Original Research Article

Indian Journal of Anesthesia and Analgesia
November - December 2019; 6(6) (Part - II): 2194-2200
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6619.50

Comparison of Analgesic Efficacy of Transversus Abdominis Plane Block with Ilioinguinal Iliohypogastric Nerve Block in Lower Abdominal Surgeries under Spinal Anesthesia: A Double Blind Randomized Study

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Abstract

Background: Regional blocks of the anterior abdominal wall have proven to be highly effective in providing excellent postoperative analgesia, decreasing opioid requirements and facilitating early mobilization and discharge after lower abdominal surgeries. In our study, we compared Transversus Abdominis Plane (TAP) block and Ilioinguinal/iliohypogastric block (IL/IH) for postoperative analgesia in lower abdominal surgeries. *Materials and Methods:* After local ethical committee approval and written consent, the double blind prospective randomized study was conducted on 116 patients (Type I error of 0.05 and a power of 0.9, a sample size of 44 patients/group) of ASA Grade I-II undergoing lower abdominal surgeries under spinal anesthesia. Patients were randomly divided into two Groups through computer generated sequence: Group T: Bilateral TAP block and Group I: Bilateral IL/IH block. Patients were assessed postoperatively for tramadol requirement, first analgesic demand, postoperative pain using Verbal Analog Score (VAS), nausea, vomiting and sedation. Statistical analysis was done by SPSS software version 20 (SPSS Inc., Chicago, IL, USA) and Student's *t* - test, Mann-whitney U test and Fisher's exact test applied. (p – value < 0.05 significant). *Results:* Demographic data were comparable. Tramadol requirement (primary outcome) was lesser in Group T as compared to Group I ($p < 0.001$), time for first analgesic dose was greater in Group T. Group T expressed significantly lesser VAS scores at 4, 12, and 24 hours. Postoperative nausea & vomiting was reduced in Group T as compared to Group I but was statistically insignificant. Patient satisfaction was greater in Group T. *Conclusion:* Transversus Abdominis Plane block provided better pain control than ilioinguinal-iliohypogastric block in lower abdominal surgeries.

Keywords: TAP Block; Ilioinguinal-Iliohypogastric block; Bupivacaine; tramadol.

How to cite this article:

Shruti Sharma, Archana Agarwal, Trilok Chand et al. Comparison of Analgesic Efficacy of Transversus Abdominis Plane Block with Ilioinguinal Iliohypogastric Nerve Block in Lower Abdominal Surgeries under Spinal Anesthesia: A Double Blind Randomized Study. Indian J Anesth Analg. 2019;6(6 Part - II):2194-2200.

Introduction

A substantial amount of pain experienced by patients after abdominal surgery is attributed to the anterior abdominal wall incision. The anterior abdominal wall is innervated by nerve afferents coursing through the transversus abdominis neuro-vascular fascial plane.[1] Pain after surgery has both somatic and visceral components and can be effectively relieved with neuraxial or systemic narcotics.[2] Somatic (cutaneous) pain generated from a Pfannensteil incision is

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Received on 25.09.2019, **Accepted on** 02.11.2019

principally conducted by the iliohypogastric and ilioinguinal nerves supplying afferent coverage to the L1–2 dermatome. Suboptimal analgesia accounts for considerable patient dissatisfaction, prolonged length of stay, and delayed return to normal daily activity.

Opioids given either systematically or as part of regional anesthesia are the most commonly used modality for pain control after lower abdominal surgeries. Though opioids have been seen to provide adequate analgesia they are also responsible for side effects such as nausea, vomiting, pruritis, sedation and respiratory depression.[3,4]

Also, pain relief is provided by infiltration of the incision site with local anesthetic or by providing epidural block where local anesthetic and other additives are injected through an epidural catheter into the epidural space of the lower back numbing the nerves that supply the abdomen.

