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THE ANALGESIC EFFICACY FOR POST OPERATIVE PAIN RELIEF OF BILATERAL TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK AFTER EXPLORATORY LAPAROTOMY UNDER GENERAL ANESTHESIA

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ABSTRACT **Background:** Transversus Abdominis Plane (TAP) block has gained rapid popularity in last few years. The present study was conducted to evaluate analgesic efficacy of Bilateral TAP Block in patients listed for exploratory laparotomy under General Anesthesia.

Methodolgy: 50 adult ASA I/II eligible patients scheduled for Exploratory Laparotomy under General Anesthesia were randomized with 25 each in two groups. Group A (control) group received 0.9% saline as TAP block and Group B group received bilateral TAP block with 1.0 mg/kg Bupivacaine. The presence and severity of pain, nausea, and sedation were assessed at 2, 6, 12 and 36 hours after TAP blockade using Visual Analog Scale (VAS), Categorical Pain Scoring System (CPSS), time to first request for rescue analgesia and 24 hours Fentanyl requirement. SPSS software was used for analysis.

Results: Statistically significant difference was observed in mean time to first request for rescue analgesia, mean requirement of fentanyl 36 h as postoperative multimodal rescue analgesia, pain scores as per CPPS at 2h, 6h and 12h & VAS pain scores at rest as well as on movement at 2h, 6h, 12h and 36 hrs in two groups. The TAP block reduced pain scores, both at rest and on movement, and reduced overall postoperative fentanyl requirements by more than 76% in the first 24 postoperative hours.

Conclusion: Bilateral TAP block holds considerable promise as a single injection block with easily identifiable landmarks, relatively few contraindications and offers reliable, correct deposition of local anesthetic drug for providing widespread analgesia for exploratory laparotomy.

KEYWORDS : Transversus Abdominis Plane (TAP) block, Analgesic Efficacy, Rescue analgesia, Visual Analog Scale (VAS), Categorical Pain Scoring System (CPSS)

INTRODUCTION

Exploratory laparotomy surgery irrespective of indication under General Anesthesia, is a major abdominal surgical procedure. Postoperative pain and discomfort in such patients are significant and can be hindrance in facilitating early ambulation, reduction of surgical stress and can augment postoperative morbidity[1,2].Most commonly and most reliable, postoperative analgesia in exploratory laparotomy surgeries is provided by Epidural Analgesia with epidural catheter insertion either prior to induction of General Anesthesia or after completion of surgery.[3,4] However, epidural catheter insertion is avoided in some patients, due to relative or absolute contraindications.

A multimodal analgesic regimen is known to achieve the goal of optimum post operative pain relief, increased time to first request for rescue analgesia with opioid as well as its reduced total consumption. However, the optimal components of this regimen continue to evolve. Although single-shot neuraxial analgesic techniques using long-acting opioids, or patient-controlled epidural opioid administration, produce effective analgesia, they are associated with a frequent incidence of side effects, particularly nausea, vomiting, and pruritus, which reduce overall patient satisfaction.[1,2] In addition, there is a risk of delayed respiratory depression due to rostral spread of hydrophilic opioids such as morphine.[4] Furthermore, it is not always possible to provide neuraxial opioid analgesia due to logistic issues and/or the presence of medical contraindications.[3,4]

Abdominal field block is another technique for postoperative analgesia in patients undergoing exploratory laparotomy. In this technique, the sensory nerve supply to the anterior abdominal wall is blocked by employing postoperative analgesia after abdominal incision[5]. But, this technique is now obsolete since it is not reliable and is of poor clinical utility due to poorly defined anatomical landmarks, improper needle positioning and uncertain instillation of local anesthetic in required anatomical plane. However, there has been renewed interest in abdominal field blocks and the quest for a single injection providing widespread analgesia has led to the rapid popularity of the transversus abdominis plane (TAP) block[6].

