Utilization of Transversus Abdominis Plane Block as Option for Postoperative Analgesia

Khaled Fawzy Ali El-Eraki, Ayman Abdelsalam Abdelgaleel, Olfat Abdelmoniem Ibrahem Amin, Ayman Eskander Tawfeek

Department Anesthesia, Intensive care and pain management, Faculty of Medicine, Zagazig University, Egypt.

Corresponding author: Khaled Fawzy Ali El-Eraki

E-mail: khaled.eraki91@gmail.com

Conflict of interest: None declared.

Funding: No funding sources

Abstract

A peripheral block involving the nerves of the front abdominal wall has recently been described; it is known as the transversus abdominis plane (TAP) block. Specifically, the block has been designed to alleviate discomfort experienced by patients following gynecologic and abdominal surgeries. on the first method, the lumbar triangle of Petit was outlined as a landmark to reach the TAP and put the local anaesthetic solution on the neurovascular plane. A subcostal approach called the "oblique subcostal" access and an ultrasound-guided approach that uses the mid-axillary line—the space between the iliac crest and the costal margin—to reach the neurovascular plane are two more methods. Seven randomized clinical trials involving 364 patients (180 of whom got TAP blocking) were found to investigate the effect of TAP block on post-operative pain through a systematic literature search. Following a midline abdominal incision, the patient underwent a caesarean section, an abdominal hysterectomy, an open appendectomy, a laparoscopic cholecystectomy, and a big bowel resection. The patient also underwent a transverse lower abdominal wall incision for the hysterectomy. In general, the findings are promising, and the majority of research has shown that opioid consumption and pain after surgery are significantly reduced. Additionally, there have been some positive impacts on opioid-related adverse effects, such as drowsiness, nausea, and vomiting after surgery. To back up the results of the main published trials and to provide broad suggestions for using a TAP block, additional research is necessary.

Keywords: transversus abdominis plane block

Tob Regul Sci.™ 2023 ;9(1): 7772 - 7779

DOI: doi.org/10.18001/TRS.9.1.549

Introduction

Peripheral nerve blocks have grown in popularity during the past 20 years. Novel nerve blocks with new indications and decreased patient complications risk have been made possible with the

use of anatomical landmark-based techniques, peripheral nerve stimulators, or ultrasound-guided procedures.1,2

A recently developed block called the transversus abdominis plane (TAP) block involves the nerves of the anterior abdominal wall. It was first described in studies as a neurofascial plane block that would be accessed between the internal oblique and the transversus abdominis muscles through a well-defined entrance at the triangle of Petit. Recent clinical trials with patients undergoing major abdominal and gynaecological surgeries have shown promising results when used as part of a multimodal approach to post-operative pain treatment.

The techniques employed for the TAP block are concisely summarized in this article. We conducted a comprehensive search and evaluation of clinical research that examined the impact of the TAP block on pain following surgery. We talk about some ways the TAP block can be evaluated and used in the future.

Approaches to TAP blocking

Injecting local anaesthetic into the neurovascular plane of the abdominal wall—between the internal oblique and the transversus abdominis muscles—is done using the lumbar triangle of Petit as a landmark. This block was initially described in a letter by Dr. Rafi in 2001 and was further developed and tested by McDonnell et al.4,6-8. Additionally, anatomical dissections have shown that the T6-L1 communicate closely and branch widely with neighbouring segmental nerves in this plane.9 The anterior abdominal wall is supplied by nerves that originate from T6 to L1, which pass through this plane.8,9

The iliac crest serves as the basis of the Petit triangle, which is bounded anteriorly by the external oblique muscle and posteriorly by the latissimus dorsi muscle. Fascial extensions of the internal and external obliques muscles form the base of the triangle (Fig. 1). Place the blunt regional anaesthesia needle in the triangle of Petit perpendicular to the skin just cephalad to the iliac crest and behind the mid-axillary line. Use a two-'pop' sensation (or loss of resistance) method to pinpoint the plane of the transversus abdominis fascia. A local anaesthetic solution can be injected into the transversus abdominis fascial plane, which allows for the innervation of the various muscles of the anterior abdominal wall, after the first "pop" signifies penetration of the external oblique muscle's fascia and the second "pop" signifies penetration of the internal oblique muscle. Injecting 20 ml of lidocaine at a concentration of 5 mg/ml in volunteers created a sensory block that ran from T7 to L1.8. While the TAP block can be done unilaterally, it is necessary to administer both in order to provide adequate analgesia during midline abdominal surgery.

