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Content list available at: www.benthamopen.com/TOATJ/

DOI: 10.2174/1874321801610010040

REVIEW ARTICLE

Analgesic Benefits of Ultrasound-Guided Thoraco-Abdominal Wall Peripheral Nerve Blocks

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Received: August 05, 2016 Revised: November 04, 2016 Accepted: November 16, 2016

Abstract:

Background and Objectives:

Peripheral nerve blocks have been associated with decreased opiate consumption along with decreased associated side effects, improved pain scores, improved patient satisfaction scores, and decreased hospital length of stay. The aim of this review is to describe the use of ultrasound-guided thoraco-abdominal wall peripheral nerve blocks for perioperative analgesia.

Content:

This review article discusses the indications, anatomy, techniques, risks, and available clinical evidence of ultrasound-guided transversus abdominis plane (TAP), paravertebral, PECS, rectus sheath, and ilioinguinal/ iliohypogastric truncal blocks to update practitioners on the utility of these interventions in perioperative pain management.

Conclusion:

The increased use of ultrasound guidance in the performance of regional anesthesia has increased the tools available to physicians to provide analgesia in patients with thoraco-abdominal pain after surgery and trauma.

Keywords: Ultrasound, Thoraco-Abdominal Wall, Analgesic, Nerve Blocks, Postoperative Pain, Surgery.

INTRODUCTION

The use of regional anesthesia for intraoperative and postoperative pain management is becoming more widespread in major thoracic and abdominal surgeries and can be especially useful in the outpatient setting. Truncal peripheral nerve blocks have been used to provide perioperative analgesia in these cases due to their association with decreased opiate consumption and associated side effects, improved pain scores, improved patient satisfaction scores, and decreased hospital length of stay. Additionally, the evolution of regional anesthesia from paresthesia and landmark-based techniques to ultrasound-guidance has been shown to improve the ease of block performance, improve block success rates, and decrease complications [1]. Although epidurals have been the mainstay for postoperative pain management in major thoracic and abdominal surgeries, not all patients are suitable candidates for them and they can be associated with unpleasant side effects, and although rare, debilitating complications.

This review discusses the indications, anatomy, techniques, risks, and available clinical evidence of thoracic paravertebral, PECS I/II, serratus plane, transversus abdominis plane, rectus sheath, and ilioinguinal/iliohypogastric truncal blocks to update practitioners on the utility of these interventions in perioperative pain management.

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THORACIC PARAVERTEBRAL BLOCKS

Indications

Paravertebral blocks are most commonly used for the management of perioperative and acute pain resulting from breast surgery, thoracotomy, herniorrhaphy, and multiple rib fractures. Their use has also been reported for biliary and renal surgery, appendectomy, minimally invasive cardiac surgery, acute post herpetic neuralgia, liver capsule pain, and several other procedures and conditions [2].

Anatomy and Technique

The thoracic paravertebral space is a wedge or triangular shaped area when viewed in transverse cross-section. Inside of this space lie the thoracic nerve roots (lacking a fascial sheath), along with fatty tissue, intercostal vessels, and the sympathetic chain [2, 3]. The thoracic nerve roots leave the intervertebral foramina and divide into the dorsal ramus, which innervates the paravertebral region's skin and muscles, and into the ventral ramus, which becomes the intercostal nerve [4].

The thoracic paravertebral space lies on both sides of the vertebral column, and is formed anteriorly by the parietal pleura. Opposite to that, creating the apex of the triangle with the parietal pleura is the posterior border, formed by the superior costotransverse ligament. The vertebral body, the intervertebral discs, the intervertebral foramina or the articular processes form the base of the triangle. It is not clear where the cephalad limit of the paravertebral space is, but the caudad limit is L1 [2, 4].