The abdominal wall includes three muscle layers named as the external oblique, the internal oblique and the transversus abdominis alongwith their associated fascial sheaths. The central abdominal wall consists of the rectus abdominis muscles and its associated fascial sheath. This muscular wall is innervated by nerve afferents that course through the transversus abdominis neuro-fascial plane. The TAP block is performed by accessing entry point, the Triangle of Petit[7], where local anaesthetic drug is deposited which makes it possible to block the sensory nerves of the anterior abdominal wall before they pierce the musculature to innervate the abdomen. (fig 1) The success of technique is dependent on feeling double “pops” as the needle crosses the external oblique and internal oblique muscles. Transversus Abdominis Plane (TAP) block is a single injection block with easily identifiable landmarks, relatively fewer contraindications and offers reliable, correct deposition of local anesthetic drug for providing widespread analgesia.[8,9,10] TAP block techniques has gained rapid popularity in last few years and successfully been utilized for postoperative pain relief in patients undergoing exploratory laparotomy under General Anesthesia.

This present study was conducted to evaluate the Analgesic Efficacy of Bilateral Transversus Abdominis Plane (TAP) Block after Exploratory Laparotomy under General Anaesthesia in tertiary care settings with twin objectives of:

1. To assess the analgesic efficacy of Bilateral Transversus Abdominis Plane (TAP) Block for postoperative pain relief after Exploratory Laparotomy under General Anaesthesia.
2. To study the time to first request for rescue analgesia with opioid fentanyl and its total consumption in the two groups to validate the analgesic efficacy of Bilateral TAP blockade.

MATERIAL & METHODS

Study Outcomes: The primary outcome measure of this study is to find out analgesic efficacy of Bilateral Transversus Abdominis Plane (TAP) Block for postoperative pain relief after Exploratory Laparotomy under General Anaesthesia based on VAS scores and CPSS scores in the post operative study phase. The secondary outcomes of the study are time to first request for rescue analgesia with fentanyl and its total consumption in the two groups to validate the analgesic efficacy of Bilateral TAP blockade.

Study design, sampling and sample size:

This randomized prospective study was conducted at a tertiary care super specialty centre from June 2017 to Apr 2019 amongst indoor patients scheduled for exploratory laparotomy under General

Anesthesia who qualifies the eligibility criteria. Those patients with known allergy to bupivacaine, pediatric age group, coagulation abnormalities, local skin infection at the injection site and patients who had received epidural analgesia were excluded. For the purposes of sample size calculation, it was assumed that a clinically important reduction in 36 h fentanyl consumption would be a 25% absolute reduction.[16] Based on initial pilot studies, we projected a mean 36 h fentanyl requirement of 158 µg with a standard deviation of 17 µg in the control group. It was calculated that 20 patients would be required per group for incorporating two equal sized groups, with $\alpha = 0.05$ and $\beta = 0.2$. To minimize any effect of data loss, 25 patients per group were studied.

Study protocol:

After obtaining approval by Hospital/ Institutional Ethics Committee and written informed patient consent, 50 adult ASA I/II patients scheduled for Exploratory Laparotomy under General Anesthesia were considered for the study with 25 in each group. Patients were randomised by sealed envelopes, to undergo bilateral TAP block (n = 25) or to receive standard care (n = 25). The allocation sequence was generated by a random number table, and group allocation was concealed in sealed, opaque envelopes that were not opened until patient consent had been obtained. 25 patients randomly received bilateral TAP block with 1.0 mg/kg Bupivacaine & 25 patients shall act as control received 0.9% saline as TAP block. Each patient was administered General Anesthesia with endotracheal intubation and positive pressure ventilation. Standard monitoring, including ECG, NIBP, pulse oximetry and end-tidal carbon dioxide were employed.