Physical features that define the Petit's lumbar triangle, an entry location for the blind transversus abdominis plane block as performed by an orthopedic surgeon. The external and internal oblique muscles' fascia, as well as the transversus abdominis fascial plane, can be felt with a double "pop" sound when a blunt needle is inserted.

Despite the claimed ease of this "blind" TAP block approach and its low complication rate (3-6,10), some patients may have difficulty palpating the triangle of Petit if they are overweight (3-5), and one case of unintentional liver trauma occurred in a patient who was scheduled for a total

abdominal hysterectomy (1-2). It was emphasized that the patient, who was short and had an enlarged liver, needed to feel the edge of the lever before the TAP block could be applied.11

First described in a letter by Hebbard12, ultrasound-guided access to the neurovascular plane involves positioning the probe on the abdominal wall in the mid-axillary line, between the iliac crest and the costal margin, and then carefully moving it postero-laterally to identify the transversus abdominis fascial plane (Fig. 2). The local anesthetic is carefully placed by inserting a needle anteriorly and in line with the probe and then visually monitoring its progress. Just recently, the same author also detailed an approach to subcostal access that she calls "oblique subcostal." In this method, the probe is positioned parallel to the costal margin and the needle is inserted close to the xiphoid process. One possible use for this access is to improve analgesia in the supraumbilical region of the abdomen.

Additionally, a hockey stick probe initially positioned just lateral to the umbilicus has been described as a form of ultrasound-guided access to the TAP block for toddlers. Lateral sliding allows for the identification of the abdominal wall's muscle layers and the deposit of local anesthesia near the origin of the thoracolumbar roots.14

Research on the effects of a TAP block on pain following surgery

Searching the literature and evaluating its quality

Using the PubMed database, which does not limit searches based on language, researchers methodically sought out randomized, blinded, controlled studies using TAP block for acute post-operative pain reduction. We utilized free-form word combinations such as "post-operative analgesia," "post-operative pain," and "transversus abdominis plane block" to find this study. This search was last conducted in December 2009. To find other papers, we looked through the reference lists of the retrieved manuscripts.

The three-item (1-5) Oxford Quality Scale was used to assess study quality (randomization/allocation concealment, details of the blinding process, and description of withdrawal and dropouts). The five-item (1-16) Oxford Pain Validity Scale was used to assess study validity. Two of the authors, P. L. P. and O. M., read and scored each identified study. In cases of disagreement, a third author, J. B. D., was brought in to reach a consensus.

Research in human clinical practice

There were seven randomized, double-blind clinical trials that examined the effects of a TAP block on post-operative pain. These trials included 364 patients, 180 of whom were given the block. The studies had generally high quality scores (median 5, range 2-5) and validity scores (median 14, range 2-15) with three of them being conducted by the same group of investigators.

These surgical procedures were performed: large bowel resection through a midline abdominal incision, a cesarean delivery through the Pfannenstiel incision, an abdominal hysterectomy through a transverse lower abdominal wall incision, an open appendectomy, and a laparoscopic cholecystectomy with all four ports described as inserted below the umbilicus.

Patients in four studies (4,5,17,18) were given general anaesthesia, while three studies used spinal anaesthesia. Sixteen of the seven studies (4-6,19) used a combination of paracetamol (1 mg every

6 hours) and nonsteroidal anti-inflammatory drugs (NSAIDs) such as diclofenac 100 mg every 16-18 hours or ibuprofen 400 mg every 8 hours, in addition to PCA-morphine. Eighteen patients who had appendectomy were given a combination of paracetamol (1 g every 6 hours), diclofenac (50 mg as needed), and PCA-morphine as part of a multimodal postoperative analgesic regimen. One study that involved cesarean deliveries employed a combination of intravenous morphine and fentanyl with a multimodal analgesic regimen that included paracetamol 1 g every 6 h, diclofenac 50 mg every 8 h, and intrathecal opioids. Request 2 milligrams of morphine. No preventative anti-emetic medication was utilized in any of the investigations; the most recent one solely employed PCA-morphine.

