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Evaluation of Fentanyl as Adjuvant in Transversus Abdominis Block in Abdominal Hysterectomy for Post-operative Analgesia

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Abstract

Background: The transversus abdominis plane (TAP) block is a regional analgesia technique that forms part of the multimodal approach to post-operative pain management for abdominal surgeries. Local anesthetics like Bupivacaine with longer duration are preferred for TAP block. *Objectives:* To evaluate if Fentanyl as an adjuvant to bupivacaine in ultrasound guided TAP block improve the duration and quality of post-operative analgesia following abdominal hysterectomy. *Methods:* Forty four patients, aged 18–60 years of American Society of Anesthesiologist (ASA) Physical status I or II, posted for elective open abdominal hysterectomy under general anesthesia were recruited by convenience sampling technique, to receive TAP block using 19.5 ml of bupivacaine hydrochloride 0.25% + 0.5 ml saline 0.9% (Group B, n = 22) or 19.5 ml of bupivacaine hydrochloride 0.25% + 0.5 ml Fentanyl. (25 micrograms) (Group BF, n = 22), after the completion of surgery but prior to extubation. Visual analog scale (VAS) scores at rest and movement were assessed on the emergence, at 0, 2, 4, 6, 12 and 24 hours (h). *Results:* VAS score was significantly lower in study group, at rest at 2h (14.68 vs 20.63, $p = 0.006$), 4h (24.46 vs 24.77, $p = 0.02$), 6h (22.27 vs 28.45, $p = 0.002$) and 12h (18.90 vs 21.00, $p = 0.043$) and that with movement, at 2h (20.45 vs 25.86, $p = 0.006$), 4h (25.23 vs 30.95, $p = 0.001$) and 6h (29.14 vs 33.90, $p = 0.006$). Sedation score in study group was relatively significant at 4h (1.77 vs 1.27, $p = 0.01$) but clinically in-significant to cause major adverse effects. *Conclusion:* Fentanyl as an adjuvant to bupivacaine in ultrasound guided transversus abdominis plane block, following abdominal hysterectomy under general anesthesia improves the quality and duration of post-operative analgesia without any major adverse effects.

Keywords: Bupivacaine; Fentanyl; Ultrasound guidance; Transversus abdominis plane block; Adjuvant, Analgesia.

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Introduction

The Transversus Abdominis Plane (TAP) block is a regional anesthesia technique, that form part of the multimodal approach to post-operative pain management and can provide analgesia for abdominal surgeries like abdominal hysterectomy.[1,2] The block provides analgesia for the skin, subcutaneous tissue muscle and parietal peritoneum and the NSAIDS along with or without opioids provide analgesia for visceral pain. The use of ultrasound guidance has improved the success rate and accuracy of regional blocks.[3] Local anesthetics with longer duration

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are preferred for the transversus abdominis plane block. In that regard, Bupivacaine has significantly longer analgesic duration compared to other commonly used local anesthetics. But even that is in-sufficient to match the duration of post-operative pain. Many adjuvants including fentanyl have been studied for local anesthetics to extend the duration of post-operative analgesia following regional blocks.[4,5] The study was done to evaluate if Fentanyl as an adjuvant to local anesthetic bupivacaine extend the duration post-operative analgesia of transversus abdominis plane block in abdominal hysterectomy and to compare the post-operative nausea and vomiting incidence and post-operative sedation level in the two groups.

Materials and Methods

Study Population: 44 patients aged *18–60 years* of ASA ASA Class I and II;

Study Design: Comparative Observational Study;

Study Settings; Patients posted for abdominal hysterectomy under general anesthesia at Pushpagiri Institute of Medical Sciences and Research Centre, Tiruvalla;

Study Duration: *January 2015* to *March 2016*

Sample Size Estimation: Duration of post-operative analgesia in review literatures as measured by time to first analgesia was found to be in, control group a mean time of 325.4 [SD = 36.6] *minutes* and in study group a mean time of 459.8 [SD = 75.3] *minutes*,[6] and assuming a difference of *60 minutes* in the proposed study the sample size was thus figured out to be 22 in either group.

Inclusion Criteria: 44 patients aged *18–60 years* of American Society of Anesthesiologists (ASA) Grade I and II posted for abdominal hysterectomy by suprapubic transverse incision under general anesthesia.

Exclusion Criteria:

(a) Patient allergic or with contraindications to drugs involved in study;

(b) Patients with infection at proposed injection site;

(c) Patients already on an analgesic drug in past *24 hours* before induction;

(d) Patients with Body mass index > *30 kg/m*^{2}.

