Narrative Review

Understanding the Anatomy of Retroperitoneal Interfascial Space: Implications for Regional Anesthesia

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Background: Fascial plane block techniques have evolved considerably in recent years. Unlike the conventional peripheral nerve block methods, the fascial plane block's effect can be predicted based on fascial anatomy and does not require a clear vision of the target nerves. The anatomy of the retroperitoneal interfascial space is complex, since it comprises multiple compartments, including the transversalis fascia (TF), the retroperitoneal fasciae (RF), and the peritoneum. For this reason, an in-depth, accurate understanding of the retroperitoneal interfascial space's anatomical characteristics is necessary for perceiving the related regional blocks and mechanisms that lie underlie the dissemination of local anesthetics (LAs) outside or within the various retroperitoneal compartments.

Objectives: This review aims to summarize the retroperitoneum's anatomical characteristics and elucidate the various communications among different interfascial spaces as well as their clinical significance in regional blocks, including but not limited to the anterior quadratus lumborum block (QLB), the fascia iliaca compartment block (FICB), the transversalis fascia plane block (TFPB), and the preperitoneal compartment block (PCB).

Study Design: This is a narrative review of pertinent studies on the use of retroperitoneal spaces in regional anesthesia (RA).

Methods: We conducted searches in multiple databases, including PubMed, MEDLINE, and Embase, using "retroperitoneal space," "transversalis fascia," "renal fascia," "quadratus lumborum block," "nerve block," and "liquid diffusion" as some of the keywords.

Results: The anatomy of the retroperitoneal interfascial space has a significant influence on the injectate spread in numerous RA blocking techniques, particularly the QLB, FICB, and TFPB approaches. Furthermore, the TF is closely associated with the QLB, and the extension between the TF and iliac fascia offers a potential pathway for LAs.

Limitations: The generalizability of our findings is limited by the insufficient number of randomized controlled trials (RCTs).

Conclusions: Familiarity with the anatomy of the retroperitoneal fascial space could enhance our understanding of peripheral nerve blocks. By examining the circulation in the fascial space, we may gain a more comprehensive understanding of the direction and degree of injectate diffusion during RA as well as the block's plane and scope, possibly resulting in effective analgesia and fewer harmful clinical consequences.

Key words: Fascial anatomy, retroperitoneal space, transversalis fascia, renal fascia, nerve block, quadratus lumborum block

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The fascia plane block is a regional anesthetic (RA) technique in which local anesthetics (LAs) are administered between fasciae rather than in a specific nerve or plexus. This technique prevents nerve transmission across a specific fascial plane or compartment, ensuring effective anesthesia induction in the target site. Furthermore, in this RA technique, LAs can block nerves that are somewhat distant from the target site by migrating and diffusing in large quantities. Initially, fascia plane blocks were guided by the landmarks of surface anatomy, but physicians who use these blocks have recently begun to incorporate extensive ultrasound guidance due to its efficiency in reducing the blocking failure rate. Moreover, ultrasound guidance has enhanced the development and application of other innovative fascia plane block techniques, such as the quadratus lumborum block (QLB), fascia iliaca compartment block (FICB), and transversalis fascia plane block (TFPB).

A better understanding of the characteristics of the fascial anatomy was critical in discovering the aforementioned innovative RA techniques. The abdominal cavity, which comprises multiple compartments, including the peritoneum, transversalis fascia (TF), anterior renal fascia (RF), posterior RF, and lateroconal fascia (LCF), might be a complex fascial system. Several newly developed fascial plane blocks are focused on these fasciae and their related compartments. Notably, retroperitoneal fasciae are currently believed to be multilayered structures with a potential for expansion (1). In addition to helping anesthesiologists improve block success rates, awareness of the anatomy and interrelation of retroperitoneal fasciae could aid in identifying potential recesses around the target structure in case LAs are injected incorrectly. We also expect more innovative RA techniques to develop as the comprehension of fascial structures increases. This review aims to summarize the retroperitoneum's anatomical features and elucidate the various communications among different peritoneal spaces, enabling anesthesiologists to better navigate them in clinical practice.

Anatomy of the Peritoneum, TF, and RF

Peritoneum

The peritoneum is divided into 2 layers: the parietal peritoneum and the visceral peritoneum. The peritoneal cavity is the latent space between the parietal peritoneum, which wraps the abdominal wall, and the visceral peritoneum, which covers the abdominal organs (2).

TF

The TF, a part of the intraabdominal fascia, is located in the transversus abdonimis's deep surface. The posterior RF and TF may merge, forming the medial border of the posterior pararenal space (PPS). Additionally, the TF connects with the internal thoracic fascia behind the diaphragm, thickens, and then connects with the medial and lateral arcuate ligaments, establishing communication with the thoracic paravertebral space.

RF

The RF wraps around the kidneys and the surrounding fat tissues. The 2 RF layers are fused to form the LCF behind the ascending or descending colon. Furthermore, the posterior RF merges with the psoas major (PM) and quadratus lumborum (QL) fasciae at the renal hilum level, with structural implications. The posterior RF can be divided into 2 layers: one is a thinner anterior layer that connects with the anterior RF, and the other is a posterior layer that connects with the LCF. The potential gap between the 2 layers is interlinked with the anterior pararenal space (APS).

