Peripheral Nerve Blocks for Pediatric Anesthesia

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Updated 11/2019
Disclosures

No relevant financial relationships
Learning Objectives:

• Review the indications and contraindications for peripheral nerve blocks (PNBs) in children

• Identify the basic anatomy of the common PNBs including TAP, ESP, Supraclavicular, Femoral, and Popliteal blocks

• Describe the sensory innervation of the nerves covered by the above blocks

• Assess indications for choosing particular PNBs based on the analgesia provided
Peripheral Nerve Blockade (PNB)

*Indications*

- Important tool in multimodal pain control for surgery on the extremities or smaller low abdominal incisions
- May assist with opioid sparing anesthesia
- May reduce dose exposure for general anesthetic
- May reduce perioperative pain and the morbidity associated with undertreated pain in children
- In settings with limited postoperative monitoring and analgesic options that PNB can be a safe way to improve pain control in wards
Peripheral Nerve Blockade

Contraindications

• Absolute:
  - Parental or patient refusal
  - Local infection
  - Allergy to local anesthetic

• Relative:
  - Pre-existing neurologic deficits
  - Coagulation disorders
TAP Block

• Indications: Lower abdominal surgery

• Dosing: 0.3-0.5ml/kg/side of 0.25% bupivacaine

• Distribution: T10-L1
  • Abdominal skin, muscles, and parietal peritoneum via block to the intercostal nerves, subcostal nerve, iliohypogastric, and ilioinguinal nerves.

• Duration: variable, likely 8-12 hrs

• Complications: Peritoneal entry and bowel injury

Source: NYSORA.COM
Transversus Abdominis Plane (TAP) Block

**Indications**

- Useful alternative in pediatric patients with spinal anomalies preventing neuraxial anesthesia

- Most suitable for abdominal surgery below the umbilicus, such as appendectomy, colectomy, hernia repair

- Orange arrow in image indicates the target fascial layer for the needle.

Orange arrow indicates needle trajectory
EOM = External Oblique Muscle
IOM = Internal Oblique Muscle
TAM = Transverse Abdominis Muscle

Source: NYSORA.COM
Transversus Abdominis Plane (TAP) Block

• At the mid-axillary line, the anterior rami of the T9-T12 and first lumbar nerves are found in the intermuscular plane between the internal oblique and transversus abdominis muscle.

• Blockade provides unilateral analgesia to skin, muscle, and parietal peritoneum of the anterior abdominal wall.

Orange arrow indicates needle trajectory
EOM = External Oblique Muscle
IOM = Internal Oblique Muscle
TAM = Transverse Abdominis Muscle

Source: NYSORA.COM
Rectus Sheath Block

- **Indications:** Surgery to umbilical region
  - A good option for upper abdominal surgery if epidural is not possible

- **Dosing:** 0.1ml/kg 0.25% bupivacaine to each side

- **Distribution:** Midline abdominal incision

- **Duration:** around 8-12 hrs

- **Complications:** Peritoneal entry and bowel injury

Source for both images: NYSORA.COM
Femoral Nerve Block

- **Indications:**
  - Surgery on the anterior thigh, femur, patella, or knee
  - Hip fracture analgesia perioperatively

- **Dosing:** 0.2-0.4ml/kg

- **Distribution:**
  - Derives from roots of L2-4
  - Anterior/medial thigh, knee, medial leg, medial foot
  - Hip, knee, and ankle joints
  - Indicated for surgery where anesthesia to these areas would be beneficial

- **Duration:** 8-12 hrs

- **Complications:** Intravascular injection, nerve injury

Source: NYSORA.COM
Femoral Nerve Block

Procedure occurs at the level of the femoral crease

- At this level, the nerve (hyperechoic) lies beneath the fascia iliaca and above the iliopsoas muscle (hypoechoic)

- The position of the nerve is immediately lateral to the artery

- From lateral to medial: NAVEL (Femoral Nerve, Artery, Vein, Empty Space, Lymphatics)

Orange arrow indicates needle trajectory
FN = Femoral Nerve
FA = Femoral Artery
Source: NYSORA.COM
Fascia Iliaca Block (3-in-1 Block)

