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DERLEME/REVIEW

The Role of Plane Blocks in Postoperative Pain Management in Spinal Surgery: A Narrative Review

Spinal Cerrahide Postoperatif Ağrı Yönetiminde Plan Bloklarının Rolü: Derleme

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ABSTRACT
Spinal surgeries are major procedures that cause severe postoperative pain. Therefore, multimodal analgesia techniques are commonly adopted to achieve effective pain control. In recent years, various plane blocks have been increasingly investigated for this purpose. This study aimed to review the plane blocks described for spinal surgeries and to evaluate their analgesic efficacy, advantages, and disadvantages.
Erector spinae plane block, thoracolumbar interfascial plane block, retrolaminar block, multifidus block, mid-transverse process to pleura block, and intersemispinal plane block were reviewed. Their analgesic effects, potential complications, and clinical differences were compared based on current literature.
Among these techniques, the erector spinae plane block appears to be the most frequently studied and widely applied. However, other plane blocks may also provide effective and safe alternatives at specific surgical levels. Considering the possible benefits and risks of multilevel or bilateral applications, an individualized analgesic approach is recommended.
Keywords: Plane blocks, spinal surgery, multimodal analgesia

ÖZET
Spinal cerrahiler, postoperatif dönemde şiddetli ağrıya neden olan majör girişimlerdir. Bu nedenle, etkili ağrı kontrolü için multimodal analjezi yaklaşımları sıklıkla tercih edilmektedir. Son yıllarda, bu amaçla farklı plan blokları üzerine yapılan araştırmalar artış göstermiştir. Bu çalışmada, spinal cerrahilerde tanımlanmış plan bloklarının incelenmesi, analjezik etkinliklerinin, avantaj ve dezavantajlarının değerlendirilmesi amaçlanmıştır.
Literatürde yer alan erector spinae plan bloğu, torakolomber interfasiyal plan bloğu, retrolaminar blok, multifidus blok, mid-transverse process to pleura blok ve intersemispinal plan blok teknikleri incelenmiş; analjezik etkileri, potansiyel komplikasyonları ve klinik uygulamalardaki farklılıkları karşılaştırılmıştır.
Erector spinae plan bloğu, en sık incelenen ve en yaygın uygulanan teknik olarak öne çıkmaktadır. Bununla birlikte, diğer plan bloklarının da belirli cerrahi düzeylerde etkili ve güvenli alternatifler sunabileceği görülmektedir. Ayrıca, çok seviyeli veya bilateral uygulamaların olası yarar ve riskleri göz önünde bulundurularak bireyselleştirilmiş bir analjezi yaklaşımı önerilmektedir.
Anahtar kelimeler: Plan blok, spinal cerrahi, multimodal analjezi

Introductions

Postoperative pain following spinal surgery can be significant. It has the potential to impede controlled rehabilitation, prolong hospitalization, decrease patient satisfaction and comfort, and contribute to chronic pain during the postoperative period[1]. Research continues to focus on optimal analgesia management for patients undergoing spinal surgery.

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Traditional opioid-based analgesic techniques are frequently employed after spinal surgery. However, the well-known side effects of opioids such as nausea, vomiting, pruritus, respiratory depression, and delirium[2] have prompted clinicians to explore alternative approaches. Multimodal analgesia involves the use of various pharmacological agents, including gabapentin, nonsteroidal anti-inflammatory drugs (NSAIDs), and ketamine, to reduce opioid consumption. Multimodal analgesia aims to optimize pain control while minimizing opioid-related side effects, and fascial plane blocks have emerged as a promising alternative due to their efficacy and safety profile. Nevertheless, the side effects associated with these alternatives can limit their use[3].

The placement of an epidural catheter has been considered the gold standard for pain management in spinal surgery[3]. Although effective, this technique carries the risk of serious complications. Dural injury during surgery may allow local anesthetic (LA) to migrate from the epidural to the intrathecal space postoperatively[3]. Additionally, the use of an epidural catheter can delay the diagnosis of potential neurological complications arising from sensory and motor block development[4]. Recently, fascial plane blocks have been explored for spinal surgery analgesia management. They are performed at a site distant from the surgical field, are technically straightforward to implement, and carry minimal risk of complications[5].

This review discusses the advantages and disadvantages of fascial plane blocks applied after spinal surgery, aiming to provide comprehensive and comparative scientific evidence to date.

The Anatomy and Operational Principles of Fascial Plane Blocks

Fascial plane blocks represent a peripheral regional analgesia technique targeting the potential space between two distinct fascial layers via injection. Fascia is composed of collagen fibers permeated by hydrated glycosaminoglycans, adipocytes, and fibroblasts. Fluid can diffuse through this structure but cannot traverse in bulk. The inter-fascial plane is filled with a fat-glycosaminoglycan matrix, which facilitates sliding and cushioning between structures and serves as a conduit for nerves and blood vessels[6].

