Review Article

Peripheral nerve blocks for analgesia following cesarean delivery A narrative review

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Abstract

Spinal and epidural blocks are commonly employed for pain relief during and following cesarean section. Intrathecal morphine (ITM) has been the gold standard for the same for many years. In recent times, many peripheral nerve blocks (PNBs) have been tried for postoperative analgesia following cesarean delivery (PACD). This article has reviewed the common PNBs used for PACD. The role of PNBs along with ITM has been studied and the current best strategy for PACD has also been explored. Currently, Ilio-inguinal nerve and anterior transversus abdominis plane block in conjunction with intrathecal morphine have been found to be the most effective strategy, providing lower rest pain at 6 hours as compared to ITM alone. In patients not receiving intrathecal morphine, recommended PNBs are lateral transversus abdominis plane block, single shot local anesthetic wound infiltration, or continuous wound infiltration with catheter below rectus fascia. PNBs are recommended for PACD. They have an opioid-sparing effect and are devoid of adverse effects associated with central neuraxial blocks such as hypotension, bradycardia, and urine retention. However, caution must be observed with PNBs for possible local anesthetic toxicity due to the large volumes of drug required.

Keywords: Analgesia, cesarean section, nerve blocks

Key Messages: Peripheral nerve blocks form an effective component of multi-model analgesic regimens for pain control following cesarean section. Ilio-inguinal nerve and anterior transversus abdominis plane block in conjunction with intrathecal morphine is the most effective strategy. In the absence of intrathecal morphine, lateral transversus abdominis plane block or local anesthetic wound infiltration should be administered.

Introduction

Spinal and epidural blocks are commonly employed for pain relief during and following cesarean delivery (CD). Intrathecal Morphine (ITM) is considered the gold standard for postoperative analgesia following cesarean delivery (PACD).[1] ITM is associated with undesirable side effects such as nausea, vomiting, pruritis, sedation, and urinary retention.[1] Various peripheral nerve blocks (PNBs) have been tried for PACD. These have an opioid-sparing action and can be administered in combination with spinal anesthesia or as a part of multimodal analgesia in patients receiving general anesthesia. In this article we review the commonly used PNBs for PACD.[2]

Material and Methods

Medical search engines: PubMed, Medline, Ovid, Embase, and Cochrane database were searched for literature relating to peripheral nerve blocks for analgesia following CD. Reviews, meta-analyses, and randomized clinical trials were

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included. Some relevant websites describing nerve blocks were also considered. Among the articles giving similar information, recent articles were included and older ones were excluded.

General considerations in PNBs for PACD

Mostly the PNBs are administered at the completion of cesarean section. This allows for pain relief as the mother recovers from the spinal anesthetic or general anesthesia. All blocks are given bilateral for pain relief following cesarean section, except local wound infiltration. Post-CD, abdominal wall tissue planes can change and ultrasonography guided blocks help in more accurate placement of drug solution as compared to landmark guided techniques.[2] The local anesthetic drug solution (LADS) commonly used are the combination of 0.2–0.5% ropivacaine or bupivacaine 0.1–0.25% and 1% lignocaine. Most of the PNBs used for PACD are volume dependent. A total drug volume of 15–30 ml is injected on each side. Care should be taken not to exceed recommended safe doses of the local anesthetic agent with bilateral injections. Moreover, physiological changes in pregnancy lead to an increased risk of local anesthesia (LA) toxicity. Careful monitoring of patients for 40–90 minutes after PNBs is advised. Negative aspiration should always be done before the injection of LADS and after every 5 ml injection. Lower doses of LA within the recommended dose range should be used. Ng *et al.*[3] in his meta-analysis on Transversus abdominis plain (TAP) block for PACD found similar postoperative analgesia, 24-hour pain scores, and opioid-sparing effects in patients receiving high-dose LA (bupivacaine equivalent to more than 50 mg per side) as compared to low-dose LA group (bupivacaine equivalent less than 50 mg per side). Absolute contraindications for PNBs are patient refusal, local infections, allergy to LA, and bleeding disorders. Anatomical abnormalities, hemodynamic instability, and known neurologic disorders form relative contraindications.