Bilateral TAP block was performed at the end of surgery prior to extubation in patients designated for TAP block using 25 G blunt tip Whitacre needle by Double Pop Loss of Resistance Technique at the Lumbar triangle of Petit region.[6,7] Iliac crest was palpated from anterior to posterior until latissimus dorsi muscle was felt. The Lumbar triangle of Petit is situated between lower costal margin and iliac crest, bounded posteriorly by latissimus dorsi and anteriorly by external oblique muscle. Needle was introduced through skin at right angle to skin just cephalad to the iliac crest in the Triangle of Petit. Needle was further advanced perpendicularly in the coronal plane till resistance was felt. This indicated that the needle tip was just above external oblique muscle. Gentle advancement led to first "pop" sensation indicating needle position in the plane between external and internal oblique fascial layers. Further gentle advancement resulted into second "pop" which indicated needle entry into Transversus Abdominis Plane. After negative aspiration 1.0 mg/kg Bupivacaine[11] was injected in the Transversus Abdominis Plane. The TAP block was performed on the opposite side using same technique.

Subsequent to bilateral TAP block patients were extubated and shifted to PACU. Patients in both groups received Paracetamol 20 mg/kg IV every 8 hours with Fentanyl (0.5 mcg/kgbw) in aliquots as multimodal postoperative pain relief regimen. Rescue analgesia shall be administered in multimodal regime including opioids if block is inadequate or fails.

The presence and severity of pain, nausea, and sedation were assessed systematically by an investigator blinded to group allocation. These assessments were performed in the PACU at 2, 6, 12 and 36 hours after TAP blockade using Visual Analog Scale, Categorical Pain Scoring System and 24 hours opioid (Fentanyl) requirement. Visual Analog Scale (0 = no pain, 10 = worst imaginable). Categorical Pain Scoring System (none = 0; mild = 1; moderate = 2 and severe = 3). All patients were asked to give scores for their pain at rest and on movement (knee flexion) and for the degree of nausea at each time point. The study ended 36 h after TAP blockade.

DATA ANALYSIS:

Descriptive analysis was carried out by mean and standard deviation of normally distributed quantitative variables. Categorical variables are presented as number and proportions while Ordinal data are presented as medians and interquartile ranges. Chi-square test/ Fischer's exact test was used to test statistical significance with $p < 0.05$ as statistically significant. IBM SPSS ver 22 (IBM Corp., New York, USA) was used for statistical analysis.

RESULTS

The two groups were comparable in baseline patient characteristics in terms of age, body mass index, duration of surgery, intraoperative analgesic requirement as well as frequency of previous abdominal surgery. The analgesic efficacy of TAP blockade with bupivacaine with two study variables as patient undergoing TAP block with bupivacaine had reduced fentanyl requirement in post operative phase over observation period of 36 hours and also longer time to request for rescue analgesia. (Table 1)

Table 1: Baseline Patient Characteristics

Group	Control (n= 25)	TAP Block (n=25)
Age (yr)	52 ± 11.2	48 ± 12.2
Weight (kg)	66 ±13	68 ±10
Height (m)	1.62 ± 0.06	1.63 ± 0.04
BMI (kg/m^2)	26 ± 2.7	28 ± 2.3
Duration of Surgery (mins)	153 ±11	155 ± 9
Intraoperative Fentanyl (mcg/kg)	136 ± 11.9	140 ± 10.2
Previous Abdominal Surgery (n)	10	08

Note: Continuous data are presented as mean ± SD. Categorical variables are presented as number and proportions. There was no significant difference between groups. TAP = Transversus Abdominis Plane

The mean time to first request for rescue analgesia in control group was 22.3 ± 6.9 mins while in TAP blockade group with bupivacaine was 162 ± 23.2 and this was found to have statistically significant difference of $p \leq 0.001$. There was statistically significant difference in mean requirement of fentanyl @ 0.5 mcg/kgbw requirement over 36 h as post operative multimodal rescue analgesia regimen over and above standard pain relief regimen of paracetamol 20 mg/kg IV every 8 hours in the two groups. (Table 2) There is a statistically significant difference in postoperative pain scores as per Categorical Pain Scoring System at PACU, 2h, 6h and 12h in the two groups (Table 3); VAS pain scores at rest at PACU, 2h, 6h, 12h and 36 hrs in the two groups as well as VAS pain scores on movement at PACU, 2h, 6h and 12h in the two groups. (Table 4) VAS pain scores were found to be significantly lower in patients who received the TAP block in comparison to control group but not all point of time of observation.

