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Benefits of Interfascial Plane Blocks for Acute Pain Management: A Narrative Review

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ABSTRACT

Fascial plane blocks have become an innovative pain control technique as a part of multimodal analgesia. The objective of the current narrative review article is understanding the benefits of fascial plane blocks for acute pain management in trauma cases. Fascial plane blocks have the capacity for well-tolerated and successful analgesia modality as part of a multimodal pain reduction protocol for thoracic trauma patients, surgical patients and abdominal surgeries. For thoracic surgical patients, the pectoralis and serratus anterior plane blocks can provide effective analgesia of the lateral chest wall. The plane block of erector spinae provides more comprehensive analgesic scope. SAP block has benefits in thoracic surgery over local analgesia which may act as a supplemental thoracic analgesic strategy. Clavipectoral fascia blocks provide good analgesia for clavicle trauma cases and clavical surgeries in the postop period. Ultrasound technologies greatly increased the TAP blocks success rate and protection. QL block, ESP block, rectus sheath blocks, transversalis fascia plane blocks helps in decreasing the pain in abdominal surgeries. The current research suggest that as part of a multimodal approach, the fascial plane blocks will have benefit with the goal of reducing or even removing ongoing opioid treatment for patients recovering from severe pain. These blocks helps in decreased use of intravenous analgesics and benefits from their adverse effects. The current review suggests that further prospective and randomized controlled trials and case reports on new and broader series be needed.

Keywords: Fascial plane blocks, acute pain management.

INTRODUCTION

Epidural, paravertebral blocks are widely used for postoperative analgesia management of thoracic, abdominal surgeries. Fascia plane is a plane which includes a layer of fibrous tissue covering muscles, arteries and nerves. The nerves are passing in between the two fascial planes. This is mainly made of collagen, and often found under the skin that binds, stabilizes, encloses and divides muscles.[1]Facial planes will be identified by ultrasound, CT, MRI, PET Scan. Fascial plane blocks by using ultrasound are important multimodal analgesia technique in pain control. In recent years, owing to the progress in the ultrasound-guided block technique and understanding of the musculoskeletal ultrasound anatomy, numerous papers testing modern ultrasound-guided fascial plane blocks have been published. Furthermore, ultrasound guidance is helpful when conducting fascial plane blocks, and the right fascial plane to which local anesthetics should be deposited is calculated using the ultrasound picture.[2]The local anaesthetic has to be deposited in fascial plane and therefore demands an sufficient amount.[3] The volume of local anaesthetic drug should be more than the single nerve block so as to have a good pain relief. Lidocaine, Prilocaine, Mepivacaine are local anesthetics medications with moderate effect with identical pharmacodynamic profiles, except that mepivacaine has a significantly longer period with operation than lidocaine. Commonly used are Ropivacaine which is less cardiotoxic than bupivacaine and is also a common alternative for large-dose fascial plane blocks of high volume. Blocks of fascial planes are considered to be at low risk of nerve injury and a relatively simple technique. Blocks on fascial planes have variable efficiency. And, not every block of fascia planes is equal. A sequence of TAP block derivations (e.g., subcostal TAP), Pectoralis (Pecs) I and Pecs II, anterior serratus and lumborum quadrate (QL) blocks, transversalis fascia block, and erector spinae plane (ESP) block succeeded the transversusabdominis plane (TAP) block and proceeded rapidly. Several fascial plane blocks, such as the plane transversusabdominis and rectal sheath blocks, are commonly used by abdominal surgery cases.[4] In the recent decade many new interfascial plane blocks have been developed in an effort to improve safe, effective, efficient and inexpensive peri-operative pain management. With comparatively few high-quality scientific studies of the interventions and how they impact perioperative results, nearly all of the blocks were commonly incorporated into clinical practice recntly. Many specific procedures in breast surgery have been identified for perioperative analgesia. Not only can nearly all of the blocks control acute post-operative

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pain, they also help reduce persistent post-surgical pain.