Two mechanisms are proposed for the analgesic effects of fascial plane blocks. First, there is a local effect on nociceptors and neurons within the plane or adjacent muscle and tissue compartments. The distribution of LA injected into the plane occurs via diffusion, and the resulting conduction block depends on the mass of LA reaching the target. Variations in effectiveness among blocks are likely explained by anatomical differences, changes in fluid distribution within compartments, and the pharmacodynamics of LA. Second, vascular absorption of LA provides a systemic analgesic effect in remote regions[7].

Fascial Plane Blocks Utilized in Spinal Surgery

Among fascial plane blocks investigated, the Erector Spinae Plane Block (ESPB) is the most extensively studied academically and the most commonly employed clinically in spinal surgery. Research primarily assesses postoperative pain scores and opioid consumption, while factors such as mobilization times, length of hospital stay, recovery scores, observed side effects, and complications are also considered.

Within the spinal region, block application areas vary depending on the type of surgery: cervical, thoracic, lumbar, and sacral regions. Interventions may involve one or more levels. The plane blocks currently under investigation are described below.

The Erector Spinae Plane Block (ESPB)

The ESPB was initially described by Forero et al. in 2016[8] (Figure 1). They shared their cadaveric studies and clinical experiences concerning the use of ESPB in the management of thoracic neuropathic pain. The technique is recognized not only for its ease of application and safety but also for its efficacy in producing analgesic outcomes.

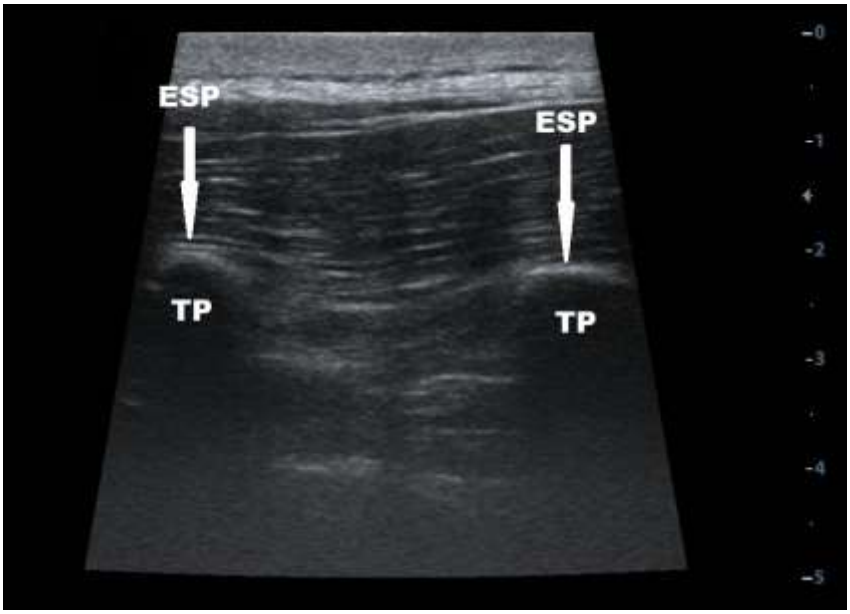


Figure 1. Sagittal sonogram of the lumbar area at T10-11 level. The arrows indicate the needle trajectories. Abbreviations: TP: Transverse process, ESPB: Erector spinae plane block.

The precise mechanism of action of ESPB, like other plane blocks, remains to be fully elucidated. Ongoing animal experiments, cadaveric studies, and clinical investigations continue to explore this topic. In their review of ESPB's mechanism of action, Chin et al. suggested that the most likely mechanism involves a direct effect on neuronal tissue[7]. Analgesic efficacy is achieved by influencing the ventral branches and spinal nerve roots through channels created by dorsal branches within the fascia and by piercing vascular structures. The involvement of these neuronal structures explains the cutaneous and visceral analgesia as well as the sympathetic blockade observed with ESPB.

As summarized in Table 1, the vast majority of randomized controlled trials (RCTs) predominantly focus on the lumbar region. Case reports are also available in the literature for long-segment surgeries, such as scoliosis, and for isolated cervical spinal surgeries. These studies present an alternative approach in the management of multimodal analgesia[34–37]. Current research includes efforts to expand analgesic coverage of dermatomal regions through multi-level interventions during extended spinal surgeries, as well as to prolong analgesic duration via catheter insertion. Amoroso et al. reported the unexpected cessation of their study, which aimed to compare ropivacaine and saline injections through a continuous erector spinae plane catheter in spinal fusion surgeries, due to unforeseen neuraxial spread[38]. The researchers also observed symptom regression in patients after catheter removal and speculated that this phenomenon might be related to postoperative alterations of the fascial plane. In multi-segment surgeries, another challenge arises in optimizing the blocking procedure. Distinctive groups, such as those undergoing scoliosis surgery, often experience variations in vertebral alignment and paraspinal muscle atrophy, complicating the achievement of an optimal approach[39].

Studies involving thoracic ESPB have predominantly focused on thoracic, cardiac, and breast surgical procedures. Research in spinal surgeries, particularly those encompassing the lower thoracic region, remains limited to long-segment procedures, highlighting the need for further investigation.