Using the blind technique via the triangle of Petite as described under methods, three studies performed the TAP block bilaterally after induction of anaesthesia. The remaining studies used ultrasound guidance for the procedure. In each study, 15 or 20 ml of levobupivacaine, bupivacaine, or ropivacaine at varying concentrations was injected. On the other hand, one study involved an appendectomy, and injection was done unilaterally. As a placebo, four studies (5, 6, 19, and 20) injected 0.9% saline into the control group; the other trials (4, 17, and 18) did not.

Twenty studies found that compared to the control groups, patients using the TAP block consumed 33% to 74% less PCA-morphine 24 hours after surgery (Fig. 3). According to a meta-analysis, the TAP block treatment was favored due to a notable decrease in the consumption of morphine after 24 hours (WMD: -22 mg, 95% CI: -31 to -13 mg). It was found through a subgroup analysis that the results for the landmark-based technique (WMD: −38 mg, CI: −61 to −16 mg) and the ultrasound-guided technique (WMD: −11 mg, CI: −19 to −2 mg) differed (Fig. 4). An extended 48-hour analgesic effect of the TAP block was examined in three studies5,6, and 20. Two trials, out of six, found that the TAP block treatment reduced the need for analgesics for 48 hours. The majority of the 12-hour time periods in the tests indicated a significant opioid-sparing impact, while the morphine-sparing effect was most noticeable within the first 12 hours.

In four investigations (bowel resection, abdominal hysterectomy, caesarean section, and appendectomy), the TAP block significantly lowered pain levels at rest and during movement in the early post-operative period (0-6 hours). After 24 hours, pain levels were also lowered following appendectomy, intestinal surgery4, and abdominal hysterectomy 5. In addition, patients reported less pain at rest and during mobilizing for up to 48 hours after the abdominal hysterectomy procedure. Two investigations (one involving a cesarean section and the other without pain scoring) found no improvement in patients' reported levels of discomfort after the procedure.

Out of the seven studies that were conducted, five dealt with postoperative nausea and vomiting (PONV), four with sedation, and four with other topics. One study found that both the incidence and severity of PONV were reduced 30 minutes after surgery when the TAP block was used. Another study found that the incidence of PONV was reduced, but the reduction in nausea scores was modest. In three out of four investigations, sedation was lessened using the TAP block. 4-6,19

Sensory testing was not used in any of the investigations to determine the TAP block's distribution. A patient experienced an adverse reaction after receiving the local anesthetic

injection, according to one study. The block treatment was found to be free of any additional reported problems or failures.

Results from trials included in this evaluation suggest that the transversus abdominis plane block could be a game-changer for patients receiving anterior abdominal wall surgery when it comes to post-operative pain management. Six out of seven trials found that the TAP block successfully reduced opioid intake after surgery. In addition, four out of six trials showed that TAP block treatment was associated with lower pain levels during movement and during rest.

The TAP block could provide an alternative to epidural analgesia for patients having colonic surgery; this method has the potential to alleviate postoperative pain without the side effects of motor blockage, which are common with this method. Patients whose coagulation issues make a central neuraxial block impractical may find relief from postoperative pain with the TAP block, an effective alternative.

However, broad suggestions for TAP block use may appear hasty given that only seven studies have been published thus far.21 Future investigations are needed to corroborate the findings from the seven published main studies, three of which are from the same group of authors. Due to the small sample sizes, the trials do not capture the full picture of the TAP block's safety or the frequency of any unusual problems or adverse effects. The results of the current research suggest that the TAP block may alleviate some of the nausea and vomiting (PONV) that patients experience. However, the evidence is lacking at the moment, so it would be wise for future trials to additionally concentrate on this possible benefit of the new block.

The best amounts and concentrations of local anesthetic to inject into the TAP block for each procedure will need to be determined in further experiments. Additionally, post-administration serum concentrations of local anaesthetics and other safety data are required.

Additional research on continuous methods is needed, as is an evaluation of the analgesic duration of a single dosage. Research and comparison of the block's varying impacts on various surgical operations are warranted. It is unclear if the ultrasound-guided TAP block, as described by Hebbard12, is adequate for supra- and infraumbilical level surgical procedures, or if upper abdominal procedures require an extra TAP block, such as the "oblique subcostal" block13, to be effective.