A) Cervical fascial plane block: erector spinae plane block

The block erector spinae plane (ESP) was first described by Forero et al. in 2016 for the treatment of thoracic neuropathic pain. Several reports have confirmed its analgesic effects for therapeutic conditions ranging from anxiety pain to amputation of the transfemoral leg. The cervical fascial plane block is useful for surgery with the cervical spine. Throughout the age of minimally intrusive treatment, blocks of the erector spinae plane can be helpful in some cases.[5]Cervical ESP block useful in shoulder surgeries and cervical spine surgeries for postop analgesia. Continuous C7 ESP block with catheter provides good analgesia for shoulder surgeries in the postop period.

B) Thoracic fascial plane blocks:

The lateral chest wall has been covered with several fascial planes, these fascial plane blocks help in pain relief during the postoperative period. When part of a multimodal pain management protocol, the thoracic fascial plane blocks provide a well controlled and successful analgesia for thoracic surgical patients. Fascial plane blocks of the chest wall (CWFPBs), primarily used for breast surgery, have recently been incorporated into thoracic surgery. Such specific strategies more peripherally anesthetize the intercostal tactile nerves as they pass through the muscle membranes, thereby avoiding the neuraxium.[6]

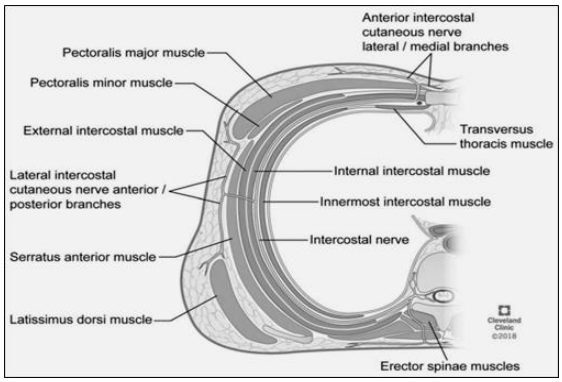

Figure 1: Anatomy of Chest wall Source: Marciniak et al (2019)

PEC I & II block: PEC stands for Parts 1 and 2 of pectoralis. The pectoralis (PECS) 1 is meant to anesthetize the lateral and medial pectoral nerves by depositing local anesthetic between the pectoral major and minor muscles in the fascial axis. Although mainly sensory nerves, blockage may be useful when transecting muscles. PECS 2 includes deposition of the local anesthetic between pectoralis minor and serratus anterior muscles. This block anesthetizes the lateral T2–T6 branches of intercostal nerves, intercostobrachial nerves, and large thoracic nerves. Therefore the PECS 2 occupies most of the lateral anterior chest wall to the midclavicular axis and stretches to the midaxillallary side.7 PEC I &II blocks are used as a part of multimodal analgesia techniques in cases of breast surgeries.