Regional blocks of the anterior abdominal wall including TAP block and Ilioinguinal block can significantly help with intraoperative and postoperative analgesia. The benefits of adequate postoperative analgesia include a reduction in the postoperative stress response, reduction in postoperative morbidity, and in certain types of surgery, improved surgical outcome. Effective pain control also facilitates rehabilitation and accelerates recovery from surgery. Other benefits of effective regional analgesic techniques include reduced pain intensity, decreased incidence of side-effects of opioid usage and improved patient comfort.

In this study, we explored the utility of regional blocks of the anterior abdominal wall in developing a multimodal approach to postoperative analgesia. In the past few years, there has been increasing research and interest describing how TAP and ilioinguinal blocks are being used for pain relief in both adults and children having abdominal surgical procedures. Several studies have documented that the TAP block provided effective analgesia during the first *24 hours* after surgery in a series of lower abdominal or pelvic surgical procedures. Comparisons of TAP block were performed with a control group receiving systemic analgesia.

Complementary information is still required concerning the TAP block compared with other techniques of regional anesthesia in terms of efficacy and side-effects.[5] Both TAP block and ilioinguinal-iliohypogastric block have proven to provide effective analgesia after lower abdominal surgeries.[6]

Materials and Methods

After the approval of our instituional review board, the double blind randomized study was conducted according to the study protocol submitted to the board. After taking written informed consent, 116 adult patients, of ASA Grade 1 and 2 undergoing lower abdominal surgeries including gynecological surgeries as well as urogenital surgeries, under spinal anesthesia were recruited in this prospective double blind study. Recruited patients were randomnly allocated into two Groups on the basis of computerized randomization technique. The patients received either TAP block or IL/IH block according to group allocation with bupivacaine 0.5% (*2 mg/kg*), *10 ml* each side.

As a part of routine preoperative preparation, standard monitors including pulse oximetry, blood pressure and ECG were applied to all patients. Patients received intravenous metoclopramide (*10 mg*) and ranitidine (*50 mg*) *20–30 minutes* before transfer to the operation theatre. All patients were preloaded with *500 ml* ringer lactate before start of surgery and received spinal anesthesia with *3–3.5 ml* of 0.5% bupivacaine heavy. Intraoperative antiemetics were not used routinely,but if needed, *4 mg* of ondansetrone iv was used. With the onset of satisfactory block, the surgeon proceeded with the surgery and at the end of surgery bilateral transversus abdominis block or bilateral ilioinguinal block was given. Transversus abdominis plane block was performed by using the landmark technique as described by Rafi *et al*.[7] The aim was to place a large volume of local anesthetic in the fascial plane between the internal oblique and transversus abdominis muscles which contains the nerves from T7 to L1. With the patient in the supine position, the iliac crest was palpated from anterior to posterior until latissimus dorsi muscle insertion could be felt. The 'Triangle of Petit' was located (bounded anteriorly by the external oblique, posteriorly by the latissimus dorsi, and inferiorly by the iliac crest). A *22 gauge 5 cm*. long blunt tipped, short-bevelled needle was inserted in the triangle of petit just above the iliac crest at right angle to the coronal plane until resistance was felt. This indicated that the needle tip pierced the external oblique muscle. The needle was advanced in the same direction until a pop sensation was felt. This showed the entry into fascial plane between the external oblique and internal oblique muscles. Further, advancement of the needle resulted in a second 'pop' after passing through the internal oblique fascia into the transversus abdominus plane. At this point, after careful aspiration, *10 ml* of

0.5% bupivacaine was injected. The same procedure was applied on the other side.In the other group patients received Ilioinguinal-iliohypogastric block, which was performed at a location *2 cm* medial and *2 cm* cephalad to the ASIS, using a 2-pop technique. Bupivacaine 0.5% (*10 ml* each side) was injected. The same procedure was repeated on the other side. After completion of the procedure, the patient was shifted to Postanesthesia care unit (PACU). The patients received standard analgesia according to the obstetric department protocol including Inj diclofenac *i.m 12 hrly* and Patient Controlled Analgesia (PCA) pump was also connected to the intravenous line. The patient was instructed to press the demand button whenever the patient felt pain. PCA device was set to deliver a *50 mg* loading dose of tramadol with a bolus dose of *25 mg* and a lock out time of *15 minutes* and *4 hour* limit of *300 mg*.

