Upper extremity cutaneous innervation

- Upper extremity cutaneous innervation is supplied primarily by the Brachial Plexus, emerging from spinal roots C5-T1 – the exceptions being the supraclavicular nerve (C3/4) and the Intercostobrachial nerve (branches from intercostal nerves).

- The brachial plexus is best learned schematically, but the sensory nerves supplying the upper extremity are:

    - Axillary – C5/6, sensory innervation to lateral shoulder

    - Musculocutaneous – C5-7, sensory innervation to lateral forearm from wrist to elbow

        - Lateral antebrachial cutaneous nerve – C5/6 (branch of musculocutaneous nerve), sensory innervation to lateral forearm

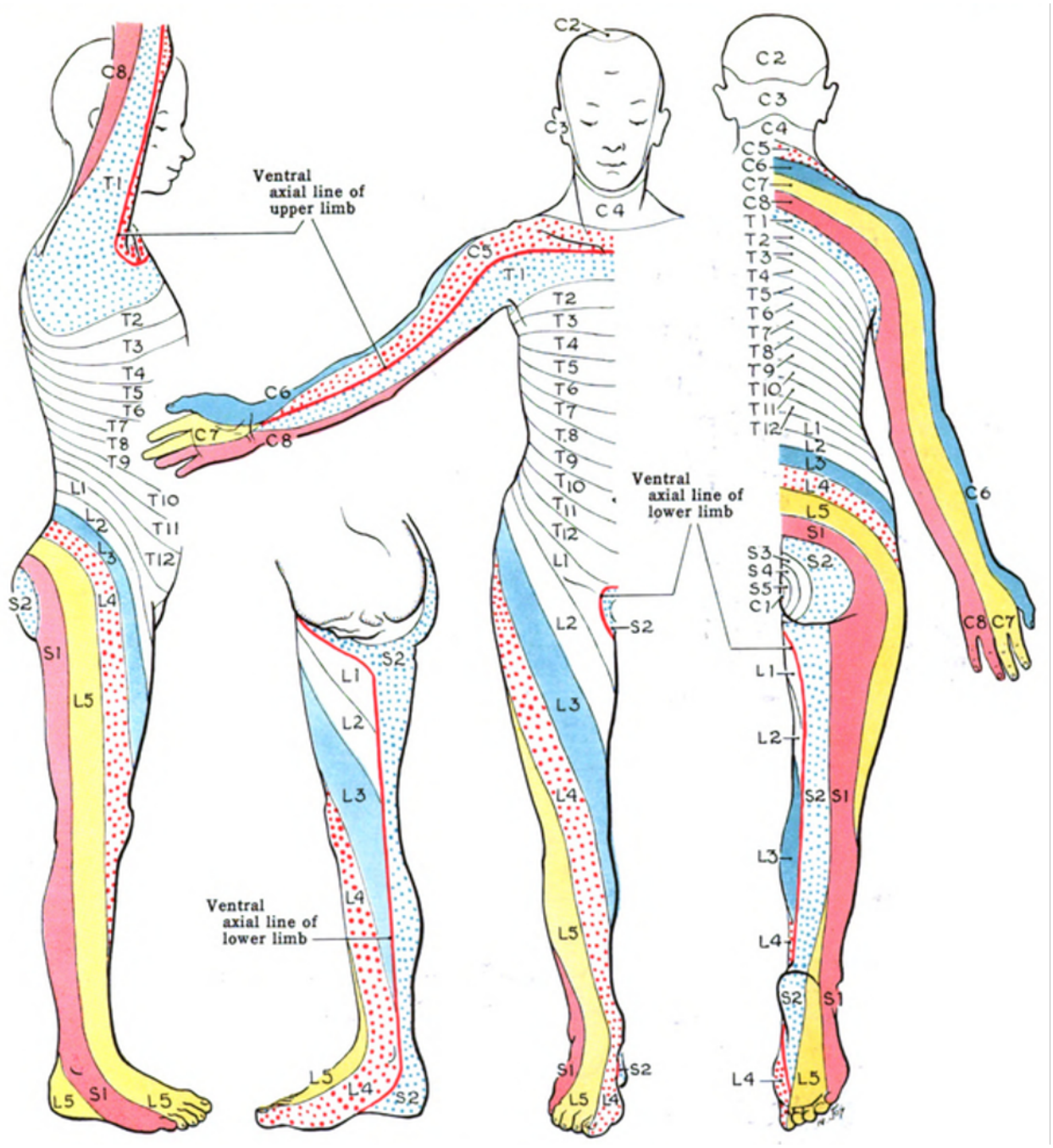
    - Radial Nerve – C5-T1, sensory innervation to posterior arm in a strip from the triceps down to the dorsum of the hand and dorsal surface of the first 3 fingers

