Overview of Transversus Abdominis Plane Block for postoperative Analgesia in Elective cesarean section

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Abstract

Cesarean section can cause moderate to severe postoperative pain in large percentage of women. Adequate pain relief is vital to improve the mother's ability to care for her infant in the intermediate postpartum period. In the cesarean delivery population, peripheral nerve blocks play a role in cesarean delivery analgesia. Transversus abdominis plane (TAP) block is the most studied trunkal nerve block. It provides analgesia by blocking nerves originated from the anterior rami of thoraco-lumbar spinal nerves (T6–L1) as they traverse the transversus abdominis plane. The surface anatomy landmark technique has been superseded by ultrasound-guided. It's used as an adjunct for postoperative pain control in abdominal, gynecologic or urologic surgery involving the T6 to L1 distribution.
TAP block after caesarean section is associated with longer time for demand of first analgesia, reduction in total morphine use and VAS scores. Using of ultrasound guidance has increased the accuracy and efficacy of the technique.

Keywords: Transversus Abdominis Plane Block, postoperative Analgesia, cesarean section

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Introduction

Pain after cesarean section (CS) is usually described as moderate to severe by most patients and failure to adequately treat it may affect mother-baby bonding, care of baby, and breastfeeding. It may even increase the risk for thrombo-embolism as a result of immobility due to pain (1).

The components of pain after cesarean section were analyzed: Somatic and visceral. Somatic pain results from direct trauma of tissues due to surgical incision form the layers of skin, muscle and soft tissue of the anterior abdominal wall along the Pfannenstiel incision and also the peritoneal wall. These structures are supplied by the lower thoracic and upper lumber nerve **(2)** , while visceral pain is caused by inflammation carried by Sensory fibres from the body of the uterus pass via sympathetic nerves (T10–L1) and from the cervix via parasympathetic nerves (S2–4) **(3,4,5)** as shown in (figure 1)**(2)** and (figure 2)**(5).**

