Review Article

Fascial plane blocks as the main anesthetic method: A narrative review

ABSTRACT

This narrative review evaluates the efficacy of fascial plane blocks (FPB) as sole anesthetic method for surgery. Particularly in selected high-risk patients, fascial plane blocks may be a more useful and convenient option than general anesthesia or neuraxial anesthesia. In recent years, with the use of ultrasound, newly defined FPBs have emerged and these techniques have become popular. There are case reports in the literature reporting the use of these blocks for anesthesia, but clinical studies are limited and clinicians may be undecided about which block or combination to apply in which case. In this narrative review, which is the first in this field in the literature, we aimed to discuss the use of FPBs and which combinations can be used in which incisions and which surgeries.

Key words: Anesthesia, fascial plane blocks, review, sole anesthetic method, surgical anesthesia

Background and Rationale

While the term regional anesthesia was frequently used in the literature before the 2000s to describe neuraxial anesthesia, including spinal/epidural techniques, and articles were mostly in this direction, thanks to the technological development and accessibility of ultrasound technology, plexus blocks, and nerve blocks were mostly seen in the first decade and the first half of the second decade, and studies on fascial plane blocks have gained importance in the last decade.

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Ultrasound-guided interfascial plane blocks (or fascial plane blocks, as they are more easily expressed) are regional anesthesia techniques generally used for perioperative analgesia but can be used as an alternative anesthesia method in 'selected' cases, especially in cases where general and neuraxial anesthesia are avoided, in procedures where the third spaces are not opened (or minimally manipulated). However, such attempts, without a comprehensive knowledge of anatomy, can often fail, forcing the practitioner to make

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decisions such as hasty intubation, thus endangering patient safety.

In this narrative review, we did not aim to encourage surgical applications under fascial plane blocks; we aimed to shed light on the possibility of considering fascial plane blocks (or combinations) as an alternative anesthesia method for appropriate procedures in patient groups with high mortality and morbidity. For this purpose, we will discuss surgical procedures and possible blocks/combinations, region by region, following general principles.

Fascial Plane Blocks: Mechanisms and Applications

Fascia, which plays an important role in the organization and function of the human body, is a complex connective tissue. It surrounds, supports, and sometimes separates the muscles, bones, and internal organs in the body. Although it is expected to have an effect by administering local anesthetic (LA) to this area to reach the nerves running between two fascias or to reach the related neuronal structures (e.g. paravertebral area), the exact mechanism of action of fascial plane blocks (FPB) has not yet been fully demonstrated.[1] For instance, in addition to these postulated mechanisms, the efficacy of the erector spinae plane block may also involve systemic absorption of the LA, immunomodulatory effects, and potential direct innervation of the fascia itself.[2]

The earliest defined FPB is the rectus sheath block (RSB), and over the years, there have been FPBs defined for almost every region. Considering the anatomical feature of fascia that surrounds the entire body, it would not be surprising for it to be used so widely. Paraspinal FPBs (e.g., erector spinae plane and midpoint transverse process to pleura blocks) are particularly effective for managing pain in the posterior thorax. Interpectoral and pecto-serratus, and serratus anterior plane blocks are prominent for the anterior and lateral thorax, while parasternal blocks (superficial and deep) are preferred for the anterior mediastinum. The abdominal region should be divided into anatomically distinct areas, and fascial plane blocks (e.g., transversus abdominis plane block, quadratus lumborum block, external oblique block) should be selected based on the location of the surgical incision.

The main reasons for their popularity are that they are easy to apply, have a gentle learning curve, and are relatively safe. However, compared to traditional regional techniques, they also have certain limitations, such as the inability to provide dense nerve blockade, reliance on larger volumes of LA, and inconsistent dermatomal coverage due to variable distribution patterns.[3]

Mechanisms and role of the combinations

The introduction of ultrasound-guided FPBs into regional anesthesia practice, especially in the last 10 years, has significantly expanded regional anesthesia techniques.[4,5] This has provided safer alternatives to more invasive approaches such as neuraxial and paravertebral blocks. Recent developments include combinations in which two anatomical planes are targeted to increase the efficacy of sensory blockade rather than LA injection into a single plane.[6] These combinations aim to improve analgesic coverage by targeting both true anatomical information and anatomical variations. While the combination of two FPBs has been shown in many studies to provide postoperative analgesia or reduce opioid consumption, the evidence on whether it can provide surgical anesthesia is not yet sufficient. The anatomical spread of a high-volume LA between different fascial layers may result in different clinical outcomes.[7] The location of the surgical intervention, its relation to visceral pain, and the presence of some unpredictable surgical procedures are important here. It should also be kept in mind that different fascial compartments may have different properties of the fascia (thickness–elasticity–collagen and elastin content, layered structure), which may result in different LA distractions.[8]