Table 2: Postoperative Rescue Analgesic Requirement

Study Variable	Control (n= 25)	TAP Block (n=25)
Time to first request for fentanyl (mins)	22.3 ± 6.9	162 ± 23.2$^{\$}$
Mean 36 h fentanyl requirement (µg)	163 ± 15.5	86 ± 12.4$^{\$}$

TAP = Transversus Abdominis Plane PACU = Post Operative Anesthesia Unit $ $p \leq 0.001$

Table 3: Postoperative Pain Scores as per Categorical Pain Scoring System (CPSS)

Study Variable	Control (n= 25)	TAP Block (n=25)
PACU	2.7 (2,3)	0.3 (0,1)$^{\#}$
2 h	2.3 (2,3)	0.7 (0,1)$^{\#}$
6 h	2.4 (2,3)	1.1 (1,2)$^{\#}$
12 h	2.2 (1,3)	1.4 (1,2)$^{\#}$
36 h	1.9 (1,2)	1.4 (0,2)

Ordinal data are presented as medians and interquartile ranges (given in parenthesis),
TAP = Transversus Abdominis Plane PACU = Post Operative Anesthesia Unit # $p \leq 0.01$

Table 4: Postoperative Pain Scores as per Visual Analog Scoring System (VAS) at rest

Study Variable	Control (n= 25)	TAP Block (n=25)
PACU	6.9 (4,9)	1.2 (0,3)$^{\#}$
2 h	5.8 (4,8)	1.5 (0,3)$^{\#}$
6 h	4.7 (2,6)	2.2 (1,4)$^{\#}$
12 h	4.1 (1,5)	2.4 (2,5)$^{\#}$
36 h	3.2 (3,6)	2.1 (2,4)$^{\#}$

Ordinal data are presented as medians and interquartile ranges (given in parenthesis),
TAP = Transversus Abdominis Plane PACU = Post Operative Anesthesia Unit # $p \leq 0.01$

DISCUSSION

Summary of key findings:

This is randomized prospective hospital based study demonstrated that supplementing a multimodal analgesic regimen with a TAP block resulted in reduced 36 h opioid (fentanyl) requirement and pain scores, as well as delayed request for supplemental opioid analgesia,

compared with the standard regimen alone. Statistically significant difference was observed in mean time to first request for rescue analgesia, mean requirement of fentanyl requirement over 36 h as post operative multimodal rescue analgesia regimen over and above standard pain relief regimen, postoperative pain scores as per Categorical Pain Scoring System at PACU, 2h, 6h and 12h in the two groups; VAS pain scores at rest at PACU, 2h, 6h, 12h and 36 hrs in the two groups as well as VAS pain scores on movement at PACU, 2h, 6h and 12h in the two groups.

Strengths of the study:

Abdominal field blocks vis ilioinguinal and hypogastric nerve blocks has long been recognised for effective ablation of nerve supply to abdominal wall muscles to accomplish reasonable postoperative analgesia in patients undergoing surgical procedures such as cesarean delivery[12] and inguinal herniorrhaphy.[3] Alternatively a simple, reliable and effective regional analgesic technique viz TAP block may be employed to achieve desirable effects. The transversus abdominis plane gives access to space where local anesthetic is introduced to achieve sensory blockade of both muscular as well as cutaneous sensations. The TAP block also offers advantage of blocking lateral cutaneous afferents too, ensuring blockade of the complete anterior abdominal wall.[5] Dorsal to the mid axillary line there is an easily identifiable and palpable triangle known as Petit triangle. Using loss of resistance technique local anaesthetic can be easily administered in the transverse abdominal neuro-fascial plane.[7,8]