LCF

The LCF is a fascial layer in the human body that was first documented in the early 1900s. This layer is located behind the ascending or descending colon, separating the APS and PPS. The LCF comprises a flat, fatty mass comparable to the fatty capsule surrounding the kidneys. This fatty tissue is often referred to as the "flank pad." When planning invasive procedures in the retroperitoneal area, it is important to consider the colon's anatomical relationship with the LCF and kidneys.

Interfascial Spaces Formed by the Peritoneum, TF, and RF

Extraperitoneal Space

The extraperitoneal space is the section of the abdomen and pelvis that lies outside the peritoneal region between the TF and peritoneum. The preperitoneal space is the anterior region of the extraperitoneal space, whereas the subperitoneal pelvic space constitutes the extraperitoneal space's pelvic region (3). Meanwhile, the retroperitoneum is the space in the posterior abdominal wall restricted to the abdominal and pelvic walls (Fig. 1).

Retroperitoneum

The retroperitoneum is a specific space in the abdominal cavity enclosed by the posterior parietal peritoneum and TF in the front and back, respectively. This space extends from the diaphragm at the top of the abdomen to the pelvic brim at the bottom. The area is further divided into 3 distinct compartments: the APS, perirenal space, and PPS. These compartments are separated by fascial planes.

Anterior Pararenal Space (APS)

The APS is a compartment in the retroperitoneum enclosed by the posterior parietal peritoneum, anterior RF, and LCF in the front, back, and sides, respectively (Fig. 1). Notably, there are important digestive organs within the APS (4).

Perirenal Space

The perirenal space is a cone-shaped compartment within the retroperitoneum that extends from the diaphragmatic fascia at the top of the abdomen to the iliac fossa at the bottom. This compartment is enclosed by the anterior and posterior RFs and contains important structures related to the urinary system and a perirenal fat layer.

Scholars are currently debating the formation, circulation, and lower boundary of the perirenal space, a compartment surrounding the kidneys and other related structures within the retroperitoneum. While some experts believe that the merging of RFs generates the perirenal space, more recent research has demonstrated that the bottom edge of the space communicates with the pelvic region outside the peritoneum (5,6) (Fig. 2).

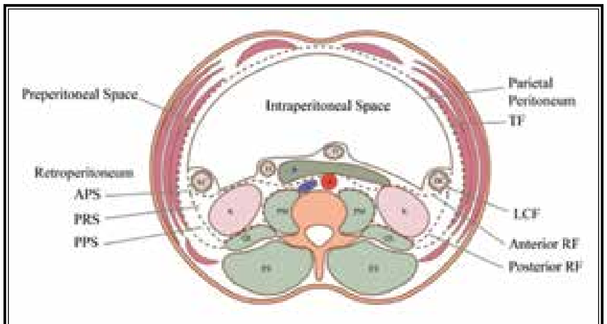

Fig. 1. *Extraperitoneal space and organs*.
APS, anterior pararenal space; PRS, perirenal space; PPS, posterior pararenal space; RF, renal fascia; LCF, laterconal fascia; TF, transversalis fascia; AC, ascending colon; D, duodenum; P, pancreas; DC, descending colon; K, kidney; V, vena cava; A, aorta; ES, erector spinae; QL, quadratus lumborum; PM, psoas major.

Posterior Pararenal Space (PPS)

The PPS is another compartment in the retroperitoneum enclosed by the posterior RF, TF, and PM in the front back, and middle, respectively. The space extends laterally beyond the LCF and transforms into the preperitoneal fat on the external layer of the abdominal wall. The PPS, which is composed almost exclusively of fat, without organs, opens laterally toward the flank and downward toward the pelvis. The PPS may be connected on both sides but only through the preperitoneal fat tissue of the abdominal anterior wall (5,6).

Implications for Regional Anesthesia

Quadratus Lumborum Block (QLB)

Anatomical Relationship Between the QLB Approaches and the TF

Both the QL and PM muscles are covered by the TF, which is cranially divided into 2 layers. One of these layers connects to the endothoracic fascia, while the other layer merges with the diaphragm near the arcuate

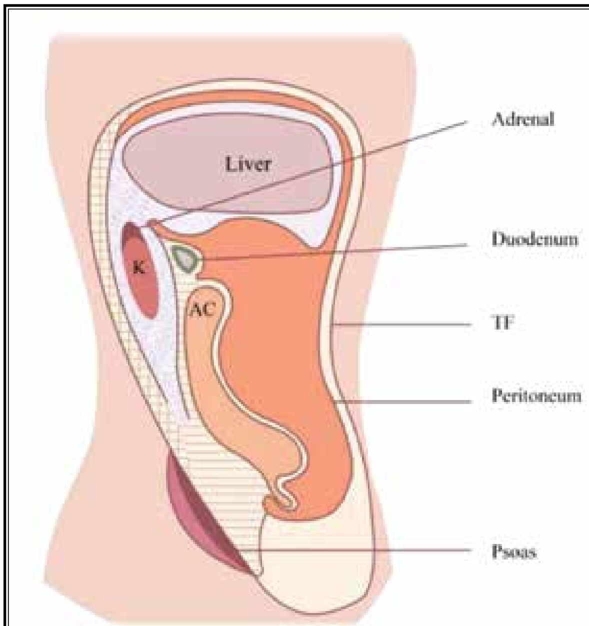

Fig. 2. *The schematics of extraperitoneal spaces*.
Streaked areas = APS; spotted areas = perirenal space; cross-lined areas = PRS. K, kidney; AC, ascending colon; TF, transversalis fascia.