Table 1. Randomized Controlled Trials on the Erector Spinae Plane Block Included in the Review

Block type	Comparator intervention	Procedure	Number of patients	Primary outcome	Results	References
ESPB	No block	Lumbar spinal surgery	68	Pain score	-Lower NRS in ESPB group at the 6th, 12th, and 24th hours -Lower Total opioid consumption in ESPB Group	Asar et al., 2022[9]
ESPB	No block	Lumbar spine surgery	40	Pain score	-Lower morphine consumption in ESPB Group -Lower pain score at 6th hour after surgery in ESPB Group	Singh et al., 2020[2]
ESPB	Sham block	Elective lumber discectomy surgery	54	Morphine consumption	-Lower morphine consumption at 6th, 12th, and 24th hours -Similar NRS scores	Yörükoğlu et al., 2021[10]
ESPB	No block	Posterior lumbar spinal surgery	80	Pain score	-Lower NRS at ESPB group at 6th, 12th, 24th, and 48th hours	Yu et al., 2021[11]
ESPB	No block	Lumbar spinal fusion	60	Pain score	-Lower pain scores at rest at 4th, 8th,12th hours	Zhanget al., 2021[12]
ESPB	No block	Lumbar disc surgery	162	Persistent low back pain after surgery	-A significant improvement in pain scores in Group ESBP at the end of the sixth month	Akyuz et al., 2022[13]
ESPB	Sham block	Posterior lumbar fusion surgery	40	Oxycodone consumption	-Lower Oxycodone consumption in the first 48 hour after surgery -Lower rest and exercise pain scores in the ESPB Group	Zhu et al., 2021[14]
ESPB	Wound infiltration	Posterior lumbar interbody fusion surgery	60	Cumulative opioid consumption	-Lower cumulative opioid consumption at 6th, 12th, 24th hours	Zhanget al., 2023[15]
ESPB	No block	Posterior lumbar interbody fusion	84	Quality of recovery 24 h postoperatively	-Higher QoR score at ESPB Group -Lower morphine consumption	Linet al., 2022[16]
ESPB	No block	Minimally invasive posterior stabilization for vertebral fractures	60	Opioid consumption	-Lower opioid consumption -Lower pain score	Holaset al., 2023[17]
ESPB	No block	Posterior lumbar spinal surgery	62	Morphine consumption	-Lower 24 h-morphine consumption in ESPB Group	Wittayapairojet al., 2023[18]
ESPB	No block	Lumbar decompression surgery	60	Pain score	-Lower VAS score and tramadol consumption	Yayık et al., 2019[19]

ESPB	No block	Single-level lumbar spinal fusion	100	Opioid consumption	-Lower NRS score and opioid consumption	Goel et al., 2021[20]
ESPB	No block	Lumbar spine surgery	40	Pain score	-Lower pain score in ESPB Group -Lower meperidine consumption in ESPB Group	Nashıbı et al., 2022[21]
ESPB	Wound infiltration	Lumbosacral surgery without fixation	40	Pain score	-Lower VAS score in ESPB	Beltrame et al., 2023[22]
ESPB	No block	Lumbar arthrodesis	60	Pain score	-Lower NRS score in ESPB -Lower opioid consumption in ESPB	Vergari et al., 2022[23]
ESPB	Intrathecal morphine (ITM)	Lumbardiscectomy or fixation	82	Pain score	-Lower pain score in ITM Group -Higher time to rescue the first analgesia in ITM -Higher complication rate in ITM	Mahmoud et al., 2023[24]
ESPB	No block	Lumbar laminoplasty	60	Pain score	-Lower NRS scores in the ESP group in the initial six hours, reducing total opioid consumption.	Jin et al., 2021[25]
ESPB	Sham block	Posterior spinal instrumentation and fusion	56	Pain score	-Lower VAS score and morphine consumption	Yeşiltaş et al., 2021[26]
ESPB	No block	Thoracolumbar decompression	60	Quality of recovery score	-Higher QoR score in ESPB Group	Finnerty et al., 2021[27]
ESPB	No block	Lower-thoracic and lumbar spinal fusion	30	Morphine consumption	-Lower morphine consumption in ESPB Group -Lower NRS scores in ESPB Group	Bellantonio et al., 2023[28]
ESPB	No block	Posterior cervical spine surgery	86	Pain score	-Lower score in ESPB -Lower opioid consumption in ESPB	Kanna et al., 2023[29]
One level ESPB	Two level ESP	Posterior lumbar interbody fusion	83	Sensory block area	-Larger block area at two level blocks -No difference between groups in opioid consumption	Zheng et al., 2022[30]
ESPB	No block	Lumbar spine surgery	60	The duration to the first analgesic	-Longer the duration to the first analgesic in ESPB	Zhang et al., 2021[31]
ESPB	Sham block	Lumbar spine surgery	50	Morphine consumption	-No difference between groups in morphine consumption, pain score	Avis et al., 2022[32]