Many reported case reports or case series demonstrate the need for additional pharmacologic intervention due to anatomical and surgical variations.[9–12] It is possible to summarize the primary mechanism of combination fascial plane blocks as follows:

- *To block the spared cutaneous branches of nerves that are targeted in a fascial plane block in a fascial plane that is either more superficial or deeper.*
- *The sensory block is performed by blocking other nerves that are involved in the innervation of the area that is targeted by the fascial plane block.*
- *In order to facilitate the dissemination of LA beyond the injection spot, a fascial plane block should be performed.*
- *In the event that there are anatomical differences in the path that a nerve is assumed to travel, whether it be in a plane or potential space, it is important to make sure that both modifications are blocked.*

Breast surgery and thoracoscopic surgery

The use of FSB has been increased due to their difficulty of application and the high complication risk of thoracic epidural analgesia and paravertebral blocks.[4,13,14] The literature includes case reports and clinical studies about the use of FSB as the main anesthetic method for breast and video-assisted thoracoscopic surgery (VATS).

Knowledge of the innervation of the thorax and breast is essential for the choice of the block technique. Thoracic innervation is provided primarily by the T1–T6 spinal nerves. A spinal nerve divides into two branches: the dorsal rami (posterior) and the ventral rami (anterior, continuing as the intercostal nerves). The intercostal nerves give off lateral cutaneous branches, which divide into anterior and posterior terminal branches. The anterior cutaneous branches innervate the sternum, parasternal region, and the medial half of the breast. The supraclavicular nerves, which originate from the cervical plexus, innervate the superior aspect of the breast. The lateral and medial pectoral nerves (C5-C7) innervate the pectoralis major and minor muscles. The intercostobrachial (ICB) (T1-T2), thoracodorsal (TD), and long thoracic nerves (LTN) (C5-C7) innervate the axillary region.[4,5]

Serratus anterior plane block (SAPB), erector spinae plane block (ESPB), and rhomboid intercostal block (RIB) may be used alone or in combination with each other as the main anesthetic method in non-intubated VATS (NI-VATS).[15–19] SAPB targets T2-T8 intercostal nerves, TD, and LTN. The RIB provides anesthesia between T2-T9 dermatomes.[4,5] ESPB spreads to the paravertebral region (dorsal and ventral rami), and lateral cutaneous branches. Therefore, ESPB may provide a certain anesthesia of the hemithorax for NI-VATS.[4] In cases where there is insufficient anesthesia in the chest drain area, SAPB may be used for this purpose. Serratus posterior superior intercostal plane block (SPSIPB) is a novel and promising fascial plane block technique described in 2023. It is performed between the 3rd rib and the serratus posterior superior muscle at the medial edge of the scapula, and multidermatomal blockade is achieved in the hemithorax by spreading the LA in a craniocaudal direction. In a case report, Manici *et al*.[20] performed SPSIPB as the main anesthesia method in a high-risk patient who underwent VATS. They reported that SPSIPB was successful in anesthesia management.

The dermatomal area that needs to be blocked in breast surgery is more complex and complicated than VATS because it is necessary to consider the nipple and axilla as well. In awake breast surgery, not only the skin but also motor muscle blockade is required due to the use of electrocautery.[9] Therefore, motor blockade of the pectoral muscles and serratus anterior muscle is necessary. For this purpose, both sensory and motor blockades may be provided by interpectoral (PECS-I) and pecto-serratus (PECS-II) blocks and by combining these blocks with SAPB. In addition, it should not be forgotten that the upper part of the breast is innervated by the suprascapular nerves. Thus, there may be insufficient blockade in the superior part of the nipple.[4,5,9] Parasternal blocks can also be added to block the complex anastomoses of the anterior and lateral branches in the medial part.[21] Peri-paravertebral blocks RIB or ESPB + PECS-II or SAPB combinations may be used for awake breast surgery.[9,21–25] Table 1 shows fascial plane blocks used for anesthesia in NI-VATS and breast surgery. Figure 1 shows the innervation of the breast.

Abdominal Surgical Procedures

The selection of an appropriate anesthesia method is very important in elderly patients who have comorbidities and will undergo abdominal surgery, as it will affect postoperative recovery.[28] The use of ultrasound-guided abdominal wall blocks has increased in recent years due to the difficulty of applying neuraxial techniques and the risks of complications such as hemodynamic instability of central blocks. There are case reports in the literature reporting the use of FPB as the main anesthesia method for abdominal surgeries.