ligaments. Furthermore, the TF transforms into the iliac fascia within the pelvic cavity (7). Clinically, the QLB is a technique for administering LAs to block nerve pathways, which is achieved by injecting LAs through various trajectories into the fascial spaces surrounding the QL muscle or directly into the muscle itself (8) (Fig. 3). Different QLB approaches may be employed depending on the needle tip's position relative to the QL muscle. These approaches include the lateral, anterior, and posterior QLBs (9). In the lateral QLB (LQLB) approach, the puncture needle is inserted through the aponeurosis of the transversus abdominis (TA) (10), and the LAs are delivered laterally to the QL muscle, where they spread between the TF and TA. Carney (11) and Carline (12) have reported that LAs may potentially diffuse into the thoracic paravertebral space via this approach. Transmuscular QLB (TQLB) involves administering LAs into the compartment posterior to the TF, specifically between the QL and PM muscles (13). The LAs injected via this approach then infiltrate the thoracic paravertebral space through the posterior pathway near the medial and lateral arcuate ligaments. The subcostal, iliohypogastric, and ilioinguinal nerves may be blocked through a QLB, potentially resulting in a T12-to-L2-level blockade. An explanation for this outcome may be that the aforementioned nerves originate from the ventral branch of the L1 spinal nerve and occasionally from T12, L2, and L3.

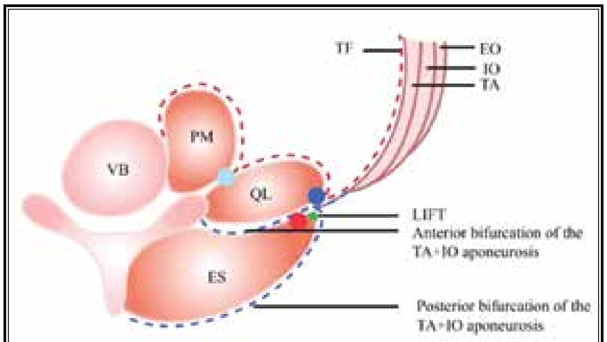

Fig. 3. *Different approaches for QLB. The surfaces of the QL and PM muscles are covered by TF. The aponeurosis of the TA and IO divides into anterior and posterior laminae, surrounding the surface of the ES and contributing to the formation of the LIFT. The light blue area represents the anterior QLB approach. The red area represents the posterior QLB approach. The dark blue area represents the needle target of lateral QLB approach.*
TF, transversalis fascia; PM, psoas major; QL, quadratus lumborum; ES, erector spinae; EO, external oblique; IO, internal oblique; TA, transversus abdominis; VB, vertebral; LIFT, lumbar interfascial triangle.

Several QLB approaches have been applied in multiple clinical procedures, including cesarean sections, gastrointestinal surgery, urinary surgery, lower limb surgery, and chronic pain treatment. Although QLBs have been established to reduce patients' opioid use after cesarean sections and kidney surgeries, the evidence of the block's role in other types of surgeries remains insufficient.

Elsharkawy et al (14) proposed the subcostal QLB (SQLB) technique, a novel approach for performing a type of anterior QLB. This technique involves scanning the paramedian sagittal plane through ultrasonography and inserting a needle into the latent space between the QL muscle and TF at the L1-L2 level (14,15) (Fig. 4). At the diaphragm level, the TF is divided into 2 laminae, one attached to both the medial and lateral arcuate ligaments and the other connected to the endothoracic fascia (16,17). A feasible pathway for LA diffusion into the subendothoracic compartment, which contains the thoracic nerve roots, can be created through the QLB approach. Elsharkawy et al reported that the SQLB technique's blocking level should reach T6 (18), a high level of blockage achieved by ensuring that the LAs infiltrate the thoracic paravertebral space via the access points at the medial or lateral arcuate ligaments. Since the medial and lateral arcuate ligaments are essential for connecting the lumbar to the thoracic paravertebral spaces, their integrity is crucial to the SQLB technique's blocking efficacy (19,20).