ESPB	Caudal epidural block (CEB), No block	Single level lumbar fusion surgery	81	Opioid consumption	- Similar opioid consumption between CEB and ESPB, upper opioid consumption in control group	Patel et al., 2023[33]
ESPB, erector spinae plane block; NRS, numerical rating scale; QoR, quality of recovery; VAS, visual analog scale; ITM, intrathecal morphine; CEB, caudal epidural block						

Studies have reported the safety of using ESPB in the cervical region [40,41] (Figure 2D). However, considering the potential phrenic nerve involvement demonstrated in their cadaver study, Elsharkawy et al. strongly suggested avoiding bilateral ESPB application[42]. Furthermore, brachial plexus involvement may induce postoperative motor weakness, potentially influencing the evaluation of surgical outcomes[43]. Similar to other interfascial plane blocks (such as the multifidus cervicis plane block and intersemispinal plane block), blocking the dorsal branches more distally could serve as an alternative approach in this procedure. Nonetheless, it is important to note that there is a paucity of adequate studies in this regard.

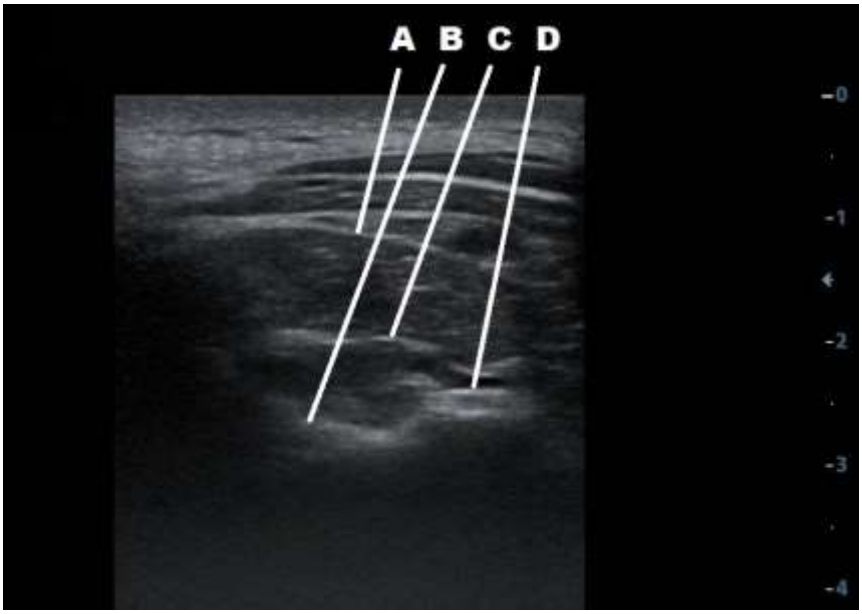


Figure 2. Transverse sonogram of posterior neck area at C4 level. The arrows indicate the needle trajectories: inter-semispinal plane block (A); retrolaminar cervical block (B); multifidus cervicis plane block (C); cervical erector spinae plane block (D).

When assessing ESPB across all spinal segments, potential complications include pneumothorax, vascular injury, hematoma, LA toxicity, hemorrhage, and motor blockade[44]. In their study encompassing 182 cases with diverse indications, Tulgar et al. shared their experiences with ESPB, reporting transient quadriceps weakness following application at Th11, temporary aphasia and apathy after Th9 application, temporary perioral numbness and slurred speech following Th3 application, and transient muscle tone loss with loss of consciousness after another Th9 application[45]. In the first case, lumbar plexus involvement was suggested, whereas LA toxicity was considered responsible for the others. Subsequently, Selvi et al. reported unexpected motor weakness following bilateral T11 ESPB[46], while De Cassai et al. described near-complete motor loss in the lower extremities following bilateral L3 ESPB after lumbar laminectomy[47]. Kumar et al. reported hypotension and bilateral motor-sensory deficits after bilateral ESPB administration at the Th4 level[48]. Furthermore, Pratheep et al. retrospectively evaluated the complications of elective spinal surgery following bilateral ESPB administration[49]. In two cases, motor and sensory deficits were observed; the authors postulated that the surgical level alone could not account for this loss, leading to the hypothesis that

LA spread through the epidural space played a role. Based on these data, complications related to lumbar plexus and/or epidural spread appear to be contingent upon the level of application in the thoracic and lumbar regions. Additionally, sympathetic ganglion involvement through paravertebral spread may also explain the occurrence of hypotension.

In light of the growing evidence supporting the efficacy of ESPB in reducing pain and opioid consumption, increasing attention has been directed toward its potential side effects and complications. Notably, studies are being conducted on its impact on intraoperative neuromonitoring during spinal surgeries[50]; however, this issue has yet to be definitively resolved. Another area of focus is the timing of block administration. When ESPB is administered preoperatively in long-segment surgeries, the duration of effective analgesia from a single-dose injection may be shortened. Conversely, postoperative administration can alter drug distribution due to anatomical disruption. Further research is needed to establish a definitive stance on these issues.

