of this guide. [4]
  - The use of regional anesthesia in pediatric patients decreases overall opioid requirements and opioid-related side effects, reduces the overall amount of intraoperative anesthesia, limits the stress hormone response, improves overall analgesia, and shortens recovery time.[5]
- Patient Considerations
  - ICB may be performed safely both in awake, cooperative patients or after GA is induced in younger or less cooperative patients.[6]
  - Standard GA considerations apply for those performed after induction of GA.
- Associated Comorbidities/Syndromes
  - The presence of neuropathy or other preexisting active neurologic deficits, trauma affecting the area where the nerve block will be performed, superficial skin infection, or coagulopathic disease may preclude the use of ICB.

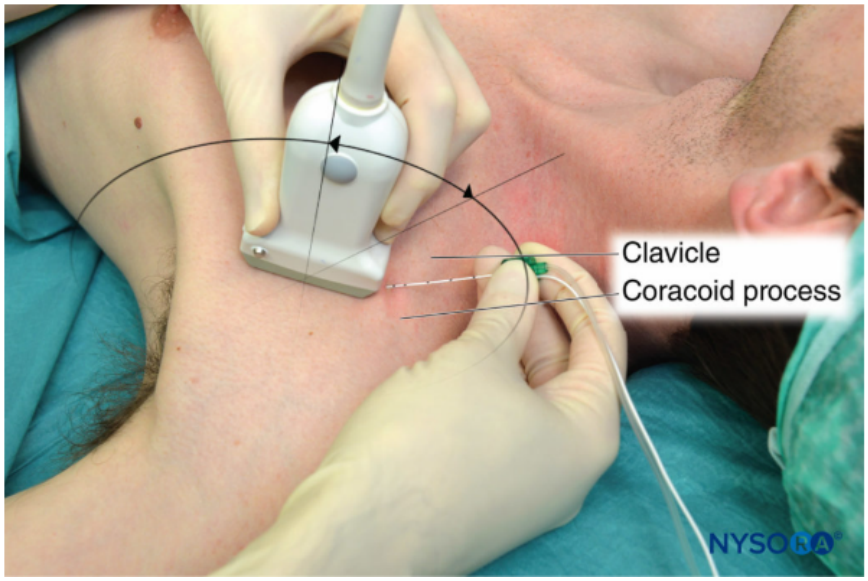
Anesthetic Planning:

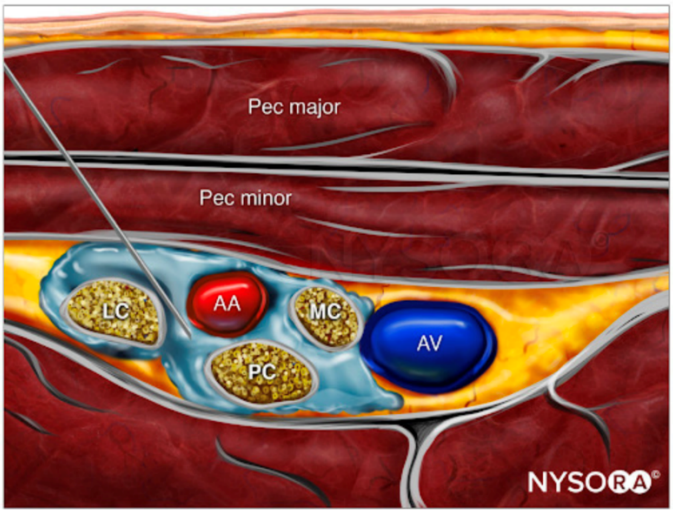
- Pre-Anesthetic Evaluation
  - Standard preoperative anesthetic evaluation as well as block-specific considerations such as pre-existing neuropathy or other neurologic deficits, presence of rash or infection over the site of needle placement, coagulopathy or use of anticoagulant medications, or allergy to local anesthetic medications.
  - Discuss Risks/Benefits/Alternatives with caregivers and the surgeon.
    - Benefits of ICB include predictable, targeted anesthesia over the upper extremity and reliable postoperative analgesia, allowing for decreased use of opioids and sedative medications and other benefits listed above.
    - ICB is 100% elective. The alternative to ICB is oral or intravenous (IV) analgesic medications and/or local infiltration by the surgeon.
    - Risks associated with ICB include block failure, infection, hematoma, pneumothorax, sympathetic blockade, arterial puncture, intravascular injection, local anesthetic systemic toxicity (LAST), and nerve injury.[1]
  - Additional labs/tests indicated during work-up
    - None indicated.
    - Document pre-existing neurological deficits prior to block start.
  - Discussions to have with surgeon/family
    - Nuances of patient response to a numb extremity.
    - Failure of block requiring alternative pain control techniques.
    - Postoperative neurological exam may be compromised secondary to motor and sensory blockade.
    - Need for additional analgesic medications once block has resolved.

