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Optimizing Pain Management in Truncal Surgery: A Narrative Review of Regional Anesthetic Techniques

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Abstract

Background. Effective postoperative analgesia is essential for optimizing recovery and enhancing patient satisfaction after surgery. Regional anesthesia techniques, particularly fascial plane blocks, are key components of multimodal analgesia, offering targeted somatic and sometimes visceral pain relief.

Aim. To review the indications, techniques, efficacy, contraindications, and complications of commonly used truncal regional anesthesia blocks, including TAP, subcostal TAP, quadratus lumborum, rectus sheath, ilioinguinal/iliohypogastric, intercostal, PECS I & II, and serratus anterior plane blocks.

Material and methods. A narrative review of recent clinical studies and systematic reviews was performed, focusing on ultrasound-guided fascial plane blocks in abdominal, thoracic, and breast surgeries. Data on efficacy, safety, and clinical application were synthesized to guide perioperative analgesic strategies.

Results. TAP and subcostal TAP blocks effectively reduce somatic pain after lower and upper abdominal surgery, respectively, while quadratus lumborum blocks provide both somatic and visceral analgesia. Rectus sheath and ilioinguinal/iliohypogastric blocks are effective for midline and lower abdominal procedures. Intercostal, PECS, and serratus anterior plane blocks offer targeted analgesia for thoracic and breast surgery. Ultrasound guidance enhances safety and efficacy. Complications are rare and include local anesthetic toxicity, bleeding, infection, or block failure, with specific risks such as pneumothorax (ICNB) or transient femoral nerve palsy (TAP, ilioinguinal/iliohypogastric).

Conclusions. Truncal regional anesthesia techniques play a vital role in multimodal analgesia, improving pain control, reducing opioid use, and supporting enhanced recovery after surgery. Optimal block selection should be tailored to the surgical site and patient factors. Further high-quality studies are needed to refine techniques and optimize outcomes.

Key words: truncal regional anesthesia, transversus abdominis plane (TAP) block, quadratus lumborum block (QLB), pectoral nerve blocks (PECS I & II), postoperative analgesia, fascial plane blocks, enhanced recovery after surgery (ERAS)

1. Introduction

Surgical procedures inevitably cause tissue injury, triggering a systemic inflammatory response that alters endocrine and metabolic homeostasis. In addition to surgical stress, anesthesia and perioperative pain can further modulate immune function, potentially impairing postoperative recovery. Effective pain control therefore plays a pivotal role in optimizing surgical outcomes, reducing complications, and enhancing patient satisfaction.

Regional anesthesia offers distinct advantages by providing targeted afferent nerve blockade, thereby attenuating the neuroendocrine stress response and preserving immune competence. Among the various regional techniques, thoracic epidural analgesia has long been considered the gold standard for pain relief in thoracic and upper abdominal surgery due to its superior analgesic efficacy and physiological benefits. However, its use may be limited by contraindications — particularly in patients receiving anticoagulant or antiplatelet therapy— and by potential adverse effects such as hypotension or urinary retention.

The evolution of surgical practice toward minimally invasive techniques has also influenced postoperative pain management, prompting a shift toward less invasive, fascial plane blocks such as the transversus abdominis plane (TAP) block. Recent studies suggest that TAP block achieves analgesic outcomes similar to epidural analgesia while offering improved hemodynamic stability and shorter hospital stay.

In contemporary perioperative care, a multimodal analgesic approach—combining regional techniques with systemic pharmacologic agents—has emerged as the most effective strategy for optimizing pain control, reducing opioid consumption, and facilitating enhanced recovery after surgery (ERAS) protocols. Nonetheless, further high-quality studies are needed to establish evidence-based recommendations for selecting the optimal regional anesthesia technique for trunk surgery in diverse patient populations. [1, 2]

2. The main truncal regional anesthesia techniques

2.1 TAP and sTAP Block

The Transversus Abdominis Plane (TAP) block is designed to provide analgesia to the anterior and anterolateral abdominal wall. It involves the ultrasound-guided deposition of local anaesthetic in the fascial plane between the internal oblique and transversus abdominis muscles, targeting the thoracolumbar nerves from approximately T6 to L1 as they run in this plane. Through blockade of these somatic afferent nerves, the TAP block can reduce pain from skin incision, musculature, and parietal peritoneum of the abdominal wall, though it does not reliably block visceral pain. Variants in approach (e.g., lateral, posterior, subcostal) influence the extent of dermatomal coverage and thus analgesic effect. [3, 4, 5]