Results showed that both the original blind method and the ultrasound-guided access were simple to execute and had low complication rates in the current investigations. Ultrasound guidance, on the other hand, shortens the time it takes to break a block, requires fewer attempts, and slows down the time it takes for a block to begin, according to recent reviews1,22. The potential avoidance of unintentional perforation of the internal gastrointestinal organs, as was documented with the TAP block11, is an additional benefit of employing an ultrasound-guided method. In addition, a cadaver study23 examined the placement of the Petit lumbar triangle and found that it was smaller and had different sizes and shapes than previously reported in the literature, as well as being more posteriorly placed. Not all pertinent anterior abdominal wall nerves crossed the transversus abdominis plane at the Petit lumbar triangle point, which allowed for mid-axillary line ultrasound-guided TAP block access.23

We found that the two TAP-block methods differed significantly in their ability to save morphine in our subgroup meta-analysis. Since the ultrasound-guided procedure makes use of an injection site that is posterior to the Triangle of Petit, one could wonder if this is the cause of the discrepancy. On the other hand, it's conceivable that the procedure-specific differences in post-operative pain and morphine intake that were seen in the trials could be the only explanation for the different outcomes across the approaches.

Remarkably, the TAP block was found to significantly reduce morphine use in two out of three cesarean birth studies6,19 and the abdominal hysterectomy study 5. It is not known that the TAP block blocks visceral afferents, but post-operative pain in these individuals can be characterized as a mix of somatic (from the abdominal wall incision) and visceral (from internal organs) discomfort. Consequently, it is necessary to investigate alternative action mechanisms involving the TAP block. The anti-arrhythmic action of lidocaine was demonstrated by serum concentrations within or slightly over the therapeutic range in a recently published study that examined 24 blood concentrations of the drug following a 2 × 20 ml TAP block with lidocaine 10 mg/ml. The authors concluded that additional research is needed to determine if the analgesic effect was due to a systemic or local analgesic effect of the local anesthetic.

Patients undergoing caesarean sections were not significantly benefitted by TAP blockade in one study.20 The study's multimodal analgesic regimen included intrathecal morphine, a treatment with great analgesic efficacy25 but significant side effects. Because the control group in this trial had low pain levels and morphine use, it was difficult to show that the TAP blocking improved analgesia.

There was a decrease in both pain scores and opiate use in the majority of the trials that have been published so far. This demonstrated the efficacy of a TAP block when supplemented with paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs), suggesting that the block could play a significant role in a multimodal pain management program. Similarly, a recent letter documented four cases of laparoscopic appendectomy.26 In all cases, the patients were given a TAP block along with paracetamol and NSAIDs. Interestingly, none of the patients needed further opioids for the first twelve hours after the operation. Two out of four patients who underwent the procedure did not take any opioids.26 This suggests that the TAP block might be especially helpful for procedures involving mild to moderate pain and trauma, such as day case surgeries, where it could reduce the need for opioids and painkillers and speed up the healing process.

Conclusion

The use of a TAP block to alleviate postoperative pain after abdominal wall surgeries has shown encouraging results, including a marked decrease in morphine intake and an improvement in pain scores. However, additional research is needed to back up the results of the main published trials and provide broad guidelines for using a TAP block, particularly as part of a multimodal post-operative pain regimen, before it is used in everyday clinical practice.

No Conflict of interest.

References:

1 Liu SS, Ngeow JE, Yadeau JT. Ultrasound-guided regional anesthesia and analgesia: a qualitative systematic review. Reg Anesth Pain Med 2009; 34: 47–59.

2 Abrahams MS, Aziz MF, Fu RF, Horn JL. Ultrasound guidance compared with electrical neurostimulation for peripheral nerve block: a systematic review and meta-analysis of randomized controlled trials. Br J Anaesth 2009; 102: 408–17.

3 Rafi AN. Abdominal field block: a new approach via the lumbar triangle. Anaesthesia 2001; 56: 1024–6.

4 McDonnell JG, O'Donnell B, Curley G, Heffernan A, Power C, Laffey JG. The analgesic efficacy of transversus abdominis plane block after abdominal surgery: a prospective randomized controlled trial. Anesth Analg 2007; 104: 193–7.

5 Carney J, McDonnell JG, Ochana A, Bhinder R, Laffey JG. The transversus abdominis plane block provides effective postoperative analgesia in patients undergoing total abdominal hysterectomy. Anesth Analg 2008; 107: 2056–60.

6 McDonnell JG, Curley G, Carney J, Benton A, Costello J, Maharaj CH, Laffey JG. The analgesic efficacy of transversus abdominis plane block after cesarean delivery: a randomized controlled trial. Anesth Analg 2008; 106: 186–91.

