

ORIGINAL RESEARCH

Comparison of Analgesic Efficacy of Fentanyl and Tramadol in TAP (Transversus Abdominis Plane) Block After Percutaneous Nephrolithotomy: A Randomized Controlled Study

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ABSTRACT

Background: Transversus abdominis plane (TAP) block is a well-established analgesic technique for postoperative analgesia in abdominal surgeries. In our study, we compared the analgesic efficacy of adjuvant fentanyl and tramadol with Bupivacaine in TAP block following percutaneous nephrolithotomy.

Methods: In this randomized, prospective, controlled study, 90 patients of ASA grade I and II were divided into three groups; Group A, Group B, and Group C. Surgical procedure was done under spinal anesthesia. At the end of surgery, we introduced TAP block unilaterally in the triangle of Petit by feeling two pop technique. Group A received 28 ml of 0.25% bupivacaine with 50 µg of Fentanyl; 1 ml normal saline was added to make total 30 ml, Group B received 28 ml of 0.25% bupivacaine with 100 mg of tramadol (2ml), and Group C received 28 ml of 0.25% bupivacaine with 2 ml of normal saline. The primary outcome was duration of analgesia (time to first rescue analgesia) and the secondary outcomes were total dose of rescue analgesics and visual analog scale (VAS) score recorded at 0, 2, 6, 4, 8, 12, and 24 hr. If VAS score >4 or patient complained of pain, then injection diclofenac 75mg intravenous was given as rescue analgesic.

Results: Duration of analgesia was higher with fentanyl than tramadol & normal saline. It was 7.01 ± 0.176 hrs., 4.89 ± 0.713 hrs. and 3.01 ± 0.125 hrs. respectively with fentanyl, tramadol, and normal saline. The total dose of rescue analgesic was lower with fentanyl than tramadol and higher with normal saline. VAS score was also lower with fentanyl in comparison to tramadol and normal saline.

Conclusion: Postoperatively many adjuvants were added in TAP block to improve the quality of analgesia but fentanyl prolonged the postoperative analgesia effectively in comparison to tramadol or plain TAP block.

Keywords: Nephrolithotomy, Bupivacaine, Visual Analog Scale (VAS) Score, Spinal Anesthesia.

INTRODUCTION

Pain after Percutaneous Nephrolithotomy mainly occurs at the flank area overlying kidney. Many patients experience anxiety before surgery owing to their fear of pain, and as a result of this pain, they are unable to breathe properly afterward.¹ Therefore, this Postoperative pain was not only delaying the recovery but also causing postoperative pulmonary complications.² Hence, postoperative pain management is a crucial aspect of recovery.

There are different modalities to treat this acute pain i.e., drugs (NSAIDs, opioids, local anesthetics), a regional anesthetic technique such as local anesthetic infiltration, abdominal field blocks, ilioinguinal nerve blocks, and transversus abdominis plane (TAP) blocks. Transversus abdominis plane block offers analgesia to the anterolateral abdominal wall by blocking peripheral nerves into the tissue plane between the internal oblique and transversus abdominis muscle using landmark techniques. Due to the low vascularity of this plane, medicines administered by this route have a longer duration of action and are not associated with serious side effects.³