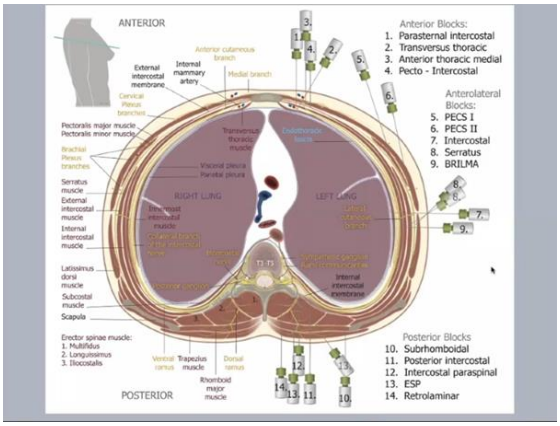

Figure 2: Blocks of Chest wall

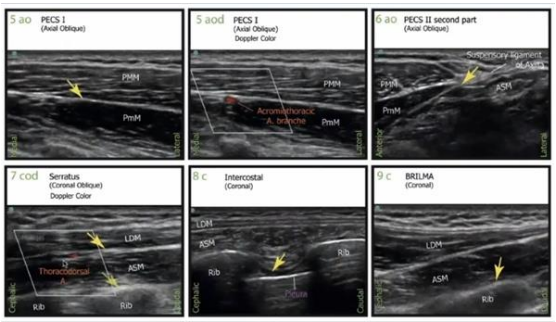

Figure 3: Sonoanatomy of different blocks

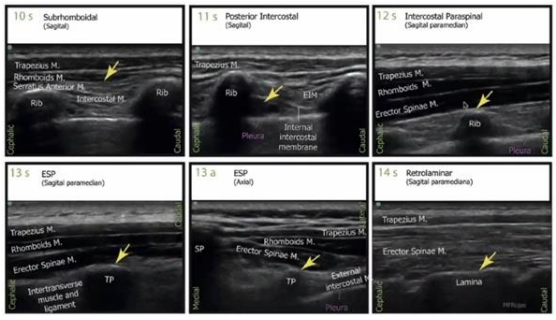

Fig 4: Sonoanatomy of different blocks

SAP (Serratus anterior plane) block:

The block serratus anterior plane (SAP) anesthetizes the lateral cutaneous branches of the intercostal nerves at estimated rates T2–T9 by deposition of the local anesthetic in the fascial plane between the latissimus dorsi and the anterior (superficial) serratus muscles or the anterior (deep) serratus muscles of the anterior and anterior ribs. The SAP block is performed either supine or laterally. Alternatively, this block can be inserted until the patient is laterally prepared for surgery. Specific anesthetic injection of serratus muscle is achieved either superficially or profoundly.8SAP blocks help in pain relief for cases like multiple rib fractures, thoracic surgeries.

Erector spinae plane block:

Initially the erector spinae plane (ESP) block was identified as a 'paravertebral block by proxy' for the treatment of chronic thoracic neuropathic pain. This block anesthetizes the spinal nerves' unilateral dorsal which ventral rami, which produces analgesia in a manner identical to a PVNB. Local anesthetic is administered anterior to the muscle of the erector spinae, and travels craniocaudad, 5–9 thoracic stages, inside the costotransverse foramen zone. Ultrasound-guided ESP blocks are performed in the posture of sitting, lying, or lateral decubitus. Local anesthetic (10–20 ml) is injected and the erector spine muscle is raised away from the transverse process. As contrasted with SAP blocks, ESP blocks produced superior analgesia and improved time for first analgesic requirements.[9] Used in thoracic surgeries, multiple rib fractures etc.

Transverse Thoracic Plane Block:

The transversal thoracic plane block (TTPB), previously known as the parasternal plane block, is a regional procedure that delivers analgesia to the anterior medial chest wall which may also decrease pulmonary morbidity and the need for large-dose of opioids. Despite a large prevalence of persistent pain in the surgical community, TTPB appears to be a valuable tool in the arsenal of anesthesiologists. The muscle plane block transversus thoracis (TTP) is a recently evolved regional anesthesia procedure that delivers analgesia to the anterior chest wall. This method has been used since its implementation for a wide variety of surgical operations as well as for non-operative indications.[10]

Intercostals nerve blocks:

Intercostal sections of the nerves (ICNBs) are not called chains of fascial planes. Instead, local anesthetic is injected between the internal intercostal membrane and the endothoracic fascia or parietal pleura, typically 7-8 cm lateral, to anesthetize the intercostal nerve as it passes through the inner and innermost intercostal muscles. Such blocks may be performed with clear vision, visual instruction in the surgical area, or with ultrasound percutaneously.[11]

Clavipectoral fascia plane block:

The Clavipectoral Fascial Plane block was first described at the Regional Anaesthesia Congress of the European Society of 2017. Previously, discomfort can be treated with a combination superficial cervical plexus-interscalene block following clavicle fracture operation, and lately with the clavipectoral fascia plane block (CPB). This can be used during clavicle surgery to relieve postoperative analgesia. CPB can be an alternative to the brachial plexus barrier at interscalene. This is an easy and extremely effective treatment and can provide anesthesia for clavicle fractures and sustained analgesia. CPB can be an alternative to the interscalene brachial plexus block, with this benefit and its analgesic potency for clavicle surgery.[12]

C) Abdominal facial plane blocks:

The abdominal wall pain after surgery is significant cause of discomfort. There are many of the fascial plane blocks are performed to relieve the postoperative pain.

