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Original Research Article

Efficacy of Ultrasound-Guided Transversus Abdominis Plane for Post-Operative Analgesia in Abdominal Surgeries

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Abstract:

Background and Aim: An effective postoperative analgesic technique for patients undertaking lower abdominal surgeries, transversus abdominis plane (TAP) block is among the innovative approaches utilised in this regard. In abdominal surgeries, the purpose of the present investigation is to compare the two TAP block techniques used for postoperative analgesia.

Material and Methods: One year was devoted to the present cross-sectional investigation, which was conducted at the Tertiary Care Teaching Institute of India's Department of Anaesthesia. Appendicectomy, appendicular perforation, umbilical, paraumbilical, incisional and ventral hernia repair, hysterectomy, exploratory laparotomy, and hysterectomy were among the procedures that one hundred patients were admitted for under general anaesthesia. For blind TAP block or USG-guided TAP block, they were separated into two groups. A TAP block containing 20cc of 0.25% Bupivacaine was administered to each group in the supine position at the conclusion of the procedure, prior to its reversal. Analogue scale pain scores were recorded during the twenty-four hours of patient follow-up. Rescue analgesic was intravenous diclofenac, while breakthrough pain was treated with intravenous tramadol. Complicated matters, including the total analgesic need for twenty-four hours, were documented.

Results: Analgesia scores were comparable in both groups during the initial postoperative period (10 minutes to 20 minutes) following extubation. However, pain scores improved significantly (30 minutes, 60 minutes, 3 hours, 6 hours, and 12 hours), with USG-guided groups having lower scores (p0.05). Pain scores remained comparable after 16 hours, 20 hours, and 24 hours. A statistically significant difference in VAS scores was observed between the blind and USG-guided groups at multiple time intervals for a duration of 12 hours ($p<0.05$). The blind technique necessitated a significantly greater quantity of rescue analgesics than the USG-guided group.

Conclusion: Utilising ultrasound to administer local anesthetic in the correct plane enables more precise administration; however, it necessitates an increased period of learning. As an uncomplicated, risk-free, and straightforward technique that provides superior analgesia, TAP block should be incorporated into multimodal analgesia and recovery strategies for patients undergoing abdominal surgery.

Keywords: Appendicectomy, Postoperative Pain, Transversus abdominis plane, Ultrasound-guided.

Introduction

The whole sensation of pain is a result of the interaction between the sensory and emotional aspects of pain. Pain is defined as an unpleasant emotional and sensory experience brought on by existing or potential tissue damage, or as such damage explained in terms of such damage, by the International Association for Study of Pain (IASP). [1]

After a Caesarean delivery (CD), the inability to manage postoperative pain can have a detrimental impact on nursing, ambulation, and mother-child attachment. After a caesarean delivery, significant pain is expected; thus, an analgesic regimen should guarantee safe and efficient analgesia. [2]

Reducing opioid use may have specific advantages such as a decrease in ileus, nausea and vomiting, urine retention, and hyperalgesia. In order to lessen the negative effects of opioids, alternative methods must be used in their place. [3] Via the Transversus Abdominis neuro fascial plane, nerve afferents innervate the muscular layer of the abdominal wall. [4] While numerous methods and medications are employed to alleviate postoperative pain, only opioids offer sufficient relief. Opioids nevertheless have a lot of negative side effects. To lessen the need of opioids, regional blocks and local anaesthetic medications are therefore thought to be necessary. [3] The transversus abdominis plane (TAP) block blocks the sensory nerve supply to the anterior abdominal wall, hence producing analgesia. Rafi officially documented it in 2001 after Kuppuvelumani et al. [5] had described it in 1993. [6] Numerous studies have indicated that the lumbar triangle of petit may serve as a viable entry point for blocking the sensory nerve supply in the neurofascial plane that runs between the internal oblique and the Transversus Abdominis muscle. [7] The iliac crest forms the triangle's base, and the external oblique forms it from the anterior and the lattismus dorsi from the posterior.

TAP block is beneficial for patients with numerous comorbidities and lowers post-operative pain, post-op narcotic use, respiratory problems, early ambulation, and decreased postop nausea and vomiting. It can be carried out utilizing ultrasound guided techniques, which have higher success rates and accuracy, or blind techniques. [8,9] This study attempts to evaluate the two TAP block procedures for postoperative analgesia in abdominal surgeries because there aren't many studies comparing the blind technique with the USG-guided technique.