7 Reid SA. The transversus abdominis plane block. Anesth Analg 2007; 105: 282–3.

8 McDonnell JG, O'Donnell BD, Farrell T, Gough N, Tuite D, Power C, Laffey JG. Transversus abdominis plane block: a cadaveric and radiological evaluation. Reg Anesth Pain Med 2007; 32: 399–404.

9 Rozen WM, Tran TM, Ashton MW, Barrington MJ, Ivanusic JJ, Taylor GI. Refining the course of the thoracolumbar nerves: a new understanding of the innervation of the anterior abdominal wall. Clin Anat 2008; 21: 325–33.CAS

10 O'Donnell BD, McDonnell JG, McShane AJ. The transversus abdominis plane (TAP) block in open retropubic prostatectomy. Reg Anesth Pain Med 2006; 31: 91.

11 Farooq M, Carey M. A case of liver trauma with a blunt regional anesthesia needle while performing transversus abdominis plane block. Reg Anesth Pain Med 2008; 33: 274–5.

12 Hebbard P, Fujiwara Y, Shibata Y, Royse C. Ultrasound-guided transversus abdominis plane (TAP) block. Anaesth Intensive Care 2007; 35: 616–7.

13 Hebbard P. Subcostal transversus abdominis plane block under ultrasound guidance. Anesth Analg 2008; 106: 674–5.

14 Suresh S, Chan VW. Ultrasound guided transversus abdominis plane block in infants, children and adolescents: a simple procedural guidance for their performance. Paediatr Anaesth 2009; 19: 296–9.

15 Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJM, Gavaghan DJ, McQuay HJ. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials 1996; 17: 1–12.

16 Smith LA, Oldman AD, McQuay HJ, Moore RA. Teasing apart quality and validity in systematic reviews: an example from acupuncture trials in chronic neck and back pain. Pain 2000; 86: 119–32.

17 El-Dawlatly AA, Turkistani A, Kettner SC, Machata AM, Delvi MB, Thallaj A, Kapral S, Marhofer P. Ultrasound-guided transversus abdominis plane block: description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy. Br J Anaesth 2009; 102: 763–7.

18 Niraj G, Searle A, Mathews M, Misra V, Baban M, Kiani S, Wong M. Analgesic efficacy of ultrasound-guided transversus abdominis plane block in patients undergoing open appendicectomy. Br J Anaesth 2009; 103: 601–5.

19 Belavy D, Cowlishaw PJ, Howes M, Phillips F. Ultrasound-guided transversus abdominis plane block for analgesia after Caesarean delivery. Br J Anaesth 2009; 103: 726–30.

20 Costello JF, Moore AR, Wieczorek PM, Macarthur AJ, Balki M, Carvalho JCA. The transversus abdominis plane block, when used as part of a multimodal regimen inclusive of intrathecal morphine, does not improve analgesia after cesarean delivery. Reg Anesth Pain Med 2009; 34: 586–9.

21 Bonnet F, Berger J, Aveline C. Transversus abdominis plane block: what is its role in postoperative analgesia? Br J Anaesth 2009; 103: 468–70.

22 Koscielniak-Nielsen ZJ. Ultrasound-guided peripheral nerve blocks: what are the benefits? Acta Anaesthesiol Scand 2008; 52: 727–37.

23 Jankovic ZB, Du Feu FM, McConnell P. An anatomical study of the transversus abdominis plane block: location of the lumbar triangle of Petit and adjacent nerves. Anesth Analg 2009; 109: 981–5.

24 Kato N, Fujiwara Y, Harato M, Kurokawa S, Shibata Y, Harada J, Komatsu T. Serum concentration of lidocaine after transversus abdominis plane block. J Anesth 2009; 23: 298–300.

25 Dahl JB, Jeppesen IS, Jørgensen H, Wetterslev J, Møiniche S. Intraoperative and postoperative analgesic efficacy and adverse effects of intrathecal opioids in patients undergoing cesarean section with spinal anesthesia: a qualitative and quantitative systematic review of randomized controlled trials. Anesthesiology 1999; 91: 1919–27.

26 Mukhtar K, Singh S. Transversus abdominis plane block for laparoscopic surgery. Br J Anaesth 2009; 102: 143–4.