Thoracolumbar Interfascial Plane (TLIP) Block

The TLIP block was initially described by Hand et al.in 2015[51] (Figure 3). In their research, they reported the establishment of an analgesic region in the midline through administration of the block at the L3 spinal level in healthy volunteers. The TLIP block is performed in the plane between the multifidus and longissimus muscles, targeting the dorsal branches of spinal nerves while leaving the ventral branches untouched. In spinal surgeries, this approach is believed to positively impact patients' ambulation time and offer advantages in terms of intraoperative neuromonitoring requirements.

Compared to ESPB, it has been suggested that the TLIP block's greater distance from the surgical field prevents the LA from penetrating beyond the intended area, thereby enhancing block quality and duration[52].

Ueshima et al. have redefined the TLIP block as a modified TLIP using a different technique[53]. In this method, the injection is administered between the longissimus and iliocostal muscles. They argue that this new technique reduces the risk of postoperative infection, offers a more accessible application, and involves fewer complications due to the slightly greater distance from the surgical field. RCTs on the TLIP block are summarized in Table 2.

Table 2. Randomized Controlled Trials on the Thoracolumbar Interfascial Plane Block Included in the Review

Block type	Comparator intervention	Procedure	Number of patients	Primary outcome	Results	References
ESPB	mTLIP, no block	Lumbar discectomy	90	Fentanyl consumption	-Lower Fentanyl consumption both in ESPB and mTLIP groups -No differences between esp-mtlıp	Ciftci et al., 2020[54]
TLIP	wound infiltration	Posterior lumbar spine fusion	70	Time of the first request for rescue analgesia	-Later time of the first request for rescue analgesia at the TLIP group -Lower tramadol consumption	Pavithran et al., 2022[55]
TLIP	No block	Vertebral surgery	64	Pain score	-Lower VAS pain score	Tapar et al., 2022[56]
mTLIP	cTLIP	Lumbar disc surgery	60	Performance time of the block procedures	-Lower performance time at mTLIP group	Çiftçi et al., 2020[57]

					-No differences in efficacy between groups	
TLIP	No block	Lumbar spinal fusion surgery	60	Opioids and anesthetic consumption	-Lower Opioids and anesthetic consumption in the TLIP group -Lower VAS and BCS scores in the TLIP group at 12th, 24th, and 36th hours	Chenet al., 2019[58]
TLIP	No block	Lumbar spine surgery	60	Analgesic consumption	-Lower morphine and fentanyl consumption in the TLIP group	Eltaheret al., 2021[59]
TLIP	No block	Lumbar discectomy	70	Pain score	-Lower pain score both on rest and movement in the TLIP group	Ammar et al., 2018[60]
mTLIP	ESPB	Single or double-level lumbar discectomy or primary lumbar laminoplasty	60	Postoperative and intraoperative fentanyl consumption	At 24th h, lower fentanyl consumption and pain score	Kumaret al., 2023 [61]
mTLIP	cTLIP	Posterior lumbar decompression and stabilization surgery	8	Pain score	-Lower NRS score in 12th hour at mTLIP group -No difference in opioid consumption	Tantri et al., 2022[62]
TLIP, ESPB	No block	Lumbar spine fusion	304	Movement and static pain scores	-Lower pain score in the ESPB group and lower opioid consumption	Wang et al., 2021[63]
TLIP	Sham block	Elective single level herniated lumbar disk surgery	90	Pain score	-Lower pain score and opioid consumption in TLIP group	Ozmen et al., 2019[64]
TLIP	Wound infiltration	Lumbar disc surgery	60	Opioid consumption	-Lower opioid consumption at all time in TLIP group	Ekinci et al., 2020[65]
TLIP	Quadratus Lumborum Block	Microendoscopic discectomy	60	Quality of recovery score	-Higher QoR score in TLIP group -Lower NRS score at 1-16 hours in TLIP group	Alver et al., 2023[66]

TLIP	ESPB	Elective posterior spinal fusion surgery	60	Quality of recovery score	-Similar QoR scores between both groups	Bilge et al., 2023 [67]
ESP	TLIP	Lumbar discectomy	68	Total opioid consumption	-Lower opioid consumption in ESPB Group	Dilsiz et al., 2024[68]
ESPB, erector spinae plane block; TLIP, throcolomber interfascial plane; VAS, visual analog score; QoR, quality of recovery; NRS, numerical rating scale						

