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A Comparative Study Between the Use of Usg Guided Errector Spinae Block and USG Guided Paravetebral Block for Urological Surgeries

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ABSTRACT

Background: Urological surgeries are often associated with moderate to severe postoperative pain due to extensive manipulation of abdominal and retroperitoneal structures. Effective perioperative analgesia is essential for enhanced recovery, improved pulmonary function, early mobilization, and reduced opioid consumption. Ultrasound-guided regional anesthesia techniques such as erector spinae block (ESB) and paravertebral block (PVB) have emerged as promising modalities. However, limited evidence exists comparing their efficacy in urological surgeries.

Aim: To compare the analgesic efficacy and safety of USG-guided erector spinae block and paravertebral block in patients undergoing urological surgeries.

Materials and Methods: This prospective, randomized, controlled study was conducted on 94 patients scheduled for elective urological surgeries under general anesthesia. Patients were randomly allocated into two groups: Group A (n=47) received USG-guided erector spinae block, while Group B (n=47) received USG-guided paravertebral block. All patients received intra-operative fentanyl (2 µg/kg). Postoperative pain scores, requirement of rescue analgesia, time to first rescue analgesia, hemodynamic stability, and complications were recorded. Statistical analysis was performed with significance set at $p<0.05$.

Results: The demographic profiles were comparable between groups. Rescue analgesia was significantly lower in Group A (34.04%) compared to Group B (82.98%) ($p<0.0001$). The mean time to first rescue drug was longer in Group A (281.25 ± 323.27 min) than Group B (158.46 ± 119.79 min, $p=0.036$). Requirement of second rescue analgesia was lower in Group A (6.38%) compared to Group B (27.66%, $p=0.012$). Only a small proportion required a third dose (2.13% vs. 4.26%, $p=1.000$). No major block-related complications were reported.

Conclusion: Both USG-guided erector spinae and paravertebral blocks provided effective analgesia in urological surgeries. However, erector spinae block demonstrated superior postoperative pain control, delayed requirement of rescue analgesia, and reduced opioid consumption compared to paravertebral block. Thus, ESB may be considered a safer and more effective alternative for perioperative analgesia in urological surgeries.

Keywords: Erector spinae block, Paravertebral block, Urological surgeries, Ultrasound-guided block, Postoperative analgesia.

INTRODUCTION

Urological surgeries, encompassing procedures such as nephrectomy, prostatectomy, ureterolithotomy, percutaneous nephrolithotomy (PCNL), and transurethral resections, are associated with significant postoperative pain owing to the involvement of abdominal and retroperitoneal structures. Adequate perioperative analgesia is crucial not only for patient comfort but also for improved respiratory function, early mobilization, reduced opioid consumption, shorter hospital stay, and decreased morbidity. Traditionally, postoperative pain management in urological surgeries has relied on systemic

opioids, non-steroidal anti-inflammatory drugs (NSAIDs), and neuraxial techniques such as epidural analgesia. However, these methods are often limited by side effects, contraindications, or technical challenges. Neuraxial blocks may be contraindicated in anticoagulated patients or those with spinal deformities, while systemic opioids are associated with nausea, vomiting, respiratory depression, constipation, and delayed recovery. These limitations have driven interest in alternative regional anesthesia techniques that can provide effective and safer analgesia.

Among such alternatives, the ultrasound-guided (USG) erector spinae plane (ESP) block and paravertebral block (PVB) have gained increasing attention in recent years. Both techniques target thoracic spinal nerves but differ in anatomical approach and spread of local anesthetic. The ESP block, first described by Forero et al. in 2016, involves deposition of local anesthetic deep to the erector spinae muscle at the transverse process level, leading to multi-dermatomal analgesia through spread into the paravertebral and epidural spaces. It is considered relatively easy to perform, with a favorable safety profile due to its distance from pleura, neuraxis, and major vascular structures [1,2]. Several studies have demonstrated its efficacy in thoracic, abdominal, breast, and spine surgeries, with promising results in urological procedures [3,4].