The ultrasound may be used to identify the location of the transverse processes and their depth, guiding the placement of the needle and injection of local anesthetic. A recent article by Krediet *et al.* described several approaches to perform paravertebral blocks with ultrasound guidance [3]. Ultrasound examinations performed in the transverse plane place the probe lateral to the spinous process to visualize the transverse process and rib. The probe is then moved caudad until the next transverse process and the pleura are visualized. The needle is advanced lateral to medial, in plane with the ultrasound. The needle is visualized passing through the superior costotransverse ligament as it enters the paravertebral space. Local anesthetic is then injected or a catheter is placed [3]. Single shot blocks tend to be done at multiple levels in the thoracic area with 5-10 ml of local anesthetic at each level. Continuous paravertebral blocks are generally initiated with a large bolus of local anesthetic at a single level that spreads through multiple levels before the infusion is started. For performance of the block in the sagittal plane, the probe is initially placed 5 cm lateral to the midline [3]. The needle is then directed to the space between the internal intercostal membrane and the pleura.

There are several possible complications associated with thoracic paravertebral blockade including hemorrhage and vascular puncture, local anesthetic toxicity, inadvertent pleural puncture and pneumothorax, hypotension, dural puncture or intrathecal injection, and chronic pain [4 - 7]. In general, the rate of complications is low.

Clinical Evidence

Multilevel or single level thoracic paravertebral blockade with either sedation or general anesthesia is a safe and effective anesthetic for breast surgery and is associated with a high degree of patient satisfaction. According to Pusch and colleagues, breast surgery patients receiving thoracic paravertebral blocks have shorter recovery times, require fewer analgesics because they report less post-operative pain, get out of bed sooner, and have an improved quality of recovery after surgery [8]. In addition, Exadaktylos looked at retrospective data and postulated that paravertebral blocks might reduce the risk of recurrence and metastasis secondary to a reduction in perioperative stress response [9]. There are several prospective trials ongoing to test the validity of this hypothesis.

The gold standard for effective pain management after thoracotomy is thoracic epidural, but this method of perioperative pain management is not without complications. Epidurals require close management of perioperative anticoagulation and can be associated with hypotension, dural puncture, and high failure rates. Richardson *et al.* compared thoracic paravertebral infusions with epidural infusions in patients undergoing thoracotomies [12]. The infusions were initiated prior to incision and were continued into the post-operative period and all patients received multimodal analgesia consisting of perioperative opioids and NSAIDS. The paravertebral infusion was shown to be superior to the thoracic epidural regarding pain control and the preservation of pulmonary function [10].

Post-operative pain associated with nephrectomy can be severe due to the long incision and the rib resection, which is common with this procedure. In 2014, Baik and colleagues looked at a single shot thoracic paravertebral block with

IV PCA versus IV PCA alone and found that pain scores and fentanyl consumption were significantly lower in the paravertebral group [11]. Moawad *et al.* compared paravertebral block and general anesthesia with epidural and general anesthesia in patients undergoing open renal surgery and found that paravertebral blockade has similar analgesic outcomes but is associated with greater hemodynamic stability than epidural anesthesia [12].

Blunt chest trauma is a major cause of morbidity and mortality in trauma patients. Patients with multiple rib fractures have severe pain and are at significant risk for progressing to respiratory insufficiency because of poor compliance with chest physiotherapy, ineffective coughing, inability to breathe deeply and sputum retention. Karmakar and colleagues determined that continuous thoracic paravertebral blockade provides effective pain relief and improved both oxygenation and respiratory function [13]. This has been confirmed by multiple case reports and studies that were published in 2003 [14 - 16]. Mohta *et al.* determined that thoracic paravertebral blockade was as effective as thoracic epidural, which has been the standard in treating multilevel rib fractures [14]. A recent Cochrane review showed that paravertebral blocks help prevent the development of chronic pain after breast surgery [17].

Future Research

Ultrasound has largely increased the use of paravertebral blocks for a variety of surgical procedures. These are useful blocks with proven efficacy, and in some cases proven superiority over other more commonly used techniques. Therefore, future research efforts should seek to increase proper utilization of paravertebral blocks, compare them to newer block techniques, such as PECSI/II and serratus plane blocks, and investigate their role in prevention of chronic pain and cancer recurrence.