The QL muscle is located on either side of the spine, from the T12 rib to the iliac crest. Meanwhile, the lateral arcuate ligament is located between L1 and

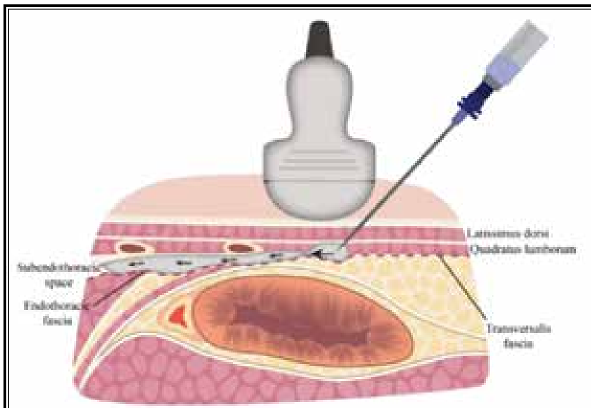

Fig. 4. *Subcostal QLB approach. The relationship between the TF and subendothoracic fascia in sagittal view. The needle trajectory is noted, and LAs diffuse cranially along the TF and endothoracic fascia.*

the T12 rib. This spatial arrangement implies that the QL muscle's anterior compartment, located above the lateral arcuate ligament, is critically involved in the propagation of LAs in the QLB approach. Direct injection of LAs into the QL muscle's anterior compartment above the lateral arcuate ligament allows them to diffuse directly into the thoracic paravertebral space, eliminating potential interference by the medial and lateral arcuate ligaments. Knowing this, our group tested the anterior QLB approach at the supralateral ligament (21-23). In the long-axis scan method, the diaphragm was observed to extend toward the caudal side in relation to the TF (24). The lateral arcuate ligament delineates the diaphragm's lower border, and the position of the puncture needle represents the potential compartment between the QL and the diaphragm (Fig. 5). Compared to the conventional anterior QLB approach, this method offers several benefits, including clear visualization of relevant anatomy, a shorter onset time, and more stable coverage of the sensory block across the dermatomes.

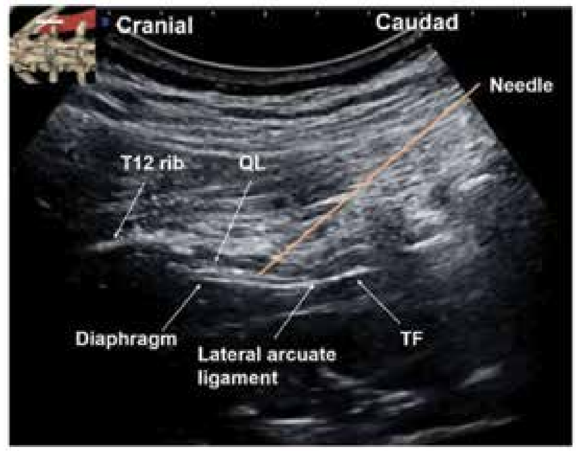

Fig. 5. *The long-axis scan method for the ultrasound-guided supralateral arcuate ligament block. The ultrasound image shows the apposition zone of the QL and diaphragm. The diaphragm's lowest border is the lateral arcuate ligament. The puncture target is the apposition zone between the QL and diaphragm. The inserted image indicates the position of the probe.*
QL, quadratus lumborum; TF, transversalis fascia.

The Multilayered Fusion Structure of the TF and Posterior RF Increases the Difficulty in Needle Insertion for SQLBs

According to dissection studies, the 2 layers of the posterior RF can be separated at different points in the kidney. They are also somewhat associated with the anterior RF and LCF. Previous research (25) has demonstrated that the posterior RF joins with the QL and PM fascia at the renal hilum level. Moreover, the rear layer of the posterior RF may merge medially with the TF (6) (Fig. 6). This complex, multilayered fusion structure of the TF and posterior RF may pose challenges to anesthetists in distinguishing between the 2 structures during ultrasound scanning, particularly in elderly or obese patients.

Because the SQLB approach primarily targets the compartment between the TF and QL's investing fascia, the complex anatomy described above may reduce the block's success rate. Furthermore, an ultrasound-guided SQLB carries a risk of accidentally puncturing the TF and entering the PPS, resulting in block failure. In that event, LAs may block the nerves traveling on the surfaces of the QL and PM muscles, including the subcostal, iliohypogastric, ilioinguinal, genitofemoral, and lateral femoral cutaneous nerves (19). Notably, no blocking effect will occur in the middle thoracic spinal nerves when the LAs are not administered into the compartment between the TF and the QL muscle's investing fascia, which communicates with the parathoracic space. Additionally, it is important to be cautious during an SQLB procedure, since the needle may be inserted through the posterior RF and into the perirenal space, causing harmful clinical consequences. The LAs in these cases may diffuse upward to the liver, mediastinum, and subpleural regions or downward to the pelvis through the potential space between the anterior and posterior RFs (26).

The infralateral arcuate ligament block (ILALB), which differs from the SQLB in terms of probe placement and scanning approach, has been proposed as a means of raising the success rate of SQLB procedures. In this method, the ultrasound probe is placed laterally to the L1 transverse process tip, followed by paramedian longitudinal scanning. The target of injection is the potential compartment between the QL and TF. This compartment is located under the lateral arcuate ligament, which delineates the diaphragm's lower boundary. The ultrasound image obtained through this method clearly shows the apposition zone between the QL and the diaphragm (Fig. 7). The ILALB method could be regarded as a modified version of the SQLB approach (27).

