Section: Anesthesiology

Original Research Article

COMPARISON OF ULTRASOUND-GUIDED DUAL TRANSVERSE ABDOMINIS PLANE BLOCK (SUBCOSTAL AND POSTERIOR) VS EPIDURAL BLOCK BY USING 0.25% ROPIVACAINE WITH FENTANYL FOR PATIENTS UNDERGOING OPEN NEPHRECTOMY UNDER GENERAL ANAESTHESIA: RANDOMISED CLINICAL STUDY

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Abstract

Background: Open nephrectomy is a major surgical procedure that is associated with significant postoperative pain. Postoperative pain management after open nephrectomy remains a challenge that affects patient satisfaction and recovery. This study compared the efficacy of ultrasound-guided dual transverse abdominis plane block (subcostal and posterior) with epidural block for nephrectomy surgeries. **Materials and Methods:** This randomised, double-blinded, prospective study included 40 patients who underwent nephrectomy at the Institute of Anesthesiology, Madras Medical College, between May 2019 and May 2020. Forty patients were randomised by closed envelope method into Group E (20 patients), who received epidural block, and Group T (20 patients), who received Dual TAP block under ultrasound guidance. Pain was assessed using the numerical pain rating score, and haemodynamic parameters, such as heart rate, blood pressure, and oxygen saturation, were monitored. **Result:** Demographic parameters such as age, weight, height, duration of surgery, and nephrectomy side were similar in both groups. There was no difference in haemodynamic parameters between the groups during the intraoperative and postoperative periods. The duration of analgesia was comparable in Group T(14.3±4.32) and Group E (15.0±3.46). A higher dose of fentanyl was needed in group E than in group T. The mean postoperative numerical rating pain scores showed the same trend in Groups T and E 2–24 h postoperatively. No complications were observed in either group. **Conclusion:** Dual Subcostal and Posterior (TAP) block may be a better alternative for patients undergoing open nephrectomy who cannot be provided with an Epidural Block.

INTRODUCTION

Open nephrectomy is a major surgery associated with significant postoperative pain, and when it comes to easing pain after open nephrectomy, finding the best method is crucial. Inadequate pain control can lead to complications, delayed ambulation, and increased length of hospital stay. Epidural analgesia provides excellent pain relief for nephrectomy surgeries, but its use in renal surgery is limited due to hypotension and anticoagulant use. Hence, analgesic requirements in patients undergoing open nephrectomy remain challenging and require opioid use despite side effects. Opioids, while effective, have undesirable side effects, such as nausea, vomiting, and respiratory depression.[1-4] A Dual TAP Block (Subcostal and Posterior) on the side of the nephrectomy may reduce postoperative pain. Compared with epidural analgesia, TAP blocks do not cause hypotension. Furthermore, the TAP block is relatively safe, even when patients are anticoagulated.

Ultrasound-guided TAP Blocks have been shown to reduce postoperative pain and opioid use. There are four approaches to the TAP block. The subcostal TAP block provided analgesia to the upper abdomen (dermatomal level), while the posterior TAP block provided analgesia and visceral analgesia to the lower abdomen (dermatomal level). Additionally,

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ultrasound guidance improves the success rate and reduces the incidence of complications. Both TAP block and epidural anaesthesia have shown promise in making things more comfortable for patients. However, we need to determine which method works better, especially when using ropivacaine and fentanyl. Ropivacaine, a long-acting local anaesthetic with a relatively safer profile and less motor blockade, is used along with fentanyl.[4,5]

Identifying the best methods for managing postoperative pain while maintaining safety and efficacy.[1,2,5] The present study examined the intricate field of analgesic treatment for individuals with open nephrectomies. This study aimed to compare the analge sic efficacy of Ultrasound-guided Dual Transverse Abdominis Plane Block (subcostal and posterior) and epidural block for nephrectomy surgeries, to evaluate the duration of postoperative analgesia, and to assess intraoperative and postoperative haemodynamics and postoperative numerical pain scores.

MATERIALS AND METHODS

This randomised, double-blinded, prospective study was conducted on 40 patients undergoing nephrectomy at the Institute of Anesthesiology, Madras Medical College, from May 2019 to May 2020. The ethical committee, permission from the Department of Urology, and written informed consent were obtained from all study participants.

Inclusion Criteria

Patients aged 15–65, ASA I, II, and III, elective surgery, and valid informed consent were included.

Exclusion Criteria

Patients not satisfying the inclusion criteria, those scheduled for emergency surgery, those with absolute contraindications to TAP block, soft-tissue infection of the abdominal wall and skin, bleeding disorders and coagulation abnormalities, kyphoscoliosis, allergy to drugs used, patient refusal, and those with severe cardiovascular, endocrine, respiratory, hepatic, or psychiatric diseases were excluded.