Sampling Technique: Convenience Sampling.

Methodology

Those patients satisfying inclusion and exclusion criteria were included in study till desired sample size and allotted to Group B (n = 22) to receive Ultrasound guided TAP block with *19.5 ml* of bupivacaine hydrochloride 0.25% + *0.5 ml* normal saline 0.9% on either side and Group BF (n = 22) to receive Ultrasound guided TAP block with or *19.5 ml* of bupivacaine hydrochloride 0.25% + 0.5 *ml* Fentanyl (*25 micrograms*) on either side. Informed consent was secured from patients satisfying inclusion and exclusion criteria.

Pre-anesthetic Evaluation

During the pre-anesthetic assessment, visual analogue scale of 0 to *10 cm* for assessment of pain with *0 cm* corresponding to no pain and *10 cm* to the worst pain imaginable was taught to them. Routine NPO and Pre-medication protocols. Routine Monitoring protocols as adopted by the Department. All patients received general anesthesia standardised with Morphine *15 mg/kg*, Propofol *1.5 mg/kg*, Vecuronium for adequate muscle relaxation and Sevoflurane as inhalational agent. All patients prior to completion of surgery received *1 gram* Acetaminophen Infusion over *30 minutes*. All patients prior to extubation was given USG TAP block under sterile aseptic precautions.

Reversal of muscle relaxation with mixture of Neostigmine *0.05 mg/kg* and Glycopyrrolate *0.01 mg/kg*. After the patient has adequately recovered from anesthesia, and was able to assess pain, postsurgical analgesia was assessed with VAS 0 to *10 cm* at *0, 2, 4, 6, 12* and *24 hours* and whenever the patient complained of pain. When VAS score exceeded > *4 cm* or when the patients demanded for the first analgesic, Injection Tramadol *2 mg/kg* I.V. was given at, whichever was earlier.

The incidence of post-operative nausea and vomiting will be studied for the first *24 hours*. Nausea to be measured using a categorical scoring system (none = 0, mild = 1, moderate = 2; severe = 3). Rescue anti-emetic Injection Ondansetron *4 mg* will be given if patient complains of nausea or vomiting. The level of sedation will be assessed using sedation score (0 = awake and alert, 1 = minimal sedated with appropriate response to verbal conversation or sound 2 = moderately sedated with arousability on light tactile stimulation or verbal command, 3 = Deeply sedated with arousability on significant physical stimulation, 4 = unarousable).

Statistical Analysis

Statistical Package for Social Sciences (SPSS) software is used for analysis of data (17.0 (SPSS Inc., Chicago, IL, USA). Duration of post-operative analgesia as measured by time to first rescue analgesic (TFA) was analysed by applying unpaired *t*-test to the mean value. Quality of post-operative analgesia as measured by Visual analogue scale (VAS score) at rest and movement wias analysed by applying unpaired *t*-test to the mean value of both. Post-operative Nausea and Vomiting (PONV) score and Sedation score were compared using unpaired *t*-tests. Heart Rates (HR) and Systolic Blood Pressure (MAP) were compared using Anova. A *p*-value of less than 0.05 was considered statistically significant.

Results

Table 1: Demographic and Operative details of the participants in two groups

Variable	Group BF Mean (SD)	Group B Mean (SD)	*p* value
Age (*year*)	44.32 (5.85)	44.41 (4.80)	0.972
Weight (*kg*)	62.5 (9.04)	65.23 (8.16)	0.372
Height (*cm*)	163.19 (8.29)	160.5 (8.68)	0.280
BMI (kg/m^2)	23.35 (1.78)	25.30 (2.27)	0.003#
Duration of surgery (*minutes*)	125.77 (23.34)	133.5 (26.60)	0.488
Duration of Anesthesia (*minutes*)	147.32 (24.86)	158.32 (25.19)	0.188

Shown as in **Table 1**, the mean age in Group BF and Group B were 44.32 ± 5.85 *years* and 44.41 ± 4.80 *years* respectively. The difference in ages between the two groups was not statistically significant (*p* value = 0.972 > 0.05). The mean weight in Group BF and Group B were 62.5 ± 9.04 *kg* and 65.23 ± 8.16 *kg* respectively. The differencein weight between the two groups was not statistically significant (*p* value = 0.372 > 0.05). The mean height in Group BF and Group B were 163.19 ± 8.29 *cm* and 160.5 ± 8.68 *cm* respectively. The difference in height between the two groups was not statistically significant (*p* value = 0.280 > 0.05).