TAP block

Transversus abdominis plane (TAP) block is an abdominal wall block that provides somatic analgesia of the abdominal wall by blocking thoracolumbar nerves, T6-L1. The anterolateral abdominal wall is innervated by the anterior rami of spinal nerves T6/T7 to T12/L1. These nerves run between the internal oblique (IOM) and transversus abdominis (TAM) muscles dividing into lateral and anterior cutaneous nerves near the midaxillary line.[4-6]

There has been controversy in the literature regarding the level of block achieved with a single TAP injection. It is reasonable to expect a good analgesic effect in the region between T-10 and L1 following a single posterior injection, making it suitable for lower abdominal surgeries.[7]

The aim is to deposit local anesthetic in the plane between the IOM and TAM targeting the spinal nerves in this plane.[5,6,8,9] This shall interrupt the innervation of abdominal skin, muscles, and parietal peritoneum.

Landmark technique TAP block

The point of entry for the landmark guided TAP block is the lumber triangle of Petit, situated between the lower costal margin and the iliac crest. Its base is formed by the iliac crest and it is flanged by the external oblique muscle (EOM) and latissimus dorsi muscle on each side.[8] A blunt needle is used for this technique and "double pop" is appreciated on traversing the external oblique and internal oblique fascial planes.[8,9]

Ultrasound-guided TAP block

The ultrasound probe is placed in the mid axillary line, in transverse plane between the iliac crest and lower end of ribs.[4,5,9] Ultrasound machine with a high frequency probe (10–5 MHz) and 50 mm or 80 mm needle is required for this block. Catheter can be introduced for prolonged continuous block.[5,9]

The needle is advanced "in-plane" till the plane between the IOM and TAM[4,5] [Figure 1]. After injection of 1–2 ml of saline to confirm correct needle placement, 15–20 ml of LADS is injected on each side. The TAP is visualized expanding with the injection (appears as a hypoechoic space) [Figure 1]. An infusion of a dilute LADS can be given at 7 to 10 ml per hour if the catheter is put.[5,8]

Approaches to TAP block[4]

- Subcostal TAP—Ultrasound probe placed at the lower margin of the rib cage and LADS injected between IOM and TAM.[4]
- Anterior TAP (aTAP)—Ultrasound probe is placed on a line joining Anterior Superior Iliac Spine (ASIS) with umbilicus, immediately cephalad to ASIS, in an oblique

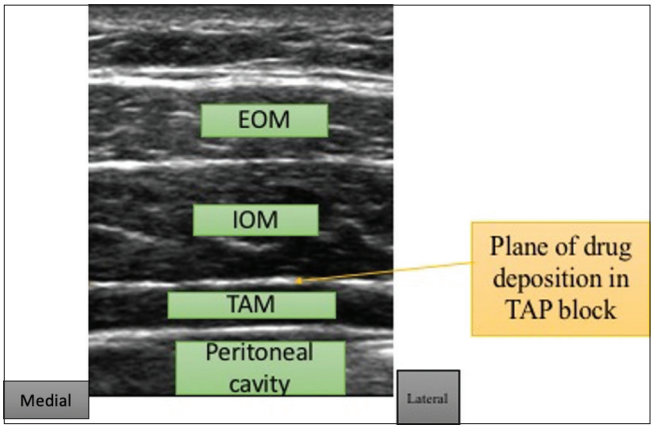

Figure 1: Ultrasound view of abdominal muscles and TAP block (EOM—External Oblique muscle, IOM—Internal Oblique Muscle, TAM—Transversus Abdominis Muscle)

direction. LADS is injected between IOM and TAM just medial of ASIS, near the deep circumflex iliac artery.[4]

- Lateral TAP (L-TAP)—Ultrasound probe placed transversely, in the axial plane at the midaxillary line between the subcostal margin and iliac crest. LADS is injected between IOM and TAM at the midaxillary line.[4]
- Posterior TAP—Ultrasound probe position is similar to the lateral TAP block approach. The probe is moved posteriorly and LADS is injected at the posterior limit of TAP between IOM and TAM.[4]

Complications

Complications include intraperitoneal injection, bowel hematoma, intravascular injection, transient femoral nerve palsy, and LA toxicity.[5]

Quadratus lumborum block (QLB)