The two TAP block techniques—the landmark guided blind technique and the ultrasounds guided approach—were compared primarily for the length of time that analgesia was achieved. Secondary goals included figuring out the Visual Analogue Scale (VAS) postoperative pain score variation, how many rescue analgesics were needed in a 24-hour period, how much breakthrough analgesic was needed, and whether there were any problems or adverse effects.

Material and Methods

This cross-sectional study was carried out over the course of a year at the Tertiary Care Teaching Institute of India's Department of Anaesthesia. Adult patients between the ages of 18 and 60 who had ASA physical status I or II and had been scheduled for elective abdominal surgery were included. The institutional ethical committee granted ethical approval, and each subject provided written informed permission. Computer-generated chits were used to randomly pick the technique.

We observed that the minimal sample size for each group was 50, with a 95% confidence interval, 80% power, and a mean difference of 20 minutes in the entire duration of analgesia (Shrunkanta Oak research).[10]Ten requirements for inclusion were: patients had to give informed consent; they had to be in the 18–60 age range, be in the ASA physical class I or II, and be scheduled for abdominal surgery. Additionally, patients who refuse treatment, ASA III and IV, coagulation abnormalities, systemic illnesses like heart, pulmonary, and neurologic/neuromuscular disorders, allergies to local anesthetics, and local site infections are all considered exclusion criteria.

Among the general surgeries that were performed were appendicectomy, appendicular perforation, umbilical, paraumbilical, incisional, and ventral hernia repair. Additionally, hysterectomy and exploratory laparotomy were performed for gynecological procedures. According to institutional standards, all patients had evaluations, and the bare minimum of investigations was obtained. Every patient received an explanation of the procedure, its potential risks, its benefits and drawbacks, the medication's effects, and the necessary monitoring.

After determining the patients' level of malnutrition, intravenous (18 G i.v.) RL fluid was started for them on the day of the procedure. Throughout the intraoperative period, continuous monitoring was done on heart rate (three-lead ECG), non-invasive arterial pressure, oxygen saturation, and end-tidal CO_2. Patients were premedicated with intravenous injections of midazolam (0.03 mg/kg), glycopyrrolate (0.004 mg/kg), and pantoprazole 40 mg. administered intravenously with injections of fentanyl (2 mcg/kg), propofol (2 mg/kg), and succinylcoline (2 mg/kg). Patients were kept on 50:50 oxygen to nitrous oxide ratio, with inhalation agents such as sevoflurane or isoflurane and intravenous injections of atracurium or vecuronium. An hour after anaesthesia was induced, an intraoperative injection of 1 grammes of paracetamol IV was administered. Before reversing course at the end of the process, TAP blocks were distributed according to the pre-assigned groups using computer-generated chits for technique selection. Group A was given a TAP block led by the USG. Group B got a TAP block that was blind. On each side, 20ml of 0.25% Inj. bupivacaine were administered to both groups.

The patients received a USG guided block while in the supine position. The skin was prepped with povidoneiodine solution, and a sterile ultrasound gel was applied before cleaning and covering a high-frequency linear ultrasound probe—which was used for superficial visualization—with a sterile cover and a depth of penetration of five centimetres. On the anterolateral abdominal wall, between the subcostal border and the iliac crest, a transverse probe was positioned. The anterior abdominal wall's three muscles—the transversus abdominis, internal oblique, and external oblique—was recognised. A 22 G Quincke needle was inserted anteriorly in the plane of the ultrasound beam after the neuro-fascial plane between the transversus abdominis muscle and the internal oblique was identified. After negative aspiration, Inj. bupivacaine was injected upon reaching the fascial plane.

The drug is visible spreading as Petit's dark oval-shaped triangle between the iliac crest and the external oblique. The local anaesthetic was applied and the needle "pop" feeling was advanced, puncturing the external and interior oblique fascial layers, respectively. This process was repeated on the other side. All the patients received Inj. Paracetamol 1g post-operatively at every 6 hours at VAS > 4. Inj. Tramadol 100 mg IV at VAS>7 if pain persists even after Diclofenac injection.

PACU discharge score was recorded based on 5 parameters, postoperatively at 24 hours, before discharging the patient from PACU to the ward. 6 Scores were given out of 2, in each group.