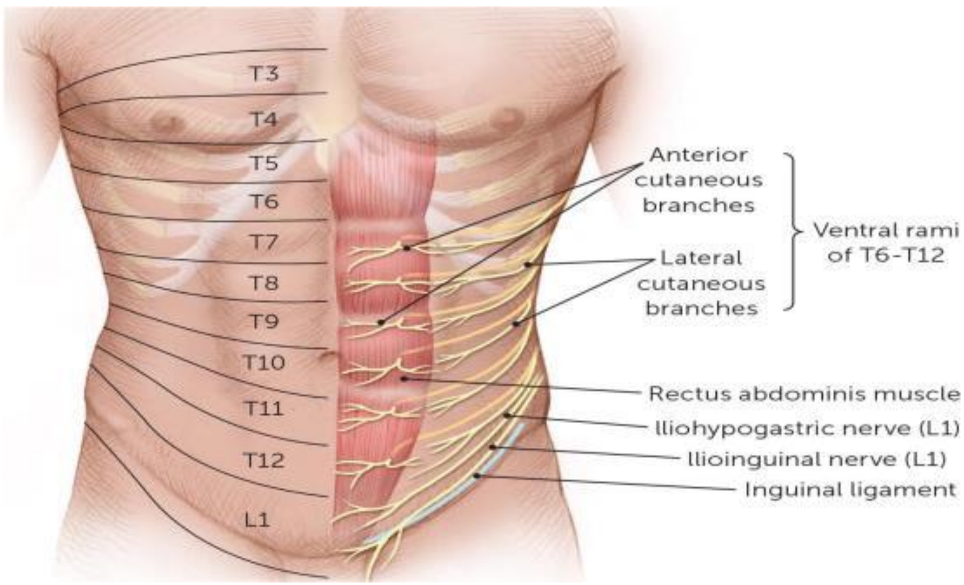

Figure (1): Nerve supply of the anterior abdominal wall **(2)**

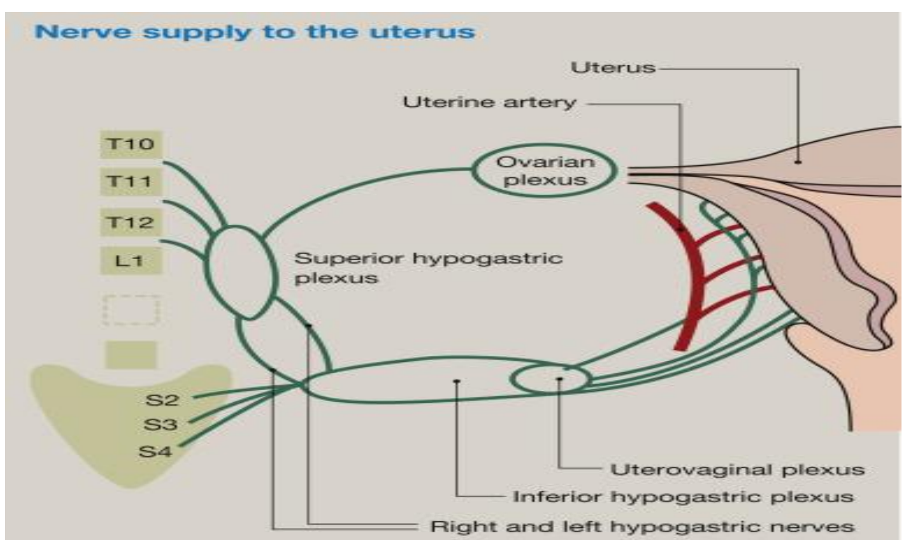

Figure (2): Nerve supply to the uterus **(5)**

It is necessary that pain relief be safe and effective, not to interfere with the mother's ability to move around and care for her infant and result in no adverse neonatal effects in breast-feeding women **(6)**

The most commonly used modalities are: Systemic administration of analgesic drugs (opioids-non opioids), neuraxial injection of opioid and/ or adjuvants, regional blocks and non-pharmacological methods of analgesia.

Although not performed routinely, peripheral nerve blocks play a role nowadays in cesarean delivery analgesia. Several blocks have been investigated to assess their potential benefit in multimodal and rescue analgesia. Peripheral blocks for cesarean delivery include: paravertebral, transversus abdominis plane, rectus sheath block, quadratus lumborum, iliohypogastric and ilioinguinal, erector spinae, and continuous wound infiltration blocks.

Anatomical considerations of the anterior abdominal wall:

Muscles of the anterolateral abdominal Wall:

The muscles of the anterolateral abdominal wall can be divided into two main groups shown in **(figure 4) (7):**

A. Flat muscles: three flat muscles includes: external Oblique, internal Oblique and transversus Abdominis, situated laterally on either side of the abdomen.

B. Vertical muscles include two vertical muscles: rectus Abdominis and pyramidalis, situated near the mid-line of the body.

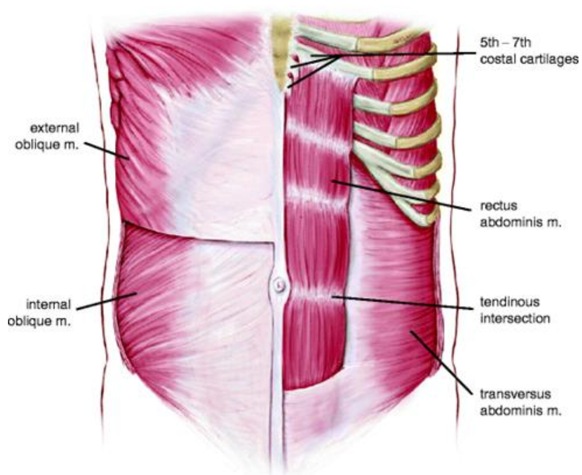

Figure (3): anterior abdominal wall muscles (7)

Nerve supply of the anterior abdominal wall (8):

The skin and muscles of the abdominal wall are supplied by spinal nerves originating from T6 to L1 level. A typical spinal nerve originates and divides into anterior and posterior divisions/ rami. The anterior rami supply the muscles and skin of the anterolateral abdominal wall. The spinal nerves can be clubbed into:

a. **Thoracoabdominal nerves:** These are anterior rami of the spinal nerves of T6–T11. They divide into lateral and anterior cutaneous branches. Lateral cutaneous branches arise in the neurovascular plane between the internal oblique and transversus abdominis muscle, near the angle of the rib, and supply the skin after piercing the external oblique and internal oblique muscle. The anterior cutaneous branch arises similarly at the lateral border of the rectus sheath and it pierces the rectus abdominis muscle before supplying the skin. They supply the muscles and skin of the upper anterolateral abdominal wall, between the umbilicus and coastal margin.