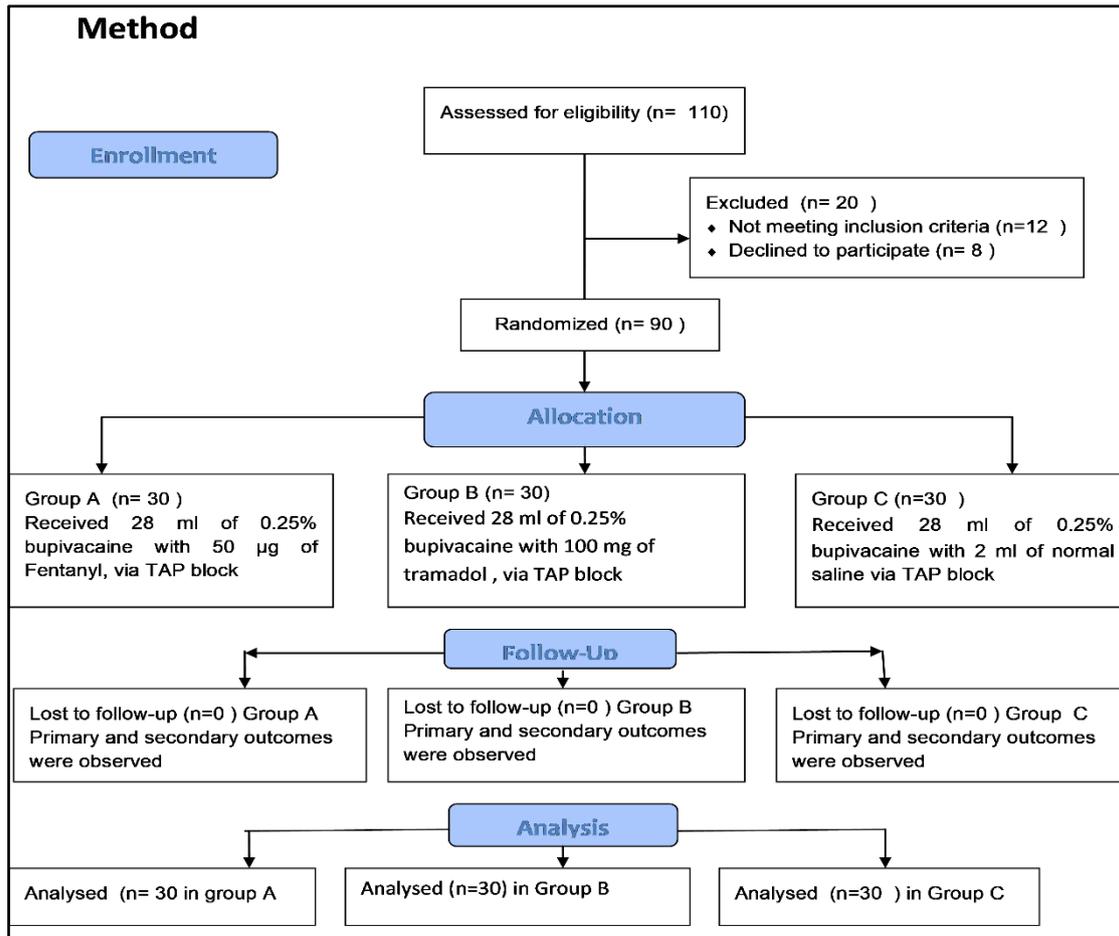
Multiple adjuvants (opioids and other additives, such as dexmedetomidine or dexamethasone) have been employed in everyday clinical practice to maximize the duration of TAP block.⁴⁻⁶ Because opioid receptors are located on peripheral nerves in the transverse abdominis plane, when LAs are combined with opioids, the duration and quality of this block can be improved.^{7,8}

Following a thorough literature search, there was no single study that compared their effects, thus this one was chosen to assess the analgesic efficacy of Fentanyl and Tramadol in the TAP block. The primary objective was to determine the duration of analgesia (time to first rescue analgesia) with secondary objectives including total dose of rescue analgesic, visual analog scale (VAS) score, side effects (if any).

MATERIALS AND METHODS

This randomized, prospective, double, blind controlled study was carried out in the department of anesthesia, Government medical college, Dafia (M.P.) from April 2019 to September 2020. The study included 90 individuals aged 30-70 years, ASA grade I and II, of either sex, who were scheduled for percutaneous nephrolithotomy under spinal anaesthesia and patients who refused, deranged renal function, coagulopathy, hypersensitivity, spinal site infection, systemic diseases (CVS, Pulmonary, Hepatic, CNS, etc.) were excluded from the study. After getting written informed consent from the patient, a numerical pain rating scale with 0 to 10 points was explained to them.

Computer-generated numbers in sequentially sealed envelopes were used to divide all patients into three groups. Group A received 28 ml of 0.25% bupivacaine with 50 µg of fentanyl diluted with 1 ml normal saline to make 30 ml total drug, Group B received 28 ml of 0.25% bupivacaine with 100 mg of tramadol (2 ml), and group C received 28 ml of 0.25% bupivacaine with 2 ml of normal saline.



All of the patients were shifted to OT and baseline monitors were attached on them. Spinal anesthesia was administered using a 25 G Quincke's needle and 0.5% heavy bupivacaine 3.5 ml (18 mg) and the operation was carried out under spinal anesthesia. The aseptic approach was used to administer a TAP block after the surgery was completed. The iliac crest was identified and palpated posteriorly till the latissimus dorsi muscle was felt. A 22-G stimuplex, 100 mm needle was inserted in the triangle of Petit just above the iliac crest at a right angle to the skin in a coronal direction until resistance felt (which indicates that the external oblique muscle was reached). An initial 'pop' sensation was felt as the needle was carefully moved into the plane between the external and internal oblique muscles. The study drug (which was prepared by another colleague outside of the OT) was injected over 90 seconds after confirmation of the needle's position and negative aspiration. During this time, the patient was watched for signs of local anaesthetic toxicity. After monitoring vital signs for 20 minutes, patients were transferred to the post-anesthesia care unit. A nurse on duty recorded the study parameters as requested. All the patients received intravenous (IV) paracetamol 1 gm infusion at the end of surgery. Diclofenac 75 mg intravenous injection was used as a rescue analgesic on demand or when the VAS score was more than four. The total amount of analgesic required throughout the course of 24 hours was also recorded.

