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Rectus sheath and Transversus abdominis plane block for postoperative pain relief following Cesarean delivery

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Abstract

Lower segment Caesarean sections (LSCS) can be performed either in the elective or emergency setting for various indications. Pain management is an integral part of such surgeries in pregnant women and adequate pain relief after operative deliveries is vital to promote feto-maternal bonding as well to improve maternal well-being. Regional blocks are already popular modes of analgesia in obstetrics. Rectus sheath block (RSB) can be performed intraoperatively by the surgeon or postoperatively by the anaesthesiologist. It blocks the terminal branches of the 9th, 10th and 11th intercostal nerves, which run in between the internal oblique and transversus abdominis muscle. Transverse abdominis plane block (TAP) block is another promising truncal block for operative deliveries. It blocks the abdominal wall neural afferents between T6 and L1 dermatomal level. This neurovascular plane is located between the internal oblique and transversus abdominis muscles. Both these blocks can be performed either blindly or preferably, ultrasound-guided. The introduction of ultrasound (USG) has revolutionized regional anaesthesia in obstetrics. Both local anaesthetics and several adjuvant drugs can be infiltrated in rectus sheath and TAP blocks. Recently, percutaneous USG-guided catheter techniques have been used for continuous TAP blocks. This chapter focusses on various aspects of RSB and TAP blocks for obstetric regional anaesthesia and analgesia, including USG-guided blocks for Caesarean sections.

Keywords: Rectus sheath block; Transverse plane block; Caesarean section; Ultrasound-guided; Obstetric anaesthesia

Introduction

Cesarean section is the one of the most commonly performed surgical procedure in the world. It is performed as lower transverse or *pfannensteil* incision on the skin below the umbilicus to facilitate the delivery of baby from uterus. Substantial postoperative discomfort and pain can be anticipated following caesarean section delivery. Inadequate pain relief can cause a negative impact on early ambulation, breastfeeding, maternal bonding and infant weight gain [1].

Neuraxial anaesthesia has become the anaesthesia technique of choice in caesarean delivery because of its safety and reduction in maternal mortality. Various pain modalities for postoperative pain relief have been mentioned in the literature, but the optimum form of postoperative pain relief is unknown and depends upon institutional practice. Neuraxial as well as systemic opioids can provide a very effective pain relief in immediate postoperative period but they are associated with unwanted problems like nausea, vomiting, pruritus, urinary retention and delayed respiratory depression. The incidence of pruritus is increased with increasing dose of neuraxial opioids . NSAIDs (Non-Steroidal Anti-inflammatory Agents), ketamine and gabapentin have been found to be useful in few clinical trials, but their safety in the early postoperative period has not been established well in the literature yet. More multicentre large size RCTs (randomised controlled trials) and meta-analysis are required to depict their safe use in the postoperative period following caesarean deliveries . Wound infiltration with either ropivacaine or levo-bupicaine for post caesarean analgesia have also been tested in the recent years . But, their results are found to be inferior to transverse abdominis plane block and may also be associated with complications like postoperative wound site infection . So,there is always a need for safe alternative modalities of pain relief offering beneficial reduction in side effect profile with no loss of analgesic efficacy. This chapter aims to elucidate the techniques and utility of performing rectus sheath and transverse abdominis plane block in major obstetric regional anesthesia.

Background and Brief Review of Literature

Regional blocks have been gaining popularity in the prevention and treatment of acute postoperative pain since last two decades. The success of ultrasound-guided peripheral nerve localisation has heralded a new era in block technique and structure identification, with minimal to no complications. Sensory nerves transmitting pain from the anterior abdominal wall can be blocked by the injection of local anaesthetics into transversus abdominal plane (TAP block) and rectus sheath (rectus sheath block).