b. **Subcostal nerve:** This is the anterior rami of the T12 spinal nerve, which follows the course similar to thoracoabdominal nerves and terminates in similar lateral and cutaneous branches. It innervates muscles and skin of the lower anterolateral abdominal wall, between the umbilicus and inguinal ligament.

c. **Ilio-hypogastric and ilioinguinal nerves:** Terminal branches of the anterior rami of the L1 spinal nerve. The dermatomal distribution of the abdominal wall closely correlates with the pathway of spinal nerves and their branches because there is no plexus formation at paravertebral level. Branches further communicate at multiple locations, including large branch communications on the anterolateral abdominal wall (intercostal/upper TAP plexus) and plexuses that run with the deep circumflex iliac artery (DCIA) (lower TAP plexus) and the deep inferior epigastric artery (DIEA) (rectus sheath plexus). Since these segmental nerves communicate just above the transversus abdominis muscle, the subfascial spread of local anesthetic can provide anterolateral abdominal wall analgesia.

Transversus abdominis plane blockade (TAP block)

TAP blockade is the most studied trunkal nerve block. The surface anatomy landmark technique has been superseded by ultrasound-guided.

It is a peripheral nerve block designed for anesthesia of the nerves supplying the anterior abdominal wall (T6 to L1). First it was described in 2001 by Rafi as a traditional blind landmark technique using the lumbar triangle of Petit (9)

Local anesthetic is injected between the internal oblique and transverse abdominis muscles just deep the fascial plane where the sensory nerves pass (10) (figure 3)(11).

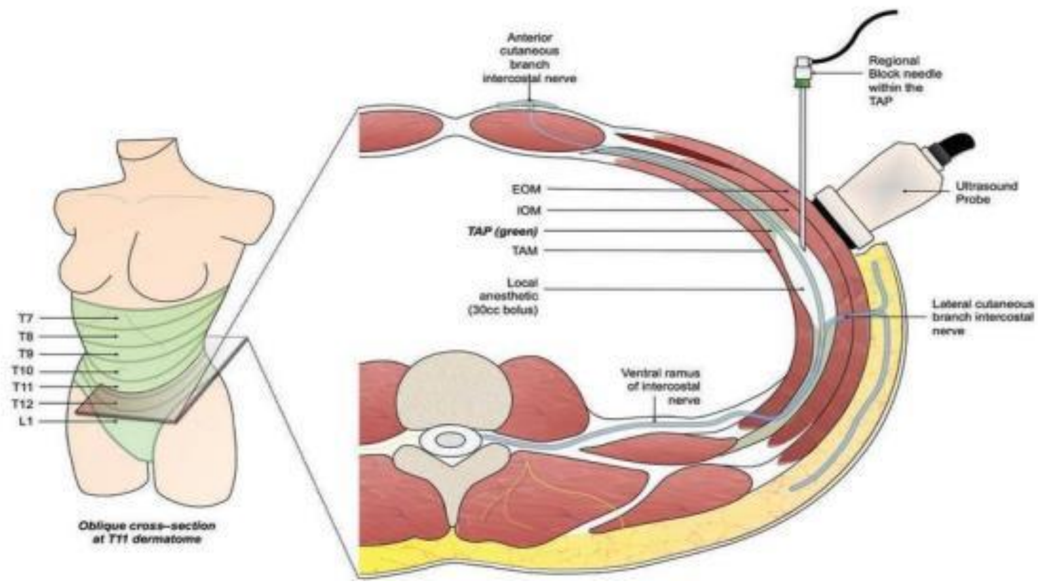

Figure (4): TAP block anatomy.

***EOM: external oblique muscle *IOM: internal oblique muscle. *TAM: transversus abdomius muscle (11).**

Indications of TAP block:

TAP block used as an adjunct for postoperative pain control in abdominal, gynecologic or urologic surgery involving the T6 to L1 distribution **(12)**. As in surgical procedures including large bowel resection, cesarean delivery, abdominal hysterectomy, open appendectomy, inguinal hernia repair radical prostatectomy, nephrectomy, and many different laparoscopic procedures in general as laparoscopic cholecystectomy **(13)**.

Bilateral TAP blocks can be used for midline incisions and will be useful in procedures where epidural analgesia is contraindicated. In addition; a continuous TAP block technique with placement of a catheter has been described if prolonged analgesia is desired **(14)**.