Table 2: Demographic Characteristics of the groups

Characteristic	Group BF	Group B
Age		
Upto 44	11 (50%)	11 (50%)
45 and above	11 (50%)	11 (50%)
Body Mass Index		
Upto 24.99	18 (81.8%)	9 (40.9%)
25 and above	4 (18.2%)	13 (59.1%)
ASA Grade		
Grade 1	15 (68.2%)	15 (68.2%)
Grade 2	7 (31.8%)	7 (31.8%)

Shown as per **Table 2**, the percentage of subjects with ASA Grade 2 in Group BF and Group B were 31.8% and 31.8% respectively. The difference in percentage distribution of ASA Grade 2 between the two Groups was not statistically significant ($p = 1.00 > 0.05$). The percentage of subjects with BMI *25* kg/m^2 and above in Group BF and Group B were 18.2% and 59.1% respectively. The difference in percentage distribution of BMI *25* kg/m^2 and above between the two groups was statistically significant ($p = 0.0122 < 0.05$).

Table 3: Comparison of VAS score at Rest (*mm*)

Time of observation	Group BF Mean (SD)	Group B Mean (SD)	*p* value
0 hours	5.64 (4.62)	6.45 (4.69)	0.457
2 hours	14.68 (6.24)	20.63 (6.44)	0.006
4 hours	24.46 (22.31)	24.77 (4.92)	.020
6 hours	22.27 (6.76)	28.45 (4.86)	.002
12 hours	18.90 (3.42)	21.00 (3.31)	.043
24 hours	19.63 (3.81)	20.91 (3.13)	.309

Shown as per **Table 3**, the mean VAS score at rest was lower in Group BF compared to Group B at *0 hour*, *2 hour*, *4 hour*, *6 hour*, *12 hour* and *24 hours*. The difference in VAS scores at rest between Group BF and Group B was statistically significant at *2 hour* ($p = 0.006 < 0.05$), *4 hour* ($p = 0.02 < 0.05$), *6 hour* ($p = 0.002 < 0.05$) and *12 hour* ($p = 0.043 < 0.05$).

Table 4: Comparison of VAS score at Movement (*mm*)

Time of observation	Group BF Mean (SD)	Group B Mean (SD)	*p* value
0 hours	9.45 (6.03)	10.14 (4.81)	.698
2 hours	20.45 (6.28)	25.86 (6.07)	.006
4 hours	25.23 (4.89)	30.95 (4.76)	.001
6 hours	29.14 (6.79)	33.90 (4.41)	.006
12 hours	25.68 (3.29)	26.45 (2.87)	0.338
24 hours	20.27 (3.52)	19.64 (3.81)	0.232

Shown as per (**Table 4**), the mean VAS score at Movement was lower in Group BF compared to Group B at *0 hour*, *2 hour*, *4 hour*, *6 hour* and *12 hour*. VAS score at movement in *24 hour* was higher in Goup BF compared to Group B. The difference in VAS scores at Movement, between Group BF and Group B was statistically significant at *2 hour* ($p = 0.006 < 0.05$), *4 hour* ($p = 0.001 < 0.05$), and *6 hours* ($p = 0.006 < 0.05$).

Table 5: Comparison of Groups in Terms of Sedation Score

Time of observation	Group BF Mean (SD)	Group B Mean (SD)	*p* value
0 hours	2.28 (.43)	2.14 (.35)	0.44
2 hours	1.95 (.21)	1.77 (.43)	0.082
4 hours	1.77 (.43)	1.27 (.70)	0.010
6 hours	1.32 (.57)	1.00 (.62)	0.087
12 hours	.82 (.39)	.77 (.43)	0.712
24 hours	.45 (.51)	.28 (.43)	0.116

Shown as in **Table 5**, the mean Sedation score was higher in Group BF compared to Group B at *0 hour*, *2 hour*, *4 hour*, *6 hour*, *12 hour* and *24 hours*. The difference in Sedation scores, between Group BF and Group B was statistically significant at *4 hour* ($p = 0.01 < 0.05$).

Table 6: Comparison between groups according to Post-operative Nausea and Vomiting (PONV)

Groups	PONV	No PONV	*p* value
Group BF	4 (18.2%)	18 (81.8%)	0.664
Group B	2 (9.1%)	20 (90.91%)	

Shown as in **Table 6**, the percentage of incidence of Post-operative Nausea and Vomiting (PONV) in Group BF and Group B were 18.2% and 9.1% respectively. The difference in percentage of the incidence of post-operative Nausea and Vomiting (PONV) between the two Groups was not statistically significant ($p = 0.664 > 0.05$).