Quadratus Lumborum (QLM) is a posterior abdominal wall muscle that originates from the posteromedial iliac crest and inserts into the 12th rib and the transverse processes of the 1st to 4th lumbar vertebrae.[10,11]

The QLM is surrounded by thoracolumbar fascia. According to the three-layered model, the posterior layer surrounds the erector spinae muscles (ESM), the middle layer passes between the ESM and QLM, and the anterior layer lies anterior to both the QLM and psoas muscles.[10,11]

The fascial planes provide the pathway of injectate spread from the abdominal to the thoracic cavity and paravertebral fascia. This explains the clinical effect of QLB.[10,11] Because of its spread to paravertebral space, QLB can confer visceral analgesia and sympathetic block as well, in addition to abdominal wall analgesia. Drug can spread to lumbar plexus. Ilio-hypogastric and ilio-inguinal nerves are consistently involved in QLB. Sensory blockade includes the T7-L2 dermatomes.[10,11]

Ultrasound-guided QL block

The patient can be positioned supine with a lateral tilt, lateral, sitting, or prone.

A curvilinear low frequency transducer is often used, although QLB can be given using linear probes in average built individuals. The aponeurosis of the abdominal wall muscles (EOM, IOM, and TAM) is noted, which is located posterolateral to the QLM. The QLM is often hypoechoic relative to the psoas major muscle, which is found anteromedially to QLM. The three approaches of USG (Ultrasonography) guided QLB are shown in Figure 2. One intramuscular approach has also been described.[12] Any one approach can be used with 15–20 ml of LADS injected on each side.[10,11]

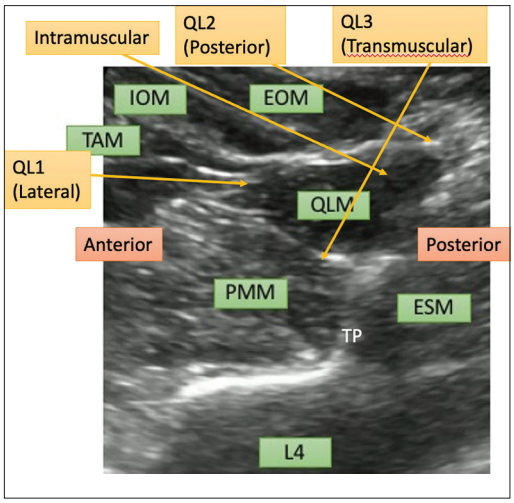

Figure 2: Ultrasound-guided QLB (EOM—External Oblique muscle, IOM—Internal Oblique Muscle, TAM—Transversus Abdominis Muscle, PMM—Psoas Major Muscle, ESM—Erector Spinae Muscle, L4–L4 vertebra)

Complications

1. Prolonged motor block if it spreads to the lumbar plexus, delaying early mobilization and hospital discharge.
2. Lower limb weakness has been reported after use of all QLB approaches.
3. Hypotension may be related to LADS spread to the paravertebral space which enhances visceral analgesia but confers greater hemodynamic changes.[13]

Ilio-inguinal and ilio-hypogastric nerve blockade

Bilateral Ilio-Inguinal (II) and Ilio-hypogastric (IH) nerve blocks can be used as single shot blocks or as continuous infusions.[14] Combined Ilio-Inguinal–IH (IIH) blocks have replaced isolated II nerve block, with similar block performance time.[15]

The II nerve courses caudal to IH nerve. It is preferred to block IH nerve as proximal as possible, preferably posterior to ASIS before it branches into anterior and lateral cutaneous branches.[16]

Landmark technique

In this technique, a line is drawn obliquely connecting ASIS to umbilicus. The needle insertion point is 25 mm medial to ASIS on this line. Alternatively, the needle entry point be taken as 2 cm medial and 2 cm cephalad to ASIS. The needle is advanced perpendicular to the skin. Loss of resistance (first pop) is felt when needle lies between EOM and IOM. 3–5 ml LADS is injected here. Needle is advanced further till second pop is felt when IOM is penetrated and needle lies between IOM and TAM. 3–5 ml of LADS is injected again. Some LADS is also injected in fan-like distribution at these two places. The total LADS volume administered is 12–15 ml. The block is repeated on contralateral side.[17]