Disruption of the TF's Integrity Influences the Efficacy of the Anterior QLB

The anterior QLB, which integrates the transmus-

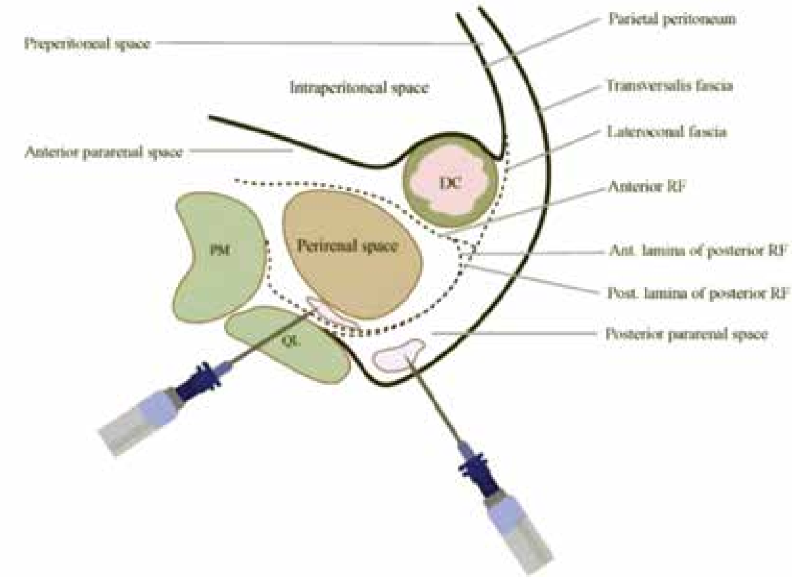

Fig. 6. *Schematic diagram of the RF and interspaces. The posterior RF merges with the investing fascia of the QL or PM at the renal hilum. The posterior RF bifurcates into 2 layers. The anterior layer shifts as the anterior RF, while the posterior layer shifts as the LCF. The 2 blue areas represent the needle accidentally puncturing the posterior RF, entering the perirenal space, and penetrating the PPS through the TF.*
QL, quadratus lumborum; PM, psoas major; DC, descending colon; RF, renal fascia.

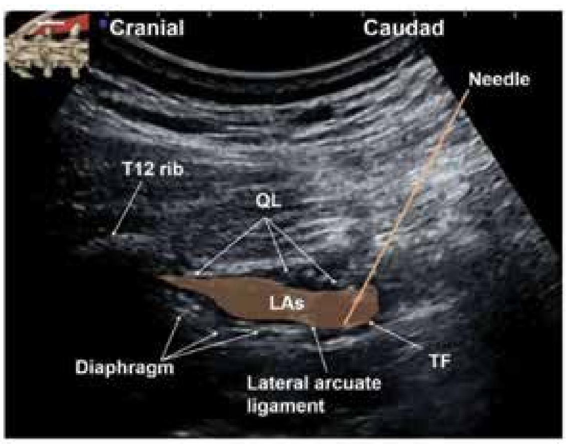

Fig. 7. *The infralateral arcuate ligament QLB. The puncture target is the apposition zone between the QL and diaphragm and is below the lateral arcuate ligament. After injection, a significant downward diaphragm shift can be visualized. The inserted image indicates the probe's position.*
QL, quadratus lumborum; TF, transversalis fascia.

cular and subcostal approaches, has been widely used for postoperative analgesia following laparoscopic nephrectomy. Dam et al (28) have reported that a preoperative bilateral TQLB can significantly reduce the patient's postoperative analgesic opioid dosage and delay the timing of the first opioid application. Notably, the effectiveness of the TQLB relies on preserving the completeness of the TF. The TF, posterior RF, and fascia on the QL and PM muscles form a multilayered fusion structure. This multilayered structure is destroyed during laparoscopic nephrectomy, potentially compromising the TF's integrity. As a result, the LAs would not diffuse into the lower thoracic paravertebral space but rather leak into the retroperitoneal space, leading to block failure. However, TF damage is a common occurrence during laparoscopic nephrectomy, and a TQLB's success depends somewhat on the extent of that damage.

Identifying Potential Recesses Between the Psoas Major and the QL to Avoid the Wrong Injections When Performing TQLBs

The QL and PM muscles, located near the L4 vertebra, have overlapping portions that are separated by the TF, which covers both muscles above the split (Fig. 8A) and surrounds each muscle individually below that split (Fig. 8B). As a result, during an ultrasound scan at the suprailiac level, 3 potential relations emerge between the QL and PM muscles: the overlap of QL and PM muscles, the contact of TF-encased QL and TF-encased PM muscles, and the separation of TF-encased QL and TF-encased PM muscles. Since the resolution of point-of-care ultrasound is not high enough to visualize some patients' fasciae clearly, it is difficult to use ultrasound imaging to differentiate the overlap of QL and PM muscles from the contact of encased QL and encased PM muscles. If the area's anatomical structure is not perceived accurately, the potential recess between the TF-encased QL and TF-encased PM muscles may be treated as the LA injection target, potentially causing block failure. The fascial space should be the right site for injecting LAs through the TQLB between the QL and PM muscles, since that area enables the LAs to spread cranially to the lower thoracic paravertebral space. A previous study developed a dynamic test for determining the relative anatomical relations between the QL and PM muscles (29). This test clearly demonstrates that when the PM muscle contracts away from the QL muscle, the fat in the preperitoneal space is squeezed into the potential recess created between the 2 muscles (Fig. 9), implying that the potential recess between the QL and PM muscles should be carefully identified when performing a TQLB. For this reason, a routine dynamic test should be recommended.