The Subcostal Transversus Abdominis Plane (sTAP) block is a variant of the TAP block in which local anaesthetic is injected in the fascial plane near or just below the costal margin (usually between the posterior border of the rectus abdominis and the transversus abdominis, or between the internal oblique and transversus abdominis muscles along the subcostal line). It is typically performed under ultrasound guidance. For example, a systematic review found that in sTAP the needle-insertion point is near the xiphoid process and the anaesthetic is directed infero-laterally along the costal margin, providing sensory blockade of the anterior rami of T6–T9 dermatomes. Because this technique targets the somatic nerves of the abdominal wall (not visceral afferents), it is especially suited for analgesia of upper abdominal wall incisions. [6, 7, 8]

The transversus abdominis plane (TAP) block is indicated as part of postoperative analgesia for surgeries involving the lower thoracic and abdominal wall, particularly when somatic pain from the abdominal fascia and wall is expected. It is commonly used in major abdominal surgeries such as colorectal, gynecologic, and urologic procedures, where incision pain is significant. The technique is also beneficial in minimally invasive abdominal procedures, including laparoscopic cholecystectomy, where port-site pain and abdominal wall soreness contribute to postoperative discomfort. Additionally, the TAP block is applied in lower abdominal wall operations such as hernia repair and caesarean section. In the current era of enhanced recovery protocols and multimodal analgesia, it is often employed as part of a broader analgesic strategy in combination with systemic analgesics, non-opioid medications, and other regional techniques [3,9].

The subcostal transversus abdominis plane (sTAP) block is indicated primarily for postoperative analgesia in upper abdominal surgeries involving the abdominal wall, particularly those performed through subcostal incisions where somatic pain from the incision, musculature, and parietal peritoneum is expected. Recent studies have demonstrated its effectiveness, including in laparoscopic cholecystectomy, where a randomized controlled trial found that patients who received sTAP had significantly lower pain scores and reduced analgesic consumption in the first 24 hours compared with those who did not receive a TAP block. The technique has also been shown to be beneficial in upper abdominal surgery performed via subcostal incision [10, 11].

Absolute contraindications common to all regional blocks within the trunk include a known allergy to the planned local anaesthetic agent, lack of patient consent, local skin infection at the needle insertion site, and situations in which nerve blockade interferes with the surgery or prevents the desired postoperative neurological assessment.

Relative contraindications or cautions common to all regional blocks within the trunk include coagulopathy or an anticoagulated state, pre-existing neuropathy or peripheral nervous system disorders such as diabetic or inflammatory neuropathies that may be aggravated by nerve blockade, systemic infection with a risk of spreading infection, excessive anxiety or inability to cooperate, cognitive deficits or movement disorders that impair patient cooperation, anatomic distortion such as prior surgery, obesity, or scarring that makes block placement difficult, and pregnancy — while generally considered safe, any procedure during pregnancy should be performed with caution and under appropriate medical supervision [12,13].

Furthermore, TAP and sTAP blocks are contraindicated in patients who have visceral pain as the dominant component. They may not sufficiently address visceral nociception. [14]

Complications common to all regional blocks within the trunk include local anaesthetic systemic toxicity (LAST) resulting from inadvertent intravascular injection or excessive volume or absorption, particularly in highly vascular areas. Bleeding or hematoma formation may occur due to vascular injury, especially in patients receiving anticoagulant therapy or those with coagulopathy. Visceral injury, such as to the bowel, liver, or spleen, or intraperitoneal injection can occur, particularly when using a landmark-based rather than ultrasound-guided technique. Other potential complications include incomplete or unilateral block leading to breakthrough pain, as the TAP block only addresses the abdominal wall component and not deep visceral pain. Transient motor or sensory changes may occur due to inadvertent spread of the local anaesthetic to adjacent dermatomes, and although rare, infection at the injection site can also develop [15,16].

Rare complication specific to TAP is transient femoral nerve palsy. Complications of sTAP include those that are common to all blocks within the trunk. [14]

2.2 QLB

The Quadratus Lumborum Block (QLB) is a deep fascial plane block targeting the quadratus lumborum muscle, located in the posterior abdominal wall. It provides analgesia by spreading local anesthetic in the fascial plane, affecting somatic and visceral afferents. There are several approaches to performing the QLB, including lateral (QLB1), posterior (QLB2), and transmuscular (QLB3) techniques, each with varying anatomical targets and clinical applications.