1. Vital signs: 2- BP, PR within 20% of pre-op; 1- BP, PR between 20-40%; 0- BP, PR >40%.

2. Activity level: 2- ambulate without assistance; 1- ambulates with assistance; 0- cannot ambulate.

3. Nausea and vomiting: 2- treated with oral medication; 1- treated with parenteral medication; 0- vomiting persist even with treatment.

4. Pain: 2- controlled by analgesics and acceptable; 1-not acceptable even after analgesics.

5. Surgical bleeding: 2- do not require a dressing change; 1- two dressing changes required; 0- ≥3 dressing changes required.

The efficacy score was measured using 4 parameters 7, each scored out of 2.

1. VAS range: 2- VAS 0-4; 1- VAS 4-7; 0- VAS 7-10.

2. PONV: 2- no nausea vomiting; 1- nausea only; 0- vomiting also.

3. Respiratory depression: 2-Spo2- >94% on RA, RR12-20 bpm; 1- Spo2- 90-94% on RA, RR- 8-11 bpm; 0- Spo2-<90 on RA, RR<8 bpm

4. Sedation: 2- awake and alert; 1- lightly sedated; 0- asleep but rousable.

Patients were monitored for complications like inadvertent peritoneal puncture, abdominal wall hematoma, nausea, vomiting, nerve injury, intravascular injection, etc.

Statistical analysis

The collected data was combined, input into a spread sheet using Microsoft Excel 2007, and exported to the SPSS version 15 data editor page (SPSS Inc., Chicago, Illinois, USA). Depending on how they were distributed, quantitative variables were defined as means and standard deviations or median and interquartile range. Counts and percentages were used to display the qualitative factors. The significance threshold and confidence level for each test were set at 5% and 95%, respectively.

Results

Regarding their demographics and the length of their surgeries, the patients in both groups were similar (Table 1). Following extubation, pain scores at 10 minutes, 20 minutes, and 30 minutes were similar in both groups. However, after 60 minutes, 3 hours, 6 hours, and 12 hours, pain scores significantly improved (lower in the USG guided group, p<0.05), and they were later comparable at 16 hours, 20 hours, and 24 hours. The exact TAP block when USG was utilised was suggested by the substantially longer time to first rescue analgesia in the USG-guided group (19.70 ± 4.54 hours) compared to the blind procedure (13.69) ± 6.78 hours (p≤0.05).

The average amount of rescue analgesics needed in the blind group was 1.54 ± 0.72 and 1.30 ± 0.51 in the USG-directed group, respectively. This indicates a significantly lower need for rescue analgesics in the USG guided group (p<0.05).

Table 2 shows that the USG-guided group's PACU discharge score, which took into account vital signs, activity level, PONV, pain scores, and surgical bleeding, was 9.14± 1.48 points higher than the blind group's (8.5 ± 1.23, p<0.05). Improved analgesia and fewer need of adjuvant analgesics were suggested by the USG-guided group's considerably improved efficacy score (p<0.05), which included respiratory depression, PONV, VAS score range, and sedation. (Listing 3) Block failure occurred in 10% (n=5) of the Group B patients while it occurred in 6% (n=3) of the Group A patients. Rests there are no more issues.

Table 1: Demographic characteristics of patients

Group	Group A	Group B	P value
Age (Mean ± SD)	41.30 ± 14.52	40.29 ± 11.32	0.45
Gender	25/25	27/23	0.22
Weight (Mean ± SD)	63.24 ± 11.10	62.50 ± 10.48	0.09
Duration of surgery (Mean ± SD)	169.67 ± 43.242	172.14 ± 60.48	0.1

Statistically significance at p≤0.05

Table 2: PACU discharge score

Group	Group A (Mean±SD)	Group B (Mean±SD)	P value
Vital signs	1.70 ± 0.42	1.88 ± 0.14	0.03*
Activity level	1.49 ± 0.4	1.61 ± 0.33	0.1
Nausea and vomiting	1.52 ± 0.36	1.79 ± 0.39	0.05*
Pain	1.56 ± 0.47	1.68 ± 0.36	0.02*
Surgical bleeding	1.80 ± 0.35	1.91 ± 0.48	0.09
Total	8.5 ± 1.23	9.14± 1.48	0.09

* indicate statistically significance at $p \leq 0.05$

Table 3: Efficacy score

Group	Group A (Mean±SD)	Group B (Mean±SD)	P value
VAS Range	0.68 ± 0.4	0.92 ± 0.36	0.02*
PONV	1.59 ± 0.47	1.79 ± 0.32	0.03*
Respiratory	1.89 ± 0.22	2.1 ± 0.6	0.9
depression	1.91 ± 0.30	1.98 ± 0.22	0.1
Sedation	6.20 ± 1.30	6.71 ± 0.81	0.02*