Table 7: Changes in Heart Rate over time in both the groups

Time of observation	0 hours	2 hours	4 hours	6 hours	12 hours	24 hours	*p* value
Group BF	73	74	74	78	75	77	0.420
Group B	75	74	75	77	78	76	0.318

Shown as per (**Table 7**), the changes in Heart Rate over time in Group BF was not statistically significant

($p = 0.420 > 0.05$). The changes in Heart Rate over time in Group B was also not statistically significant ($p = 0.318 > 0.05$).

Table 8: Changes in Systolic Blood Pressure over time in both the groups

Time of observation	0 hours	2 hours	4 hours	6 hours	12 hours	24 hours	*p* value
Group BF	133	131	130	130	130	128	0.107
Group B	133	131	134	135	134	132	0.871

Shown as per **Table 8**, the changes in Systolic Blood pressure over time in Group BF was not statistically significant ($p = 0.107 > 0.05$). The changes in Systolic Blood pressure over time in Group B was also not statistically significant ($p = 0.871 > 0.05$).

Discussion

The Transversus Abdominis Plane (TAP) block is a novel rapidly expanding regional anesthesia technique, that provides analgesia following abdominal surgeries. The study was conducted on two groups with 22 patients each, who were posted for abdominal hysterectomy under general anesthesia. Group B ($n = 22$) served as control group and received ultrasound guided TAP block with *19.5 ml* of bupivacaine hydrochloride 0.25% + 0.5 *ml* normal saline 0.9% on either side and Group BF ($n = 22$) served as study group and received ultrasound guided TAP block with or *19.5 ml* of bupivacaine hydrochloride 0.25% + 0.5 ml Fentanyl (*25 microgram*) on either side, after surgery and prior to extubation.

Nearly 60% of patients in Group BF was having BMI *25 kg/m*^{2} and above, while it was only 18% in Group B. The difference in percentage distribution of BMI *25 kg/m*^{2} and above between the two Groups was statistically significant ($p = 0.0122 < 0.05$). Patients with BMI > *30 kg/m*^{2} were excluded from the study since in obese individuals, thick subcutaneous tissue at the abdominal wall makes it too difficult to reach depth of TAP and to obtain optimal ultrasound image. An out-of-plane technique is more useful in obese patients as needle tip may not be seen throughout the procedure. A low frequency curved transducer may be required to achieve the image depth of abdominal wall structures.[7,8]

The mean VAS score at Movement was lower in Group BF compared to Group B at *0 hour, 2 hour, 4 hour, 6 hour* and *12 hours*. VAS score at movement in *24 hours* was higher in Group BF compared to Group B. The difference in VAS scores at movement, between Group BF and Group B was statistically significant at *2 hour* ($p = 0.006 < 0.05$), *4 hour* ($p = 0.001 < 0.05$), and *6 hours* ($p = 0.006 < 0.05$). In one study, when dexamethasone was added to bupivacaine for TAP block for post-operative analgesia in abdominal hysterectomy under general anesthesia, the pain VAS score at movement was significantly lower in the study group, at the post-operative *2 hour* (4.9 *vs* 28.1, $p = 0.01$), *4 hour* (12.2 *vs* 31.1, $p = 0.01$) and *12 hour* (15.7 *vs* 25.4, $p = 0.02$). TFA was significantly longer in the dexamethasone group (459.8 *vs* 325.4 *min*, $p = 0.002$.[6] In another study, dexmedetomidine was added to bupivacaine for TAP block for post-operative analgesia in abdominal hysterectomy under general anesthesia, the pain VAS scores at rest and movement were significantly lower in study group, in the first *8 hours* post-operatively ($p < 0.001$).[9,10] In one study, when Fentanyl was added to ropivacaine in ultrasound guided TAP block for cesarean section under subarachnoid block, there was no improvement in post-operative pain outcome and no significant differences in the post-operative nausea and vomiting sedation levels.[11]

Conclusion

Addition of *0.5 ml* Fentanyl (*25 microgram*) to *19.5 ml* of bupivacaine hydrochloride 0.25%, in ultrasound guided transversus abdominis plane block following abdominal hysterectomy under general anesthesia, improved the quality and duration of post-operative analgesia without any major adverse effects.

Conflict of Interest: None declared.

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