It is important to know the abdominal innervation to determine the appropriate abdominal wall block for anesthesia. The anterior and lateral abdomen is innervated by the T7-T12 thoracoabdominal nerves and the L1 spinal nerve. The transversus abdominis plane (TAP) is located between the transversus abdominis muscle and the internal oblique muscle on the anterolateral abdominal wall, and the TAP plexus (anterior and lateral branches of the T7-L1 spinal nerves) is located within the TAP.[29,30] These nerves need to be targeted to anesthetize the anterolateral abdomen. In addition, the transversalis fascia (TF) is a subperitoneal areolar tissue in the abdominal cavity. The outer surface of the TF is located deep to the transversus abdominis muscle in the anterolateral abdomen. The ilioinguinal (L1), iliohypogastric (T12-L1), and subcostal nerves (T12) cross the

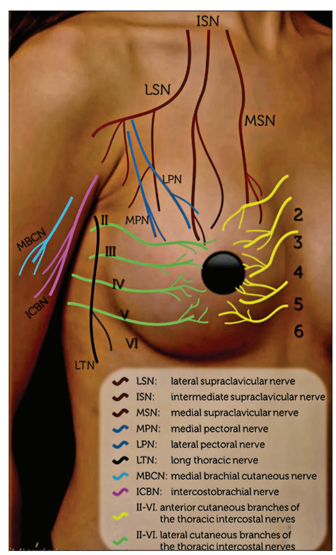

Figure 1: Illustrative representation of the breast innervation

Table 1: FPB used for anesthesia in NI-VATS and breast surgery

Study	Study design	Surgical Procedure(s)	Number of patients	Type of FPB	Volume, type of LA and sedatives	Authors' comments
Longo F. (2019)[15]	Case report	Video-assisted thoracoscopic surgery	1	RISS	30 mL of 0.375% ropivacaine + TCI infusion of remifentanil and propofol.	RISS could be an alternative to general anesthesia or Serratus Anterior Plane Block and Erector Spinae Plane Block.
Bellini R. (2023)[18]	Case-match study	Video-assisted thoracoscopic surgery	20/158	ESPB	20 mL of ropivacaine chloridrate 0.75% + midazolam or propofol	Diagnostic and/or palliative thoracoscopy can therefore be safely and effectively offered to elderly and frail patients using loco-regional anesthesia, with very little anesthesiologic risk.
Cesur S 2019[26]	Case report	Thoracic mass excision	2	ESPB	20 mL of bupivacaine 0.25%	We think that it is clinically significant to have anesthesia and analgesia with ESP block.
Manici M 2024[20]	Case report	Video-assisted thoracoscopic surgery	1	SPSIPB	30 ml of 0.25% bupivacaine + 3 mg of midazolam IV, 50 micrograms of fentanyl IV, and 70 mg of propofol IV	SPSIPB could be an advantageous technique for thoracic surgery, deserving further investigation in larger patient cohorts.
Bagaphou TC. (2020)[21]	Case report	radical mastectomy	2	PECS II + parasternal block	30 m of 0,35% levobupivacaine + propofol at 1-2 mg/kg/h	Major breast surgery can be performed, with excellent intra- and postoperative pain control, with the combination of PECS block and parasternal block associated with sedation, avoiding general anesthesia
Ertas G (2024)[9]	Proof-of-concept study	breast cancer surgery	70	PECS I, PECS II, SAPB	30 mL of 0.20%/0.25% bupivacaine + propofol infusion between 0.5 and 4 mg/kg	The combination of deep serratus plane block, interpectoral block, and pecto-serratus block at appropriate and safe doses/volumes, along with low to moderate sedative support, can complete awake breast cancer surgery procedures.
Pedrosa FP. (2020)[23]	Case report	Breast Surgery	1	SAPB	25 mL of ropivacaine 0.75% + 10 mL lidocaine 1% was needed on the medial margin of the tumor, close to the end of the surgery. + ketamine (30 mg) and propofol (80 mg)	The use of a SAPB without general anesthesia as an anesthetic technique for lumpectomy with axillary dissection allows good surgical conditions and patient comfort.
Sepolvere G (2021)[24]	Case report	Breast cancer surgery	1	ESPB	40 m of 0,5% levobupivacaine plus dexamethasone 4 mg + Propofol infusion at the rate of 1 ng/m TCI) to obtain a Ramsay sedation scale level of 3	ESPB could have a good anesthetic potency and be a valid alternative to conventional techniques, especially in seriously ill patients.
Tulgar S (2019)[25]	Case report	Breast surgery	1	PECS II + RIB	50 mL consisted of 25 mL %0.5 bupivacaine, 10 mL lidocaine %2, and 15 mL normal saline + 20 mg ketamine (iv)	The combination of PECs II and RIB is an effective main surgical anesthesia method in breast surgery.
Gürkan Y (2024)[27]	Case report	Breast surgery	1	TPVB + PECS I + SAPB	40 ml of mixture with 7 ml of 0.5% bupivacaine, 2% lidocaine, 8 ml of isotonic + 70 mg IV propofol	Multiple thoracic wall blocks are required for surgical anesthesia of the breast.

