Section A -Research paper

Transversus Abdominis Plane Block and Quadratus Lumborum Block for Postoperative Analgesia: Review article

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Abstract:

Preemptive analgesia is an intervention provided prior to initiating painful stimuli which may reduce or prevent subsequent pain. Different analgesic modalities have been tried to provide adequate analgesia including systemic drugs (opioids), local anesthetic (lidocaine), and neuraxial techniques (epidural). Regional block techniques (Transversus Abdominis Plane block and Quadratus Lumborum block) are abdominal blocks used for perioperative pain management of both upper and lower abdominal surgeries. They are also having an evolving role in postoperative analgesia and opioids consumption, with minimal procedure related morbidity.

Keywords: Transversus Abdominis Plane, Postoperative Analgesia, Quadratus Lumborum Block.

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Introduction:

Optimum pain management should start before surgery. All patients should undergo a pre-operative assessment that includes a section on pain management. This allows planning of optimal pain management techniques and facilitates early discussions to help alleviate fear of post-operative pain**(1).**

Discussion of post-operative pain management at preoperative assessment aims to optimize patient satisfaction and reduce adverse effects. Common phenotypes and conditions predict poor post-operative pain control and increased opioid intake, including: younger age; female sex; smoking; depression; anxiety; sleep disorders; negative affectivity; pre-operative pain; use of peri-operative analgesia and surgical factors including type of surgery (major, emergency or abdominal) and its duration **(2, 3).**

Ultrasound-guided regional anesthesia and pain procedures have a wide clinical acceptance in the last decade. Ultrasound provides real-time image guidance for regional anesthesia and interventional pain procedures. It is a practical tool as it is portable, moderately priced, and devoid of radiation risks **(4).**

❖ Transversus Abdominis Plane Block

Transversus abdominis plane (TAP) block was first described by Rafi (**5**) and subjected to randomized controlled trials by McDonnell **(6, 7)**. Their landmark approach utilized the lumbar triangle of Petit to access the neurovascular plane. Ultrasound techniques were then described and popularized by Hebbard (**8, 9)**. It involves injecting local anesthetic into the neurovascular plane between the internal oblique and transversus abdominis muscles and has analgesic effects on anterolateral abdominal wall and parietal peritoneum that cover anterior division of the T6 to L1 spinal nerves, which runs into the plane between abdominal wall muscles **(10).**

Indications

Most commonly, Transversus abdominis plane blocks are used as one component of multimodal postoperative analgesic technique. They have been effective following colorectal surgery, appendicectomy, cholecystectomy, prostatectomy, abdominal hysterectomy, hernia repair and renal transplantation **(11).**

Contraindications

Transversus abdominis plane block has absolute contraindication counting infections and skin diseases at the injection area, Patient refusal and allergy to local anesthetic. With relatives caution in patients taking anticoagulation, pregnant patient, and in patients where anatomical landmarks are indistinguishable **(12).**

Techniques:

- **Classical Transversus abdominis plane block:**

The classical TAP block is the landmark-based TAP approach which was first introduced by Rafi. The “triangle of petit” is the landmark from where the TAP is approached *(Figure 1).* The triangle of petit is situated between the iliac crest and subcostal margin. The base of the triangle is formed by the iliac crest, and it is bounded anteriorly by the external oblique muscle and posteriorly by the latissimus dorsi muscle **(5).**

According to the technique described by McDonnell, the iliac crest is palpated in anterior to posterior direction and insertion of the latissimus dorsi is identified. A 5 cm 25gauge blunt tip needle is inserted just above iliac crest perpendicular to the skin, till a “double pop” sensation is felt**.** The first pop indicates that the needle has crossed the external oblique muscle. The second pop indicates that the needle has crossed internal oblique muscle and lies at a plane between internal oblique and transversus abdominis muscles, commonly known as the TAP

plane. Since it is a field block, a large amount of local anesthetic is required **(7).**