The present study demonstrated that TAP block produced effective and prolonged postoperative analgesia, when compared with standard therapy, in patients undergoing surgery via a midline abdominal wall incision. The TAP block reduced postoperative pain scores, both at rest and on movement, and reduced overall postoperative fentanyl requirements by more than 76% in the first 24 postoperative hours. The finding that the TAP block reduced fentanyl requirement for each 12 hourly intervals up to 36 h is of importance, in that it demonstrates that a single-shot TAP technique can produce effective analgesia for at least up to 36 h. The poor vascularisation of transverse abdominis plane offers an anesthetic advantage which is the poor clearance of the drug from the site of deposition and therefore enhanced duration of analgesic outcome which last significantly after TAP blockade.[8,9] Therefore, the TAP block seems to be effective for patients undergoing surgery involving either midline or lower abdominal incision.

The dose of 1.0 mg/kg Bupivacaine used in this study is significantly higher[8,9,11,13] even when differences in drug potency are considered. The rationale for using a higher dose of local anesthetic stems from the aim to provide prolonged analgesia with a single-shot TAP block. However, the dose is higher than that recommended by the manufacturer for infiltration or minor nerve block analgesia for the purpose of postoperative analgesia. Of importance, this dose is within the recommended safe dose range for bupivacaine.[11]

Limitations of the study: Firstly, the study limited assessment of postoperative analgesia to the first 36 postoperative hours. However, the TAP block has been demonstrated to produce clinically useful levels of analgesia for at least 48h postoperatively. Secondly, there are difficulties in adequately blinding studies such as these, given that the TAP block produces loss of sensation of the abdominal wall. Thirdly, landmarks in obese patients may be challenging. Fourth, the study was not large enough to assess safety. There is a risk of inadvertent peritoneal puncture with this block. Although the incidence is not known, if the block is performed as described, the risk of peritoneal puncture[13] is likely to be low. Although complications relating to peritoneal puncture were not encountered in the present study. The use of ultrasound to confirm needle position is a promising approach that should further reduce the risk of this complication. Finally, we did not perform a dose-response study to determine if a lower dose of ropivacaine would lead to the same results.

Interpretation and implication in the context of the totality of evidence: Initial cadevaric, and the subsequent studies on the volunteers have shown that the TAP block extend its analgesia by involving the lower six thoracic and upper lumbar sensory afferents.[5,14] This block is indicated for any lower abdominal surgery including appendectomy[4], hernia repair[2], caesarean section,[12] abdominal hysterectomy[15] and prostatectomy[16]. Efficacy in laparoscopic surgery and renal transplantation has also been demonstrated.[6,15] Bilateral blocks can be given for midline incisions or laparoscopic surgery. While performing the bilateral blocks one should be careful with the safe doses of local anaesthetic agents[17] and it should not exceed at any point of time. There are controversies in regard to the cephalad spread of the drug during a single TAP injection. Some initial studies have demonstrated cephalad spread upto C7 level while other have failed to demonstrate the same and thus making this block suitable for lower abdominal surgeries. Small cadaveric studies have shown that T11-L1 were the most constant segments which involved with TAP block, while the T10 segment is involved only in 50% of the cases.[11] Thus it is reasonable to expect a good analgesic effect in the region between T10 an L1 following a single posterior injection. Corollary to that, injection of local anesthetic by TAP block in subcostal region will enable higher block upto T7. This is done by placing ultrasound probe just beneath costal margin and needle is inserted from lateral aspect of rectus muscle in order achieve extension of analgesia above the umbilicus[7,9].