Blunt tip needles are preferred for better appreciation of pop sensations. Skin incision can be made by a sharp needle and blunt needle can then be used for the block. "Needle through needle" technique (with small blunt block needle going through sharp skin piercing needle) has been described.[18,19]

Ultrasound-guided Ilio-inguinal and IH nerve block (USG-IIH)

USG-IIH block increases the success rate and reduces complications such as peritoneal injury, bowel, and vascular injuries. With the patient lying in the supine position, the high frequency linear USG probe (10 Mhz or higher) is placed on a line joining ASIS with the umbilicus, immediately cephalad to ASIS, in oblique direction. The three abdominal wall muscles (EOM, IOM, and TAM) separated by hyperechoic fascia are identified. [Figure 3]. The II and IH nerves appear as hypoechoic ovals, around 1 cm apart, in the plane between IOM and TAM. Deep circumflex iliac artery lies adjacent to these nerves in the same plane and can be identified using Color Doppler. This acts as an additional landmark and avoids vascular injury. After negative aspiration, a total of 10–15 ml of LADS solution is administered in 5 ml aliquots. The block is repeated on the contralateral side.[19,20]

Complications

Failure rate is around 10–25% with the landmark technique. It mostly happens due to LADS being injected in the wrong plane.[19,20] Peritoneal perforation and bowel injuries, vascular injuries, and pelvic retroperitoneal hematoma can happen during the block. LA can track down along the fascial planes and block the ipsilateral femoral nerve leading to "Transient Femoral Nerve Palsy" and lower limb weakness. It resolves spontaneously within a few hours.

Surgical site wound infiltration

Surgical site wound infiltration can be single shot wound infiltration (SSWI) or continuous wound infiltration (CWI). In CWI, the catheter is placed by the surgeon at the end of the surgery either between the rectus fascia and subcutaneous tissue (above rectus fascia CWI-AR) or below the rectus fascia (CWI-BR). SSWI has a limited duration of action, whereas CWI can provide analgesia for a longer postoperative period, up to 3 to 4 days also, as desirable. CWI may lead to local anesthetic toxicity, variable analgesic efficacy due to catheter misplacement, and leaking of drug around the suture line.[21-23]

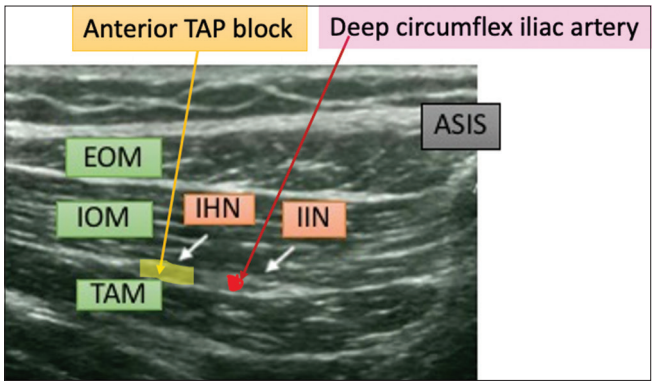

Figure 3: Ilio-Inguinal and Ilio-Hypogastric nerve block (EOM—External Oblique muscle, IOM—Internal Oblique Muscle, TAM—Transversus Abdominis Muscle, IHN—Ilio-hypogastric nerve, IIN—Ilio-inguinal nerve, ASIS—Anterior Superior Iliac Spine)

Various regimens are used. SSWI of 10–15 ml LADS (0.2% ropivacaine) can be done. With CWI, a bolus of 10–15 ml LADS followed by continuous infusion at the rate of 2–3 ml/h for 24–30 hours can be administered. Diclofenac 75 mg has also been used in CWI.[2,21-23]

Erector spinae plane blockade

In Erector spinae plane block (ESPB), the LADS is placed in the paraspinal fascial plane between the ESM and transverse process of vertebra. It spreads through the paravertebral space and blocks the dorsal and ventral rami and rami communicantes, including sympathetic nerve fibers of thoracic and abdominal spinal nerves at various levels. For PACD, bilateral ESPB is performed at the level of T9.