The assessment of presence and intensity of pain (both on rest and on passive flexion of hip and knee), nausea,vomiting sedation, patient satisfaction score was done immediately after transfer to PACU (0 hrs) and at *6, 12, 24, 48 hrs* after surgery.

Pain using verbal rating scale was assessed on a scale of 0-100 (0-No pain, 100-Severe pain). Nausea and vomiting was assessed on a three point score (0-No nausea/vomiting, 1-Nausea in postoperative period, 2-Vomiting in postoperative period). Sedation was assessed on a 4 point score (0-Awake and restlessness, 1-A quietly awake patient, 2-Asleep but arousable, 3-Deep sleep). Patient was assessed regarding pain, nausea, vomiting and sedation at arrival in the postoperative unit, *6 hrs*, *12 hrs*, *24 hrs* and *48 hrs* after surgery was over.

In PACU, all the observations were made by an independent observer who had no information of group allocation. The primary outcome variable was total dose of tramadol consumed in *48 hours*. The secondary outcomes were VAS score at rest and movement, time for 1st request of analgesia, postoperative nausea vomiting score, sedation score and patient satisfaction score. Electronic memory of PCA device was used to obtain the time of first PCA tramadol and total tramadol consumption.

Primary end point of the study was to evaluate 30% decrease in analgesic consumption between the two groups at estimated time intervals postoperatively. A sample size of at least 48 patients per group was required to detect this difference with a power of 90% at the 5% significance level. All statistical analyses were performed using SPSS software (Statistical Package for Social Sciences) version 20 (SPSS Inc., Chicago, IL, USA) Data are presented as mean and standard deviation. Means were compared by using Student's t or Mann Whitney *U* tests, where appropriate. Chi-square or Fisher's Exact tests were used for categorical comparisons. A *p* - value less than 0.05 was considered statistically significant.

Results

Patient's characteristics were comparable in the two groups. Female patients were predominant in both the groups but the two groups were statistically insignificant with respect to sex distribution of the patients. Tramadol consumption was reduced by 30% in Group T as compared to Group I with a highly significant difference between the two groups. Tramadol consumption was lesser in Group T as compared to Group I during the 1st 24 *hours* and 24–48 *hours*. The difference was highly significant. On movement pain scores were reduced in Group T than Group I at 6 and 12 *hours* but beyond 12 *hours* pain scores were similar in both the groups. Time for first request of analgesia was prolonged in Group T in comparison to Group I. PONV scores were reduced but comparable in both the groups. No significant difference was found between the sedation scores of both the groups.

Table 1: Total analgesic (tramadol) consumption in 48 hours

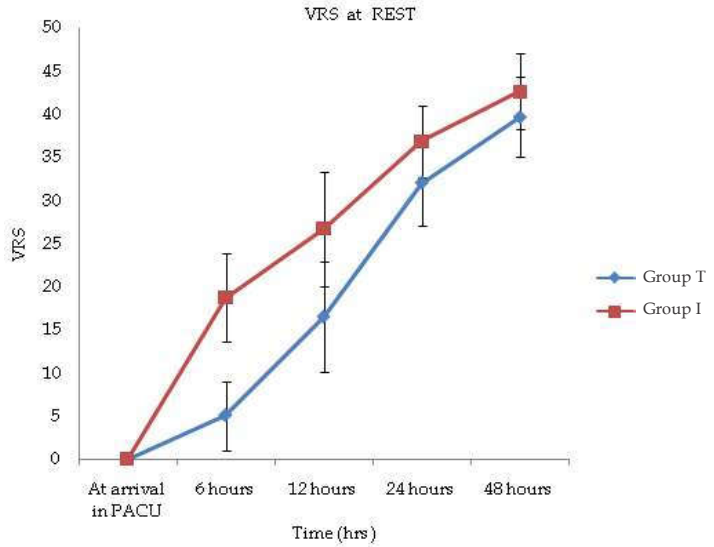
	Group T	Group I	*p* Value
Tramadol Consumption (*mg*) in 48 hours	128.01 ± 16.27	211.63 ± 23.51	<0.0001