Contraindications of TAP block:

They include; bleeding disorders, previous adverse effects with local anesthetics, superficial infection at site of potential insertion, inadequate knowledge to perform block and inadequately experienced ward staff to care for patient post operatively **(15)**.

Complications:

Complications are mainly; failure, rectus sheath hematoma (damage to superior and inferior epigastric vessels), IV administration of local anesthetic causing toxicity, puncture of peritoneum and/or bowel and Infection **(15)**.

TAP block approaches:

I. Traditional (Blind) Approach

In this approach, the lumbar triangle of Petit is identified. The triangle of Petit is formed by the iliac crest as the base, the external oblique muscle as the anterior border, and the latissimus dorsi muscle as the posterior border. The floor of the triangle is made up of the fascia from both the external and internal oblique muscles. A needle is inserted perpendicular to the skin just cephalad to the iliac crest near the midaxillary line. The TAP is identified using a 2-pop sensation (loss of resistance). The first pop indicates penetration of the fascia of the external oblique muscle, and the second indicates penetration of the fascia of the internal oblique muscle. Local anesthetic is then injected with multiple aspirations **(16)**.

II. Ultrasound guided:

Patient position: The patient can be supine or in lateral position with the arm on the side to be blocked elevated and turned to the opposite side.

Type of needle: A 5 or 10 cm, 21G, insulated needle can be used. using an 18-G epidural needle provides a better visualization of this larger needle and its curved rounded tip could lower the risk of accidental penetration of the peritoneum and abdominal cavity.

Type of transducer: A linear high frequency (8-15 MHz) probe is usually sufficient. In larger patients a curved, low frequency (3-7 MHz) probe may be necessary.

Volume and concentration of local anesthetic: Depending on the patient's weight and the concentration of the local anesthetic, an injection of 15 to 20 ml of local anesthetic with concentration of 0.25% bupivacaine or 0.5% ropivacaine **(17).** Local anesthetic adjuvants may be added to improve efficacy and duration as magnesium sulphate, dexamethasone, dexmedetomidine and other drugs **(18).**

Classification of ultrasound approaches:

Table (1): approaches of US guided TAP block **(16)**.

Approach	Nerve blocked	Supplied area
Subcostal	T6–T9 – Anterior cutaneous nerves	Upper abdomen, just below xiphoid and parallel to costal margin
Lateral	T10–T12 – Anterior cutaneous nerves	Anterior abdominal wall at the infraumbilical area, between two midclavicular lines
Posterior	T9–T12 – Anterior	Anterior abdominal wall at the

	and possibly lateral cutaneous nerves	infraumbilical area and possibly lateral abdominal wall
Oblique subcostal	T6–L1 – Anterior cutaneous nerves	Supraumbilical and infraumbilical anterior abdominal wall
Dual TAP	T6–T12 – Anterior and possibly lateral cutaneous nerves	Supraumbilical and infraumbilical anterior abdominal wall

1. **Subcostal Approach**

With the patient supine, the ultrasound probe is placed parallel to the subcostal margin near the xiphoid process. The transversus abdominis muscle is identified as the more hypoechoic muscle layer just beneath the rectus abdominis muscle near the xiphoid, between the lateral edge of the rectus and the medial edges of the internal and external oblique muscles, the aponeurosis above the transversus abdominis is the first layer below the subcutaneous tissue. With the probe near the xiphoid, the needle is advanced in-plane, passing just below the rectus to the TAP. As with the posterior approach, local anesthetic is deposited with intermittent aspiration and visualized as a hypoechoic layer transecting the TAP **(16)**.

The anesthetic solution spreads across the location of T6-L1 nerves and thus potentially covers both the upper and lower abdominal walls. Since it requires only a single penetration through the subcostal approach but covers both the upper and lower TAP plexuses **(10)**.

2. **Lateral approach:**

The probe is placed transversely on the lateral abdominal wall at midaxillary line between costal margin and iliac **(19)**. The three abdominal muscles are seen below subcutaneous fat, the plane between internal oblique and transversus abdominis muscle is identified. The needle is inserted in the plane in medial to lateral direction, local anesthetic injected in the TAP plane **(20)**. Even if local anesthetic is deposited below the fascia, and above the transversus abdominis muscle, it may exert an analgesic effect as all nerves travel in the deep part of fascia. It is always better to hydrodissect with saline to confirm the correct position of the needle tip before injecting local anesthetic **(21)** (figure 6) **(19)** and (figure 7) **(20).**