PECS I, PECS II AND SERRATUS PLANE BLOCKS

Indications

The PECS I block was first described by Blanco in 2011 to treat post-operative breast surgery pain [18 - 20] He suggested it as an alternative to paravertebral blocks and thoracic epidural blockade, both of which can be technically difficult and can have unwanted side effects, especially in the setting of outpatient surgeries where the associated complications of blocks near the spine or lungs are unacceptable. Blanco describes this technique as particularly useful for post-operative pain after placement of breast expanders or subpectoral prostheses [18 - 20], but it could be beneficial for various other chest and thoracic procedures.

In 2012, Blanco described the modified PECS I block, also called the PECS II block, designed to treat pain at the breast and over the serratus muscle not covered by the PECS I block [21]. This block can be utilized for breast lumpectomies, mastectomies and excision of sentinel nodes. The PECS I and II blocks can be used as the primary procedural component of a multimodal analgesic regimen for breast surgery, or used as a rescue block for failed thoracic epidural or paravertebral blocks.

In 2013, Blanco published another thoracic wall nerve block technique, which he and his colleagues called the serratus plane block [22]. This block was developed to anesthetize the lateral intercostal nerves and to provide analgesia to the entire anterolateral chest wall and upper abdomen. Because of this wide coverage, this block can be used perioperatively for breast and shoulder surgery, acutely for thoracic trauma such as rib fractures, and even for chronic pain management of post-thoracotomy pain syndrome.

Anatomy and Technique

The PECS I block targets the lateral and medial pectoral nerves, which originate from the brachial plexus, the lateral pectoral from C5-C7 and the medial pectoral from C8 and T1. It is performed with a linear ultrasound transducer on the chest, near the distal third of the clavicle, aligned parasagitally in a manner similar to the infraclavicular approach to the brachial plexus [18 - 20]. The pectoralis major and pectoralis minor muscles are then identified and 10ml of local anesthetic is deposited into the interfascial plane between these two muscles.

The PECS II block aims to anesthetize the anterior divisions of the thoracic intercostal nerves T2 to T6, the long thoracic nerve, which innervates the serratus muscle, and the thoracodorsal nerve, which innervates the latissimus dorsi. This block is performed in a similar manner as the PECS I block, with a linear ultrasound probe lined up parasagitally as in preparation for an infraclavicular block [21]. The probe is aimed medially, allowing identification of the second rib, and then the probe is moved inferiorly and laterally into the axilla to allow visualization of the 3rd and 4th ribs. Once the 4th rib has been identified, the needle is passed in plane from cephalad to caudad and medial to lateral where 20 ml of local anesthetic is deposited on top of the 4^{th} rib [21].

The serratus plane block is useful for anesthetizing the lateral cutaneous branches of the T2 to T9 intercostal nerves [22]. This block is performed under ultrasound guidance, with a linear ultrasound probe in the parasagittal orientation initially inferior to the middle clavicle. The ribs are counted as the probe is moved inferiorly and laterally until the 5^{th} rib is identified at the mid axillary line. At this point the latissimus dorsi, teres major, and serratus over the 5^{th} rib should be seen. The block is performed by injecting local anesthetic either superficial or deep to the serratus muscle [22].

Clinical Evidence

The PECS I, PECS II and serratus plane blocks are newly described within the last 5 years, therefore, the available data justifying their use is mostly in the form of case reports or in comparison to a non-procedural intervention. Data comparing these blocks to the standards of thoracic epidural and thoracic paravertebral blocks is nonexistent at the time of this review.

The initial presentation of PECS I by Blanco was followed up by an observational study in the Spanish literature looking at 20 patients and describing their pain outcomes [18 - 20]. However, this study did not compare this block to any other therapy or placebo. It is impossible, then, to determine how efficacious the block is until more clinical studies are done.