In contrast, the paravertebral block, first described in the early 20th century and later refined with ultrasound guidance, involves injection of local anesthetic into the paravertebral space adjacent to the spinal nerves as they exit the intervertebral foramina. This results in unilateral somatic and sympathetic blockade, providing dense analgesia comparable to epidural anesthesia but with fewer systemic side effects [5]. The PVB has long been used in thoracic and breast surgeries, and more recently, its application has expanded into abdominal and urological surgeries [6,7]. However, the technique requires precise anatomical knowledge and carries a higher risk of complications such as vascular puncture, pleural puncture, or inadvertent neuraxial spread when compared to the ESP block.

Ultrasound guidance has significantly improved the accuracy, safety, and success rates of both ESP and PVB techniques. Visualization of target muscles, transverse processes, paravertebral space, pleura, and needle trajectory under real-time imaging has reduced the incidence of complications, while allowing smaller volumes of local anesthetic to achieve effective blockade [8]. In the context of urological surgeries, where unilateral incisions and flank or retroperitoneal approaches are common, both ESP and PVB offer effective postoperative analgesia, reduced opioid consumption, and improved recovery outcomes [9].

Despite their similarities, clinical experience suggests that ESP and PVB may differ in terms of efficacy, dermatomal spread, duration of analgesia, and complication rates. Comparative studies evaluating the two blocks in urological surgeries are limited, and there remains uncertainty regarding which technique offers superior analgesia and safety in this patient population. Given the growing emphasis on multimodal and opioid-sparing analgesia in enhanced recovery after surgery (ERAS) protocols, the role of USG-guided ESP and PVB in urological procedures warrants systematic exploration [10]. The aim of the present study is to evaluate the effect of ultrasound-guided erector spinae plane block (ESPB) and ultrasound-guided thoracic paravertebral block (TPVB) on patients undergoing urological surgeries with respect to postoperative analgesia. The primary objective is to compare postoperative pain between the two groups using the Visual Analogue Scale (VAS). The secondary objectives include assessing intraoperative hemodynamic parameters to evaluate stability during surgery, and comparing the incidence of complications, if any, arising from the two blocks, thereby determining their relative efficacy and safety in clinical practice.

MATERIALS AND METHODS

Study Design: This study will be a prospective, randomized, controlled study conducted in patients undergoing elective urological surgeries.

Sampling Method: Convenience sampling method will be used.

Sample Size: the study will include 47 participants in each group, making a total of 94 patients.

- **Group 1 (n = 47):** Patients receiving ultrasound-guided erector spinae plane block (ESPB) intraoperatively after induction with propofol.
- **Group 2 (n = 47):** Patients receiving ultrasound-guided thoracic paravertebral block (TPVB) intraoperatively after induction with propofol.

Inclusion Criteria:

- Patients belonging to ASA Physical Status I–II
- Both genders
- Age between 18 and 60 years

- Body Mass Index (BMI) < 30

Exclusion Criteria:

- Patient refusal to participate
- ASA III–IV patients
- BMI > 30
- Pregnant patients
- Known allergy to study drugs (bupivacaine/ropivacaine)
- Patients with pre-existing respiratory or cardiac disorders
- Age < 18 years or > 60 years
- Patients with heart rate < 60/min

Statistical Analysis: -

For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

RESULT

Table: 1. Age Distribution

Age (years)	Group A (n=47)	Group B (n=47)	Total	P value
21-30	23 (48.94%)	26 (55.32%)	49 (52.13%)	0.918
31-40	19 (40.43%)	17 (36.17%)	36 (38.30%)	
41-50	3 (6.38%)	3 (6.38%)	6 (6.38%)	
51-60	2 (4.26%)	1 (2.13%)	3 (3.19%)	
Mean ± SD	31.51 ± 8.23	31.23 ± 6.37	31.37 ± 7.32	
Median (25th-75th percentile)	32(24.5-36)	30(27.5-34)	30(26-35)	0.856
Range	21-57	21-52	21-57	