The QLB1 involves injection of local anesthetic on the lateral side of the quadratus lumborum muscle, at the level of its contact with the transversalis fascia, where the transversus abdominis muscle (TAM) tapers into its aponeurosis. QLB1 is indicated for procedures involving the anterior abdominal wall, such as colorectal, gynecological, and urological surgeries. While effective for somatic analgesia, QLB1 has a more limited spread compared to QLB2 and QLB3, potentially leading to less comprehensive pain control. [17]

In the QLB2 local anesthetic is applied between the quadratus lumborum muscle and the thoracolumbar fascia. This technique targets both somatic and visceral afferents, providing broader analgesia. QLB2 is suitable for a wide range of abdominal and pelvic surgeries, including nephrectomy, hernia repairs, and cesarean sections. Studies have shown that QLB2 provides significant postoperative analgesia, reducing pain scores and opioid consumption compared to control groups. [18]

The QLB3, or transmuscular approach, involves injecting local anesthetic between the quadratus lumborum and psoas major muscles, targeting the lumbar and thoracic paravertebral spaces. This technique offers the most extensive spread of analgesia among the QLB approaches. QLB3 is particularly beneficial for complex or extensive surgeries, such as hip arthroplasty, spinal surgeries, and major abdominal surgeries. Research indicates that QLB3 provides superior postoperative analgesia, with lower pain scores and reduced opioid consumption compared to QLB2. [19]

Each QLB approach offers distinct advantages depending on the surgical procedure and desired extent of analgesia. QLB1 is effective for somatic pain control, QLB2 provides broader analgesia for a variety of surgeries, and QLB3 offers the most extensive pain relief, especially for complex procedures. Selection of the appropriate approach should be based on the specific surgical requirements and patient considerations. [20]

Absolute contraindications specific to QLB include sepsis, bleeding disorders, and anticoagulant therapy. Relative contraindications include neurological disorders and hemodynamic instability.

While QLB is generally safe when performed correctly, potential complications specific to this block include lower extremity weakness, which has been reported in some cases and may result from spread to the lumbar plexus; hypotension, potentially due to spread in the paravertebral spaces; and retroperitoneal hematoma, especially associated with posterior approaches. [21]

2.3 RSB

The rectus sheath block (RSB) provides analgesia to the anterior abdominal wall, primarily in the midline region. It targets the terminal branches of the thoracoabdominal nerves (T7–T12) that run within the rectus sheath, between the rectus abdominis muscle and the posterior rectus sheath. By depositing local anesthetic in this fascial plane, the sensory nerves supplying the anterior abdominal wall are effectively blocked, resulting in pain relief for surgical procedures involving midline incisions.

RSB is indicated for various abdominal procedures, including midline abdominal surgeries such as laparotomy and cesarean sections; gynecological procedures, including total laparoscopic hysterectomy, where RSB has been shown to provide superior analgesia compared to quadratus lumborum block, reducing opioid consumption and the need for rescue analgesia; cardiac surgeries, where, when combined with parasternal blocks, RSB improves postoperative pain control and respiratory performance; and pediatric surgeries, where it is effective in managing postoperative pain in children undergoing umbilical hernia repair. [22, 23, 24]

Contraindications and complications of RSB include those that are common to all blocks within the trunk. [25]

2.4 Ilioinguinal and Iliohypogastric Nerve Block

The ilioinguinal and iliohypogastric nerves are branches of the first lumbar nerve (L1) and provide sensory innervation to the lower abdominal wall, including the inguinal region, mons pubis, and upper medial thigh. A block of these nerves involves the injection of local anesthetic near the anterior superior iliac spine (ASIS), targeting the nerves as they emerge between the internal oblique and transversus abdominis muscles.

The ilioinguinal and iliohypogastric nerve block is indicated for postoperative analgesia following surgeries such as cesarean sections, inguinal hernia repairs, and other lower abdominal procedures, with a randomized controlled trial demonstrating significant improvement in both acute and chronic postoperative pain outcomes after cesarean section. It is also indicated for inguinal hernia surgery, providing effective intraoperative and postoperative pain management, particularly in older adults, as a randomized controlled trial found that a single-point ultrasound-guided block reduced postoperative complications and provided effective analgesia. [26, 27]

Contraindication include those that are common to all blocks within the trunk. Complication specific to ilioinguinal and iliohypogastric nerve block is transient femoral nerve palsy. [28]

2.5 ICNB

An intercostal nerve block (ICNB) involves the injection of a local anesthetic around the intercostal nerves, which are located between the ribs. These nerves provide sensory innervation to the chest wall, including the skin and muscles. The block can be performed using landmark-based techniques or, more commonly, under ultrasound guidance to enhance precision and safety. Ultrasound guidance allows for real-time visualization of the needle and surrounding structures, reducing the risk of complications.