- 3-in-1 block provides local anesthetic to three of the nerve branches from the lumbar plexus
- Blockade of the femoral nerve, lateral femoral cutaneous nerve, and obturator nerve
- Indicated for hip fractures
- Performed with accurate placement of local anesthetic along femoral nerve
- Mechanism for the block is the caudal, lateral and medial spread of the local anesthetic

Source: NYSORA.COM
Popliteal Sciatic Block

- Indications: foot & ankle surgery
  - Often combined with Saphenous block for lower extremity surgery to cover both femoral and sciatic nerve distribution
  - Variations: Fascia Iliaca plane block
    - Large volume plane block deposited beneath the fascia iliaca to spread to the femoral nerve and LFCN
- Dosing: 0.3-0.5ml/kg
- Distribution
  - Derives from roots of L4-S3
  - All of the lower extremity below the knee except the medial leg/foot
  - Indicated for surgery on the lower leg
- Complications: Intravascular injection, nerve injury
- Duration: around 8 – 12 hrs

Source: NYSORA.COM

CPN = Common Peroneal Nerve
TN = Tibial Nerve
**Popliteal Sciatic Block**

**Procedure occurs in the popliteal fossa**

- Identify the popliteal artery (PA) and popliteal vein (PV)
- At this level, the sciatic nerve has typically branched into the common peroneal nerve (CPN) and tibial nerve (TN)
- The CPN and TN appear as a hyper-echoic bundle that is lateral and superficial to the popliteal vein
- Branch point is variable—track the nerves up above the popliteal fossa to be certain that you are capturing both the CPN and TN together in the block site

*Blue arrows* indicate possible needle trajectory, depositing local anesthetic between CPN and TN, and above nerves.

*Source: NYSORA.COM*
Supraclavicular Block

• Indications
  - Upper extremity surgery
  - Most common US-guided approach to the brachial plexus (BP) due to ease and comprehensive analgesia for entire arm

• Dosing: 0.3-0.5ml/kg of 0.25% bupivacaine

• Complications
  • PTX, intravascular injection, nerve injury

• Duration: around 8 – 12 hrs

• Distribution
  - Divisions of the brachial plexus (roots of C5-T1)
  - Block reliably covers upper extremity
  - Spares the suprascapular nerve so may produce incomplete shoulder coverage

BP = Brachial Plexus
SA = Subclavian Artery
MSM = Middle Scalene Muscle
Supraclavicular Block

- Place probe superior to the clavicle and identify the subclavian artery

- Identify the subclavian artery (SA)

- The plexus is just superior & posterior to the SA

- Do not start block until you clearly identify pleura and rib deep to the brachial plexus (BP)

- Maintain pleura in view during procedure to reduce risk of pneumothorax

Blue arrows indicate needle trajectory

Source for both images: NYSORA.COM
Erector Spinae Plane (ESP) Block

Fascial plane block targeting spinal nerves

- Indications
  - Rib fractures, some thoracic or high abdominal surgery
  - Good safety profile as there is significant distance from block site to important structures such as spinal cord or major vessels

- Dosing: 0.5ml/kg/side of 0.25% bupivacaine

- Distribution
  - Block likely occurs at the ventral and dorsal rami of the spinal nerves, likely via diffusion back from site of injection in fascial plane

- Complications: PTX

- Duration: likely 8-12 hrs
Erector Spinae Plane (ESP) Block

Procedure occurs at the transverse process

- Erector spinae muscle lies on top of the transverse process
- Target the fascial plane deep to the muscle, just above the transverse process
- Orient the ultrasound probe in a longitudinal direction, adjacent to the palpated spinous process
- Slowly scan in a medial to lateral direction until the flattened hyperechoic shape (with rectangular acoustic shadow below) of the transverse process is identified
- Choose the most central spinous process for the block as LA will spread both cranially and caudally
- Injection of LA should spread along the fascial layer laterally and medially, similar to the spread seen with the TAP block injection.
- If injection shows spread into the muscle, advance needle further to get to appropriate compartment
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Conclusions:

• Peripheral nerve blocks can be an important tool in multimodal analgesia, allowing reduced exposure to general anesthetics, opioid sparing, and improved pain control postoperatively

• Choice of peripheral nerve block is based on the sensory distribution of the nerves targeted and the planned surgery

• A thorough understanding of the anatomy of each block lowers the risk of common complications
References:

1. www.nysora.com (permission was granted to use all images from NYSORA)
2. Euroespa.com