- Specific or Unique Room Set-up Requirements
  - Airway
    - Natural airway.
    - A nasal cannula may be placed for administration of supplemental O_2 if needed as well as for CO_2 monitoring.
    - LMA or ETT placement if block is performed after induction of GA.
  - Equipment [1-2,4]
    - Ultrasound machine with curved array transducer (8 MHz)
    - Sterile ultrasound probe sleeve and gel
    - Sterile gloves
    - Antiseptic solution for skin disinfection
    - Echogenic nerve block needle
    - 3-way stopcock
    - Sterile saline syringe (10 mL)
    - Local anesthetic mixture syringes (drawn up in 10 mL syringes)
    - Lidocaine in 1 mL syringe with 25G needle for skin wheal (if not performing under GA)
    - Peripheral nerve stimulator and insulated stimulating needle if using nerve stimulation-based technique
    - Block assistant (if available) for injection and/or ultrasound adjustment
  - Emergency Equipment [1]
    - O_2 source
    - Suctioning
    - Resuscitation equipment including lipid emulsion
  - Drugs [1-2,4,7-8]
    - Local Anesthetic (LA) Medications (institutional practice may vary)
      - 0.2-0.5 mL/kg, maximum 25 mL
      - LA choice (institutional practice may vary)
        - 0.2-0.5% ropivacaine
        - 0.25-0.5% bupivacaine
        - 2% lidocaine
    - Catheter-Based Technique Dosing: 0.1-0.2 mL/kg/hour or 0.1-0.2 mg/kg/hour
    - Total Dose should be determined based on a calculation of the maximum toxic LA dose for each patient
    - Adjuvants (institutional practice may vary)
      - Epinephrine 1:200,000
      - Dexamethasone IV 0.5 mg/kg, maximum 10 mg, at time of block
      - Dexmedetomidine perineural (PN) or IV 1 mcg/kg, maximum 50 mcg
    - Premedication (as needed for awake nerve block)
    - Rescue Medications (in the event of LAST)
      - Epinephrine 1 mcg/kg (smaller than code dose)[9], midazolam
      - Lipid emulsion: initial bolus of 1.5 mL/kg over 1 minute, repeated every 3-5 minutes as necessary, followed by infusion of 0.25-0.5 mL/kg/min
  - Monitors
    - Standard ASA monitors.
    - Place pulse oximeter and blood pressure cuff on alternate extremity.
  - Blood Availability
    - Not required.

Intraoperative Considerations:

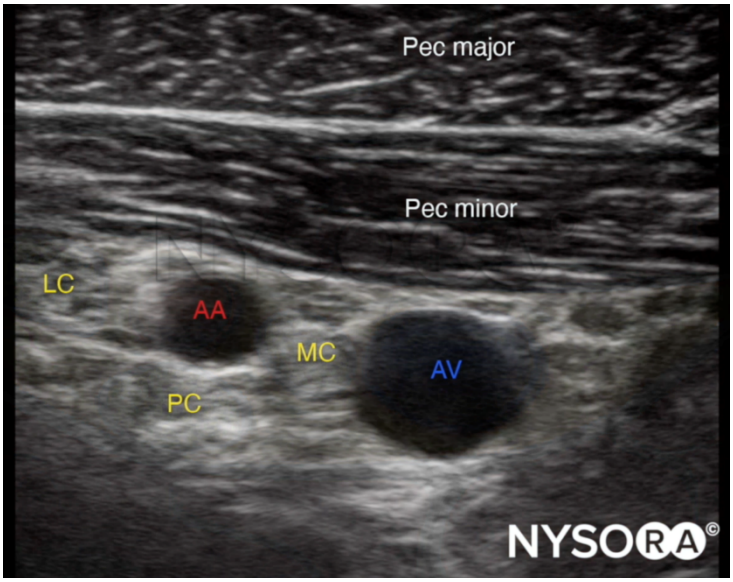
- General
  - All-stop patient/procedure time-out with verification of maximum local anesthetic dose and confirmation of correct side and site of surgery.
  - Administer sedative medications in awake patients if needed.
  - Consider post-induction blockade in children who are unable to tolerate awake block.
- Positioning[1-2,4,7-8,10]
  - Supine
  - Move the patient to the edge of the bed/stretcher opposite to the practitioner.
  - Head in neutral position
  - The block arm should be abducted and externally rotated (this will bring the plexus closer to the surface of the skin and further away from the ribs and pleura)