The original description of PECS II in 2012 by Blanco and colleagues [21] was solely an explanation of the anatomy and performance of the block with anecdotal description of the effectiveness of the block for breast surgery, but without data in its support. In 2015, Bashandy and colleagues published a study randomizing 120 patients to PECS I and II blocks plus general anesthesia versus general anesthesia alone [23]. Patients in the PECS I and II group had statistically significant lower VAS pain scores, lower intraoperative fentanyl use, lower total amount of morphine to keep VAS < 3, shorter PACU stay, lower PACU sedation scores, and shorter post-surgical hospital stays.

Future Research

PECS I and II blocks and serratus plane blocks have been shown to be efficacious for treating post- operative pain in a wide variety of thoracic and breast surgeries. However, their effectiveness in comparison with paravertebral blocks and epidurals, which are the existing standards, will determine whether or not these new procedures will be increasingly utilized in the future. Future clinical research should concentrate on comparing these new blocks to paravertebral blocks and epidurals in terms of analgesic efficacy, ease of performance, and safety.

TAP BLOCKS

Indications

Analgesia produced by transversus abdominis plane blocks has been used for a variety of abdominal procedures. In studies comparing it to placebo, TAP block produces significantly reduced pain scores and opioid requirement in inguinal hernia repair, open appendectomy, laparoscopic cholecystectomy, laparotomy, lower segment cesarean section, hysterectomy, and laparoscopic gynecology procedures [24].

Anatomy and Technique

The transversus abdominis plane block (TAP) was first described by Rafi in 2001 [25]. It is a technique where local anesthetic is injected into the transversus abdominis fascia plane between the internal oblique and transversus abdominis muscles, where the nerves from T6-L1 are located, providing analgesia of the anterolateral abdominal wall [26]. It can be performed by identification of landmarks in the triangle of Petit [25], or by direct visualization of the plane under ultrasound guidance [27]. The use of ultrasound guidance has greatly increased the use of this technique in recent years. It has been suggested as a component in a multimodal analgesic approach to enhance recovery after abdominal surgery [28].

Clinical Evidence

Laparoscopic Surgery

Several studies have demonstrated the efficacy of TAP blocks in providing postoperative analgesia for patients undergoing laparoscopic cholecystectomy [29]. A study by Peterson *et al.* showed a significant reduction in pain scores with coughing and a decrease in opioid requirements in patients receiving TAP block versus placebo [26]. In a study by El-Dawlatly [30], patients who received a TAP block for their laparoscopic cholecystectomy required significantly less intraoperative and postoperative opioids. Ra [31] showed a reduction in pain scores and opioid consumption during the first 24 hours after surgery in patients who received a TAP block. However, Ortiz [32] found no significant difference in pain scores and analgesic consumption between patients who received TAP blocks and local infiltration of port sites with 0.5% ropivacaine.

A study by Sandeman [33] compared TAP blocks to no block in pediatric patients undergoing laparoscopic appendectomy. All patients also received port site local anesthetic infiltration. The TAP block offered no decrease in morphine use or recovery time.

One study looked at the use of TAP blocks to treat pain after laparoscopic colorectal surgery [34]. Bilateral TAP blocks were associated with significantly less morphine consumption however, no difference in pain scores. Another study looked at the benefit of TAP blocks in laparoscopic bariatric surgery and found lower pain scores and decreased analgesic requirements in the TAP block group [35].

Open Abdominal Surgery

There is data comparing TAP block with placebo in patients receiving open abdominal surgery. A meta-analysis by Champaneria [36] on the use of TAP block when compared to placebo for analgesia after open gynecological surgery showed less pain at rest and movement 2 hours after surgery but not at 24 hours in patients receiving a TAP block. The investigators also found decreased morphine use at 24 hours but not at 48 hours in the TAP group.