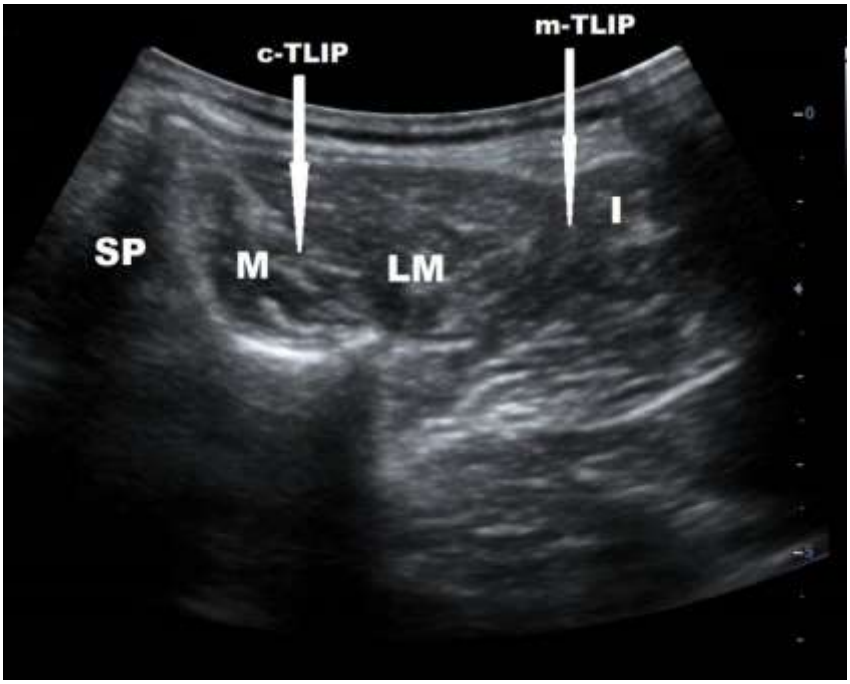


Figure 3. Transverse sonogram of lumbar area at T10 level. The arrows indicate the needle trajectories. Abbreviations: SP: Spinous process, M: Multifidus, LM: Longissimus, I: Iliocostalis, c-TLIP: classic thoracolumbar interfascial plane block, m-TLIP: modified thoracolumbar interfascial plane block

The modified version of the TLIP block was developed due to ease of administration. However, further research is needed to determine the advantages between the classic and modified blocks.

Although TLIP's effect is limited to a smaller area, restricting its use in long-segment surgeries, its use in these surgeries can be ensured through application at more than one level.

Compared to ESPB regarding analgesic efficacy in surgeries performed in relatively restricted areas, such as discectomies, a definitive conclusion has yet to be reached. However, it is worth noting that the TLIP block has not been reported to cause any motor impairment, which can be considered an advantage.

Retrolaminar Block (RLB)

In 2006, RLB was developed as an alternative technique specifically for patients who had undergone axillary lymphadenopathy excision following breast cancer and experienced treatment-resistant pain[69]. RLB, as a modified form of paravertebral block, involves the insertion of a needle 1-1.5 cm lateral to the palpable target spinous process, advancing it cranially or caudally until it contacts the lamina, and then administering a LA injection at that point (Figure 4). To reduce the risk of blind epidural injection, this method can be

supported by ultrasound guidance. This technique offers advantages in terms of ease of application compared to alternatives like ESPB and TLIP block, as it is amenable to palliation.

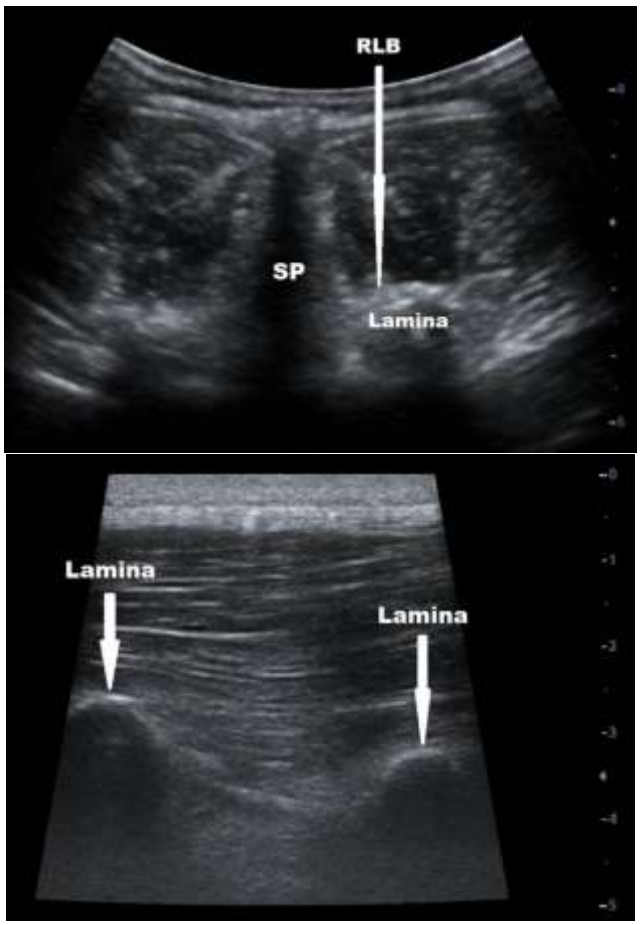


Fig. 4(A) Transverse sonogram of lumbar area at T10 level. The arrows indicate the needle trajectories. (B) Sagittal sonogram of lumbal area at T10-11 level. Abbreviations: SP: Spinous process, RLB: Retrolaminar block.