Table 2: Stratified analgesic (tramadol) requirement

Tramadol consumption(mg)	Group T	Group I	*p* Value
1st 24 *hours*	52.15 ± 8.48	78.01 ± 12.45	<0.0001
24-48 *hours*	99.13 ± 14.02	114.65 ± 13.27	<0.0001

Table 3: Verbal rating scores (VRS) at rest

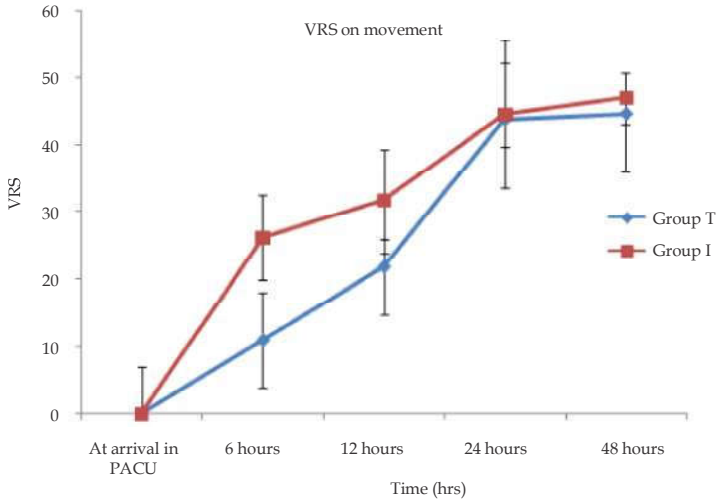
Interval	Group T (Mean ± S.D)	Group I (Mean ± S.D)	*p* Value
VRS at arrival in PACU (0 Hours)	0.17 ± 0.92	0.25 ± 1.45	0.35
VRS (6 hours)	5.07 ± 5.41	18.71 ± 5.15	0.0001
VRS (12 hours)	16.50 ± 6.38	26.72 ± 6.62	0.0001
VRS (24 hours)	32.05 ± 5.01	36.81 ± 4.16	0.0001
VRS (48 hours)	39.66 ± 4.67	42.61 ± 4.41	0.0005



Graph 1: Verbal rating scores (VRS) at rest

Table 4: Verbal rating score on movement (VRSm)

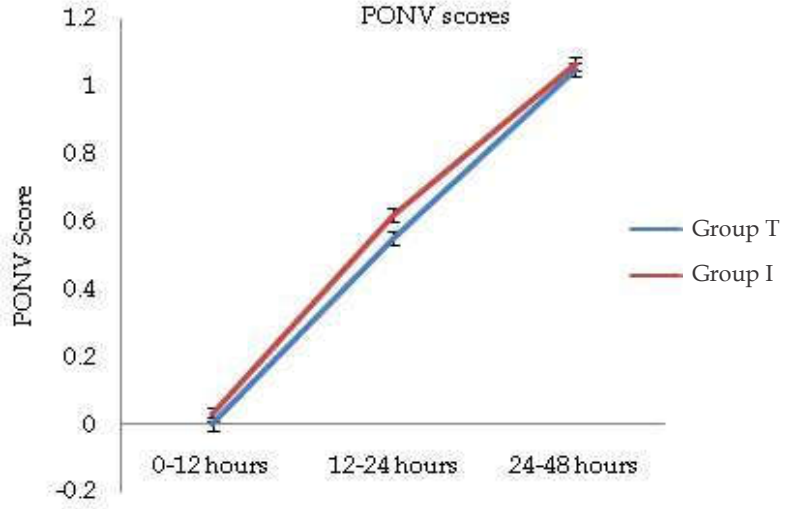
Interval	Group T (Mean ± S.D)	Group I (Mean ± S.D)	*p* Value
VRSm at arrival in PACU (0 Hours)	0.17 ± 0.92	0.34 ± 1.84	0.26
VRSm (6 hours)	10.90 ± 6.23	26.24 ± 6.97	0.0001
VRSm (12 hours)	21.84 ± 7.74	31.69 ± 7.16	0.0001
VRSm (24 hours)	43.72 ± 10.99	44.57 ± 4.0	0.5834
VRSm (48 hours)	44.57 ± 4.0	46.98 ± 8.53	0.0535