ICNB is indicated for postoperative analgesia following thoracic, abdominal, or breast surgeries, with a randomized controlled trial demonstrating superior early analgesic efficacy compared to erector spinae plane block after uniportal video-assisted thoracoscopic surgery. It is also indicated for cardiac surgery patients undergoing off-pump coronary artery bypass grafting, where preemptive parasternal intercostal nerve block reduced intraoperative opioid and vasopressor requirements, enhancing hemodynamic stability. Additionally, ICNB is effective in patients undergoing percutaneous nephrolithotomy, with bupivacaine providing superior pain control compared to placebo, resulting in reduced narcotic requirements and improved health-related quality of life in the immediate postoperative period. [29, 30, 31]

Contraindication include those that are common to all blocks within the trunk. Complication specific to ICNB is pneumothorax, a rare but serious complication. [32]

2.6 PECS I Block, PECS II Block and SAPB

The Pectoral Nerve Block Type I (PECS I block) is technique targeting the lateral pectoral nerve. It involves injecting local anesthetic between the pectoralis major and pectoralis minor muscles, aiming to provide analgesia for the anterior chest wall. It is indicated for breast surgery – effective for procedures like breast conserving surgery and sentinel lymph node biopsy. A study demonstrated that PECS I block could be performed with sedation, offering an alternative to general anesthesia for breast surgeries. [33]

The Pectoral Nerve Block Type II (PECS II block) extends the PECS I technique by targeting additional nerves, including the intercostal nerves (3–6), intercostobrachial nerve, and long thoracic nerve. This broader approach provides more comprehensive analgesia for procedures involving the chest wall and axillary regions.

The PECS II block is indicated for breast surgery, where it is widely used for postoperative analgesia following breast-conserving surgery and sentinel lymph node biopsy, with a prospective randomized controlled study showing significant reductions in postoperative opioid consumption and pain scores compared to the control group. It is also indicated for modified radical mastectomy, as a meta-analysis demonstrated that the PECS II block effectively reduces intraoperative and postoperative opioid use, postoperative nausea and vomiting, and early postoperative pain. Additionally, the PECS II block can be used for cardiac implantable electronic device (CIED) insertion, with studies highlighting its feasibility and effectiveness in reducing intraoperative local anesthesia requirements [34,35, 36].

The SAPB is technique targeting the serratus anterior muscle and the intercostal nerves. It involves injecting local anesthetic between the serratus anterior muscle and the ribs, aiming to provide analgesia for the anterior chest wall. This block can be performed using either a superficial or deep approach, depending on the desired extent of analgesia. It is indicated for breast surgery like breast conserving surgery and sentinel lymph node biopsy. A randomized controlled trial demonstrated that SAPB provided superior early analgesic efficacy compared to erector spinae plane block after uniportal video-assisted thoracoscopic surgery. [37]

Contraindication and complications of PECS I, PECS II and SABP include those that are common to all blocks within the trunk. [38]

3. Discussion

Regional anesthesia has become an essential component of modern perioperative care for truncal and thoracoabdominal surgery, offering targeted analgesia, reduction of systemic opioid requirements, and facilitation of enhanced recovery protocols. The expansion of fascial plane blocks—such as the TAP, subcostal TAP, quadratus lumborum, rectus sheath, ilioinguinal/iliohypogastric, intercostal, PECS, and serratus anterior plane blocks—has provided anesthesiologists with a versatile armamentarium to tailor analgesia to specific surgical sites, patient characteristics, and risk profiles.

A key advantage of these techniques lies in their ability to provide site-specific analgesia by selectively blocking somatic and, in some cases, visceral afferents. For example, the TAP and RSB blocks predominantly address somatic pain from the abdominal wall, whereas QLB variants can extend analgesic coverage to include visceral pain due to spread into paravertebral spaces. Similarly, PECS II and SAPB blocks expand coverage to the chest wall and axillary regions, which is particularly relevant in breast and thoracic surgeries. The ability to select the optimal block based on dermatomal coverage, procedural invasiveness, and pain type allows for more precise and effective pain management, minimizing the need for systemic opioids and their associated adverse effects.