FPB; fascial plane block, TCI; target-controlled infusion, RISS; rhomboid intercostal sub serratus, ESPB; erector spinae plane block; PECS; pectoralis nerve block, SAPB; serratus anterior plane block, RIB; rhomboid intercostal block, TPVB; thoracal paravertebral block; SPSIPB, serratus posterior superior intercostal plane block, LA; local anesthetic

quadratus lumborum muscle while passing from posterior to anterior. During this transition, they travel within the TF, deep to the transversus abdominis muscle.[30] Therefore, to target these three nerves and provide anesthesia in the inguinal region, local anesthesia is performed into the TF just below the transversus abdominis muscle.

Posterior TAPB, quadratus lumborum block (QLB 1,2), TFPB for lower abdomen and inguinal hernia surgery;

External oblique intercostal plane block (EOIPB), serratus intercostal plane block for upper abdomen;

Oblique subcostal TAP block and modified thoracoabdominal nerves block through perichondrial approach (M-TAPA) for midline incisions and incisions in the oblique line extending from the epigastrium to the iliac crest;

Rectointercostal plane block for epigastrium, *RSB* for midline and umbilical/infra-umbilical hernia;

Dual TAPB, TAPA, ESPB, and QLB 3 for wide and multiple dermatome areas may be used.

RSB provides anesthesia in the midline, and its use for anesthesia in midline surgeries such as umbilical hernia repair surgery has been reported in the literature.[31–33] M-TAPA block is a new fascial plane block technique, used for midline incisions. Balaban *et al*.[34] performed ESPB for anesthesia in a patient who was going to undergo a mini-laparotomy, performed M-TAPA when ESPB failed, and reported that M-TAPA was successful for anesthesia. Tulgar *et al*.[35] performed ESPB for anesthesia on a high-risk patient who was going to undergo ileostomy stoma closure and reported that anesthesia was achieved by obtaining a wide dermatome from T4 to T12. There are various case reports in the literature in which TAPB is used for anesthesia.[36–38] TAPB and TFPB may be used alone or in combination as the main anesthetic method for inguinal hernia repair surgery.[28,39–41] Depending on the incision site and surgical area, different TAPB approaches; lateral, posterior, subcostal, or oblique subcostal techniques may be applied. Innervation is more complicated in the inguinal region. The inguinal region is innervated from T12, L1, and L2. The localization of the iliohypogastric nerve varies due to the branches at the iliac crest level; therefore, a block performed from the proximal will be more effective.[28] Thus, TFPB may be preferred for surgical anesthesia in inguinal surgeries. In some cases, it may be difficult to guarantee the dermatome area that TFPB will provide. TAPB covers T12, where TFPB is insufficient; and TFPB covers L1, where TAPB is insufficient. Therefore, TAPB + TFPB is an effective combination in inguinal region surgeries. In addition, Balogh *et al*.[42] performed QLB 2 as the sole anesthetic method for open hernia repair in high-risk patients. Table 2 shows fascial plane blocks used for anesthesia in various abdominal surgeries. Figure 2 shows the various abdominal surgery incisions and the blockage areas of the abdominal wall blocks.

Spinal Surgery

In recent years, there is growing evidence that spine surgery under awake neuraxial anesthesia rather than general anesthesia (GA) improves patient outcomes while minimizing the risk of complications associated with opioid use.[44] However, GA remains the most common technique for spine surgery in daily clinical practice, due to the limited duration of neuraxial anesthesia and the need for patients to remain immobile and uncomfortable during surgery.[45]

Alternatively, or as a complement to central neuraxial anesthesia, several paraspinal or truncal block techniques