ESPB can result in both somatic and visceral analgesia.[24] The injectate can spread 3 to 4 segments cranially and caudally leading to a multi-dermatomal block. Transforaminal and epidural spread of injectate has also been described in a recent study.[25]

Ultrasound-guided ESPB

ESPB can be used as a single injection technique or a catheter can be placed for continuous infusion. High frequency linear probe is placed on the midline at T9 in cephalo-caudal direction and scanned laterally till the transverse process is visible. The needle is inserted in-plane from cephalad end of probe. The LADS is injected between the ESM and the transverse process.[26-28] [Figure 4]. ESPB can also be administered with the placement of USG probe in the axial plane at T9 level and in-plane needle placement. After negative aspiration, the LADS is injected in 5 ml aliquots. 20–30 ml of LADS is injected on each side.

Complications

The major structures such as pleura, blood vessels, and spinal canal are not close to the injection site; however, inadvertent injury to pleura or intravascular injection can occur. Infection, hematoma, and local anesthetic allergy can also happen.[26,27]

Rectus sheath block

Rectus Sheath Block (RSB) can provide midline analgesia between the xyphoid process and symphysis pubis depending upon the injection point. The analgesic effect spreads several

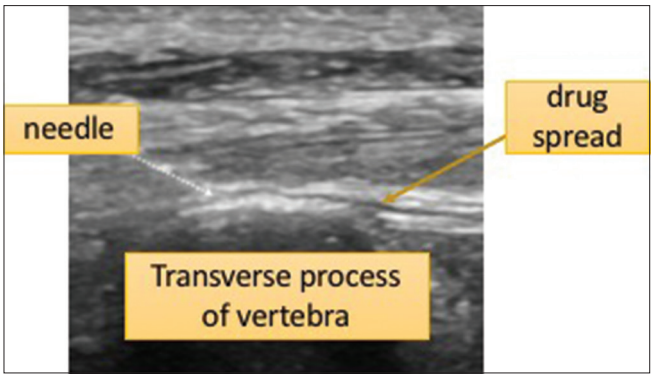

Figure 4: Ultrasound image of ESPB. The ultrasound probe is placed lateral to the spinous process to obtain a parasagittal view of the tip of the targeted transverse process with overlying ESM. The block needle (dotted arrow) is advanced in a cranial-caudal direction to contact the transverse process. Correct needle tip position is signaled by the linear spread of local anesthetic (solid arrows) deep to the ESM and superficial to the transverse process

dermatomes around the injection point. RSB is commonly used for postoperative analgesia for midline surgeries around the umbilicus and central abdominal wall. A bilateral RSB has also been used for pain control after cesarean section, although the evidence is limited.[29]

The rectus sheath contains terminal branches of T9–T11 intercostal nerves. The nerves lie between rectus abdominis muscle (RAM) and posterior wall of rectus sheath. The block is administered at the lateral border of RAM. The LADS is placed anterior to the posterior rectus sheath.

RSB can be performed intraoperatively by the surgeon or postoperatively by the anesthesiologist. It can be administered as a single injection technique or a continuous catheter technique.[30]

Landmark technique RSB

At the lateral edge of rectus muscle, blunt needle is advanced. First pop is felt, which denotes the piercing of the anterior rectus sheath. Needle is advanced through the RAM till firm resistance of posterior rectus sheath is felt. The LADS is injected here. Intraoperatively, the blunt needle tip can be felt by the surgeon from inside the open abdomen. 15–20 ml of LADS is injected. The procedure is repeated on the contralateral side.

Ultrasound-guided RSB

Linear high frequency probe is placed transversely at the level of umbilicus and linea semilunaris, and the three abdominal wall muscles (EOM, IOM, and TAM) laterally and RAM medially are identified. The needle is injected in-plane from the medial to the lateral side and LADS is placed just between RAM and rectus sheath [Figure 5].

Complications

Ultrasound-guided RSB is preferred over landmark technique to reduce the incidence of complications such as peritoneal puncture, bowel injury, epigastric artery puncture, and hematomas.