A Cochrane review suggested that TAP block is the effective way of providing analgesia with less complications in abdominal surgeries [6]. The analgesic efficacy of TAP block after caesarean section was assessed by the analysis of many clinical studies. Some of the trials showed that TAP block alone does not improve postoperative analgesia in comparison with neuraxial opioids, but this was at the expense of increased incidence of opioid related side effects. Abdullah et al in his meta-analysis stated that TAP block constitutes an effective analgesic option in ceserean

section where intrathecal opioids are not used[i]. The systemic review and meta-analysis done by Basem M et al in 2012 recommends the routine use of TAP block following caesarean deliveries in which intrathecal opioids are contraindicated [7].

Sharkey A et al in his analysis found that TAP block in cesarean section is a viable alternative to reducing opioid consumption and opioid related side effects [8]. R Champneria et al suggested that TAP block is a very effective pain relief method whenever caesarean section was carried out in general anesthesia[ii]. Ripolles J et al in his meta-analysis stated that the use of TAP block may be a good option for multimodal analgesia since it reduces the VAS score at rest and at movement in the first 24 hrs, as well as itching and postoperative nausea vomiting(PONV) [9].

Tap Block

TAP block was first described by Kuppuvelumani et al in 1993 and was formally documented in 2001 by Rafi as abdominal field block techniques [10,11]. It was then developed and tested by McDonnell et al in late 2007 [12]. It can be performed either by using anatomical landmarks technique or by ultrasound guidance.

Anatomical Considerations

Abdominal wall consists of 4 paired anterior and lateral muscles. The anterior muscle is rectus abdominis muscle, and 3 lateral muscles are transverse abdominis (TA), internal oblique (IO) and external oblique (EO) muscles respectively from deep to superficial. In the lateral abdomen, the 3 fleshy muscle bellies overlie each other. Medially, they become aponeurotic and form the *lineasemilunaris* just lateral to rectus abdominis muscle. The aponeuroses of internal oblique splits into 2 to become the anterior and posterior rectus sheaths to enclose the rectus abdominis muscle. Medial to the rectus muscle,the aponeurosis is inserted into the thick, fibrotic, *linea alba*. Somatic innervation of anterolateral abdominal wall arises from anterior rami of spinal nerves T7 to L1. T7–T11 are intercostal nerves, T12 is subcostal nerve and L1 forms ilio-hypogastric and ilioinguinal nerves. All these nerves give rise to anterior and lateral cutaneous branches as they become superficial. The intercostal nerves exit the intercostal space and traverse a course between transverse abdominis and internal oblique. The subcostal, ilio-hypogastric and ilioinguinal nerves also travel in this plane and supplying internal oblique and transverse abdominis muscles. The thoracic nerves continue anteriorly from the TAP to pierce the rectus sheath and finally end as anterior cutaneous nerves. In the posterior TAP block, both anterior and lateral cutaneous branches of 9^{th},10^{th} and 11 intercostal nerves are blocked. As the 9th, 10th and 11th intercostal nerves are consistently present in TAP plane, a subcostal TAP block is necessary to provides analgesia for incisions above umbilicus [7]. In the rectus sheath block, only terminal branches (anterior cutaneous nerves) are blocked. So, for the better postoperative analgesiafollowing caesarean deliveries the technique of choice is either posterior TAP block

(blocking both branches) or SPORT (single point rectus sheath and TAP) block.

Borders of TAP

1) Anterior border – lineasemilunaris consisting aponeuroses of external oblique, internal oblique and transverse abdominis, and extends from cartilage of rib 9 to pubic tubercle.

2) Superior border – subcostal margin,from 9^{th} to 12^{th} costal cartilage continued to the border of latissimus dorsi and the lumbar triangle of petit

3) Inferior border - Inguinal ligament, iliac crest and posterior border of lumbar triangle of petit [13] .

Types of TAP

1) Upper subcostal TAP (deep to rectus, mainly covering T7 and T8)

2) Lower subcostal TAP (lateral to rectus, mainly T9)

3) Lateral TAP (midway between costal margin and iliac crest, in mid-clavicular line covering T11- T12)

4) Posterior TAP (in area of triangle of petit)

5) Ilio –inguinal and ilio-hypogastric TAP.