The patients were visited preoperatively, the procedure was explained to them, and informed consent was obtained. Following the standard protocol, all patients were kept nil per oral for 6 hours before surgery, and premedication, tablet ranitidine 150 mg, tablet alprazolam 0.5 mg, and tablet metoclopramide 150 mg was administered. Forty patients were randomised by closed envelope method into Group E (20 patients), who received epidural block, and Group T (20 patients), who received Dual TAP block under ultrasound guidance. All standard monitors were connected after the patients were shifted to the operation theatre and baseline heart rate, blood pressure, mean arterial pressure, and saturation were recorded. Intravenous access was obtained, and fluids were administered.

In patients belonging to Group E, an epidural catheter was placed under strict aseptic technique using an 18G Tuohy needle in the sitting posture through the midline approach by the loss of resistance technique in the T8 interspace. A test dose of 3 ml of injection Lignocaine 1.5% with adrenaline 1 in 2 lakh was administered epidurally. Infusion of 0.25% ropivacaine with fentanyl 1mcg/ml was started at a rate of 5-7 ml/hr, titrated according to intraoperative haemodynamics, and continued throughout the surgery. An infusion was continued postoperatively and adjusted according to the patient's analgesic requirements and postoperative haemodynamics.

Under ultrasound guidance in patients in Group T, a dual transverse abdominis plane block (subcostal and posterior) was administered on the side of the nephrectomy. With the patient in the supine posture, a subcostal TAP block was administered with 20 ml of 0.25% ropivacaine injection of fentanyl 20mcg after hydro-dissecting the plane with 5 ml of distilled water. Subsequently, the transducer was moved more posteriorly. A posterior TAP block was administered with 20 ml of 0.25% ropivacaine injection of fentanyl 20mcg after hydro-dissecting the plane with 5 ml of distilled water.

General anaesthesia was instituted in all patients following epidural or TAP Block. The patients were premedicated with an injection of midazolam (1 mg IV), glycopyrrolate 0.2 mg IV, fentanyl 2mcg/kg IV, and pre-oxygenation. Induction was performed by injecting Thiopentone Sodium 2.5 mg/kg. After muscle relaxation with an injection of Atracurium 0.5 mg/kg, patients were intubated with an appropriately sized cuffed Endotracheal Tube and secured in place. Anaesthesia was maintained using nitrous oxide, oxygen and sevoflurane 1%. After surgery, the patients were reversed with Inj Neostigmine, Inj Glycopyrolate, and Extubated.

Heart rate, mean arterial pressure, and peripheral oxygen saturation were documented at 10, 30, 60, 90, 120, 150, and 180 minutes. The parameters were also noted after induction, and the responses at the time of skin incision and after extubation were recorded. Total intraoperative fentanyl consumption was calculated and documented. After extubation, pain was assessed using the numerical pain rating score, and haemodynamic parameters such as heart rate, blood pressure, and oxygen saturation were monitored. The sedation score was also assessed at 2, 4, 6, 8, 10, 12, 18, and 24 hours. Rescue analgesia was administered using Inj Tramadol 100 mg IM when the numerical pain score was ≥ 4. The time for the first requirement and total doses of rescue analgesia were noted, and the patients were carefully monitored for any inadvertent complications.

Statistical Analysis

All collected data were entered into a Microsoft Excel spreadsheet and then exported to the Statistical Package for Social Sciences (SPSS) software version 24.0. Descriptive statistical analysis was initially performed, and the data are presented as frequencies and percentages with appropriate central tendency and dispersion measures. Inferential statistics analysis primarily included comparing continuous

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and categorical data between Group T and Group E. The student 't' test compared the two groups for continuous, normally distributed data. Mann Whitney U test was used to compare the two groups for non-normally distributed continuous data. The Chi-square test was used to compare categorical data between the two groups. Variables measured repeatedly after various time intervals were analysed using repeated-measures analysis of variance (ANOVA) with groups as a factor for comparison.

RESULTS

The mean ages of groups T and E were 48.65 ± 12.65 and 49.95 ± 6.50, respectively. There was a higher proportion of females in group E (80%) than in group T (55%). Most patients undergoing nephrectomy were 41–50 years of age, followed by 51–60 years. The mean height in Group T and Group E was 164.7±7.92 and 160.45±9.39. The mean weight in Group T and Group E was 67.55±11.56 and 64.35±15.57, respectively. The mean height and weight of both groups were similar. There were no statistically significant differences in age, sex, height, or weight between the groups. Therefore, the number of patients in both groups was comparable at baseline.