Fascia Iliaca Compartment Block (FICB)

The iliopsoas muscle, which descends toward the front of the hip and terminates at the femur's lesser trochanter, is formed when the PM and iliacus muscles merge. The TF transforms into the iliac fascia when

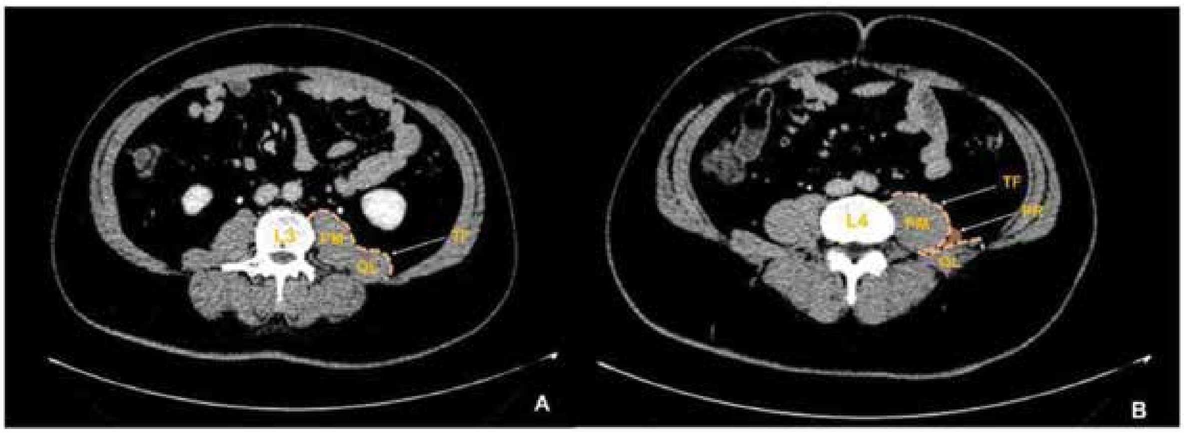

Fig. 8. *The cross-sections of CT images of the relations between the QL and PM muscles. (A) The cross-section of the L3 transverse process displays the overlap between the QL and PM muscles. (B) The cross-section of the L4 transverse process displays the separation of the QL and PM muscles. The potential recess appears between the QL and PM muscles.*
QL, quadratus lumborum; PM, psoas major; TF, transversalis fascia; PR, potential recess.

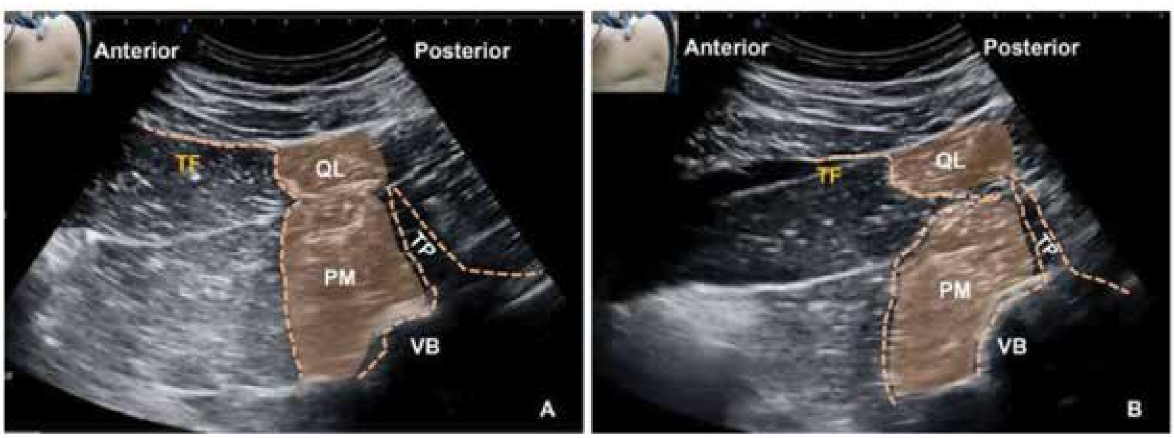

Fig. 9. *Ultrasound images before and after the dynamic test. (A) The ultrasound image displays the QL and PM muscles without separation. (B) The patient is requested to bend the knees oriented to the abdomen, and the ultrasound image displays that the fat in the preperitoneal space is squeezed into the potential recess between the QL and PM muscles. The inserted image indicates the position of the probe.*
QL, quadratus lumborum; PM, psoas major; VB, vertebra; TF, transversalis fascia; TP, transverse process.

it runs with the PM muscle into the pelvic cavity, ultimately covering the iliopsoas muscle's surface. This arrangement implies that the compartment formed by the TF, QL, and PM muscles communicates with the iliac fascia compartment.