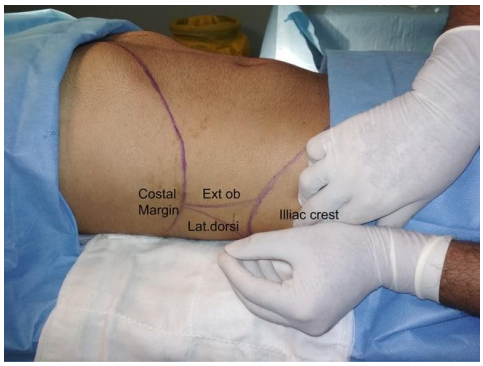


Figure (1): Triangle of Petit **(13).**

- **Ultrasound Ultrasound guided Transversus abdominis plane blocks:**

is now the established gold standard for peripheral nerve blocks. The key to ultrasound guided TAP blocks is identification of the transversus abdominis muscle and potential space above it, called the Transversus Abdominis Plane (TAP). Low frequency curvilinear probes have been used for obese patients **(14).**

Dosage

The local anesthetics bupivacaine is the most commonly employed for TAP blocks. Available evidence suggests volume rather than dose is the main determinant of efficacy, so the authors recommend 15–20 mL of 0.25% bupivacaine per side **(15).**

Approaches

Classification of TAP blocks based on a unified nomenclature system as shown in *(table 1):*

Table (1): Classification of Transversus Abdominis Plane blocks **(15).**

Approach	Nerves blocked	Area supplied
Lateral	T10–T12	Infraumbilical anterior abdominal wall
Posterior	T9–T12, with potential paravertebral spread	Infraumbilical anterior abdominal wall
Subcostal	T6–T9	Supraumbilical anterior abdominal wall
Oblique subcostal	T6–L1	Supraumbilical and infraumbilical anterior abdominal wall

a) Subcostal approach:

Initially the probe is placed transversely in the midline of the anterior abdominal wall, just below the xiphoid process with the Patient in supine position *(Figure 2 a).* Linea Alba is easily identified in the center, in between two rectus abdominis muscles. The probe is moved laterally to identify the lateral border of the rectus abdominis muscle, linea semilunaris, external and internal oblique muscles and transversus abdominis muscle **(8).**

A 25-gauge needle is inserted in medial to lateral direction in the plane to the probe, till it reaches the TAP plane between the rectus abdominis and transversus abdominis muscles. The local anesthetic is deposited here after confirming the needle

tip position with hydro dissection *(Figure 2 b)*. The spinal nerves blocked are T6–T9 supplying the upper abdomen just below the xiphoid and parallel to the costal margin, and this block is suitable for upper abdominal surgeries **(16).**

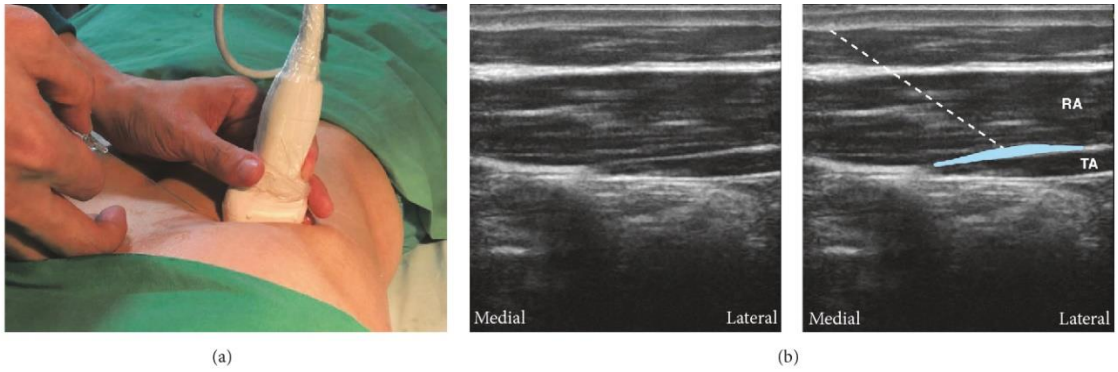


Figure (2): Subcostal approach of Transversus abdominis plane (TAP) block: **(a)** probe position, **(b)** Ultrasound images SC (subcutaneous tissue), RA (rectus abdominis), TA (transversus abdominis), L/M (lateral and medial) **(16).**

b) Lateral approach:

For analgesia over the infraumbilical area of the anterior abdominal wall between two midclavicular lines. The nerves blocked are anterior cutaneous branches of T10–T12. However, with supine position of patient. The probe is placed transversely on the lateral abdominal wall at mid-axillary line between costal margin and iliac crest *(Figure 3 a)*. The three abdominal muscles are seen below subcutaneous fat, the plane between internal oblique and transversus abdominis muscle is identified (*Figure 3b).* The needle is inserted in the plane in medial to lateral direction, local anesthetic injected in the TAP plane **(17).**

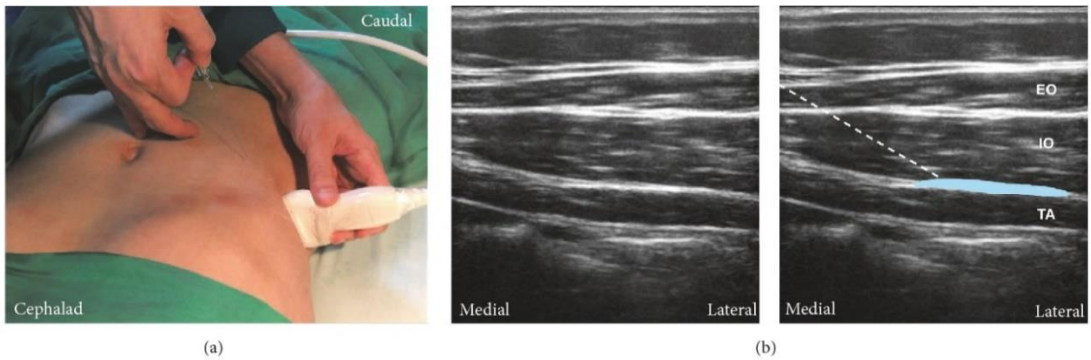


Figure (3) Lateral approach of transversus abdominis plane (TAP) block: **(a)** probe position, **(b)** ultrasound images EO: external oblique muscle, IO: internal oblique muscle, TA: transversus abdominis**(16).**

c) Posterior approach:

The patient was in lateral position and the linear probe placed in a lateral approach initially *(Figure 4)*, then it is moved posteriorly till a scan reveals the transversus abdominis muscle tailing off into the aponeurosis, near the quadratus lumborum muscle *(Figure 5).* Local anesthetic is deposited superficial to aponeurosis **(13).**

The advantages of the posterior approach over lateral approach are better prolonged anesthesia and probable blockade of lateral cutaneous nerves providing better coverage **(18)**. The prolonged analgesia is explained by posterior spread of local anesthetic to paravertebral space from T4 to L1 and partial blockade of the thoracolumbar sympathetic chain **(19).**

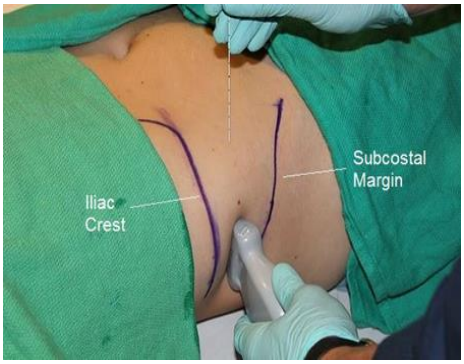


Figure (4): Probe position in the transversus abdominis plane block by posterior approach **(20).**

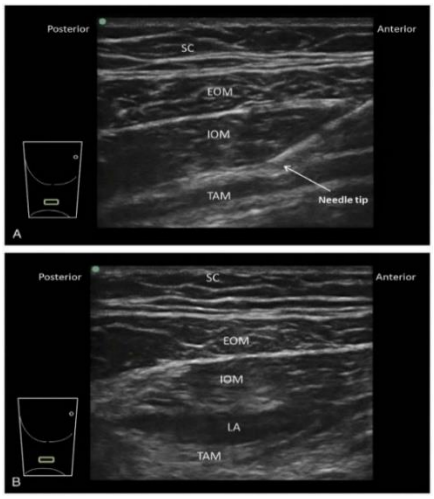


Figure (5): Ultrasound-guided transversus abdominis plane (TAP) block:(A): pre-injection image. (B): Post-injection image; local anesthetic (LA) has distended the TAP, separating internal oblique muscle (IOM) and transversus abdominis muscle (TAM) **(20).**

d)- Oblique Subcostal Block:

This is a modified form of the subcostal TAP block. The initial steps are like the subcostal approach, a linear probe is positioned over the subcostal area and the TAP plane identified. A long needle of 15–20 cm is introduced in the plane in medial to lateral direction till it reaches between the transversus abdominis and rectus abdominis. This requires a large amount of local anesthetic and is technically difficult to perform compared to other TAP block approaches **(9).**

Complication of transversus abdominis plane (TAP) block:

- **Trauma**

Visceral damage due to inadvertent peritoneal puncture while performing blind TAP block has been reported. Although the risk can be minimized with ultrasound guidance **(21).**

- **Femoral nerve palsy**

Transient femoral palsy after TAP block is induced by incorrect local anesthetic deposition between transversus abdominis and the transversalis fascia **(22).** This complication is usually self-limited but will delay patient discharge especially in day-case surgeries. Using a test solution to locate the needle tip under ultrasound guidance will help identify the TAP and avoid spread of the anesthetic toward the femoral nerve **(23).**

- **Local anesthetic toxicity**

Because transversus abdominis plane (TAP) block using large dose of local anesthetic, there is a risk of LA toxicity. This issue has remained controversial because of several reports of people whose LA levels reached or above systemic toxic limits; therefore, careful attention could be given to the total doses of LA by determining the suitable levels within the maximum doses **(24).**

- **Hematoma**

Since the TAP belongs to a vessel-rich plane. The test solution instead of local anesthetic should be injected first to hydro locate the needle tip and visualize the hypoechoic spread **(25).**

❖ Quadratus lumborum block

Quadratus lumborum (QL) block is a regional anesthetic technique, it emerged as a part of multimodal opioid sparing analgesia to improve postoperative pain control after abdominal surgery, it has been described by Blanco **(26).** The local anesthetic potentially spreads cranially along the muscle, posterior to the arcuate ligaments of the diaphragm and reaches the thoracoabdominal nerves (T6–T12) as they traverse the lower thoracic paravertebral space **(27).**

Because the quadratus lumborum block is a fascial plane block, it is also important to consider the various tissue layers surrounding the QL muscle. The thoracolumbar fascia (TLF) encases the muscles of the back *(Figure 6)*, from the

thoracic to the lumbar spine. The thoracolumbar fascia forms from the aponeurosis of the transversus abdominis and internal oblique muscles. The anterior layer of the thoracolumbar fascia is anterior to the quadratus lumborum muscle. The middle layer is between the QL and the erector spinae, and the posterior layer is posterior to the erector spinae **(28).**

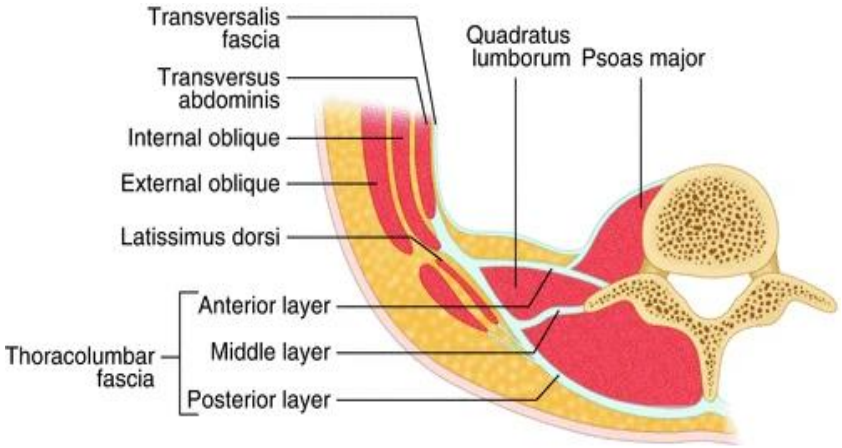


Figure (6): Thoracolumbar fascia begins at the aponeurosis of the external oblique, internal oblique, and transversus abdominis **(29).**