6) SPORT block (single point injection of rectus sheath and TAP block – US guided)

Nomenclature involving the triangle of Petit in relation to abdominal wall blockade has been confused from the start. In their landmark 2007 paper, McDonnell et al. described the triangle of Petit incorrectly in the lateral rather than posterior abdominal wall [12]. Jankovic et al. showed the anterior and middle parts of the triangle of Petit to be on average 5.8 cm and 9.3 cm posterior to the mid-axillary line, respectively [14]. In many patients, the skin over the lumbar triangle of Petit is in contact with the mattress when positioned supine.Hence, it is not possible to inject perpendicular to the lumbar triangle of petit without placing any rolls in the back of patient's body [15].

Different modes of performing TAP block

1) Blind TAP
2) LOR block
3) Ultrasound guided

Blind TAP: The blind technique aims at the lumbar triangle of petit which is bounded superiorly by costal margin, inferiorly by iliac crest, anteriorly by external oblique muscles and posteriorly by lattissimusdorsii muscle.Injecting perpendicular to the lumbar triangle of petit and feeling of double pops signifies the correct location of the needle [16].

the external oblique and internal oblique.Further advancement of the needle results in a second "pop" after it passes through the internal oblique fascia into the TAP. At this point, 20–30 ml of long-acting local anaesthetic is injected in 5mL aliquots after careful aspiration.It is always important to calculate the exact dosing of the local anaesthetic before proceeding the blocks on both sides, to avoid LA toxicity [17].

LOR RECTUS SHEATH BLOCK: The aim of rectus sheath block is to provide analgesia in area supplying by the terminal branches of the thoracic nerves (often missed by TAP block) which run in between the internal oblique and transversus abdominis muscles to penetrate the posterior wall of the rectus abdominis muscle and end in an anterior cutaneous branch supplying the skin of the umbilical area. It is identical to the blind TAP block. The point of insertion is 2-3 cm lateral to linea alba, at the level of the umbilicus. The needle first passes through anterior rectus sheath and then through the rectus abdominis muscle till resistance is felt over the posterior rectus sheath, Once the position is confirmed, 15–20ml localanesthestics is injected in 5mL aliquots. The procedure is repeated on the opposite side of the midline [17].

US guided TAP

Patient positioning **-** Supine. Exposed the region between costal margin and iliac crest. Ultrasound machine is placed just opposite to the block side.

Probe positioning **-** Place a high frequency linear probe(6-13 Hz) between the iliac crest and the costal margin, over the anterior axillary line, rotating the probe to make an acute angle with the anterior axillary line. This angle improves access for inserting a needle in plane.

Sonoanatomy- Three layers of muscle are visible in the scan deep to the subcutaneous fat. Peritoneum is visible as a shiny layer and bowel can be identified by its peristaltic movements. The TAP lies in the fascial plane between the IO and TA muscles.

Agent and concentration **-** The local anesthetic agent used for TAP blockade and concentration to be used have changed over time. The initial report was with 0.5% lignocaine then 0.375% bupivacaine 20 ml, levobupivacaine to a maximum dose of 1 mg/kg each side, and finally 0.75% ropivacaine up to 1.5 mg/kg (to a maximum dose of 150 mg) on each side for bilateral block. Higher doses were used to achieve prolonged postoperative analgesia. The effect may also be prolonged by adding adrenaline, ketamine, clonidine or dexmedetomidine to local anesthetic (LA) solution, in concentrations recommended for other peripheral blocks.

Procedure **–** Astimuplex long needle or short bevelled spinal or epidural(touhy) needle is inserted in-plane with the transducer, from medial to lateral in an anteroposterior direction. Facilitated by hydrodissection, local anesthetic solution is placed deep to the fascial layer in the plane

between internal oblique and transversus abdominis. 20 -30 ml of local anaesthetics is injected into the plane on the both sides. LA spread is visualised clearly with the help of ultrasound.