Studies on other open abdominal procedures such as colorectal surgery [37], large bowel resection [38], and open appendectomy [39] have shown than when compared to placebo, TAP block reduces opiate requirements in the first 24 to 48 hours. A meta-analysis by Johns *et al.* showed TAP blocks reduce postoperative morphine requirements as well as nausea and vomiting when compared to placebo [28].

A systematic review by Yu [40] compared TAP block to local anesthetic wound infiltration. The surgical procedures were varied but were all non-laparoscopic abdominal surgery [41 - 44]. The data showed lower pain scores 24 hours postoperatively in the TAP block patients, but no difference in 24-hour morphine requirements or pain scores at 2 and 4 hours after surgery. In this study, TAP block does show a longer duration when compared to infiltration [40].

Pediatric Patients

A recent study on children under the age of 15 undergoing non-laparoscopic abdominal surgery found no difference in the incidence of inadequate pain control between patients receiving a TAP block, local wound infiltration with bupivacaine 0.25%, or no block [45].

Future Research

There is a great deal of published research on TAP block for a variety of surgical procedures. A meta-analysis by Baeriswyl in 2015 of 1611 patients receiving TAP block for laparoscopy, laparotomy and Cesarean section showed a reduction in IV morphine consumption as well as reduced pain scores at rest and movement at 6 hours after surgery [46]. A newer ultrasound-guided posterior approach to the TAP block, called a quadratus lumborum block, has been recently described in case reports and series. It shows promise as an additional block for treatment of pain after supraumbilical abdominal surgery [47 - 49]. Additionally, the transversalis fascia plane block was first described in 2010 by Hebbard and was developed to block the proximal portions of the T12 and L1 nerves, which tend to be missed by the TAP block [50]. A small retrospective study showed lower perioperative opioid consumption and pain scores in patients undergoing anterior iliac crest bone graft harvesting [51]. In the near future, we hope to see studies that better define the clinical characteristics of both the quadratus lumborum and transversalis fascia blocks and studies that compare the TAP block to local anesthetic infiltration and epidural technique for postoperative pain management.

RECTUS SHEATH BLOCK

Indications

Schleich first described the rectus sheath block (RSB) in 1899 in adult patients to relax the abdominal wall [52]. The RSB is useful for postoperative pain management in surgeries involving vertical midline The RSB has been used most widely for umbilical hernia repair, especially in the pediatric population. Additionally, the RSB is useful for postoperative pain management in surgeries involving vertical midline incisions and single-incision laparoscopic surgeries.

Anatomy and Technique

Blockade of the nerves located in the rectus sheath results in analgesia in the periumbilical area, most often spinal dermatomes 9, 10, and 11. The rectus abdominus muscle is oval-shaped and lies under the superficial fascia on either side of the midline of the abdomen. The connective tissue surrounding the rectus abdominus muscle forms the rectus sheath and joins in the midline to insert into the linea alba [53]. The 7th, 8th, 9th, 10th, and 11th intercostal nerves and small epigastric vessels are located in the potential space between the rectus abdominus muscle and its posterior rectus sheath. Deep to the rectus sheath is peritoneum and bowel [54].

With the patient in the supine position, a high-frequency linear ultrasound probe is placed immediately lateral to the umbilicus. The needle should be inserted in-plane in a medial to lateral orientation so that the needle can be visualized passing through the subcutaneous tissue, the anterior rectus sheath, and the rectus abdominus muscle. Local anesthetic should be deposited in the potential space between the rectus muscle and the posterior rectus sheath. Care should be taken to avoid puncturing the epigastric vessels and the peritoneum. In children, 0.1ml/kg of local anesthetic per side is effective for analgesia while in adults, 10ml of local anesthetic per side usually provide adequate blockade [53].