Table 2: FPB used for anesthesia in various abdominal surgeries

Study	Study design	Surgical Procedure(s)	Number of patients	Type of FPB	Volume, type of LA and sedatives	Authors' comments
Balaban O. (2019)[34]	Case report	Mini-laparotomy	1	TAPA	20 ml 0,25% bupivacaine + 10 ml lidocaine %2	TAPA can also be a choice in procedures where sensorial blockage of the infraumbilical and lower thoracic areas are required.
Wang Y. (2024)[31]	Randomized controlled trial	Open umbilical hernia repair	72	RSB	40 mL volume of 0.25% bupivacaine hydrochloride + epinephrine hydrochloride (1:100,000)	Bilateral RSB is an effective anesthesia technique for open umbilical hernia repair in patients diagnosed with cirrhotic ascites.
Balogh J. (2020)[42]	Case report	Open Hernia Repair	2	QLB 2	20 mL of 0.5% ropivacaine + 0.1 mcg/kg/min infusion of remifentanil and dexmedetomidine 0.04 mcg/kg/h	Regional anesthetics such as QL blocks can be safely utilized as a primary anesthetic in high-risk patient populations.
Kaya C (2020)[38]	Case report	Open inguinal hernia repair	1	TAPB	20 mL of 0.5% ropivacaine + remifentanil (0,025-0,05 μg/kg/min) + 25 mg ketamine	Open inguinal hernia repair could be successfully performed by administering IV remifentanil and performing a unilateral TAP block
Tugar S. (2018)[35]	Case report	Ileostomy closure	1	ESPB	20 ml 0.5% bupivacaine + 10 ml 2% lidocaine + 40 mg ketamine	ESPB may also be a choice in procedures where deeper tissue interventions are required.
Scimia P (2018)[39]	Case report	Inguinal Herniorrhaphy	1	TFPB	20 mL of 0.5% levobupivacaine + intravenous propofol infusion (3 mg/kg/h) and 50 μg fentanyl	TFPB presents a viable alternative to US-guided anterior TAPB and QLB and to general and neuraxial anesthesia.
Tulgar S (2019)[28]	Case report	inguinal herniorrhaphy	1	TAPB + TFPB	20 mL TFPB; 20 mL TAPB (20 mL bupivacaine 0.5%, 10 mL lidocaine 2%, 10 mL normal saline) + 1 mg/kg/h of propofol infusion	A combination of TAP and TFP block under mild sedoanalgesia provides adequate and effective anesthesia and postoperative analgesia in a patient undergoing inguinal herniorrhaphy.
Gürkan y 2011[43]	Case report	Incisional hernia repair	1	TAPB	40 mL of levobupivacaine 0.25% + for skin incision 5 mL of lidocaine 2% + 50 μcg of fentanyl and 1 mg of midazolam IV	TAPB could be considered as an anesthetic option for similar cases.

FPB; Fascial plane block, TAPA; thoracoabdominal nerves block through perichondrial approach, RSB; rectus sheath block; QLB; quadratus lumborum block, TAPB; transversus abdominis plane block; IV; intravenous, ESPB; erector spinae plane block, TFPB; transversalis fascia plane block, US; ultrasound, LA; local anesthetic

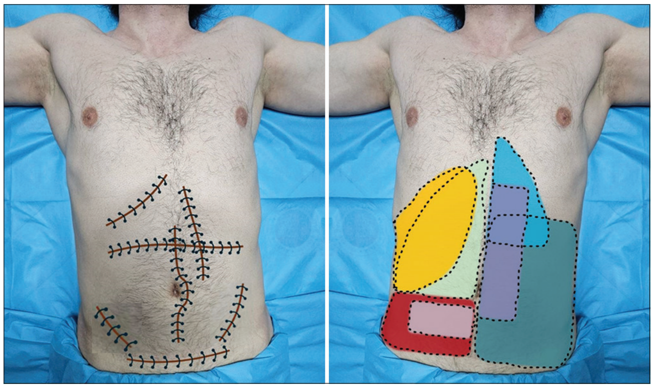

Figure 2: Illustrative representation of the blockage areas of abdominal wall blocks and surgical incisions. A. Various incisions for open abdominal surgeries B. Blockage areas of FPBs: yellow area; EOIPB, light green area; M-TAPA, OSTAP blocks, red area; TFPB, light pink area; II-IH blocks, blue area; rectointercostal block, purple area; RSB, wide green area; and ESPB, QLB 3, TAPA, dual TAP blocks

are available [Figure 3]. In recent years, the use of FPB for intraoperative and postoperative analgesia in spinal surgery has increased significantly.[46]

Among FPB, the ESPB is the most studied for spinal surgery. The anterior diffusion of LA deposited between the erector spinae muscle and the transverse process, reaching the dorsal and ventral branches of the spinal nerves, can provide both visceral and somatic analgesia.[47] Many systematic reviews have concluded that ESPB is a safe and effective method of analgesia with limited side effects in spinal surgery.[48,49] The retrolaminar block, with its target injection point more medial than the ESPB, has been reported to be effective in spine surgery; however, evidence regarding this block remains insufficient.[48–50] The multifidus cervicis plane block and inter-semispinalis plane (ISP) block aim to block the dorsal branches of the cervical spinal nerves. The more superficial and safer ISP block is recommended for postoperative analgesia following cervical spine surgeries.[51] In lumbar spine surgeries, many studies have shown that the thoracolumbar interfascial plane (TLIP) block and the modified TLIP (mTLIP) block are effective and safe for postoperative pain control.[51–53]

Although fascial plane blocks can now be used as a primary anesthetic method in several surgical fields, their application in spine surgery is still in its very early stages of development. This may be due to factors such as the complex innervation of the spine, variability in block effectiveness between individuals, the prone position required for surgery, and difficulties in maintaining airway control in sedated patients.