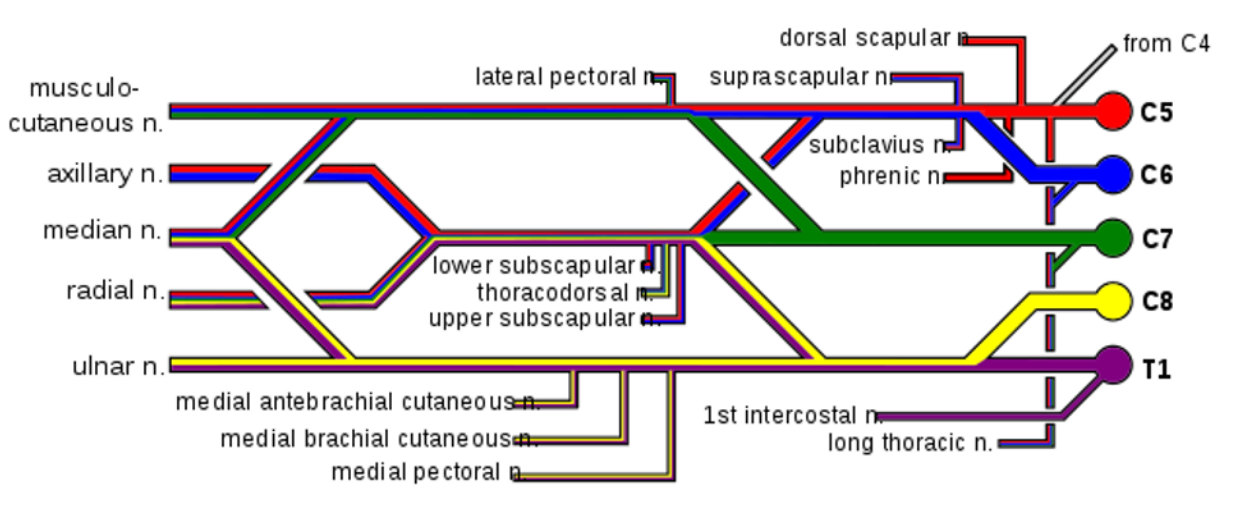
    - Median - C6-T1, sensory innervation to palm and the palmar surface of the first 3.5 fingers

    - Ulnar - C8/T1, sensory innervation to medial surface of the hand, including pinky and half of ring finger

    - Medial brachial cutaneous nerve – C8/T1, branches directly from medial cord and provides sensory innervation to medial upper arm

    - Medial antebrachial cutaneous nerve – C8/T1, also branches directly from medial cord, provides sensory innervation to medial forearm


Ventral axial line of upper limb
Ventral axial line of lower limb
Ventral axial line of lower limb
C2
C3
C4
C5
C6
C7
C8
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
C1