The inferior epigastric artery and vein run posterior to the rectus abdominus muscle. Inadvertent intravascular injection and retroperitoneal hematoma have been reported [55]. Bowel puncture is also a possible complication given that the needle is near the peritoneum and bowel when the tip is posterior to the rectus muscle. Dolan *et al.* demonstrated that ultrasound-guidance significantly improved the accurate placement of local anesthetic as compared to the loss of resistance (LOR) technique [56]. In this study, the placement of local anesthetic by LOR was accurate in only 45% of attempts with 34% superficial to the rectus sheath and 21% of punctures deep to the rectus sheath and thus, intraperitoneal [56]. A multicenter study by Polaner investigated the incidence of complications in pediatric regional anesthesia and of the 294 RSBs performed, 257 were done under ultrasound (87%) and there were no adverse events [57].

Clinical Evidence

RSBs and rectus sheath catheters are effective at relieving somatic pain only. Visceral pain must still be controlled with supplemental analgesia. Multiple studies have looked at the effectiveness of the RSB at reducing post-operative pain in children undergoing umbilical hernia repair. In a prospective randomized clinical trial, Dingeman compared the efficacy of ultrasound-guided RSB with local anesthetic infiltration (LAI) in 52 pediatric patients [58]. Median pain scores were lower in the recovery room at 10, 30, 40 minutes and later in patients that received RSBs compared to those that received LAI. There were no significant differences in use of opioid and non-opioid medications between the treatment groups at any time in the recovery room or after discharge [58]. A randomized, prospective study by Gurnaney compared the use of opioid medication in patients who received RSB with those that received LAI for umbilical hernia repair [59]. Patients that received a RSB required less opioid perioperatively. Postoperatively, opioid use was not significantly different between the two groups although there was a trend towards less opioid consumption in the RSB group [59]. Based on the available studies, RSB only seems to be marginally better than LAI of the wound site for postoperative pain control in children undergoing umbilical hernia repair [60].

In adults, rectus sheath blocks were found to be effective as part of a multimodal approach to analgesia in larger abdominal surgeries. Bashandy *et al.* randomized 60 patients who were undergoing midline laparotomies for radical cancer resections to receive RSB with general anesthesia or general anesthesia alone [61]. Not only were pain scores significantly lower in the RSB group postoperatively, but also morphine consumption was less and consequently patients developed fewer side effects like respiratory depression, excessive sedation and postoperative nausea and vomiting [61]. In a retrospective case review of 98 patients undergoing major gynecologic surgery for benign or malignant disease, patients who received a rectus sheath block performed by the surgeons intraoperatively had lower pain scores on waking, required less morphine postoperatively, had their patient controlled analgesia (PCA) discontinued sooner, and went home earlier than patients receiving standard subcutaneous infiltration of the wound [62]. Overall, the evidence indicated that the rectus sheath block provides significant analgesia as part of a multimodal approach for surgeries involving a major abdominal incision. RSBs appear to be an effective analgesic option in patients who are not suitable candidates for epidural analgesia.

Future Research

The current evidence indicates that ultrasound guidance is associated with higher block success rates than traditional techniques. However, larger studies with higher statistical power need to be conducted to demonstrate a safety advantage of ultrasound. Further research should evaluate the safety and utility of continuous infusion rectus sheath catheters. Additionally, the effects on duration of action and efficacy from combining various adjuncts to the local anesthetic should be investigated.

ILIOINGUINAL/ILIOHYPOGASTRIC BLOCK

Indications

Ilioinguinal and iliohypogastric (IL/IH) nerve blockade was first introduced in the 1980s in the pediatric population and then was later used in the adult population. The block of the IL/IH nerves results in loss of sensation to the hypogastric region, the inguinal crease, the upper medial thigh, the mons pubis, part of the labia, the root of the penis, and the anterior part of the scrotum [53]. The IL/IH block has been used to provide effective analgesia for obstetric, gynecological, inguinal and groin surgeries.