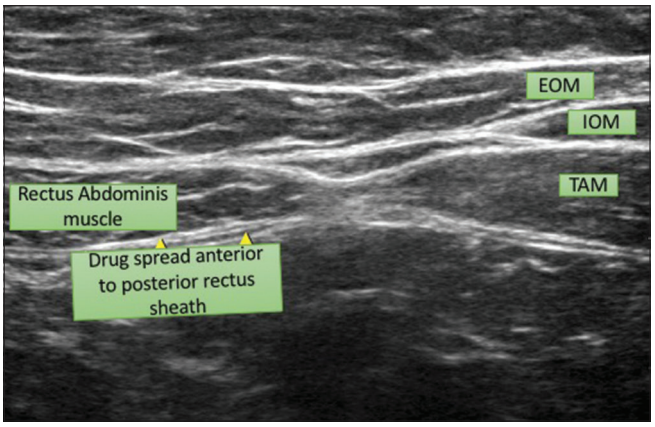

Figure 5: Ultrasound-guided RSB (EOM—External Oblique muscle, IOM—Internal Oblique Muscle, TAM—Transversus Abdominis Muscle)

Discussion

Traditionally ITM has been the gold standard technique for PACD[1] and the available PNBs are compared to ITM for gauzing their efficacy regarding PACD. TAP block, postoperative IIH block, RSB, or wound infiltration, when administered along with ITM do not offer any added analgesic benefit.[1,2,21,30] However in the absence of ITM, TAP block, postoperative IIH block as well as wound infiltration, leads to lesser pain scores and reduced opioid requirements in the first 24 hours after CD, as compared to no block.[1,2,21] Administration of RSB in the absence of ITM did not significantly improve analgesia post-CD.[30] Preoperative wound infiltration with LADS has not shown any added benefit as compared to wound infiltration at the time of wound closure.[22] In a study comparing two approaches of CWI, CWI-BR group demonstrated better pain scores at rest and lower opioid consumption as compared to CWI-AR after CD under spinal anesthesia.[2] Also, late postoperative pain at 24 hours post-CD is effectively reduced by CWI-BR. This technique should be preferred in patients particularly requiring prolong analgesia post-CD.[1]

In a comparison of TAP block, SSWI, and CWI, no significant difference was found in 24-hour opioid consumption among the three groups.[23] When compared to IIH block, TAP block reduced postoperative opioid consumption after CD under spinal anesthesia without ITM. However, the combination of IIH-TAP block together effectively reduced postoperative opioid consumption as compared to placebo at all time points.[2]

As regards QLB and ESP block, insufficient evidence is available on the comparison of QLB or ESP block with

ITM or standardized postpartum multimodal analgesia.[2] As compared to TAP block, ESP block has been shown to provide a longer duration of analgesia and prolonged time to first rescue analgesia, associated with less tramadol and total analgesic consumption in CD patients.[31,32] Paravertebral block has also been explored for pain relief after CD, but sufficient evidence is lacking for any recommendation of PVB (Paravertebral Blocks) for PACD.[2]

As discussed above, most of the PNBs do not provide any additional analgesic benefit when administered in conjunction with ITM. In the systematic review by Ryu C in 2022, the addition of ilio-inguinal nerve and anterior TAP (II-aTAP) block to ITM was shown to provide better analgesia at rest at 6 hours, as compared to ITM alone. This makes II-aTAP + ITM, the most effective strategy currently, for providing PACD.[1] Analgesic advantage obtained by adding PNBs to ITM was extensively reviewed and II-aTAP was found to be the only PNB that provides a significant analgesic advantage when administered in conjunction with ITM.[1] In the absence of ITM, L-TAP block, SSWI, and CWI-BR significantly reduced rest pain at 6 hours and morphine consumption at 24 hours post-CD. These techniques are, therefore, recommended in patients not receiving ITM such as patients receiving general anesthesia or patients allergic to opioids or prone to severe opioid associated adverse effects.[1]

PNBs form an effective component of multi-model analgesic regimens for pain control following cesarean sections. Ilio-inguinal nerve and anterior TAP block in conjunction with intrathecal morphine is the most effective strategy currently for PACD. In patients not receiving intrathecal morphine, recommended PNBs are lateral TAP block or single shot local anesthetic wound infiltration, or CWI with catheter below rectus fascia.

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Conflicts of interest
There are no conflicts of interest.

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