Sources

Upper extremity blocks Accessed September 28, 2021

TAP block: Anatomy

Innervation of the Abdominal Wall

The anterior rami of spinal nerves T7-L1 innervate the anterolateral abdominal wall. The anterior divisions of the intercostal nerves (T7-11) enter the abdominal wall between the internal oblique and transversus abdominis muscles; they continue in this space anteriorly until they pierce and innervate the rectus abdominis and end as anterior cutaneous branches, which innervate the skin on the anterior abdomen. Midway in their course, the intercostal nerves pierce the external oblique muscle to give off lateral cutaneous branches, which divide into anterior and posterior branches that innervate the external oblique muscle and latissimus dorsi, respectively. The anterior division of the subcostal nerve (T12) communicates with the iliohypogastric nerve and gives a branch to the pyramidalis muscle. Its lateral cutaneous branch perforates the internal and external oblique muscles and descends over the iliac crest to innervate part of the gluteal region. The iliohypogastric nerve (L1) divides into lateral and anterior cutaneous branches near the iliac crest. The lateral cutaneous branch innervates the skin of the gluteal region, and the anterior cutaneous branch innervates the hypogastric

region. The ilioinguinal nerve (L1) communicates with the iliohypogastric nerve between the internal oblique and transversus abdominis near the anterior part of the iliac crest. It innervates the upper and medial part of the thigh and part of the skin covering the genitalia.

TAP block technique

The goal of the TAP block is to inject local anesthetic in the plane between the internal oblique and transversus abdominis muscles. This will interrupt innervation to the abdominal skin, muscles, and parietal peritoneum; however, it will not block visceral pain. The TAP block can be performed using a blind approach or with ultrasound guidance.

Blind approach

The point of entry is the lumbar triangle of Petit. It is bound inferiorly by the iliac crest (IC), anteriorly by the external oblique muscle, and posteriorly by the latissimus dorsi. The costal margin (CM) is slightly superior to the triangle of Petit. The provider will feel a “double pop” as the needle traverses the fascial extensions of the external oblique and the internal oblique muscles.

Ultrasound-guided approach

The ultrasound probe is placed in a transverse plane to the lateral abdominal wall in the midaxillary line, between the lower costal margin and iliac crest. This allows for more accurate deposition of the local anesthetic in the correct neurovascular plane (as compared to the blind technique).

Sources

1. Mukhtar, K. (2009). Transversus abdominis plane (TAP) block. Journal of New York School of Regional Anesthesia, 12, 28-33.