Anatomy and Techniques

The IL/IH nerves are located in the fascial plane between the internal oblique muscle and the transversus abdominus muscle. The American Society of Regional Anesthesia recommends ultrasound as the preferred localization technique for IL/IH blocks. The ultrasound probe should be placed medial to the anterior superior iliac spine with the patient in the supine position. An in-plane or an out-of-plane technique can be utilized with the patient under general anesthesia. A volume of 10 ml of local anesthesia for adults and 0.15ml/kg (0.5% ropivacaine) for children is usually sufficient for effective postoperative analgesia [53].

Case reports of complications associated with the IL/IH block include bowel hematoma, bowel puncture [63], pelvic hematoma [64], and femoral nerve block [65]. High plasma levels of local anesthetic have also been associated with IL/IH block [66 - 68].

Clinical Evidence

IL/IH blocks are used widely to provide postoperative pain management for surgeries involving the inguinal region. A prospective, randomized controlled trial by Abdellatif compared caudal blocks with IL/IH nerve blocks in 50 children undergoing unilateral groin surgery and found lower pain scores along with longer time to first rescue analgesia in the IL/IH group [69].

Weintraud demonstrated the superiority of ultrasound over the landmark-based technique for IL/IH nerve blockade in children undergoing inguinal hernia repair. IL/IH blocks were performed based only on landmarks in this study and in 86% of the blocks, the local anesthetic was found to be incorrectly administered in adjacent anatomic structures instead of around the IL/IH nerves [70]. Another study in children demonstrated that IL/IH nerve blocks can be successfully achieved with significantly smaller volumes of local anesthetic with the use of ultrasound over the landmark-based approach and that intra- and postoperative analgesic requirements are lower with the ultrasound-guided block [71].

The data in adults appears no different. Randhawa used ultrasound to assess the precision of needle placement in blind ilioinguinal nerve blocks and found that in nine of the twenty-one subjects (43%), the needle tip was incorrectly placed deep to the transversus abdominus muscle [72]. The efficacy of IL/IH nerve blocks performed with ultrasound guidance was compared with anatomical landmark techniques for postoperative pain management in cases of adult herniorrhaphy. Postoperative VAS scores were lower, patient satisfaction scores were higher and both duration of hospital stay and time to first mobilization were shorter in the ultrasound-guidance group [73]. IL/IH nerve blocks have also been used successfully as the primary anesthetic for herniorrhaphy and can be considered as an alternative for patients who are not good candidates for neuraxial or general anesthesia [74].

IL/IH blocks can also be beneficial for gynecologic surgery and cesarean section. IL/IH blocks significantly decrease post-Cesarean delivery morphine requirements [75] and when compared to neuraxial morphine alone for post-cesarean analgesia, IL/IH blocks are associated with lower VAS scores, lower analgesic requirements, and greater patient satisfaction [76]. There are also case reports of IL/IH catheters being placed for pain relief after cesarean delivery [77]. In female patients undergoing non-laparoscopic hysterectomy or prolapse repair with a Pfannenstiel incision, bilateral IL block decreased postoperative morphine consumption by half [78].

Future Research

As mentioned above, the available data indicate that ultrasound guidance, when compared to traditional landmark techniques, has a higher probability of block success for IL/IH blocks. However, there is not enough recorded data and further studies need to be performed to demonstrate a safety advantage of ultrasound over blind techniques when used with this block. Additionally, further studies should be designed to address the role of IL/IH blocks in chronic pain prevention associated with hernia repair. There is a paucity of literature regarding the use of IL/IH blocks in gynecological and female pelvic procedures. Prospective randomized controlled studies to evaluate the safety and effectiveness of continuous IL/IH blocks for post cesarean sectional analgesia are in progress.

CONCLUSION

The increased use of ultrasound guidance in regional anesthesia has given physicians additional tools to treat thoraco-abdominal pain after surgery and trauma. Many of these techniques are useful in providing analgesia as part of a multimodal approach to pain management after surgery. As more studies are published that assess the efficacy of these ultrasound-guided truncal blocks in various surgical procedures, we should be able to ascertain which of these techniques should become standard of care and how to best perform them.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

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