CONCLUSION

Transversus Abdominis Plane (TAP) block is a single injection block with easily identifiable landmarks, relatively few contraindications and offers reliable, correct deposition of local anesthetic drug for providing widespread analgesia. Dorsal to the mid axillary line, landmark known as Triangle of Petit is accessed by loss of resistance technique and local anaesthetic is administered in transverse abdominal neuro-fascial plane[7,8] hence providing multi-dermatome analgesia. This had led to TAP block gaining rapid popularity for postoperative pain relief in patients undergoing exploratory laparotomy under General Anesthesia. The numerous advantages include reduction in postoperative morbidity viz pain control, reduced side effects. post op stress, early ambulation and recovery, better quality of life and better patient comfort and cooperation.

It is concluded that the TAP block holds considerable promise as part of a multimodal analgesic regimen for exploratory laparotomy. The TAP block was easy to perform, and provided reliable and effective analgesia in this study, and no complications due to the TAP block are documented by this study.

REFERENCES

1. Wall PD, Melzack R. Pain measurements in persons in pain. In: Wall PD, Melzack R, eds. Textbook of pain. 4th ed. Edinburgh, UK: Churchill Livingstone, 1999:409–426.
2. Kehlet H. Surgical stress: the role of pain and analgesia. Br J Anaesth 1989;63:189 –95.
3. Dierking GW, Dahl JB, Kanstrup J, et al. Effect of pre- vs postoperative inguinal field block on postoperative pain after herniorrhaphy. Br J Anaesth 1992;68:344–8.
4. Werawatganon T, Charuluxanun S. Patient controlled intravenous opioid analgesia versus continuous epidural analgesia for pain after intra-abdominal surgery. Cochrane Database Syst Rev 2005;CD004088
5. Rafi A. Abdominal field block: a new approach via the lumbar triangle. Anaesthesia 2001; 56: 1024-26.
6. McDonnell JG, O' Donnell BD, Tuite D, et al. The regional abdominal field infiltration (R.A.F.I.) technique: computerised tomographic and anatomical identification of a novel approach to the transversus abdominis neuro-vascular fascial plane. Anesthesiology 2004;101:A899.
7. Netter FH. Abdomen Posterolateral abdominal wall. In: Netter FH ed. Atlas of Human Anatomy. Summit, New Jersey: The Ciba- Geigy Coporation, 2009: 230-55
8. McDonnell J, Laffey J. Transversus Abdominis Plane Block. *Anesth Analg* 2007;; 105: 883.
9. Shibata Y, Sato Y, Fujiwara Y, Komatsu T. Transversus Abdominis Plane Block. *Anesth Analg* 2007;; 105: 883.
10. Bonnet F, Berger J, Aveline C. Transversus abdominis plane block: what is its role in postoperative analgesia. *Br J Anaesth* 2009 103(4): 468-470
11. Sweetman SC, ed. Martindale: the complete drug reference. London: Pharmaceutical Press, 2007:1690–713
12. Kuppuvelumani P, Jaradi H, Delilkan A. Abdominal nerve blockade for postoperative analgesia after caesarean section. Asia Oceania J Obstet Gynaecol 1993;19:165–9
13. Jankovic Z, Ahmad N, Ravishankar N, et al. Transversus Abdominis Plane Block: How Safe is it? *Anesth Analg* 2008;; 107:1758-1759
14. Tran TMN, Ivanusic JJ, Hebbard P, et al. Determination of spread of injectate after ultrasound-guided transversus abdominis plane block: a cadaveric study. Br J Anaesth 2009;; 102(1): 123-7
15. Carney J, McDonnell JG, Ochana A, et al. The transversus abdominis plane block provides effective postoperative analgesia in patients undergoing total abdominal hysterectomy. Anesth Analg 2008;107:2056-60
16. O'Donnell BD, McDonnell JG, McShane AJ. The transversus abdominis plane (TAP) block in open retropubic prostatectomy. Reg Anesth Pain Med 2006;31:91.
17. Bonnet F, Marret E. Influence of anaesthetic and analgesic techniques on outcome after surgery. Br J Anaesth 2005;95:52– 8.