2. Ilioinguinal block

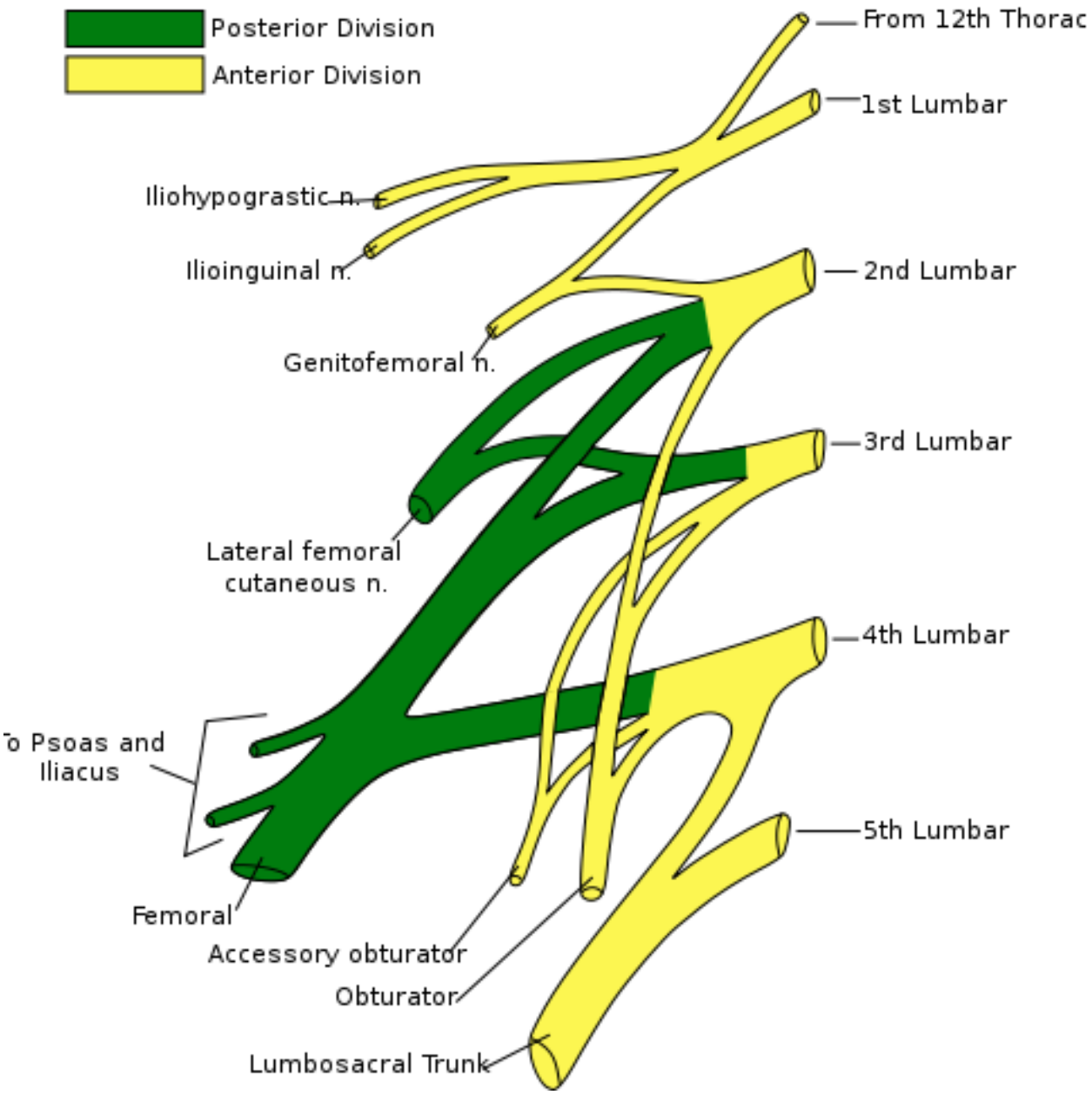
Definition

Ilioinguinal nerve

The ilioinguinal nerve is a branch of the anterior rami of the L1 spinal nerve that originates in the lumbar plexus. Additionally, the iliohypogastric nerve is a branch of L1 that travels with the ilioinguinal nerve for a distance before branching off to a different destination and innervation. After exiting the lumbar plexus, the ilioinguinal nerve travels across the quadratus lumborum muscle as it courses laterally and crosses part of the liacus muscle as it approaches the iliac crest. It then wraps around anteriorly and pierces the transversus abdominis and internal oblique muscles. It then enters the inguinal canal and travels with the spermatic cord until it leaves the superficial inguinal ring entering its final destination sites.

The ilioinguinal nerve innervates the anterior surface of the scrotum or labia majora, root of the penis or mons pubis, and a small portion of the upper antero-medial thigh. It also innervates the internal oblique and transversus abdominis muscles.

This nerve (as well as the ilio-hypogastric nerve that it travels with) can be blocked as part of a TAP (Transversus Abdominis Plane) block with local anesthetic. The two branches of L1 travel together in the plane between the Internal Oblique and Transversus Abdominis muscles near the iliac crest and course anteriorly together. Using ultrasound, local anesthetic can be deposited in the plane to block the two nerves as well as several of the anterior branches of the intercostal nerves that supply the anterior portion of the abdomen.