Complications - This is relatively free from complications. The needle tip must be visualized always, as there is a risk of intraperitoneal injection and bowel perforation [18] .

US guided Rectus sheath block

Anatomy - The rectus sheath nerves are the terminal branches of the myocutaneous nerves (T8–L1) supplying the lower two-thirds of the anterior abdominal wall, including the muscle layers and the parietal peritoneum. They enter the rectus sheath through its lateral border (lineasemilunaris) and pass towards the linea alba. Within the rectus sheath the nerves lie between the rectus abdominis muscle and the posterior wall of the sheath, and supply the central abdominal wall [19].

Patient positioning – Supine with whole abdomen exposed. Ultrasound machine is placed just opposite to the block side.

Probe positioning - Place a linear high frequency probe transversely across the linear semilunaris at the level of the umbilicus and try to identify the lateral border of rectus sheath.

Sonoanatomy - The lateral border of the rectus sheath in the abdominal wall is marked by the transition from the triple layer of muscle (EO, IO, TA) on the left side (lateral) of the scan to the single layer of muscle (RA) on the right (medial). The plane for injection between the RA and the posterior wall of the rectus sheath is indicated as RAP.

Procedure - Astimuplex long needle or short bevelled spinal or epidural (touhy) needle is inserted in-plane with the transducer, from medial to lateral in an anteroposterior direction. Facilitated by hydro-dissection, local anesthetic solution is placed deep to the fascial layer in the plane between rectus abdominis and posterior rectus sheath. The procedure is same as that of TAP block only the plane of needle insertion is different. 15-20ml of local anaesthetics is injected on the both sides.
Complications - The needle tip must be visualized throughout, because of the risk of intraperitoneal injection or bowel puncture [20].

Continuous TAP block

There are few clinical trials in the literature which suggest that by using a catheter placed in transversus abdominis plane under ultrasound guidance, a continuous TAP block could be achieved. Using epidural set, catheter can be placed in TAP plane and epidural catheter filter is placed outside the skin and fixed properly with adhesive dressings. The resistance encountered during insertion of catheter can be reduced by injecting 5–10 ml of saline beforehand (hydro-

dissection). Single shot TAP block analgesia duration is upto 6-8 hours and it can be prolonged for 2 days with the use of PCA (Patient Controlled Analgesia) local anesthetic infusion in the continuous TAP catheter. The major disadvantages of using continuous TAP are dislodgement and increased risk of infection [21] . The literature describes surgically-assisted catheter placement under direct vision and use of infusion device during the procedure [22].

Salient Points

1) Pain following caesarean section is multifactorial with somatic component arising from the abdominal wound and visceral component from uterine manipulation. TAP block is effective in relieving pain arising from abdominal component and used in parallel with opioids and can reduce the postoperative opioid requirements. Although there is no current evidence that this technique is of benefit where neuraxial opioids are used but it can be helpful in reducing opioids related side effects.

2) TAP block is relatively a safe procedure and easy to perform.US-guided TAP block is gaining popularity in relieving pain following caesarean section.

3) The use of catheters in the abdominal transverse plane block could increase the analgesic efficacy and duration. In addition, it provides a new way to explore the use of new drugs like liposomal bupivacaine in peripheral blockade.

4) Rectus sheath block done at the level of umbilicus is supplementary to TAP block and can provide pain relief in the region supplied by anterior cutaneous nerves.

Conclusion

Analgesia for the obstetric patient is challenging as it affects both the fetus and the mother. Both rectus sheath and transversus abdominis plane block can be extremely useful for pain relief following caesarean deliveries. They can also be used for the obstetric patient presenting for non-obstetric surgery. The advent of ultrasound-guided block techniques has improved both the accuracy and safety of these blocks.

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