Erector spinae plane block

One of the newest interfascial techniques with potential applications is the Erector spinae plane (ESP) device. ESP block is an interfascial block that can be conducted with a deep or shallow needle approach. As described earlier erector spinae plane block (ESP) is an interfascial plane block where a local anaesthetic is injected into a plane ideally below the tendon of the erector spinae. It emerged as an important, safe regional analgesic technique. It has a broad variety of uses ranging from immediate postoperative pain management to persistent pain regulation. ESP block has arisen as an successful novel regional strategy with productive analgesia with fewer opioid requirements. For thoracic surgery or rib fractures, ESP block often helps with improved lung expansion, superior analgesia, enables patients to cough, wean mechanical breathing, and early ambulation, as seen by others. It has broad pain management uses ranging from postoperative severe pain in breast surgery, thoracotomy, and abdominal surgeries like post lapcholecystectomy, to persistent neuropathic pain. The erector spinae plane block (ESP) is a modern analgesic method that may be used to produce analgesia with a number of surgical operations or to relieve severe or persistent pain. The procedure is fairly simple to conduct on individuals, and is performable in the pre-operative processing area with limited to no sedation. The ESP block may be used either for a single-injection technique or for continuous infusion by catheter placement. The first study on the successful use of this treatment came in 2016; the block was used to treat thoracic neuropathic pain in a woman with rib and rib fractures metastatic disease. The ESP system may be used to provide localized analgesia in the anterior, dorsal, and lateral thoracic and abdominal regions with a broad range of medical operations as well as for the treatment of acute and persistent pain syndrome. Infection at the injection site or patient rejection is absolute contraindications to execute an ESP block. Anticoagulation can constitute a relative contraindication to ESP block.[13] Lumbar ESP blocks are used for post hip surgeries. Sacral ESP block is a useful for treating the radicular pain patients.

Quadrates lumborum block

In 2007, anesthesiologist Dr. Rafael Blanco identified it as a variation of the TAP system. Years

later, using the acronym QLB, he provided a comprehensive summary of the block technique. Quadratus lumborum block may trigger local anesthetic delivery to the lumbar plexus and sustained motor obstruction, slowing mobilization and discharge from hospital. The proximity of quadratus lumborum block to pleura and kidney in the anterior subcostal approach presents a concern due to the immediate needle trauma. For its efficient and healthy usage, an awareness of the related anatomy and functional aspects of the quadratus lumborum block is important. Ultrasound-guided quadratus lumborum block (QLB) is growing in popularity for multiple surgical procedures in regional anesthesia. In the last few years, Quadratus lumborum block (QLB) under ultrasound guidance has become one of the interfascial plane blocks popularized in anesthesia, hence the large amount of indications in pediatric and adult abdomino-pelvic procedures. In clinical trials, opioid avoidance and sustained post-operative analgesia have also been shown when opposed to more traditional treatments such as TAP. After laparoscopic gynecological surgery, the posterior quadratus lumborum block is associated with reduced postoperative pain scores, and reduced need for rescue analgesia after lower abdominal surgery.[14]

Transversalis fascia block

The section of transversalis fascia plate, or section of TFP, is a component of the truncal muscles. The TFP block affects the ilioinguinal and iliohypogastric nerves between the transversalis abdominal muscle fascia and the transversalis fascia. The class TFP is distinct in a variety of respects from the main transversus abdominis plane (TAP). The TFP block is done to block the divisions of the L1 nerve which are not adequately protected by the TAP block. Although the TAP block does, the TFP block does not protect the dermatomes between L1 and T12. Local anesthetic for the TFP block is administered directly into the transversus abdominis muscle and localized to the TAP block muscle. Unlike the classic ultrasonic-guided TAP block, the TFP injection site is posterior to the mid-axillary side. Hebbard first identified ultrasound (US)-guided transversalis fascia plane block (TFPB) as a technique for blocking the T12–L1 nerves. While this procedure tends to be identical to the quadratus lumborum 1 method, the injection point is more caudal and anterior, targeting ilioinguinal and iliohypogastric nerves in particular.[15]