Despite these challenges, there have been several reports of successful use of ESPB,[54-56] middle thoracic paravertebral (MTP) block,[57] and TLIP block[58] combined with

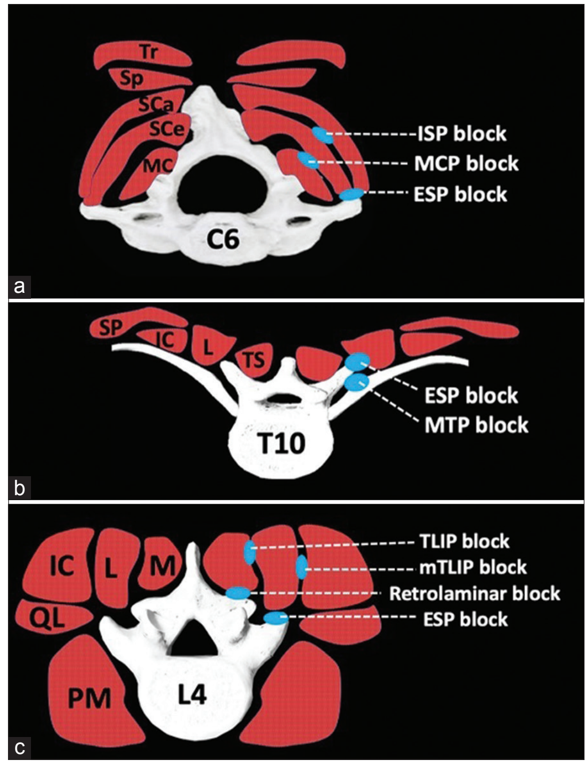

Figure 3: Simple anatomical illustrations of fascial plane blocks in the a) cervical, b) thoracic, and c) lumbar regions for spine surgery. ISP, inter semispinal plane; MCP, multifidus cervicis plane; ESP, erector spinae plane; T, trapezius muscle; SPCA, splenius capitis muscle; SCA, semispinalis capitis muscle; SCE, semispinalis cervicis muscle; CM, multifidus cervicis muscle; MTP, midpoint transverse process to pleura; TS, transversospinalis muscle; L, longissimus muscle; IC, iliocostalis muscle; SP, serratus posterior muscle; TLIP, thoracolumbar interfascial plane; mTLIP, modified thoracolumbar interfascial plane; M, multifidus muscle; QL, quadratus lumborum muscle; and PM, psoas muscle

conscious sedation as an anesthetic technique, primarily in minimally invasive and endoscopic procedures or in carefully selected comorbid patients. Compared with GA and spinal anesthesia (SA), FPBs have the strengths of long postoperative analgesic effect and prevention of complications related to GA and SA. The details of these publications are summarized in Table 3. In all case reports, FPBs and conscious sedation provided adequate anesthesia for the procedure. In the retrospective case–control study by Tae Hoon Kang *et al.*,[56] L-ESPB combined with sedation was shown to be a viable anesthesia option for unilateral bi-portal endoscopic spine surgery compared to spinal or general anesthesia. However, they reported that ESPB had no analgesic effect in the epidural space, resulting in the use of additional fentanyl, sedation, or injection of LA into the epidural space.

Compared to GA and SA, FPBs offer the advantages of prolonged postoperative analgesia and preventing complications associated with GA and SA. However, it remains unclear which fascial block technique or combination of

Table 3: Overview of FPBs as the main anesthetic method for spinal surgery

Study	Study design	Surgical Procedure(s)	Number of patients	Type of FPB	Volume, type of LA, and sedatives	Authors' comments
Kilicaslan A. (2019)[57]	Case report	T6 vertebral collapse (fracture fixation)	1	MTP	55 ml 0,25% bupivacaine (Bilateral T3, T5, and T7 levels) + iv dexmedetomidine infusion	MTP with sedoanalgesia may be used as an alternative to conventional anesthesia techniques
Tulgar S. (2019)[55]	Case report	Intercostal neurectomy	1	ESPB	10 ml bupivacaine 0.5%, 10 ml lidocaine 2%, and 40 mg methylprednisolone (T7 level) + iv 30 mg of ketamine	ESPB with sedoanalgesia may be used as an anesthetic technique in minor surgical procedures
Christopher S. (2020)[58]	Case series	Minimally invasive spinal surgery	8	TLIP	5 mL of 0.5% ropivacaine was injected superficially into the paraspinal muscles and 20 mL for the TLIP block + iv 2 mg midazolam	TLIP may be used as a sole anesthetic technique for endoscopic laminectomy
Kang TH (2023)[56]	Case-control study	Unilateral bi-portal endoscopic (UBE) spine surgery	20	ESPB	22.5 ml 0.375% ropivacaine and 7.5 ml 2% lidocaine + iv 0.03 mg/kg of midazolam and 50 μg of fentanyl during the epidural procedures	UBE lumbar decompression was possible under ESPB with sedation, but no analgesic effect of ESPB in the epidural space
Reddy A. (2024)[54]	Case report	Percutaneous endoscopic lumbar discectomy.	1	ESPB	13 ml of 0.5% bupivacaine and 13 ml of 2% lignocaine with dexamethasone 8 mg (T12 level) + iv dexmedetomidine infusion	ESPB may be used as a sole anesthetic technique for minimally invasive spine surgery