Indications

The American Society of Regional Anesthesia and Pain Medicine (ASRAPM) recommends the application of quadratus lumborum block for laparoscopic cholecystectomy, upper and lower abdominal surgeries, lower extremity vascular surgery **(30).**

There are more and more authors describing the application of quadratus lumborum for hip and femur surgery **(31).**

Contraindications

Absolute contraindications include local infection, allergy to local anesthetics and a known bleeding diathesis because it is a deep block. Relative contraindications include anatomical abnormalities, hemodynamic instability and known neurologic disorders **(30).**

Technique:

A curvilinear low-frequency transducer is often required, facilitating tissue penetration of ultrasound and a wide field of view. The transducer is placed in transverse orientation at the posterior or midaxillary line at the L2–L4 level with the objective of imaging the quadratus lumborum and erector spinae muscles, together with a transverse process forming the “shamrock sign” **(32).**

Dosage

Quadratus lumborum block typically require 15 to 30 mL of local anesthetic (0.2-0.4 mL/kg) of low concentration (0.25%) bupivacaine injected per side. Adjustment the dose needed to avoid toxic threshold, particularly when bilateral blocks are performed **(33).**

Approaches:

Quadratus lumborum block can be named based on the anatomical location of needle tip placement in relation to the quadratus lumborum muscle, as in *(table 2):*

Table (2): Classification of Quadratus lumborum block (34)

Approach	Nerves blocked
Anterior	T10–L3-4
Posterior	T7–L1
Lateral	T7–L1
intramuscular	T7–T12

a) Anterior quadratus lumborum block:

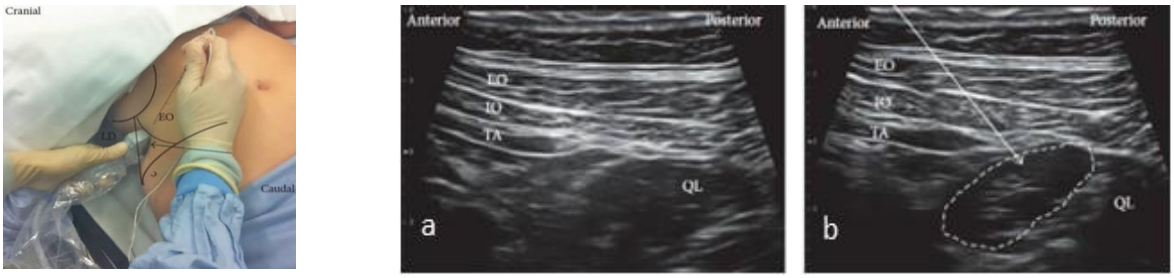
The patient was in the lateral position. A low-frequency convex probe was vertically attached above the iliac crest and a needle was inserted in the plane from the posterior edge of the convex probe through the quadratus lumborum in an anteromedial direction *(Figure 7a).* The needle tip was placed between the psoas major muscle and the quadratus lumborum muscle and the local anesthetic was injected into the fascial plane *(Figure7b).* The local anesthetic appeared to press down the Psoas major in the ultrasound image **(35).**

(a) **(b)**

Figure (7): Anterior quadratus lumborum block approach: **(a)** probe position (b) Ultrasound images, QL: quadratus lumborum, PM: psoas muscle, white arrow: needle trajectory and white dotted line: the spread of local anesthetic **(36).**

b)Lateral quadratus lumborum block:

When the patient is in a supine position, a high-frequency linear probe is within the Petit triangle region *(Figure 8 I).* The tip of the needle is inserted at the anterolateral border of the quadratus lumborum at its junction with the transversalis fascia and the local anesthetic is injected, which is seen profound into the transverse abdominal aponeurosis *(Figure 8 II)* **(36).**



(I) **(II)**

Figure (8): Lateral quadratus lumborum block approach: I probe position, II Ultrasound images (a) Pre-injection and (b) post-injection. EO: external oblique muscle, IO: internal oblique muscle, TA: transversus abdominis, QL: quadratus lumborum, white arrow: needle trajectory and white dotted line: the spread of local anesthetic **(36).**

c) Posterior quadratus lumborum block:

The patient was in the supine position as the lateral quadratus lumborum block, the patient was occasionally supported on a pillow to create space under the patient's back to be able to move a low-frequency convex probe freely. The posterior aspect of the quadratus lumborum muscle was confirmed and the needle tip was inserted into this aspect of the quadratus lumborum muscle *(Figure 9).* The local anesthetic was then injected into the lumbar inter-fascial triangle behind the quadratus lumborum muscle **(28).**

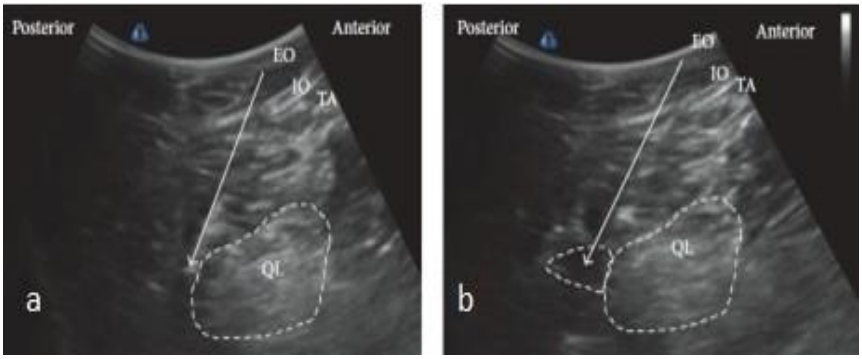


Figure (9): Ultrasound images of posterior Quadratus lumborum block approach: (a) Pre-injection and (b) post-injection. EO: external oblique muscle, IO: internal oblique muscle, TA: transversus abdominis, QL: quadratus lumborum, white arrow: needle trajectory and white dotted line: the spread of local anesthetic **(36).**

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d) Intramuscular quadratus lumborum block

The patient will lie supine then a high-frequency linear probe is put slightly cephalad to the iliac crest. The needle tip is inserted until it enters the fascia and is inserted into the quadratus lumborum muscle. Test injection is at first administered to confirm that the nearby anesthetic spreads inside the quadratus lumborum muscle *(Figure 10).* Finally, the spreading of nearby anesthetic will affirm the success of the approach **(37).**

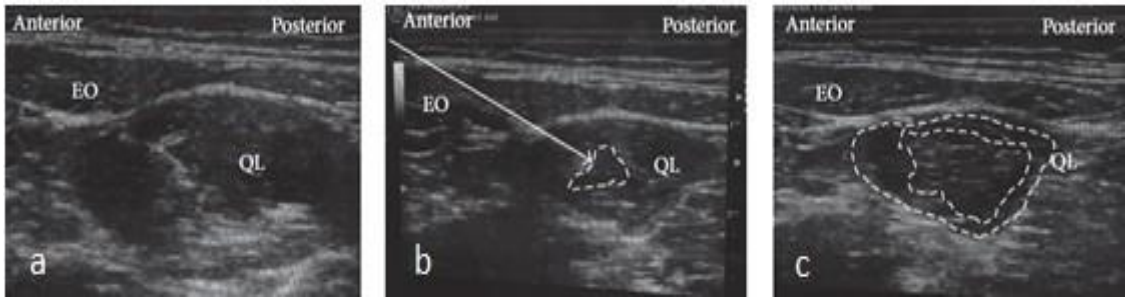

Figure (10): Ultrasound images of intramuscular quadratus lumborum block (a) Pre-injection, (b) test injection, and (c) post-injection. EO: external oblique muscle, QL: quadratus lumborum, white arrow: needle trajectory and white dotted line: the spread of local anesthetic **(36).**

Complications of quadratus lumborum block:

- **Trauma**

Quadratus lumborum block can be very difficult in obese patients and complications as infection, and organ injuries especially kidney injury should be considered **(36).**

- **Quadriceps muscle weakness**

Transient paresthesia and accidental femoral nerve palsy have been reported with low anterior trans-muscular quadratus lumborum block due to proximity to the lumber plexus and the possibility of spreading the anesthetic down the iliac fascia causing weakness in the quadriceps***(38).***

- **Hematoma**

As the quadratus lumborum block performance involves manipulation of the fascia where blood vessels exit from the paravertebral space, caution should be exercised in people receiving anticoagulant therapy due to the possible risk of hematoma**(35).**

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