TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK

Surgical Specialty:	Pediatric Pain/Regional
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Background:

- General Considerations
  - A Transversus Abdominis Plane (TAP) block is an abdominal field block performed between the internal oblique and transversus abdominis muscles.
    - This block targets the ventral rami of T7-T12 thoracic nerve roots.[1]
  - Historically, the landmark technique was used in which a blunt needle was entered via the Triangle of Petit.
    - This triangle is comprised of the costal margin and iliac crest; bound anteriorly by the external oblique and posteriorly by the Latissimus Dorsi.[2]
  - Currently, an ultrasound-guided technique is favored, given its higher success rate.
    - The ultrasound (US) probe is placed in a transverse orientation at the lateral abdominal wall above the iliac crest and below the inferior costal margin at the mid-axillary line.[3]
  - This is performed as part of a multimodal approach to decrease intraoperative analgesic requirements and shown to improve postoperative pain scores.[4]
    - The TAP block has an increased success rate and decreased complication rate with the implementation of ultrasound-guided injection.

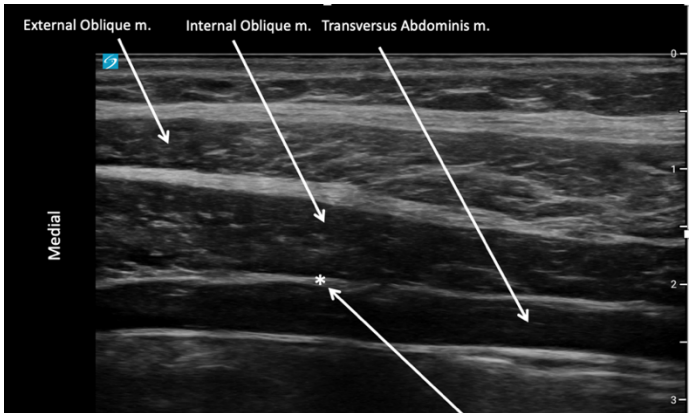

Figure 1: The above image was obtained from a volunteer patient and illustrates the relevant anatomy of a TAP block lateral to the rectus sheath. This area consists of three muscle layers. The transversus abdominis plane exists below the internal oblique muscle and above the transversus abdominis muscle.

Figure 2: The above image was obtained using a mannequin at our hospital's research facility and illustrates the approximate starting position for ultrasound placement at the lateral abdominal wall, above the iliac crest, and below the inferior costal margin at the mid-axillary line.

- Patient Considerations
  - Indications:
    - A TAP block is indicated for a variety of abdominal surgeries both open and laparoscopic including: colorectal surgery (e.g. colostomy), appendectomy, inguinal herniorrhaphy, cholecystectomy, nephrectomy, renal transplant recipients and iliac crest bone harvest among others.[1]
  - Disease Specific Considerations
    - A TAP block is contraindicated for an abdominal wall infection at or near the site of needle entry, bacteremia, impaired hemostasis, or parent/guardian refusal.[1]
  - Pediatric Considerations
    - Neonates have a combination of high relative cardiac output, immature blood-brain barrier, immature liver, higher volume of distribution, and decreased protein binding which increase the risk of local anesthetic toxicity.[3]
  - Associated Comorbidities/Syndromes
    - Obesity in the pediatric patient may increase the difficulty and decrease the efficacy of a TAP block, especially if the identification of fascial planes is started superficially.
      - For this reason, it is recommended to begin the identification of fascial planes beginning from deep to superficial layers so as not to confuse a fascial plane for subcutaneous tissue.[3]

Anesthetic Planning:

- Pre-Anesthetic Evaluation
  - Additional labs/tests indicated during work-up
    - Generally not indicated solely for the TAP block
    - Coagulation studies should be obtained if medical history is concerning.
  - Discussions to have with surgeon/family
    - Informed consent should be obtained from the parent/guardian regarding the overall benefits and risks of a TAP block.
      - Risks include pain, bleeding, infection, damage to surrounding structures, block failure, and LAST among others.
      - Benefits include reduced opiate use and nausea, increased time to first narcotic post-operatively, and improved pain scores.
      - Alternatives to a TAP block, through a multimodal approach, should also be discussed with the parent/guardian as the TAP block is generally considered an elective procedure.
  - The surgeon and anesthesia provider should discuss the overall analgesic plan, especially regarding local anesthetic (LA) administration.
    - If a TAP block is performed, this must be communicated with the surgical team to avoid excessive local anesthetic administration as this could result in Local Anesthetic Systemic Toxicity (LAST).
- Specific or Unique Room Set-up Requirements
  - Airway
    - Readily available standard emergency airway equipment
    - Regional anesthesia can safely be performed on an anesthetized child
      - Generally the preferred method for most children

        - Pediatric airway management for a TAP block varies depending on the surgery performed. TAP blocks may be done awake or with the use of sedation on an agreeable patient in the perioperative period.
    - Drugs/Infusions
        - Many local anesthetics with various concentrations have been used.
            - It is especially important that the patient's maximum local anesthetic dose be calculated.
            - Low and high concentrations of LA have given similar results as far as analgesia.[4]
        - Bupivacaine and ropivacaine are the two most commonly used local anesthetics.
            - Ranges of 0.1ml/kg-1ml/kg of local anesthetic per side has been used.
        - Adjuvants have been used successfully to increase the duration of TAP block in adults, i.e. dexamethasone, alpha-2 agonists, and magnesium.
            - More studies are necessary to delineate optimal dosing in children.[5]