Posterior Division
Anterior Division
From 12th Thorac
1st Lumbar
Iliohypograstic n.
Ilioinguinal n.
2nd Lumbar
Genitofemoral n.
3rd Lumbar
Lateral femoral
cutaneous n.
4th Lumbar
o Psoas and
Iliacus
5th Lumbar
Femoral
Accessory obturator
Obturator
Lumbosacral Trunk

Complications :

- **Local anesthetic toxicity** – this is a risk, but it is very low given the small amount of local needed to perform these blocks
- **Hemodynamic changes** – highly unlikely given the fact that the block is limited to the lower abdominal wall and inguinal region
- **Injury to the anesthetized area** – as with any other block the patient must be counseled to avoid trauma to areas that are numb
- **Later femoral cutaneous or femoral nerve blockade** – some of the local anesthetic could track down below the inguinal ligament along the fascia iliaca, giving rise to an unintended block of the femoral nerve. If this occurs the surgical team should be made aware and the patient should be counseled regarding protection of the anesthetized area and the potential for falls.
- **Small and/or large bowel perforation** – given the close proximity in extremely thin patients and the potential loss of layers or deconditioning of layers of the abdominal wall in older/deconditioned patients, perforation of the bowel is a risk with this block. Blunt tipped needles (compared to sharp needles) help the operator to feel the various fascial layers of the abdominal wall. Care must also be observed in patients with little abdominal wall musculature, because the normal three distinct layers may be too thin to appreciate a loss of resistance between

IV Regional: Mechanism

Definition

Intravenous regional anesthesia involves the intravenous injection of local anesthetic distal to an occlusive tourniquet. It is often referred to as a Bier block since the first documented use was by August Bier in 1908. Although it is most commonly employed for surgery on the upper extremity, it has been done on the lower extremity as well. The mechanism of action is felt to be via diffusion of the local anesthetic extravascularly to block distal peripheral branches of nerves. This is in contrast to the more proximal blockade involved in the other common upper extremity regional procedures. A number of adjuncts to local anesthetics have been studied in the block including ketorolac, dexamethasone, opioids, clonidine, and dexmedetomidine. The relative efficacy of these additives, as well as their respective mechanisms of action, is still an open area of study.

3. Caudal Block

Can be used to provide peri- and postoperative analgesia, can be sole anesthetic or can be combined with general anesthesia.

a. **Anesthesia and analgesia below the umbilicus** – the very young a caudal block may be adequate to carry out urgent procedures such as reduction of incarcerated hernias -superficial operations such as skin grafting, perineal procedures, and lower limb surgery. GA may be required in addition Pain relief will extend into the post operative period. The duration of the block can be prolonged by the addition of an opiate to the local anaesthetic.

b. Obstetric analgesia for the 2nd stage or instrumental deliveries. Care should be taken as the fetal head lies close to the site of injection and there is real risk of injecting local anaesthetic into the fetus

c. chronic pain problems such as leg pain after prolapsed intervertebral disc, or post shingles pain below umbilicus.

Contraindications

1. Infection at site
2. Pilonidal cyst
3. Coagulopathy
4. Congenital anomaly of spine or meninges

Anatomy

caudal epidural space: lowest portion of the epidural system and is entered through the sacral hiatus. The sacrum is a triangular bone that consists of the five fused sacral vertebrae (S1- S5). It articulates with the fifth lumber vertebra and the coccyx. The sacral hiatus is a defect in the lower part of the posterior wall of the sacrum formed by the failure of the laminae of S5 and/or S4 to meet and fuse in the midline. There is a considerable variation in the anatomy of the tissues near the sacral hiatus, in particular, the bony sacrum. The sacral canal is a continuation of the lumbar spinal canal which terminates at the sacral hiatus, and contains the cauda equina nerve roots, spinal meninges, epidural fat and epidural venous plexus. The subarachnoid space terminates typically at S2. The sacral canal is roofed by the sacrococcygeal ligament, a continuation of the ligamentum flavum. Caudal epidural block involves injection of medication through the sacral hiatus,

The volume of the sacral canal can vary greatly between adults.