Despite their efficacy, all truncal blocks share a set of potential complications inherent to regional anesthesia in the trunk, including local anesthetic systemic toxicity, hematoma formation, infection, inadvertent visceral injury, and technical failure resulting in incomplete analgesia. Awareness of these shared risks is critical, as it underscores the importance of meticulous technique, ultrasound guidance, and patient-specific risk assessment. Certain blocks also carry unique complications, such as transient femoral nerve palsy with TAP ilioinguinal and iliohypogastric nerve block, lower extremity weakness with QLB, or pneumothorax with intercostal blocks. Recognizing both common and block-specific complications informs patient counseling, procedural planning, and post-procedural monitoring.

Contraindications further guide safe practice. While absolute contraindications — such as patient refusal, local infection, or allergy to local anesthetic — apply universally, block-specific limitations must also be considered. For instance, TAP and subcostal TAP blocks may be inadequate for predominantly visceral pain, whereas QLB approaches may be contraindicated in patients with sepsis or significant coagulopathy. Matching the block type to patient condition, surgical site, and expected pain pattern is therefore essential for optimizing outcomes.

The evolution toward minimally invasive surgery and enhanced recovery protocols has reinforced the utility of fascial plane blocks. Evidence suggests that these techniques provide analgesia comparable to traditional epidural approaches, but with fewer hemodynamic effects and fewer limitations related to anticoagulation or mobility. Multimodal analgesia, combining regional blocks with systemic non-opioid medications, remains the cornerstone of contemporary postoperative pain management, maximizing analgesic benefit while minimizing adverse effects.

Overall, the expanding role of truncal regional anesthesia reflects a paradigm shift toward precision analgesia, patient-centered care, and enhanced recovery. Future research should focus on comparative effectiveness, long-term outcomes, and individualized block selection algorithms, ultimately supporting evidence-based guidelines for optimizing perioperative analgesia in diverse surgical populations.

5. Conclusions

A review of current evidence highlights the efficacy and safety profiles of multiple truncal regional anesthesia techniques for postoperative analgesia. Across all truncal blocks, ultrasound guidance enhances safety and efficacy, reducing the incidence of technical failures and serious complications. All techniques improved postoperative pain control, and facilitation of early mobilization, supporting their role as integral components of multimodal analgesic strategies. Most of them demonstrate significant reductions in opioid consumption. The choice of block should be guided by the surgical site, type of pain (somatic vs. visceral), patient comorbidities, and anticipated risks. (Table 1.)

Table 1. Truncal regional anesthesia techniques - indications, analgesic efficacy, unique considerations.

Block	Indications	Analgesic Efficacy	Unique/Block-Specific Considerations
Transversus Abdominis Plane Block	Lower thoracic and abdominal wall surgery (cesarean, hernia repair, colorectal, gynecologic, urologic)	Effective for somatic pain; reduces opioid use.	Does not reliably cover visceral pain.
Subcostal Transversus Abdominis Plane Block	Upper abdominal surgery via subcostal incision, especially laparoscopic cholecystectomy	Effective for somatic pain; reduces opioid use.	Does not reliably cover visceral pain.
Quadratus Lumborum Block	Abdominal, pelvic, and hip surgeries; cesarean, nephrectomy, hernia repair	Provides both somatic and visceral analgesia; QLB3 offers broadest coverage	May cause lower extremity weakness, hypotension, retroperitoneal hematoma; approach-specific coverage
Rectus Sheath Block	Midline abdominal surgeries, laparotomy, cesarean, gynecologic procedures	Effective for midline somatic pain; reduces opioid use	Limited to midline abdominal wall; does not cover lateral wall or visceral pain
Ilioinguinal / Iliohypogastric Nerve Block	Lower abdominal surgery, inguinal hernia repair, cesarean section	Effective for lower abdominal and inguinal somatic pain	Targeted for L1 innervation; does not cover visceral pain
Intercostal Nerve Block	Thoracic, upper abdominal, breast surgery, cardiac surgery	Effective for somatic pain along intercostal dermatomes; reduces opioid use	Rare but serious: pneumothorax; precise ultrasound guidance recommended
Pectoral Nerve Block Type I Block	Breast surgery (breast conserving, sentinel node biopsy)	Analgesia for anterior chest wall	Targets lateral pectoral nerve only; limited coverage of axilla
Pectoral Nerve Block Type II Block	Breast surgery, axillary surgery, modified radical mastectomy, CIED insertion	Broader chest wall and axilla analgesia; reduces opioids	Covers intercostal nerves (3–6), intercostobrachial, long thoracic nerve
Serratus Anterior Plane Block	Breast surgery, thoracic wall surgery	Effective for lateral/anterior chest wall analgesia	Can be performed superficial or deep; does not cover medial chest wall

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