Visual analog scale (VAS) scores were recorded at 0, 2, 4, 6, 8, 12, and 24 hs. Hemodynamic parameters such as non-invasive blood pressure, heart rate, saturation, and respiratory rate were also noted along with VAS, till $VAS \geq 4$. The study was completed 24 hours following the surgery.

STATISTICAL ANALYSIS

Continuous variables were presented in Mean \pm SD, while categorical variables were presented in number (percent). To compare the means, a one-way ANOVA test was employed. The post hoc Tukey's test was used to do a pair wise comparison and Mann Whitney test was used to compare difference between two independent groups. With a 5% margin of error and an 85 percent confidence level (power), the sample size was calculated to be 27 patients in each group, hence total 90 patients were chosen after dropouts were taken into account.

RESULTS

In terms of age, weight, height, and duration of surgery, all three groups of patients were comparable. For the purposes of the study, there were no significant differences, and the groups were comparable. (Table -1)

Time to first rescue analgesia was 7.01 \pm 0.176 hrs. 4.89 \pm 0.713 hrs. and 3.01 \pm 0.125 hrs. respectively with Fentanyl, tramadol, and normal saline. Hence, time to first rescue analgesia was higher with Fentanyl than tramadol or normal saline. In Group A, Group B, and Group C, total rescue analgesic dosages in 24 hours were 32.67 \pm 11.25 mg, 57.85 \pm 10.23 mg, and 89.58 \pm 19.37 mg, respectively. This showed that in Group A, patients need fewer rescue analgesics than Group B, and Group C. Therefore, the difference in time to first rescue analgesia and total rescue analgesic dose between the three groups ($p\leq 0.05$) was significant. (Table-2)

There was a significant difference in VAS score at 2 hrs. to 4 hrs. between Groups A and C, as well as in Groups B and C. At 6 hours, the VAS score difference between Group A and B also in between Group A and C, was substantial, but not between groups B and C. After 8 hours, the difference in VAS between the three groups was insignificant. (Table-3)

There was no evidence of nausea, vomiting, sedation, pruritis, bradycardia, hypotension, respiratory depression, or any other adverse events in any of the groups. In addition, no unintentional injuries or local anaesthetic toxicity were recorded in any of the cases examined. In all three groups, hemodynamic parameters indicated readings that were similar to their baseline levels.

Table 1: Demographic profile and duration of surgery

Characteristic	Group A (mean \pm SD)	Group B (mean \pm SD)	Group C (mean \pm SD)	P-Value (ANOVA test)
Age (in years)	45.5 \pm 12.07	47.9 \pm 7.5	46.78 \pm 11.7	>0.05
Weight (in kg)	58.7 \pm 14.5	59.5 \pm 16.2	58.3 \pm 12.4	>0.05
Height (in cm)	161.76 \pm 8.9	163.32 \pm 8.9	162.64 \pm 7.1	>0.05
Duration of surgery (in hrs.)	1.2 \pm 0.7	1.1 \pm 0.9	1.4 \pm 0.3	>0.05

Table 2: Rescue analgesia (time and total dose up to 24 hrs.)

Parameter	Group A	Group B	Group C	P-value (post hoc Tukey's test)
Time to the first rescue analgesia in hours	7.01 \pm 0.176	4.89 \pm 0.713	3.01 \pm 0.125	0.0260
Total dose of rescue analgesia in mg/24 hr	32.67 \pm 11.25	57.85 \pm 10.23	89.58 \pm 19.37	0.0271

Table 3: VAS score at a different time interval.

VAS score at hours	Mean VAS score			p-value (Mann-Whitney's U-test)		
	Group A	Group B	Group C	A vs B *	B vs C *	C vs A *
0	0.30	0.30	0.34	.05	.05	.05
2	0.36	0.38	0.60	.05	.00108	< .00001
4	0.40	0.43	2.40	.06	< .00001	< .00001
6	0.46	1.25	2.76	< .00001	< .00001	< .00001
8	1.73	2.27	2.23	.05	.05	.05
12	1.57	1.72	2.30	.05	.05	.05
24	1.37	1.53	1.50	.05	.05	.05

DISCUSSION

Previous studies have reported both positive and negative results.⁹⁻¹¹ However, the findings of this investigation were encouraging. When fentanyl and tramadol were given in TAP block with bupivacaine instead of normal saline, the duration of analgesia was prolonged. The weakly vascularized area of TAP block explains the prolonged persistence of the analgesic action, and hence medication clearance may be hindered by lower absorption into the bloodstream.¹² Due to insufficient analgesia and time of single TAP blocking, as well as instability while inserting the catheter into the abdominal wall, adjuvants have been the favored alternative for extending the duration of local anesthetics.¹³