Drugs

- 0.25 percent bupivacaine (Marcaine), preservative free at 2 mg/kg
- adults usually get 20 to 30cc for analgesia for lower extremity

Technique

- can be done in prone or semiprone or lateral position
- find landmarks: The sacral hiatus can be located by first palpating the coccyx, and then sliding the palpating finger in a cephalad direction (towards the head) until a depression in the skin is felt.
- Once the sacral hiatus is identified the area above is carefully cleaned with antiseptic solution, and a 22 gauge short bevelled cannula or needle is directed at about 45° to skin and inserted till a “click” is felt as the sacro-coccygeal ligament is pierced. The needle is then carefully directed in a cephalad direction at an angle approaching the long axis of the spinal canal.
- The needle should be aspirated looking for either CSF or blood. A negative aspiration test does not exclude intravascular or intrathecal placement. Care should always be taken to look for signs of acute toxicity during the injection. The injection should never be more than 10 ml/30 seconds
- A small amount of local anaesthetic should be injected as a test dose (2-4mls). It should not produce either a lump in the subcutaneous tissues, or a feeling of resistance to the injection, nor any systemic effects such as arrhythmias, peri-oral tingling, numbness or hypotension. If the test dose does not produce any side effects then the rest of the drug is injected, the needle removed and the patient positioned for surgery.

Complications

- Intravascular or intraosseous injection. This may lead to grand mal seizures and/or cardio-respiratory arrest.
- Dural puncture. Extreme care must be taken to avoid this as a total spinal block will occur if the dose for a caudal block is injected into the subarachnoid space. If this occurs then the patient will become rapidly apnoeic and profoundly hypotensive. Management includes control of the airway and breathing, and treatment of the blood pressure with intravenous fluids and vasopressors such as ephedrine.
- Perforation of the rectum. While simple needle puncture is not important, contamination of the needle is extremely dangerous if it is then inserted into the epidural space.
- Sepsis.
- Urinary retention.
- Absent or patchy block
- Hematoma

Caudal: System Toxicity

Basic, Clinical Sciences: Anesthesia Procedures, Methods, and Techniques

Caudal Block is a technique most commonly utilized in neonates, infants and small children (typically <5 or 6 years of age). Dose and injection site influence the plasma concentration and peak levels. Rate of absorption at different sites is, from highest to lowest: intercostal, intratracheal, caudal, epidural, brachial plexus and subcutaneous. In general, higher vascularized areas have higher rates of absorption. Epinephrine is added to the solution to vasoconstrict and decrease absorption from the site of injection.

Allowable safe levels of local anesthetic for adults are extrapolated from animal studies and then fitted for infants and children. Maximum safe doses of Lidocaine are 5 mg/kg and with epinephrine 1:200,000 are 7 mg/kg. Bupivacaine and ropivacaine are 3 mg/kg and does NOT change with the addition of epinephrine.

Dose For Caudals: Bupivacaine 2.5 mg/kg; Ropivacaine 2 mg/kg.

Toxicity levels: Bupivacaine 2-4 mcg/ml.

When injecting a test dose with epinephrine, monitor for increases in HR > 10 bpm or increase in T-wave amplitude in lead II. When using a TIVA, increased BP (>30% within 2 minutes) has been shown to be more consistent.

Symptoms of toxicity: CNS toxicity levels tend to be higher than cardiac toxicity levels, thus Cardiac symptoms appear first. This is opposite as compared to adults. The first sign of toxicity may be cardiac collapse. Can be muscle rigidity, hypoxia, tachycardia or dysrhythmias.

Sources

Smith's Anesthesia for Infants and Children, 6th Edition. Chapter 22 Regional Anesthesia. Pages 461-511.

Brown's Atlas of Regional Anesthesia, 5th Edition. Chapter 2 Pharmacology of Local Anesthetics in Pediatrics. Pages 17-22.