There was a slightly higher proportion of left-sided pathologies necessitating nephrectomy than right-sided pathologies. Most of the study subjects were classified as ASA II and ASA III in group T than in group E. There were no significant differences between the groups regarding nephrectomy or ASA status. The duration of surgery in Group T and Group E was 138.75±11.80 and 135.75±17.86, respectively. The mean duration of surgery was similar in both groups, and there was no statistically significant difference between groups T and E (p=0.535) [Table 1].

There was no significant difference in intraoperative heart rate, mean arterial pressure, and oxygen saturation between the groups at baseline and 180 min.

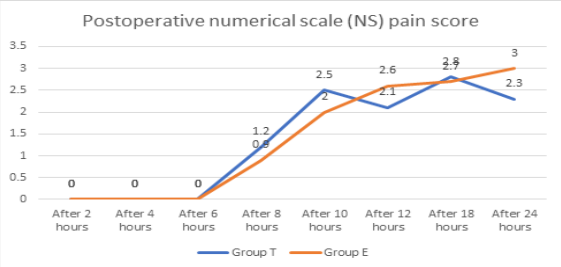

Figure 1: Postoperative numerical scale (NS) pain score between groups

The mean dose of muscle relaxant and atracurium consumption in Group T was 65.25±6.78, and that in Group E was 61.25±10.37. The total dose of atracurium needed in both groups was similar, with no statistically significant difference (p>0.05). The total dose of Inj. The fentanyl consumption in Group T was 150±13.76, and that in Group E was 239.3±41.96. A higher dose of fentanyl was needed in group E than in group T, and this difference in the mean dose of fentanyl needed between groups was statistically significant (p<0.001).

There was no statistically significant difference (p>0.05) in the dose of rescue analgesia needed in the postoperative period between Groups T and E. Patients in Group E had a slightly longer duration of postoperative analgesia than those in Group T. The difference in the mean duration of postoperative analgesia between the groups was not statistically significant (p>0.05) [Table 2].

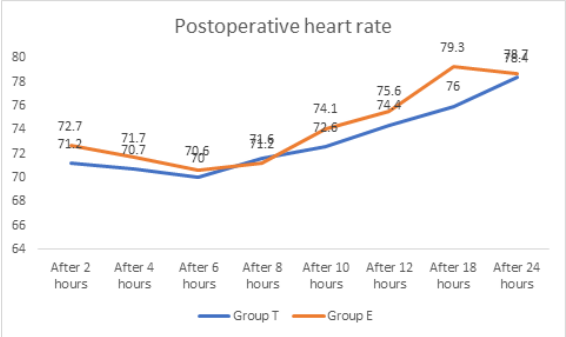

Figure 2: Postoperative heart rate between groups

There was no statistically significant difference in the mean NS score for pain, heart rate, and mean arterial pressure between the two groups from 2 to 24 hours postoperatively [Figures 1-3].

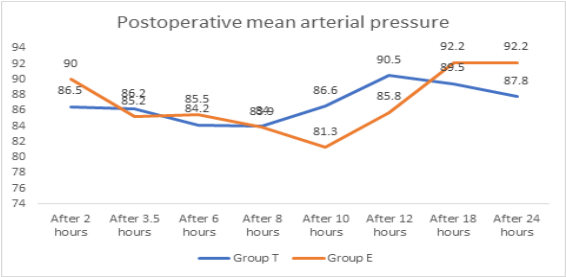

Figure 3: Postoperative mean arterial pressure between groups

Table 1: Comparison of demographic data between groups

		Group T	Group E	P-value
Mean age (years)		48.65±12.659	49.95±6.501	0.685
Sex	Male	9 (45%)	4 (20%)	0.091
	Female	11 (55%)	16 (80%)	
Height (Cm)		164.70±7.921	160.45±9.395	0.13
Weight (Kgs)		67.55±11.569	64.35±15.574	0.465
Side of Nephrectomy	Left	8 (40%)	13 (65%)	0.113
	Right	12 (60%)	7 (35%)	

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ASA physical status	ASA I	2 (10%)	4 (20%)	0.655
	ASA II	14 (70%)	13 (65%)	
	ASA III	4 (20%)	3 (15%)	
Duration of surgery		138.75±11.796	135.75±17.865	0.535

Table 2: Comparison of mean doses of various findings between groups

	Group T	Group E	P-value
Mean dose of atracurium (mg)	65.25 ± 6.781	61.25 ± 10.371	0.157
Mean dose of fentanyl (mg)	150 ± 13.765	239.30 ± 41.964	<0.001
The mean dose of rescue analgesia needed	130 ± 47.016	125 ± 44.426	0.731
Mean duration of postoperative analgesia	14.3 ± 4.318	15 ± 3.464	0.575

DISCUSSION

Ultrasound-guided Blocks are gaining popularity owing to their ease of use and fewer complications. Since the invention of the TAP Block, several comparisons have been clinically studied. With the advent of separate approaches under ultrasound guidance for the TAP Block, more studies are required to evaluate its efficacy and extend its use, limiting complications. Open nephrectomy, which is a major abdominal surgery with a subcostal incision, limits the patient's postoperative respiratory functions and requires good postoperative analgesia. No studies have compared dual TAP blocks with open nephrectomy.