FPB, Fascial plane block, MTP; midpoint transverse process block, ESPB; erector spinae plane block, TLIP; thoracolumbar interfascial plane block, UBE; unilateral bi-portal endoscopy, LA; local anesthetic

regional anesthesia techniques is most effective for awake spinal surgery. Well-designed, randomized, and prospective studies are needed to provide clarity in this evolving field

Orthopedic procedures

Although completing orthopedic procedures under FPBs may not seem feasible at first glance, clinicians appear to have developed ways to address these challenges through a comprehensive understanding of anatomy. In an academic setting where the transition from neuraxial techniques to plexus blocks remains incomplete, these ambitious techniques continue to draw significant attention. Many orthopedic procedures have been reported to have been performed with FPBs or their combinations, and we plan to discuss these from cephalad to caudal. Examples of articles in which FPBs were used as the main anesthetic method in orthopedic surgeries are presented in Table 4.

In previously awake clavicle surgeries, it was frequently reported that the procedure was performed with an interscalene level plexus block added to the superficial cervical plexus block.[63] However, after the clavipectoral fascial plane block (CPFB), which selectively targets all nerves innervating both the periosteum and skin of the clavicle, was described,[64] many new anecdotal cases have been reported that make clavicle surgery with FPB feasible.[59] Clavicle open surgeries, which are innervated by the spinal accessory nerve (CN IX), suprascapular nerve (C5-C6), axillary nerve (C5-C6), lateral pectoral nerve (C5-C7), medial pectoral nerve (C8-T1), and nerve to subclavius (C5-C6), cannot be effectively completed with CPFB alone. Therefore, a combination of blocks is almost always necessary. The scapula is another area with complex innervation, and it has been reported that surgical anesthesia in scapula surgeries can be achieved by combining FPBs, such as ESPB, with interscalene brachial plexus blocks, similar to the approach used for the clavicle.[60]

Hip surgeries, among the most significant orthopedic procedures, have been reported to provide surgical anesthesia with low-dose sedation in high-risk patients, including those undergoing proximal femoral nailing and partial prosthesis, using various FPBs. The hip innervation is roughly provided by the lumbar and sacral plexus. However, when examined in detail, the hip capsule, femoral head and neck, femoral shaft, and cutaneous areas need to be considered in great detail. The femoral nerve and obturator nerve (both cutaneous and articular branches), accessory obturator nerve (found in 30% of people), lateral femoral cutaneous nerve, ilioinguinal, iliohypogastric nerves, and subcostal nerves (especially lateral cutaneous branches) are important in the anterolateral innervation of the hip region.[65] Posterolateral, especially in the incision line, it is innervated by the superior cluneal nerve, sometimes by the posterior femoral cutaneous nerve, and deep in the capsule and by the superior and inferior gluteal nerve, sciatic nerve, and nerve to the quadratus femoris.[11,65,66] Since it is not possible to block all these nerves individually, fascial planes with a wide distribution area play a key role in the success of the block. Since the posterior part of the hip capsule contains proprioceptive rather than nociceptive receptors, it is often considered less significant in studies on analgesia and anesthesia for hip surgeries.

Table 4: Overview of fascial plane blocks as the main anesthetic method for orthopedic surgery

Study	Study design	Surgical Procedure(s)	Number of patients	Type of FPB	Volume, type of LA, and sedatives	Authors' comments
Natrajan *et al*. 2023[59]	Case series	Clavicle fracture	8	CPFB alone or in combination	10 ml 0,25% bupivacaine + lidocaine %1	CPFB can be used alone or, in complex cases, combined with upper trunk and superficial cervical plexus blocks.
Kilicaslan *et al*. 2019[60]	Case report	Scapula Fracture	1	Combined ESPB and ISB	30 ml 0.25% bupivacaine for ESPB, 15 ml 0.25% bupivacaine for ISB + 2 mg midazolam, 100 µg fentanyl, 25 mcg/kg/min propofol	ESPB can be used in combination with other peripheral nerve block techniques as an alternative anesthetic method
Ahiskalioglu *et al*. 2020[61]	Original article	Hip fx, hemiarthroplasty, IM nailing	15	Lumbar ESPB (L4)	40 mL of LA (Bupivacaine 0.25% and lidocaine 0.5%,) and propofol infusion (1.5 mg/kg/h)	L-ESPB combined with mild sedoanalgesia offers safe and effective anesthesia for high-risk, elderly patients undergoing hip surgery.
Marrone *et al*. 2023[62]	Case report	Hip fx, hemiarthroplasty	1	Lumbar ESPB (T12) + Sacral ESPB (S1)	0.3% ropivacaine 30 mL for L-ESPB (12) and 0.3% ropivacaine 30 m + dexmedetomidine 20 mcg for S-ESP (S1)	with propofol (2.5 mg.kg-1.h1) and dexmedetomidine (0.4 mcg. kg-1.h1) sedation, LS-ESP block can be an alternative anesthetic method in high-risk patients
Tulgar *et al*. 2023[11]	Case report	Hip Fx, Proximal IM nailing	1	SIFIB Parasacral ischial block + Sup. Cluneal nerve Block	50 ml, 20 ml, and 10 ml LA mixture (0.225% bupivacaine and 0.4% lidocaine) respectively	Successful anesthesia was achieved with only 30 mg of propofol and 50 mcg of fentanyl in addition to the block combination.