Based on cadaver studies, it is conceivable that RLB, by spreading from the paravertebral area, may block dorsal spinal branches[70]. Although the tight connection of muscles to the lamina in the RLB technique can restrict the cranio-caudal spread of LA, this limitation may strengthen the effect within the region it spreads to[71]. Furthermore, the blockade of the lateral cutaneous branch and intercostal nerves on the same side of the hemithorax may confer analgesic effectiveness[72]. In cadaver studies, ESPB and RLB techniques were compared regarding paravertebral and intercostal spread. Both methods exhibited varying degrees of paravertebral extension, with ESPB demonstrating superior intercostal distribution. Evaluation of the spinal plane revealed that the dye remained more laterally in the ESPB. In contrast, in RLB, it was observed to stay more towards the midline, completely covering the posterior surface of the lamina. Although these findings suggest that RLB block might offer more effective analgesia for spinal surgery, distribution in living tissue could differ[72].

There is only one RCT available that evaluated the effectiveness of RLB in post-spinal surgery. However, it could not be considered due to the full text being in Japanese [73]. Additionally, our own planned randomized controlled study (Clinical Trials Identifier: NCT05792124) to assess the efficacy of ESPB and RLB in spinal surgery is ongoing. Studies conducted in non-spinal surgical fields have reported analgesic effectiveness and encountered no complications.

Hochberg et al. communicated their application of cervical RLB to the editor in a note (Figure 2B) [74]. In response to Elsharkawy et al.'s cervical ESPB applications, they presented their approach, suggesting that RLB administered more medially than ESPB could reduce the risk of deep cervical artery injury and potential phrenic nerve involvement. Although the theoretical hypothesis they presented appears valid, it requires further support from advanced studies[74].

Multifidus Plane Block

Lumbar multifidus plane block (LMP)

The LMP block, as described by Song et al., has been presented in two cases involving patients undergoing spinal surgery [75]. The potential mechanism of the analgesic effect of this block, administered via ultrasound-guided injection of LA deep into the multifidus muscle, may be attributed to the impact of the LA on the adjacent facet joints anteriorly and the medial branches of the lumbar dorsal ramus.

In a case presentation by Diwan et al. involving 15 patients, they described a block referred to as the sub-multifidus block [76]. In this block, an injection of LA into the depth of the multifidus muscle reliably blocked the dorsal branches of spinal nerves at multiple levels. Although comparative, RCTs in the literature comparing the analgesic efficacy of this block with other established blocks have not been found, the technical safety of this block in terms of motor and sympathetic blockade is considered superior to the ESPB. However, substantial evidence still requires the quality of studies for confirmation.

Cervical multifidus plane block (MCP)

The MCP block, initially described by Ohgoshi et al., was bilaterally administered following posterior cervical laminoplasty [77]. The target region for this block is the fascial plane between the multifidus cervicis and semispinalis cervicis muscles (Figure 2C). No complications were observed in the study, and additional analgesic requirements beyond routine loxoprofen administration were not reported. In another study involving a case series of 20 cervical laminoplasty patients who received bilateral MCP, similar analgesic effectiveness and the absence of complications were reported [78].

In the context of the MCP block, it is believed that the semispinalis capitis muscle plays a limiting role, and it is presumed to provide cervicothoracic analgesia from C4 to T4, with a distribution corresponding to dermatomal patterns [79]. However, conducting RCTs can provide more precise insights regarding the duration of effect and the dermatomal distribution. Compared to the ESPB, it is asserted to be safer concerning phrenic nerve involvement and respiratory depression. Nevertheless, due to its proximity to major vascular structures, the reliability of the procedure is still unclear in terms of the risk of vascular injection and sympathetic block during the operation.

Sacral multifidus plane block

Sacral plane blocks have been explored following perianal and anorectal surgical procedures (such as hemorrhoidectomy, treatment for vaginismus, and gender reassignment). Sacral spinal surgeries, including procedures like decompression, fixation, and lumbarization, are relatively rare. The application of sacral multifidus block after these surgeries has not been thoroughly evaluated in controlled studies and is often described as case reports.

It has been reported that plan blocks targeting the deep fascial plane of the multifidus in the sacral region have been introduced. Some researchers have named this block ESP, while others have referred to it as the multifidus block. In a letter to the editor by Hamilton, it is stated that all of these approaches, with minor differences, target the deep multifidus fascia, and it is more accurate to refer to it as the sacral multifidus plane block[80]. Upon examining the anatomical plane, there exists an erector spinae muscle group covering the multifidus, which thickens and becomes the dominant muscle group in the sacral region. As per Hamilton's insight, we concur that the target region is the multifidus fascia, and therefore, we have included this block under the heading of the sacral multifidus plane block.

In their study, Mistry et al. reported the achievement of analgesic efficacy within the L4-S3 dermatome by administering a sacral multifidus plane block under ultrasound guidance at the S2 level following S1-2

decompression-fusion surgery[81]. Mahajan et al. have reported their experiences with sacral multifidus in two neonates undergoing sacrococcygeal teratoma excision[82]. The researchers recorded postoperative FLACC scores (0-1) and reported that the first need for analgesia occurred at 11 and 14 hours, respectively. They noted that in both cases, no side effects such as motor weakness, urinary retention, or constipation were observed, indicating that the ventral branches of the sacral plexus were unaffected. As Mahajan et al. have reported, the encirclement of the multifidus muscle by the erector spinae aponeurosis and the limited confinement of the applied LA in this region might have prevented the block of the ventral branches.