* indicate statistically significance at $p \leq 0.05$

Discussion

Typically, postoperative pain management involves multiple modalities. Nonetheless, numerous methods such as illio-inguinal, hypogastric nerve, and abdominal field blocks are employed to directly obstruct the neuro afferents of the abdominal wall. They have been used for a very long time to give patients having lower abdominal procedures postoperative analgesia. It has been demonstrated that efficient analgesia lowers the surgical stress response and speeds up healing, early mobilisation, and discharge. [11–13] Research have found that TAP block decreased the frequency of opioid use while also providing patients undergoing lower abdominal procedures with appropriate postoperative analgesia. Local anaesthetics minimise opioid intake and prevent opioid-related side effects and early discharge when used for postoperative analgesia, according to research by Liu et al. (2014) [14] and White (2015) [15]. Therefore, in our trial, we used local anaesthetics in conjunction with a regional (TAP) block to provide postoperative analgesia for patients having lower abdominal procedures.

Even though post-operative hemodynamic variability to pain was measured using the subjective Visual Analogue Scale (VAS) score, post-operative hemodynamic variability to pain is still an objective way to verify the intensity of discomfort.[16] If there is no underlying illness or reason, tachypnea, elevated blood pressure, and tachycardia all point to the presence of discomfort.

A drop in breathing rate could also be a sign of a side effect of respiratory depression after tramadol injection. Before releasing the patient from PACU to the ward, the PACU discharge score was evaluated after a 24-hour period. The main factor influencing the parameters for PACU discharge is inadequate pain management. Similar to the study conducted by Aparna Sinha et al. [17], the PACU discharge score was generally considerably superior in the USG-guided group, measuring 9.14 ± 1.48 and 8.5 ± 1.23 in the blind group ($p<0.05$), indicating improved postoperative analgesia for 24 hours.

According to research by Khan et al. [18] (2018), the most effective method of analgesia for patients having lower abdominal procedures during the intraoperative and immediate postoperative phases is USG-guided TAP block. According to our research, TAP block (USG-guided) has a great potential for effectiveness in both postoperative analgesia and lowering the need for analgesic rescue medications. According to Kaur et al. [19], ropivacaine is a preferable substitute for bupivacaine. Because ropivacaine acts selectively on pain-transmitting fibres, it blocks more sensory components of the nervous system and less motor ones. It is also less harmful to the central nervous system and heart. Taking into account the aforementioned, we decided to use ropivacaine since it acted more effectively on the sensory component and was only needed for analgesic purposes. It also had fewer effects on the heart and central nervous system than other local anaesthetics.

As demonstrated by Desale Tewelde Kahsay et al.'s study, the USG-guided group's Efficacy score was much better ($p<0.05$) than that of the Blind approach due to significantly decreased pain and PONV. [20] The use of ultrasound technology may increase block's effectiveness and safety. It improves patient compliance compared to several epidural top-ups for abdominal procedures because it is a single shot nerve block. Both hemodynamically unstable patients and those with low cardiovascular reserve can utilise it. In big incisions extending to the upper abdomen, more research on USG guided TAP block via approaches and four quadrant blocks will aid in the provision of post-operative analgesia.

Block failure occurred in 10% (n=5) of the patients in the group using the blind approach, compared to 6% (n=3) of the patients in the USG guided group. This was comparable to the 15% block failure rate of the landmark guided approach in the Desale Tewelde Kahsay et al. study [20].

Since it was deemed unnecessary and unethical, blinding the operators conducting the TAP block and wound infiltration was not done.

Conclusion

While there is a greater learning curve involved, the use of ultrasonography allows for more accurate local anaesthetic injection in the appropriate plane. TAP block is a straightforward, safe, and easy procedure that provides superior analgesia; therefore, it should be regarded as part of multimodal analgesia and enhanced recovery in patients following abdominal surgery. This TAP block can be regularly prescribed as a postoperative pain reduction strategy for patients undergoing lower abdominal procedures, since ultrasonography is now present in every operating room. When compared to a typical analgesic regimen, it also offers the advantages of being less costly, mobilising patients sooner, and facilitating their discharge.