Our study compared dual TAP and epidural blocks in 40 patients undergoing open nephrectomy. We observed no statistically significant differences between the two groups regarding age, sex, height, weight, ASA of Anaesthesiologist's physical status, or duration of surgery. Furthermore, in Group T, 60% of the patients underwent right-sided nephrectomy; in Group E, 65% underwent left-sided nephrectomy, which was statistically insignificant. There was no significant difference in intraoperative heart rate, mean arterial pressure, and oxygen saturation between the groups at baseline and 180 min. The total dose of atracurium required in both groups was similar, as there was no statistically significant difference ($p>0.05$) in the mean dose between groups T and E. A higher dose of fentanyl was needed in group E than in group T, and this difference in the mean dose of fentanyl needed between group T and group E was statistically significant ($p<0.05$). Since there was a continuous infusion of fentanyl (1mcg/ml) in the epidural space, total fentanyl consumption was higher in Group E.

The postoperative heart rate and mean arterial pressure showed significant variation starting from 2 hours to 24 hours into the postoperative period in both the groups, but the variation of mean heart rate was similar in both the groups as there was no statistically significant difference in variation between the group T and group E. Also, postoperative Numerical Pain scores at 2-24 hours were comparable between Group T and Group E. Similar to a study by Kandi Y compared the effects of two types of nerve blocks on postoperative pain after lower abdominal cancer surgery. The study found that the quadratus lumborum block reduced the total analgesic consumption and delayed the first request for analgesia compared with the lumbar epidural block. The study concludes that the quadratus lumborum block is a better option for managing postoperative pain following major lower abdominal cancer surgery.[6]

In our study, patients with numerical pain scores of >3 were administered rescue analgesia with Inj. Tramadol and duration of postoperative analgesia were noted. The duration of postoperative analgesia was 15 hours in Group E, which was slightly longer than that in Group T, where the duration of analgesia was 14.3 hours. However, this difference was not statistically significant ($p >0.05$). Similar to the results of the study by Carney et al. The study reported that ultrasound-guided TAP block offers several benefits, such as consistently administering local anaesthetic solution into the TAP region under real-time visualisation, which can enhance block success rates and reduce the likelihood of adverse effects.[4]

Two studies confirmed the beneficial effects of the TAP block for postoperative pain management. A study by Ra et al. found reduced pain scores and analgesic requirements in laparoscopic cholecystectomy patients when levobupivacaine (0.25-0.5%) was used for the block.7 Another study by Carney et al. showed lower pain scores in non-laparoscopic gynaecological surgeries when 0.375% ropivacaine was used for the block, compared to patients who didn't receive it.[8] Studies investigating the use of TAP block with bupivacaine (0.25–0.5%) or ropivacaine (0.375–0.75%) for non-laparoscopic abdominal/gynaecological surgeries have reported inconsistent findings, with some showing higher pain scores in patients receiving the block.[8-11]

Regarding the postoperative rescue analgesia requirement, the average tramadol consumption was 130 mg in Group T and 125 mg in Group E, which was not statistically significant ($p>0.05$). Kıtlık et al,[12] observed that morphine consumption was significantly lesser in Group 1 (received ultrasonography-guided subcostal TAP block) compared to Group 2 (did not receive TAP block) at the 2nd, 6th, and 24th hours ($p<0.05$). They concluded that the TAP block decreased 24-hour postoperative morphine consumption. Further, Lee et al. suggested that the posterior approach seems more suitable for lower abdominal surgery, and the subcostal approach is more suitable for upper abdominal surgery.[13]

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CONCLUSION

In conclusion, our findings underscore the potential of dual TAP block as a robust and patient-friendly alternative to epidural block for open nephrectomy. We found that the dual TAP block on the nephrectomy side provided good postoperative analgesia and haemodynamic stability comparable to that of the epidural block. So, a dual TAP (Subcostal and Posterior) block may be a better alternative for patients undergoing open nephrectomy who cannot be provided with an epidural block. The amalgamation of effective analgesia and haemodynamic stability positions the dual TAP block as a valuable tool for healthcare providers seeking to optimise postoperative patient care.

Limitations

The limitations of this study include the absence of a control group and the fact that the dermatomal distribution of pain and intensity of pain during movement and coughing were not recorded.

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