Graph 2: Verbal rating score on movement (VRSm)

Table 5: Time for first request of analgesic(Tramadol through PCA)

	Group T	Group I	*p* V alue
First Request for Tramadol (hours)	16.052 ± 0.78	12.336 ± 1.14	0.0001



Graph 3: Post operative nausea and vomiting scores

Graph 4: Sedation scores

Discussion

The ideal analgesic regime should be safe and effective with minimal side effects. A mutimodal analgesic regime is most likely to achieve these goals. However, optimal components of this regimen continue to evolve. Although single shot neuraxial analgesic technique using long acting opioids or patient controlled epidural opioid administration provide effective analgesia, they are associated with frequent incidence of side effects, particularly nausea, vomiting and pruritis which reduce overall patient satisfaction.

Transversus abdominis plane block is a new regional analgesic technique which targets nerves of anterio-lateral abdominal wall mainly T-10 to L1 or T-9 to T-11. The block has been found to be effective after various abdominal surgeries like abdominal hysterectomy,[8] open prostratectomy,[9], laproscopic cholecystectomy and appendicectomy. Ilioinguinal-iliohypogastric nerve block involves the blocking of ilioinguinal and iliohypogastric nerves (L1-L2) in the plane between the transversus abdominis and internal oblique. It has been found to reduce analgesic requirement after cesarian section and inguinal hernia surgeries.

Several studies have documented that the transversus abdominis plane block provided effective analgesia during the first *24 hrs* after surgery in a series of lower abdominal or pelvic

surgical procedures. But these studies included a limited number of patients for each surgical procedure and comparisons were performed with a control group receiving systemic analgesia. The aim of our study was to compare the analgesic efficacy, patient satisfaction regarding analgesia and side effects of TAP block and ilioinguinal iliohypogastric block in patients undergoing lower abdominal surgeries. We found that the overall tramadol consumption was reduced by 30% in the first *48 hours* postoperative group which received TAP block as compared to the group which received IL/IH block.

Our study demonstrated reduced mean pain scores on rest in Group T at *6 hours* (5.07 ± 0.71 *vs* 18.53, $p < 0.0001$), *12 hours* (16.4 ± 6.39 *vs* 26.64, $p < 0.0001$), *24 hours* (32.05 ± 5.01 *vs* 36.81 ± 4.16, $p < 0.0001$) and *48 hours* (39.66 ± 4.67 *vs* 42.67 ± 4.41, $p < 0.0005$) as compared to Group I.

Pain at knee flexion was significantly reduced in Group T at *6 hours* (10.90 ± 0.82 *vs* 26.33 ± 0.97, $p < 0.0001$) and *12 hours* (21.84 ± 7.74 *vs* 31.69 ± 7.16, $p < 0.0001$) but no difference was found in the pain scores beyond *12 hours* in both the groups. These findings can be explained by the fact that while providing analgesia of the skin and deeper layers of the anterior abdominal wall, regional nerve blockade would not provide analgesia for visceral pain which is diffuse and not associated with peripheral nerve supply.[8] Both the nerve blocks provided a significant duration of analgesia. This is in keeping with the prolonged duration of action of bupivacaine.[9] Along with reduced analgesic consumption we also observed that the group which received TAP block took a longer time to request for the first rescue analgesic dose as compared to the group which received IL/IH block. The mean time for 1st analgesic request analgesic in Group T was 16.052 ± 0.103 hours as compared to *12.336 ± 0.15 hours* in Group I ($p < 0.0001$).