References

1. Aydede M. Defending the IASP definition of pain. The Monist. 2017; 100(4):439-464.
2. Mankikar MG, Sardesai SP, Ghodki PS. Ultrasound-guided transversus abdominis plane block for post-operative analgesia in patients undergoing caesarean section. Indian J Anaesth. 2016; 60(4):253.
3. Dierking GW, Dahl JB, Kanstrup J, Dahl A, Kehlet H. Effect of prevs postoperative inguinal field block on postoperative pain after herniorrhaphy. Br J Anaesth. 1992; 68(4):344–8.
4. Netter FH. Back and spinal cord. In: Netter FH, editor. Atlas of human anatomy summit. New Jersey, USA: Ciba-Geigy Corporation; 1989. p. 145–55.
5. Kuppuvelumani P, Jaradi H, Delilkan A. Abdominal nerve blockade for postoperative analgesia after caesarean section. Asia Oceania J Obstet Gynaecol. 1993; 19(2):165–9.
6. Rafi AN. Abdominal field block: A new approach via the lumbar triangle. Anaesthesia. 2001; 56(10):1024–6.
7. Netter FH. Abdomen posterolateral abdominal wall. In: Netter FH, editor. Atlas of human anatomy summit. New Jersey, USA: Ciba-Geigy Corporation; 1989. p. 230–40.
8. Niraj G, Searle A, Mathews M, Misra V, Baban M, Kiani S, et al. Analgesic efficacy of ultrasound-guided transversus abdominis plane block in patients undergoing open appendicectomy. Br J Anaesth. 2009; 103(4):601–5.
9. El-sharkwy IA, Noureldin EH, Mohamed EA, Mohamed A. Laparoscopic-guided transversus abdominis plane block versus trocar site local anesthetic infiltration in gynecologic Laparoscopy. Gynecol Surg. 2018; 15(15):15.
10. Sinha A, Jayaraman L, Punhani D, Chowbey P. Transversus abdominis plane block for pain relief in patients undergoing in endoscopic repair of abdominal wall hernia: A comparative, randomised double-blind prospective study. J Minim Access Surg. 2018; 14(3):197–201.
11. Kehlet H. Surgical stress: The role of pain and analgesia. Br J Anaesth. 1989; 63(2):189–95.
12. Kehlet H, Holte K. Effect of postoperative analgesia on surgical outcome. Br J Anaesth. 2001; 87(1):62–72.
13. Capdevila X, Barthelet Y, Biboulet P, Ryckwaert Y, Rubenovitch J, d'Athis F. Effects of perioperative analgesic technique on the surgical outcome and duration of rehabilitation after major knee surgery. Anesthesiology. 1999; 91(1):8–15.
14. Liu SS, Richman JM, Thirlby RC, Wu CL. Efficacy of continuous wound catheters delivering local anesthetic for postoperative analgesia: A quantitative and qualitative systematic review of randomized controlled trials. J Am Coll Surg. 2006; 203(6):914–32.
15. White PF. The changing role of non-opioid analgesic techniques in the management of postoperative pain. Anesth Analg. 2005; 101(5 Suppl):S5–S22.
16. Metwally AAR, Abo-El-Enin KM, Allah SIA, Allah SA, Soliman NM, Abo-Omar WA. Ultrasound-guided transversus abdominis plane block for lower abdominal surgeries: bupivacaine alone or combined with fentanyl or epinephrine. Menoufia Med J. 2017; 30:538–43.
17. Sinha A, Jayaraman L, Punhani D, Chowbey P. Transversus abdominis plane block for pain relief in patients undergoing in endoscopic repair of abdominal wall hernia: A comparative, randomised double-blind prospective study. J Minim Access Surg. 2018; 14(3):197–201.
18. Khan SM, Nawaz S, Delvi MB, Alzahrani T, Thallaj A, Zubaidi A, et al. Intraoperative ultrasound-guided transversus abdominis plane block in lower abdominal surgery. International Journal of Perioperative Ultrasound and Applied Technologies. 2012; 1:1–4.
19. Kaur A, Singh RB, Tripathi RK, Choubey S. Comparision between bupivacaine and ropivacaine in patients undergoing forearm surgeries under axillary brachial plexus block:

A prospective randomized study. J Clin Diagn Res. 2015; 9(1):UC01– 6.
20. Kahsay DT, Elsholz W, Bahta HZ. Transversus abdominis plane block after Caesarean section in an area with limited resources. South Afr J Anaesth Analg. 2017; 23(4):90–5.