The iliac fascia compartment is formed by the potential interspace between the iliac fascia and both the iliacus and PM muscles. The iliac fascia is attached to the iliac crest and PM muscle's fascia on the lateral and medial sides, respectively. This compartment contains the obturator nerve (ON), the lateral femoral cutaneous nerve (LFCN), and the femoral nerve (FN). Due to the proximal diffusion of anesthetics along the PM muscle, these nerves can be blocked when a large volume of LAs is injected into the area below the iliac fascia (30,31). Since the lumbar plexus block also targets these nerves, the FICB could be considered the anterior approach for achieving the effects of a lumbar plexus block (32).

In 2011, Hebbard described the suprainguinal approach (33), which can block the LFCN more completely and facilitate catheter placement. During the procedure, the probe is placed near the anterior superior iliac spine at the suprainguinal ligament level, resulting in an easily identifiable hypoechoic shadow. The ultrasound image reveals several layers of tissue, including the abdominal muscles, iliacus muscle, ilium, and iliac fascia. The preperitoneal space, which is filled mainly with fat in adults or obese people, is the recess enclosed by the peritoneum, iliac fascia, and TF (Fig. 10). The fat may easily be mistaken for the PM muscle (Fig. 11). As a result, when the physician performs the iliopsoas plane block, the LAs may be injected into the wrong PM muscle surface (actually the preperitoneal space), causing block failure.

TFPB

Hebbard also proposed the ultrasound-guided TFPB in 2009 (34). The TFPB targets were the ilioinguinal and iliohypogastric nerves, positioned beneath the TF and above the TA muscle. During the procedure, the needle is inserted from the anterior side to the posterior side until it reaches the deep surface of the TA muscle. After the LAs are injected, a bag-shaped dark liquid area can be seen between the TA and TF (Fig. 12). As a posterior block, the TFPB is likelier to block the subcostal, ilioinguinal, and iliohypogastric nerves. This method may also provide adequate analgesia for various surgical procedures (35-37), including anterior iliac crest bone graft harvesting, cesarean sections, and lower abdominal surgery.

Due to the merging of the TF with the fascia of the PM and QL muscles, LAs administered during a TFPB will diffuse to the QL muscle surface (16). Since the TF plane has a medial continuation with the lumbar plexus plane, using LAs to expand this plane may offer another lateral approach for lumbar plexus blocking.

The TFPB approach has a potential associated risk for an FN block. Lee et al (38) reported a case of transient paralysis in the FN after a TFPB. After the TFPB was administered on the left side, a normal sensory test performed on a 50-year-old female patient revealed a flexor coxae lateralis and quadriceps femoris weakness on the TFPB side, rather than in the expected area

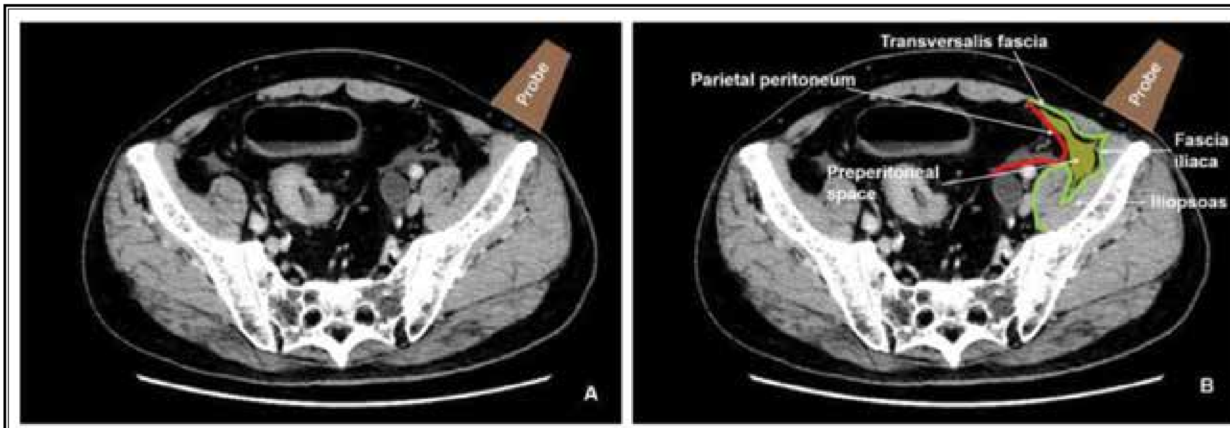

Fig. 10. *The preperitoneal space at the cross-sections of CT images. (A) The abdominal CT image at ilium level. (B) The light green line shows that the TF continues with the iliac fascia, surrounding the iliopsoas's surface. The red line represents the parietal peritoneum. The dark green space is the preperitoneal space.*