The site of penetration of the two nerves towards the abdominal wall muscles also varies, so that, the more proximal the nerves are blocked, the more effective the block could be. Nerve endings anesthetized by the TAP block originate from T7 to L1 and include the Iliohypogastric nerve which is responsible for better analgesic efficacy of TAP block when compared to IL/IH block. Tramadol demand was decreased in patients who benefited from a TAP block, but the difference in tramadol consumption between the two Groups was not important enough to account for a difference in the incidence of PONV. Sedation scores observed were similar in both the groups. None of the patients were deeply sedated to require intervention in any group.

Very few studies have been done comparing the analgesic efficacy of TAP block and ilioinguinal iliohypogastric nerve block. Most studies have been performed comparing these two abdominal nerve blocks with a placebo group and both TAP block and IL/IH block have proven to be effective in reducing pain scores and decreasing opioid consumption. A meta-analysis done by Wang *et al*. also showed that ultrasound-guided II/IH nerve or TAP block is associated with reduced use of intraoperative additional analgesia, reduced pain in day-stay unit, and reduced use of rescue drug.[6] Our results were consistent with those found by a study done by Aveline *et al*. In 2012 Aveline *et al.* compared ultrasound guided TAP block with ilioinguinal-iliohypogastric block in patients undergoing inguinal hernia repair.[5]. Median VAS pain scores at rest were lower in the ultrasound-guided TAP group at *4h,12h* and *24h*. Postoperative morphine requirements were lower during the first *24h* in the TAP block group. Aveline concluded that after open inguinal hernia repair in ambulatory patients, ultrasound-guided TAP block provided better immediate postoperative pain relief and reduced opioid demand, when compared with conventional loss-of-resistance IHN blocks.

In a recent study (2015), Faried AM, Lahloub FMF and Elzehery MM compared ultrasound guided TAP block with ultrasound guided IL/IH block in children undergoing unilateral groin surgery and found that ultrasound guided TAP block provides postoperative pain relief for longer duration as compared to ultrasound guided ilioinguinal/ iliohypogastric nerve blockade.[10]

Our study had certain limitations such as limited assessment of postoperative analgesia time to first *48 hours* after surgery. The severity of pain usually diminishes substantially by this time and pain scores are reduced. We could not use ultrasound guided blocks for our study due to the non availability of ultrasound. Therefore, we could not guarantee the correct placement of local anesthetic into the corresponding planes. The study was not large enough to assess safety of the blocks. There is risk of inadvertent peritoneal puncture with these blocks. Although their incidence is not known, risk of peritoneal puncture is likely to be low. There is also risk of needle puncture of liver in cases where hepatomegaly is seen, though we did not encounter any such cases.

We conclude that both the TAP and IL/IH nerve blocks hold considerable promise as a part of

multimodal analgesic regimen for lower abdominal surgeries but the TAP block was more effective in comparison to IL/IH block, with reduced pain scores and decreased tramadol requirement.

Conclusion

In this randomized, double-blind randomized study, we found that both the transversus abdominis plane block and ilioinguinal-iliohypogastric nerve block were easy to perform and effective in reducing analgesic demand (PCA tramadol) as a part of multimodal analgesia regime but the transversus abdominis plane block was more effective in reducing severity of pain both at rest and on movement, delayed the demand of first postoperative analgesic and reduced the need of PCA tramadol during first *48h* after surgery when compared with ilioinguinal iliohypogastric block.

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