Rectus sheath block

In 1989 Schleich identified the rectal sheath block for the first time as a way of promoting surgery affecting the anterior abdominal wall in adults. The goal of the rectus sheath block technique is to block the terminal divisions of the 9th , 10th and 11th intercostal nerves that pass through the inner oblique and transversus abdominis muscles to reach the rectus abdominis muscle's rectal wall and end up in an anterior cutaneous branch that supplies the umbilicus area. The most commonly defined procedure is a blind method that moves the needle through the anterior rectal sheath and through the muscle of the rectus abdominis and injects the local anaesthetic on the rectal sheath's posterior side. As several fascial plane blocks, rectal sheath blocks are commonly used as normal analgesic procedures in routine clinical practice for patients undergoing abdominal surgery. Recently, rectus sheath block is seen most commonly in paediatric patients. In addition, rectal sheath block is likely to be effective in identified patients undergoing basic periumbilic operation, especially those in which there are elevated complications involved with general anesthesia or central neuraxial blockage.[16]

The rectus sheath block tends to have denser analgesia with a shorter length compared with the transversus abdominis plane block. The rectal sheath block is therefore only effective for extended postoperative analgesia if continuous catheters are inserted into the posterior rectal sheath with routine dosing of local anaesthetics. The rectal sheath block is not consistent with the neural sympathectomy that follows central neuraxial blockade, thereby preventing haemodynamic changes usually seen in such a blockade. In comparison, rectus sheath block is a feasible alternative in the case of relative coagulopathy, and recent usage of antiplatelets or anticoagulants, unlike neuraxial blockade. Continuous rectus sheath block often provides the greater stability benefit. This blends superb analgesia with the retention of limb power with no compulsory attachment to the infusion systems, allowing patients to regain early movement. It will turn into significant health advantages such as the potential for decreased frequency and seriousness of deep venous thrombosis and pulmonary embolism, reduced risk of atelectasis and respiratory failure. In fact, the rectal sheath catheter should be implanted comfortably under general anaesthesia, preventing patient pain and anxiety, which may arise in an alert patient during epidural injection. This theoretically improves patient tolerance of sheath block receiving rectus. Ultrasonography-guided rectal sheath blocks provide considerable advantages such as offering non-invasive anatomy visualization, enabling real-time needle direction, and allowing local anaesthetic distribution throughout the appropriate tissue plane to be examined.[16]

TAP block: In 2001, Rafi first identified the transverse abdominis plane (TAP) block as a typical blind landmark strategy, utilizing Petit's lumbar triangle. This is a peripheral block of the nerves supplying the anterior abdominal wall (T6 to L1) intended to anesthetize them. TAP blocks are a perfect complement to an analgesic multimodal treatment. The absence of adequate visceral pain

relief with TAP blocks that therefore involve alternate analgesic modes. Using ultrasound blocks, transversus abdominis plane (TAP) can provide effective relief of somatic incisional pain. TAP is a possible anatomical area between transversus abdominis and internal oblique muscles, where local anesthetics may be injected, forming a non-dermatomal "field barrier". Normally, one quadrant of the abdominal wall is analgesic with each TAP block. One big drawback of the TAP system is that although it offers somatic analgesia, analgesia for acute pain is not given. Contraindications of TAP blocks include: patient rejection, effective injection site contamination, use vigilance in patients requiring anticoagulation, even in women with distinct anatomical characteristics, even prevent local anesthetics of others with established allergies. TAP blocks have been a significant feature for the treatment of multimodal pain in abdominal wall surgery. The block provides, comfort, and effectiveness render it an outstanding complement to perioperative pain control.[17]