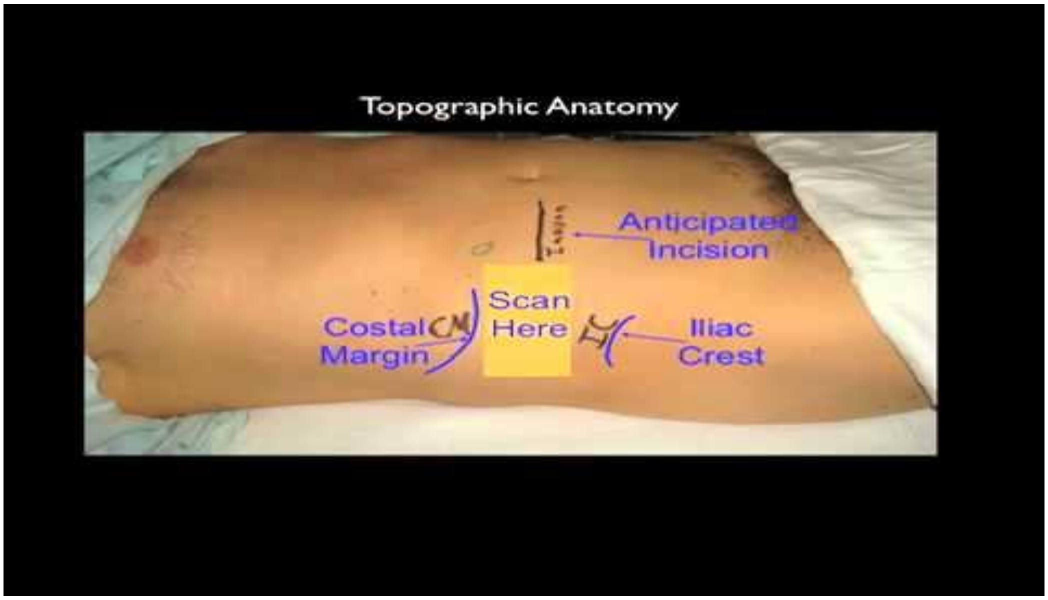

Figure (5): Probe position in lateral approach of TAP block (19).

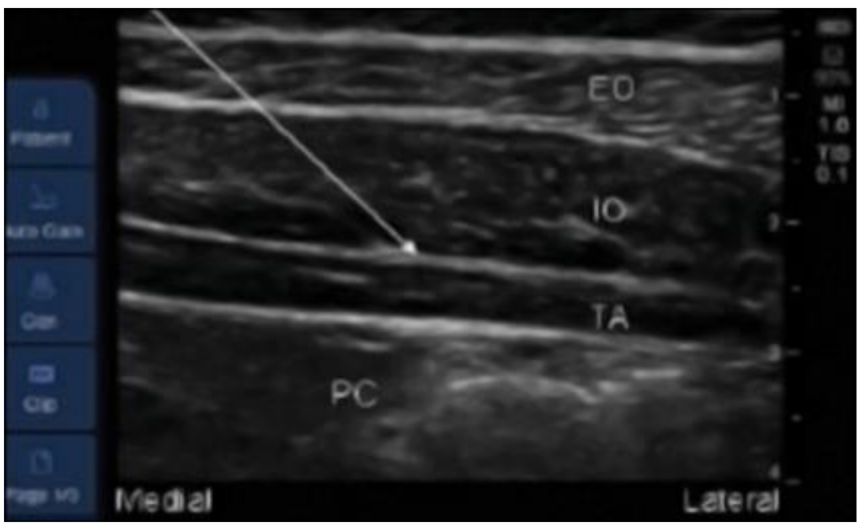

Figure (6): Ultrasound guided image of TAP block (20).

It's a replication of the classical landmark technique with ultrasound guidance, which achieves analgesia over the infra umbilical area of the anterior abdominal wall between two midclavicular lines. The nerves blocked are anterior cutaneous branches of T10– T12. However, there is sparing of lateral cutaneous branches of T10 to T12 which supply the infra umbilical lateral abdominal wall **(10)**.

3. **Posterior approach:**

The linear probe is placed in a lateral approach initially, and then it is moved posteriorly till a scan reveals the transversus abdominis muscle tailing off into the aponeurosis, near the Quadratus lumborum muscle **(16)**. Local anesthetic is deposited superficial to aponeurosis as shown in (figure 8) and (figure 9) **(16).**

Figure (7): Needle insertion in posterior TAB approach **(16)**.