Local Anesthetic	**Maximum Dose (Plain)**	**Duration of Action**
Bupivacaine	2.5 mg/kg	2-10 hours
Ropivacaine	3 mg/kg	2-10 hours
Lidocaine	5 mg/kg	1.5-3 hours

    - Monitors
        - Pulse Oximetry, Blood Pressure, 3-lead ECG
    - Blood Availability (if indicated)
        - Not required
    - PICU Bed Availability (if indicated)
        - Not required
    - Other Indicated Resources
        - Ultrasound machine
        - Sterile Probe Cover
        - Appropriately sized needle
        - Access to intralipid solution for management of LAST

Intraoperative Considerations:

- General
    - For the pediatric patient, anticipate performing this procedure while under general anesthesia either immediately after induction or just prior to emergence.
        - The procedure is unlikely to be tolerated well if performed pre-induction or post-emergence in the pediatric population.
- Positioning
    - The patient is placed in the supine position.
    - The provider will stand on the ipsilateral side of the block, while the ultrasound machine is placed on the contralateral side.
- Hemodynamics
    - Peripheral nerve blocks tend to maintain hemodynamic stability when compared to neuraxial blocks.

- Surgical Considerations
    - Maintain closed-loop communication with the surgical team about the plan for a TAP block.
        - Confirm if any local anesthetic was administered by the surgical team during the case and adjust dosing as needed.
        - Communication is paramount to avoid LAST.
- Emergence/Disposition
    - Ensure that an adequate depth of anesthesia is maintained while performing the procedure especially when timing emergence.
        - Bucking or any sudden movements precipitated by light anesthesia may increase the risk of complications.
    - A TAP block is unlikely to change the course of the patient's previously anticipated disposition expected with the surgery.
- Post-op Pain
    - Follow up closely after a TAP block in recovery.
    - Discuss with family that the procedure was performed.
    - Manage expectations about the onset and duration of the particular local anesthetic.
        - If the patient is having pain upon arrival to recovery, consider additional PRN medication.
        - Local anesthetics may have variable onsets when used for peripheral nerve blocks. (e.g. Bupivacaine's onset of action is cited anywhere from 5 to 30 minutes.)

Case-Specific Complications/Pitfalls

- Unpredictable success
    - Abdominal wall blocks provide limited analgesic coverage with unpredictable success.
        - The use of ultrasound guidance for visualization of local anesthetic infiltration has improved their accuracy and effectiveness.
        - There is debate over the optimal location and approach for a TAP block for particular abdominal surgeries in relation to the umbilicus.
            - Upper abdominal surgeries are thought to be better targeted by a subcostal block; generally performed more medially between the rectus and transversus layers.
            - Lower abdominal surgeries are targeted more optimally with a posterior approach.[6]
- Intravascular injection
    - Aspiration prior to injection of local anesthetic reduces the chance of an intravascular injection.
        - Repeat aspiration throughout the injection of total anesthetic is recommended.
- Intraperitoneal perforation
    - Increased chance of organ and bowel injury or hematoma.
- Hepatic perforation
    - Associated with right-sided TAP blocks.
        - This can be minimized with palpation of the inferior border of the liver prior to a blind technique or adequate visualization of the needle with ultrasound.[6]
- Splenic perforation
    - The spleen is relatively larger in the pediatric patient.[1]

- Femoral nerve block
  - A TAP block can theoretically cause a femoral nerve block.
    - Local anesthetic injected beyond the transversus abdominis muscle and into the transversalis fascia may enter the fascia iliaca.[6]
- Local Anesthetic Systemic Toxicity
  - No reported cases associated with a TAP block.
    - If toxicity is suspected, start an intralipid 20% at 1.5 mL/kg IV bolus followed by an infusion starting at 0.25 mL/kg/min.
    - Hemodynamic support with a reduced epinephrine dose of 1 mcg/kg is recommended; as opposed to the standard code dose of 10 mcg/kg.
    - Maximize oxygen delivery
    - Treat acidosis and hyperkalemia

References

1) Craig, R "Transversus Abdominus Plane Block." European Society for Paediatric Anaesthesiology, 1 Sept. 2022 Link

2) Mukhtar, K. "Transversus Abdominis Plane (Tap) Block - NYSORA." NYSORA, May 2009. Link

3) Roberts, S "Peripheral Nerve Blocks for Children." NYSORA, 18 Apr. 2022 Link

4) Dontukurthy S, Mofidi R. The Role of Interfascial Plane Blocks in Paediatric Regional Anaesthesia: A Narrative Review of Current Perspectives and Updates. *Anesthesiol Res Pract*. 2020;2020:8892537. Published 2020 Dec 19. doi:10.1155/2020/8892537 PubMed Link.

5) Tran DQ, Bravo D, Leurcharusmee P, Neal JM. Transversus Abdominis Plane Block: A Narrative Review. *Anesthesiology*. 2019;131(5):1166-1190. doi:10.1097/ALN.0000000000002842 PubMed Link

6) Young MJ, Gorlin AW, Modest VE, Quraishi SA. Clinical implications of the transversus abdominis plane block in adults. *Anesthesiol Res Pract*. 2012;2012:731645. doi:10.1155/2012/731645 PubMed Link

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