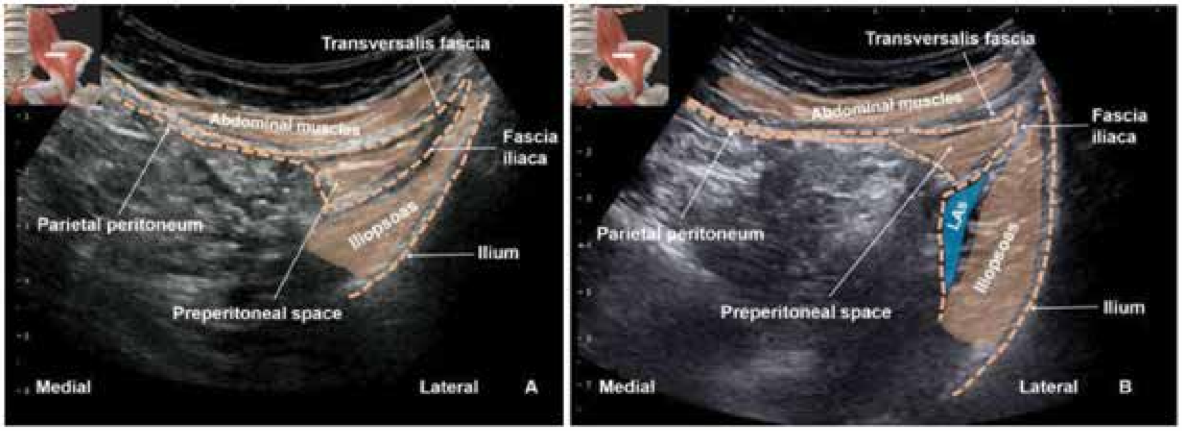

Fig. 11. *The sonogram of the suprainguinal FICB. (A) The space among the peritoneum, iliac fascia, and TF is called the preperitoneal space, which is mainly filled with fat in adults or obese people. (B) The blue area shows the LAs spreading on the surface of the iliopsoas after the FICB. The fat tissue is easily recognized as the PM muscle when performing the iliopsoas plane block. The inserted image indicates the probe's position.*

around the ilium. In a cadaver study, Rosario et al (39) found that the plane between the TA muscle and TF coincided with the fascia iliaca plane. This tissue plane could contain the FN, potentially explaining the weakness in the patient's quadriceps femoris after the TFPB as well. Choquet et al (40) also examined lateral QLB and TFPB diffusion ranges and discovered images of contrast medium diffusion in all patients' retroperitoneal spaces.

Furthermore, TFPBs are commonly applied in laparotomies or laparoscopic radical resections of colon cancer for postoperative analgesia. During colon dissociation, the integrity of the posterolateral TF may be compromised. In such cases, the LAs used in TFPBs may diffuse into the preperitoneal space, causing block failure.

Fig. 12. *The sonogram of a TFPB. The green line shows that the TF travels on the QL and PM muscles' surface. The orange line shows that the TA and internal oblique gradually taper backward to form a common aponeurosis. The needle is punctured from anterior to posterior until the tip arrives at the deep surface of the TA muscle. The inserted image indicates the probe's position.*
QL, quadratus lumborum; TP, transverse process; TF, transversalis fascia; PM, psoas major; VB, vertebra.

Preperitoneal Compartment Block

The preperitoneal space comprises 2 layers: an inner peritoneal layer and an external TF layer. The iliohypogastric and genitofemoral nerves are positioned between the parietal layer of the preperitoneal space and the TF. The preperitoneal compartment block (PCB) may achieve analgesic effects by blocking the iliohypogastric and genitofemoral nerves.

The PCB technique could be employed to provide analgesia during abdominal incision surgery. Beaussier et al (41) reported that continuously administering 0.20% ropivacaine into the preperitoneal space at a rate of 10 mL/h within 48 h after open colorectal resection could reduce morphine dosage and pain response. Furthermore, after the contrast medium was injected into the catheter, the LAs were maintained around the abdominal incision between the parietal peritoneum and muscular layer. A study compared QLBs' postoperative analgesic effectiveness to PCBs' and discovered that both blocks could exert an adequate analgesic effect after abdominal surgeries (42), except that the PCB was less expensive. Multiple studies have confirmed that a continuous PCB is as effective as a continuous epidural infusion in controlling postoperative pain. Moreover, it has been established that PCBs can facilitate faster recovery from postoperative intestinal obstruction, improve intestinal function, lower the likelihood of postoperative nausea and vomiting, and enhance nighttime sleep quality (43-46). Additionally, the PCB could be an alternative to epidural analgesia for patients who might need unplanned or contraindicated epidural analgesia, including those requiring vascular transplantation and emergency and traumatic abdominal surgery, as well as pediatric patients. A retrospective study compared pain management after cesarean deliveries that used a multimodal protocol with a lyposomal bupivacaine (LB) transversus abdominis plane (TAP) block with a multimodal protocol that did not use an LB TAP block (47). Compared to pain management without the LB TAP block, pain management with the LB TAP block showed 50% reductions in the mean postsurgical opioid consumption and pain scores. It was also reported that during the initial 3 days, resting pain scores in patients treated with the LB TAP block were significantly noninferior to patients given epidurals (48). Moreover, this technique can induce analgesia for approximately 72 h and is very promising (49). In comparison to the continuous infusion of LAs or epidural catheter placement, the LB TAP block approach may also exert noninferior or even better analgesic effects in certain patients.

Conclusions

Familiarity with the retroperitoneal fascial space's anatomy could enhance our understanding of QLBs, FICBs, and TFPBs. Based on the fascial space circulation, we can fully understand the direction and degree of LA diffusion during RA, as well as the plane and scope of the block, resulting in both effective analgesia and fewer harmful clinical complications. As a crucial RA technique, the fascial block is projected to see even wider use in anesthesia management and postoperative analgesia in the future.

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