D) uses of each blocks

a) **Thoracic fascial plane blocks:** The thoracic fascial plane blocks are used in thoracic surgery, cardiac surgery, breast surgery, multiple rib fractures and neuropathic pain.[6]

b) **Abdominal fascial plane blocks:** Abdominal fascial plane blocks are useful in caesarean sections, hysterectomies, gynaecological operations, nephro / renal / kidney surgery, lateral cholecystectomy.abdominal surgery, and abdominal trauma.[7]

c) **PEC I & II block:** PECS blocks are deemed an efficient analgesic technique for incisions affecting the anterolateral breast, and were examined during mastectomy for postoperative analgesia. The data of their efficacy in thoracic surgery is largely restricted to case studies. PECS blocks alone may provide partial relief in thoracic surgical procedures due to the limited area they cover, possibly lacking more lateral chest wall incisions, or distal chest tube sites. PECS blocks is often seen in minimally invasive cardiac and thoracic procedures requiring anterolateral chest incisions.[7]

d) **SAP (Serratus anterior plane) block:** SAP blocks are used most commonly in thoracic surgery, since they have shown improved effectiveness in the thoracic surgical community.[8] Also used in cases of chest trauma like multiple rib fractures.

e) **Erector spinae plane block:** Previous studies on the effective usage of the ESP block for postoperative pain relief of abdominal and chest wall (breast, thoracic, and sternal) incisions have been released.[9]

f) **Transverse Thoracic Plane Block:** Uses include sternotomy, sternal fractures, medial rib fractures, regional breast procedure treatment and anterior positioning of a tunneled pacemaker or cardioverter-defibrillator implantation. Current research shows that the TTP block offers appropriate analgesia for breast and heart reconstruction, cardiac implantation, pericardiocentesis and the treatment of acute and chronic pain.[10]

g) **Intercostals nerve blocks:** Acute handling of pain in cases of surgeries, rib injuries, postoperative diagnosis of pain.[11]

h) **Clavipectoral fascia plane block:** Many recent reviews of the positive usage of the CPB block for postoperative pain relief and efficient analgesia following clavicle surgery have been reported.[12]

i) **Erector spinae plane block:** It has been documented that this block has been widely used in a multitude of procedures including Nuss technique, thoracotomies,breast surgeries,shoulder surgeries, percutaneous nephrolithotomies, ventral hernia repair, and even lumbar fusions along with hip surgeries and radicular pain management.[13]

j) **Quadrates lumborum block:** Successful application of quadratus lumborum block was made for the following surgical procedures: proctosigmoidectomy, hip replacement, amputation of the upper knee, restoration of the abdominal hernia, removal of the colostomy, extreme nephrectomy, spinalsurgeries,surgeries of the lower extremities, complete hip arthroplasty, laparotomy, and colectomy.[14]

k) **Transversalis fascia block:** Transversalis fascia plane block used in the diagnosis of recurrent postherniorrhaphy with local anesthetic and steroid.[15]Also used in procedures like open appendicectomy.

l) **Rectus sheath block:** The method was first used before the counterpart to the neuromuscular block for abdominal wall muscle relief during laparotomy. Currently, following repair of the umbilical or incisional hernia and other midline surgical incisions, it is used for post-op analgesia.[16]

m) **TAP block:** Popular indications for TAP blocks include significant abdominal surgery, colorectal surgery, hernia reconstruction, abdominal wall surgeries, and Cesarean section.[17]

E) drugs used: types, dosages:

The most common drugs and dosages involved are Bupivacaine (10 ml of 0.25%), ropivacaine with concentration ranging from 0.25% to 0.5%. Lignocaine 2% is also used in these blocks.

F) MONITORING of the blocks

The monitoring, as with other regional anaesthesia blocks or anyother anaesthesia techniques, it should include common protocols such as electrocardiogram, non-invasive blood pressure and oxygen saturation. In addition to the anaesthetist performing the block , appropriately qualified nurses should be present and all the equipments for resuscitation should be available.