In a meta-analysis of seven articles, Kepeng et al. found that USG guided TAP was a useful technique for analgesia in patients undergoing laparoscopic cholecystectomy.¹⁴ Niraj G et al reported that TAP block greatly decreased postoperative morphine consumption in the first 24 hours in another investigation of ultrasound-guided TAP block in open appendectomy. However, they didn't use any adjuvants. In this study, we introduced adjuvants to prolong postoperative pain management using unilateral, landmark guided TAP block in patients undergoing open percutaneous nephrolithotomy with an anterolateral abdominal wall incision.¹⁵

Many researchers have attempted to determine whether functioning opioid receptors are present in human peripheral tissue.¹⁵⁻¹⁸ A few studies found that when adjuvants added in peripheral nerve blocks, there was an improvement in the duration of analgesia, similar to subarachnoid blocks. Fentanyl may act at the peripheral level via a variety of routes, including direct action on peripheral receptors, disseminated fentanyl from the peripheral nerve sheath to subarachnoid and epidural areas following the block, or fentanyl entering the systemic circulation from the periphery.¹⁵ According to Fletcher et al., adding fentanyl to lidocaine and adrenaline for axillary plexus block had no clinical effects.¹⁶ Another study with Fentanyl in TAP block for elective caesarian section by John R et al found that Fentanyl did not significantly improve postoperative analgesia. Because in their study, the total dose was divided evenly and supplied bilaterally, it's possible that the dose of fentanyl would not be enough to prolong postoperative pain. However, investigations by Karakaya et al. and Nishikawa et al. found that the fentanyl group had a significant increase in postoperative analgesia.^{17,18}

The TAP block, when used as part of a multimodal analgesic regimen, can surely provide better postoperative analgesia. In this study, we employed TAP block with 50 µg of fentanyl for unilateral analgesia, and considerable sustained postoperative analgesia was seen. The findings of this study were equivalent to those of John R et al. and Qi Chen et al's research, they noticed the effects of adding fentanyl to local anesthetics in TAP block in gynecologic surgery patients and observed that adding fentanyl to a local anesthetic prolongs the TAP block effect and considerably improves VAS score.^{19,20} However, because they gave fentanyl to each patient based on their body weight, this might result in dosage variation and bias. As a result, we set the dosage in our study at 50 µg to avoid dose-related bias, which has been

shown in prior studies. In addition, we only utilized TAP unilaterally to improve analgesic effect at surgical site.

Another research by Reem EL Kabariety found that adding tramadol to the local anaesthetic in a TAP block reduced immediate postoperative pain, increased the time to first rescue analgesia, decreased the mean 48-hour morphine intake, and increased the length of postoperative analgesia. However, they utilized intravenous fentanyl and morphine for analgesia for up to 48 hours. As a result of the use of intravenous opioids, the impact of TAP with tramadol could not be reliably measured.²¹

The mean diclofenac required in 24 hours was lower in Group A, in comparison to Group B and Group C. As a result, the findings showed that adding opioids analgesic to TAP block, might greatly prolong its efficacy. The findings of this investigation agreed with the findings of Solanki Rekha et al.²²

The postoperative VAS scores were considerably lower in patients of groups A and B compared with those of group C at 2, 4, 6, and 8 h postoperatively. Furthermore, until 8 hours after surgery, patients in group A had considerably lower postoperative pain than those in group B; however, the difference was not significant beyond that. Our findings were similar to those of Niraj et al. and El Kabariety.

Opioids are known to produce nausea, vomiting, sedation, respiratory depression and itching. However, in our study groups, the incidence of all these side effects was not present. It may be inferred that fentanyl and tramadol had relatively minor systemic absorption when used as an adjuvant to local anaesthetic in TAP block, resulting in central opioid receptor activation. There was no evidence of PONV or sedation in this investigation, and the findings were consistent with those of Niraj et al and Reem el kabariety.

This study has certain limitations. First, postoperative hemodynamic vitals were monitored but not mentioned. Second, because of the residual effects of spinal anaesthesia, we were unable to determine the onset time of TAP block. Finally, we did not look at how fentanyl and tramadol influenced the plasma levels of bupivacaine.

More multicenter studies are needed in the future to evaluate these readily available and cost-effective medications, and postoperative hemodynamics should be followed as well.

CONCLUSION

We discovered that adding fentanyl or tramadol to TAP blocks increased analgesia, reduced total systemic NSAID use, and improved recovery quality without worsening surgical complications. Fentanyl, on the other hand, extended postoperative analgesia longer than tramadol and normal saline.

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