Figure (8): Suggested ultrasound probe positions for various approaches.

(1) Initial scanning position for identification of linea alba and rectus abdominis, (2) probe position for subcostal approach, (3) probe position for lateral approach, (4) probe position for posterior approach **(16)**.

The advantages of the posterior approach over lateral approach are better prolonged anesthesia and probable blockade of lateral cutaneous nerves providing better coverage. The prolonged analgesia is explained by posterior spread of local anesthetic to paravertebral space from T4 to L1 and partial blockade of the thoracolumbar sympathetic chain. Although definitive randomized controlled trials comparing lateral and posterior TAP blocks are lacking **(10)**.

4. **Combined approaches:**

1. **Oblique Subcostal Block:** This is a modified form of the subcostal TAP block, introduced by Hebbard et al **(20)**. in 2010. The initial steps are like the subcostal approach, a linear probe is positioned over the subcostal area and the TAP plane identified. A long needle of 15–20 cm is introduced in the plane in medial to lateral direction till it reaches between the transversus abdominis and rectus abdominis. The TAP plane is hydrodissected obliquely under ultrasound view along the line. This requires a large amount of local anesthetic (around 40–80 mL) and is technically difficult to perform compared to other TAP block approaches. The advantage it offers is a single site injection for both supraumbilical and infraumbilical analgesic coverage, while the obvious disadvantage is the risk of local anesthetic toxicity due to the large volumes of local anesthetic required. It is said to provide analgesia from T6–L1. Figure (9) **(21).**

Figure (9): Direction of hydrodisscetion in oblique subcostal block. Initially subcostal TAP block is performed, and then the needle moved along the oblique subcostal line (21).

2. **Dual TAP Block:** This approach is a combination of subcostal block with posterior or lateral TAP block. The bilateral dual TAP block offers the same advantage as the oblique subcostal block, but is technically less challenging. **(22)**.

TAP block is cesarean section:

In a meta-analysis, the TAP block was shown to reduce the need for postoperative opioid use, increase the time to first request for further analgesia, and provide more effective pain relief, while decreasing opioid related side effects such as sedation and postoperative nausea and vomiting. Studies included a combination of both general abdominal and gynecologic procedures. The introduction of ultrasound has allowed providers to identify the appropriate tissue plane and perform this block with greater accuracy under direct visualization (23).

Multiple studies using ultrasound guided TAP block after cesarean section were associated with longer time for demand of first analgesia and reduction in total morphine use in 24 h in the active group compared with the placebo group. VAS scores also reduced in the active group compared to placebo group (24). Similarly, a study was conducted in 2008 using TAP block after caesarean delivery by the blind approach. The study confirmed the usefulness of TAP block as seen by the reduced VAS and requirement for morphine (25).

A Cochrane review suggested that TAP block is the effective way of providing analgesia with fewer complications in abdominal surgeries (26). The analgesic efficacy of TAP block after cesarean 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 (27).

Abdullah et al. in his meta-analysis stated that TAP block constitutes an effective analgesic option in cesarean section where intrathecal opioids are not used. The systemic review and meta-analysis done by Basem et al in 2012 recommends the routine use of TAP block following cesarean deliveries in which intrathecal opioids are contraindicated (27).

Sharkey 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 (28). Champneria et al. suggested that TAP block is a very effective pain relief method whenever caesarean section was carried out in general anesthesia. Ripolles 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) (29).

Hariharan et al. undergone a study on TAP block in CS and found out that 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 they found 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. They also concluded that 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 (30).

In a systemic review by Roofthooft et al., It was found that TAP block is effective in reducing pain scores and opioid requirements. Given that the potential side-effects of these regional analgesic techniques are limited, they are recommended (31).

In a recent study by Innamorato et al., they performed a randomized trial in women with term pregnancies who underwent elective CS with spinal anesthesia comparing biltaral TAP block to postoperative systemic analgesics. Bilateral TAP block has the potential to alleviate postoperative pain and reduce the need for additional analgesics after CS **(32)**.

Conclusion:

Tap block is effective for pain relief after cesarean section. It is associated with longer time for demand of first analgesia, reduction in total opioid use, reduction of VAS scores and less side effects than systemic drugs. Ultrasound guidance improves the accuracy and safety of the technique.

No Conflict of interest.

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