ISB, Interscalene brachial plexus nerve block, LA; local anesthetic, CPFB; clavipectoral fascial plane block, SIFIB; suprainguinal fascia iliaca block, ESPB; erector spinae plane block, IM; intramedullary

One of the earliest examples of anesthesia with FPBs in hip surgery was the combination of lumbar ESPB and anterior QLB.[67] The same team later published a series on hip surgeries using lumbar ESPB with mild sedoanalgesia and showed through magnetic resonance imaging that the LA spread to both the epidural space and the lumbar plexus.[61] Anecdotal reports followed, presenting lumbar, sacral, and lumbosacral ESPB as the primary anesthetic technique in hip fracture surgeries.[62,68] In addition, numerous studies have reported using the suprainguinal fascia iliaca compartment block (SIFIB) as an alternative to the lumbar plexus in anesthesia management.[10,11] SIFIB is more akin to a rectus sheath block than a typical FPB, as the LA is applied to the potential space between a thick fascia and muscle tissue. While the standard volume is 30–40 mL, studies have shown that applying higher volumes, such as 50–60 mL, can result in direct spread to the lumbar plexus, providing surgical anesthesia. SIFIB can be used not only in hip surgeries but also in almost all procedures where a lumbar plexus block can be used as an anesthetic method.[10] Similarly, it has been reported that the pericapsular nerve group (PENG) block has a lumbar plexus block-like effect at high volumes and is used as an effective anesthesia method in soft tissue surgeries, although not in osseous ones.[69,70]

In lower limb orthopedic surgeries, techniques like SIFIB and PENG as alternatives to the lumbar plexus block, or the parasacral interfascial (ischial) plane block as a substitute for the sacral plexus block, offer exciting ways to achieve anesthesia through fascial planes without directly contacting the nerves. These approaches are promising and deserve more attention in future studies.

Is it possible to provide almost all of the hip joint and cutaneous innervation that we mentioned before with FPBs and to provide anesthesia? The authors suggested that this could be done using the Samsun combination, which involves high-volume SIFIB for the lumbar plexus, along with a parasacral FPB and a superior cluneal nerve block to cover the posterior and posterolateral innervation of the hip capsule. While this approach seems worth considering, we should not overlook the risk of LA toxicity from using such high volumes.[11]

Future Directions and Considerations

Every young regional anesthesiologist, regardless of age, aspires to provide adequate anesthesia for major surgeries using FPBs, but this enthusiasm often leads to failure and discouragement. The underlying question for the clinician when faced with failure is often, 'Can this block—or combination of blocks—provide sufficient anesthesia for the surgical procedure?' Each surgical procedure is tailored to the patient, and these approaches should only be attempted with close collaboration with the surgical team. Block planning must consider the planned incision, surgical manipulations, and all possible adverse scenarios. Importantly, FPBs should

NEVER be the first option. It should be kept in mind by both the anesthesia team and the surgical team that awake surgery with FPBs has its own unique anesthesia management. The patient will not be immobile and unresponsive like a patient under general or SA. Sometimes manipulations such as traction and stretching will respond, will be stimulated with electrocautery, and will react, and sedoanalgesia or infiltrative anesthesia will be needed in some parts of the procedure.

If general or neuraxial anesthesia poses greater risks for the patient, FPBs can be considered as an alternative, though they come with their own risks. The primary concern is the heightened risk of LAST, which depends on the volume and concentration used. When high volumes are necessary, the concentration should be appropriately reduced. Anesthesia management with FPBs requires careful attention to sedoanalgesia, especially in fragile patients, where the smallest dose can mean the difference between spontaneous respiration and respiratory arrest. Patient respiration must be closely monitored. It is also important to remember that using doses above 4 mg/kg does not qualify as performing awake surgery; it simply means general anesthesia was administered without intubation.

In conclusion, anesthetic management can be achieved using FPBs, as well as peripheral nerve blocks and plexus blocks. However, it is important to work closely with the surgical team and be aware of the complications and unexpected difficulties that these techniques may present. Applying them without a solid understanding of anatomy is contrary to the fundamental principle of 'first do no harm.'

Authors' contributions

All of the authors made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; they have been involved in drafting the manuscript or revising it critically for important intellectual content and have given final approval of the version to be published.

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