G) Complications of each block

a) **Thoracic fascial plane blocks:** Potential thoracic fascial plane blocks risks involve vascular puncture, pneumothorax, intrathecal or epidural distribution, and sympathetic obstruction that contributes to haemodynamic instability.[6]
b) **Abdominal fascial plane blocks:** Complications are due to a lack of clinical knowledge and experience with needles.[7] Complications may occur like perforation of intra abdominal structures etc.
c) **PEC I & II block:** Complications associated with the PECS I and II block have been reported, such as pneumothorax.[7]
d) **SAP (Serratus anterior plane) block:** SAP complications include, vascular injuries, pleural puncture, pneumothorax.[8]
e) **Erector spinae plane block:** Erector spinae plane block is a popular alternate procedure with a reduced chance of severe complications such as epidural hematoma or epidural abscess of thoracic epidural anesthesia.[9]The complications may occur in the form of epidural/paravertebral spread of the drug and its complications.
f) **Transverse Thoracic Plane Block:** TTPB, like vascular and pericardial puncture, pneumothorax, LAST, inflammation and nerve injury, is not without its dangers.[10]
g) **Intercostals nerve blocks:** Complication risk from an intercostal block of nerves is less. Throughout the injection site, though, there may be bruise or soreness. Serious complications are uncommon including infection, collapsed lung, nerve damage and bleeding.[11]
h) **Clavipectoral fascia plane block:** Complications concerning block clavipectoral plane fascia are very uncommon.[12]
i) **Erector spinae plane block:** Complications are very uncommon, since the injection site is well removed from pleura, large blood vessels, and the spinal cord. The main risks include needle position inflammation, local anesthetic toxicity / allergy, vein puncture, pleural puncture, pneumothorax, and failed block.[13]
j) **Quadrates lumborum block:** Lower extremity fatigue with quadratus lumborum block has been identified contributing to restriction of mobilization and extended hospital stay. Weakness of Quadriceps and hypotension were stated to be more frequently correlated with anterior quadratus lumborum block.[14]
k) **Transversalis fascia block:** Complications concerning transversalis fascia block are very uncommon.[15]
l) **Rectus sheath block:** Injection into the peritoneal cavity may result in block failure and increasing incidences of perforation of the intestine or puncture of blood vessels, typically the inferior epigastric vessels. Another possible risk of RS block due to artery damage through needle or catheter insertion is the rectus sheath haematoma. RSB has few problems that can be minimized by the usage of ultrasound guidance.[16]
m) **TAP block:** Complications connected with TAP blocks are uncommon. Since abdominal wall blocks are field blocks, largely depending on the strength of the local anesthetic to promote sufficient blockage rather than attacking a single nerve, neurological damage is uncommon. Neurological damage can occur from the needle, hematoma, or local infection due to direct trauma to the nerve. Excessive penetration with needles may often lead to injuries such as intraperitoneal injection, gastrointestinal damage, neurological injury and harm to the liver.[17] The most probable severe risk of CWFPBs is Local anesthetic systemic toxicity (LAST). Extra diligence of patients undergoing such blocks under GA is suggested, since early symptoms of LAST (drowsiness, tinnitus, or circumoral numbness) are not detected. Under GA, LAST can pose as seizure-like signs or changes in cardiac rhythm, or intensity.[17]

H) Part of multimodal analgesia:

There are many documented benefits of fascial plane blocks which include the absence of opioid side effects which includes the patients consciousness, without postoperative nausea and vomiting (PONV). And the measurement of pain score is fairly simple.

CONCLUSION

As part of a multimodal pain management treatment, the fascial plane blocks helps in efficient analgesia management technique for thoracic, abdominal surgical patients. For thoracic surgical patients the pectoralis and serratus anterior plane blocks can provide effective analgesia of the lateral chest wall. The erector spinae plane block can provide more comprehensive analgesic coverage however further analysis is needed. The performance rate of TAP blocks has increased dramatically with the development of ultrasound technology. For ultrasound-guided TAP block, there are many specific methods, and the complexities of various strategies may influence the analgesic result. SAP block has benefits in thoracic surgery over local anaesthesia which may act as a supplemental thoracic analgesic strategy. Eventually, fascial plane blocks may have support for individuals recovering from severe pain as part of a multimodal intervention with the aim of reducing or even removing persistent opioid use and better pain relief.

Recommendations

The current review recommends that further prospective and randomized controlled trials and case reports on new and broader series be needed.

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