Factors such as underlying nerve damage due to reasons like surgical interventions for sacral spinal surgeries related to tumors or fractures or the invasion of nerve and vascular structures by tumor tissue may act as limiting factors for this block. However, sacral blocks still encompass a limited number of cases and are subject to debate and further development.

Inter-Semispinal Plane Block (ISPB)

Ohgoshi et al. introduced a block, which is applied in the fascial plane between the semispinalis cervicis and capitis muscles (Figure 2A). This block has been presented as an alternative to the MCP block due to the ease of ultrasonographic visualization of the ISPB plane in elderly patients. In a study involving eight healthy participants, unilateral ISPB and MCP block were compared, and it was reported that they exhibited similar effectiveness [83]. RCTs on the ISPB are summarized in Table 3.

Table 3. Randomized Controlled Trials on the Inter-semispinal Plane Block Included in the Review

Block type	Comparator intervention	Procedure	Number of patients	Primary outcome	Results	References
ISPB	No block	Posterior cervical spine surgery	52	Perioperative opioid consumption	-Lower opioid consumption at intraoperative and postoperative in the ISPB group	Abdelhaleem et al., 2023 [84]
ISPB	No block	Posterior cervical spine surgery	60	Pain score	-Significant reduction in VAS scores during the initial 12 hours. - Reduced opioid consumption both intraoperatively and postoperatively.	Mostafa et al., 2022 [85]
ISPB, intersemispinal plane block; VAS, visual analog scale						

ISPB is a plane block offered as an alternative to MCP block. It is thought that the semispinalis capitis muscle's inhibition of the distribution of local anesthetic eliminates concerns such as possible phrenic nerve and brachial plexus involvement. There are hesitant attitudes towards bilateral application of ESPB and MCP block due to the concern about respiratory system involvement in the block. However, when the block is not applied bilaterally, full analgesic effectiveness may not be achieved in the midline due to overlapping cutaneous branches 85. The idea that bilateral application is safer makes ISPB more preferable. However, the deep dorsal branches' escape from the anesthetic effect may cause patients to feel pain during mobilization. Although analgesic effectiveness is reported compared to the control group in the RCTs, there is a need to compare the effectiveness with the plane block applied to deeper groups such as ESPB and MCP block.

Mid-Transverse Process to Pleura Block (MTP)

The MTP block was initially defined as a modified paravertebral block 2017[86]. LAs are administered between the transverse processes and the pleura. This results in the distribution of a LA through fenestrations in the superior costotransverse ligament at the injection level, reaching both dorsal and ventral branches, often extending to adjacent levels. In their studies assessing the MTP block for spinal surgeries, Eskin et al. reported achieving analgesic effectiveness[87]. However, they also noted that when compared to ESPB, ESPB demonstrated superior efficacy. RCTs on the MTP block are summarized in Table 4.

While the presence of a paravertebral spread in the MTP block enhances the quality of the block, it also places it at a similar level of risk regarding complications as the ESPB. Although it holds promise for spinal surgical analgesia management, the limited nature of existing studies necessitates further advanced research in this area.

Table 4. Randomized Controlled Trials on the Mid-transverse Process to Pleura Block Included in the Review.

Block type	Comparator intervention	Procedure	Number of patients	Primary outcome	Results	References
ESPB, MTP	No block	Lumbar spinal surgery	120	Pain score	-The mean VAS scores over 48 hours. Control>MTP>ESPB - Opioid consumption Control>MTP>ESPB	Eskin et al., 2020[87]
ESPB, erector spinae plane block; MTP, midtransvers process tu pleura; VAS, visual analog scale						

Limitations

This review included only those studies that compared postoperative analgesia of various plan blocks in patients who underwent spinal surgery. Significant heterogeneity was noted for some outcomes probably because of the small sample size or few events in the RCTs. This review is limited by the quality of included studies. Therefore, there is a need for more research including good-quality primary RCTs to overcome the limitations and bring certainty to the analgesia debate of various plan blocks for spinal surgeries.

Conclusion

There has recently been increasing interest in the use of plane blocks for postoperative analgesia management following various surgical procedures. The search for optimal analgesia management continues with the use of plane blocks at the same rate in spinal surgeries. Our perspectives on the risks, benefits, and value of plane blocks applied after spine surgery are constantly evolving. Among the plane blocks we examined, the ESPB seems to be more advantageous in terms of analgesic effectiveness, especially in the thoracic and lumbar regions. In addition, more studies are still needed in terms of the existence, frequency and preventability of complications. In cervical region blocks, the risk of respiratory complications due to the intervention is the main obstacle that worries the practitioners. We believe that suggestions for more effective use of plane blocks will be generated through studies in which issues such as multiple or single intervention application and catheter insertion are evaluated specifically for the procedure. We think that as more information is revealed and will be revealed, plane blocks will be increasingly adopted by clinicians and become a part of routine practices.

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