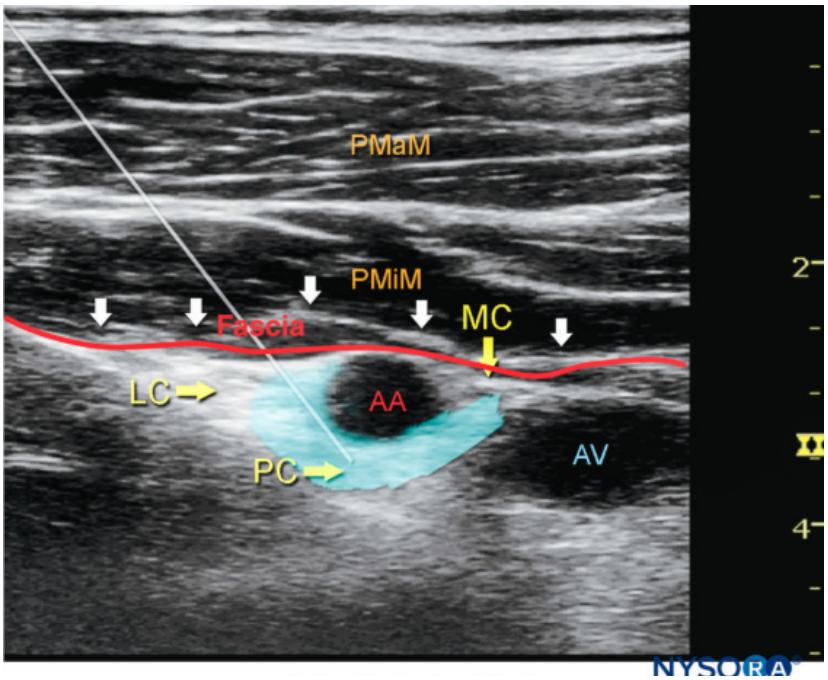
- Ultrasound Scanning[1-2,4,7-8,10]
  - Place the ultrasound probe in a parasagittal plane just inferior to the lateral infraclavicular region and coracoid process (the apex of the deltopectoral groove).

- The probe should be moved medially and laterally until the 3 cords of the brachial plexus and surrounding structures are identified.
- Identify the cords of the plexus, pectoralis major, pectoralis minor (more lateral), axillary vein, and axillary artery.
- Further identify the second or third rib, pleura, and lung where possible.



- The medial cord is usually located at the 7-10 o'clock position in relation to the axillary artery.
- The posterior cord is at the 6 o'clock position in relation to the axillary artery.
- The lateral cord is at the 3-6 o'clock position in relation to the axillary artery.

- Technique[1,2,7-8]
  - Sterile preparation of supplies.
  - Skin disinfection.
  - Insertion of the needle in a caudal direction about 2-4 cm superior to the ultrasound probe at an angle of roughly 45 degrees to the skin.
  - Needle advancement should be in-plane, in a cranial to caudal direction, with a slight cephalad orientation (to avoid the pleura and lung) towards the cords of the plexus.
  - Following negative aspiration, a test dose with saline or D5W is recommended to visualize spread and confirm nerve location.
  - The 1st injection of LA mixture should be around the posterior cord (at the 6 o'clock position relative to the axillary artery - target below the artery) so as not to push the artery and brachial plexus cords deeper and away from the needle.
  - The 2nd injection should be at the medial cord (7-10 o'clock position relative to the artery).
  - The 3rd injection should be at the lateral cord (3-6 o'clock position in relation to the axillary artery).
  - Spread of LA around the artery is usually predictive of a successful block.
  - Visualization of the needle tip at all times is critical to reduce the risk of pneumothorax and vascular puncture.



- Block Considerations
  - The use of ultrasound may result in an increased speed of onset and success rate, a reduction in the required volume of local anesthetic solution, and a decreased risk of damage to anatomical structures/complications.[1-2,4]
  - Color Doppler can be used to identify large vessels (axillary artery and axillary vein) prior to needle insertion and medication injection.
- Post-op Care
  - Standard PACU discharge criteria.

Case-Specific Complications/Pitfalls

- Intravascular Injection/LAST
  - Prevention via careful technique, use of test dose, intermittent aspiration, and incremental injection.
- Intraneural Injection
  - High injection pressure may signify intrafascicular injection.
  - Uncommon and usually transient. If prolonged, consider neurology evaluation.
- Pneumothorax (0.2-0.7%)
  - Collapse of lung secondary to needle tip placement into the thoracic cavity with subsequent air entrapment.

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