Table: 2. Analgesic Requirements and Complications

Parameters		Group A(n=47)	Group B(n=47)	Total	P value
Intra-operative analgesia	**Inj. Fentanyl 2µg/kg**	47 (100%)	47 (100%)	94 (100%)	NA
	Total	47 (100%)	47 (100%)	94 (100%)	
Rescue analgesia needed	**No**	31 (65.96%)	8 (17.02%)	39 (41.49%)	<.0001
	Yes	16 (34.04%)	39 (82.98%)	55 (58.51%)	
	Total	47 (100%)	47 (100%)	94 (100%)	
Time of requirement of 1st drug(minutes)	**Mean ± SD**	281.25 ±323.27	158.46 ±119.79	194.18 ±205.66	0.036
	Median (25th-75th percentile)	240(112.5-240)	120(90-240)	120(90-240)	
	Range	30-1440	60-720	30-1440	
Needed 2nd drug	**No**	44 (93.62%)	34 (72.34%)	78 (82.98%)	0.012
	Yes	3 (6.38%)	13 (27.66%)	16 (17.02%)	
	Total	47 (100%)	47 (100%)	94 (100%)	
Time of requirement of 2nd drug (minutes)	**Mean ± SD**	380 ±330.45	394.62 ±244.9	391.88 ±250.15	0.835
	Median (25th-75th percentile)	360(210-540)	360(240-720)	360(210-720)	
	Range	60-720	90-720	60-720	
Needed 3rd drug	**No**	46 (97.87%)	45 (95.74%)	91 (96.81%)	1
	Yes	1 (2.13%)	2 (4.26%)	3 (3.19%)	
	Total	47 (100%)	47 (100%)	94 (100%)	
Complication	**Nil**	47 (100%)	47 (100%)	94 (100%)	NA
	Total	47 (100%)	47 (100%)	94 (100%)	

The age distribution of participants in both groups was comparable, with the majority falling in the 21–30 years category [23 (48.94%) in Group A vs. 26 (55.32%) in Group B]. This was followed by the 31–40 years group [19 (40.43%) in Group A vs. 17 (36.17%) in Group B], while a smaller proportion belonged to the 41–50 years [3 (6.38%) in each group] and 51–60 years categories [2 (4.26%) in Group A vs. 1 (2.13%) in Group B]. The mean age was 31.51 ± 8.23 years in Group A and 31.23 ± 6.37 years in Group B, with an overall mean of 31.37 ± 7.32 years. The median age was 32 years (IQR: 24.5–36) in Group A and 30 years (IQR: 27.5–34) in Group B, with an overall median of 30 years (IQR: 26–35). The range of ages was 21–57 years in Group A and 21–52 years in Group B. Statistical analysis showed no significant difference in age distribution between the two groups ($p = 0.918$ for categorical comparison; $p = 0.856$ for median age).

All patients in both groups received intra-operative analgesia with Inj. Fentanyl 2 µg/kg. Postoperatively, a significant difference was observed in the requirement of rescue analgesia, with only 34.04% of patients in Group A requiring rescue medication compared to 82.98% in Group B ($p < 0.0001$). The mean time to requirement of the first rescue drug was 281.25 ± 323.27 minutes in Group A versus 158.46 ± 119.79 minutes in Group B, which was statistically significant ($p = 0.036$). With respect to second rescue analgesia, 6.38% of patients in Group A required an additional dose, compared to 27.66% in Group B ($p = 0.012$). The mean time to second drug administration was comparable between the groups (380 ± 330.45 minutes vs. 394.62 ± 244.9 minutes, $p = 0.835$). Only a small proportion of patients required a third dose (2.13% in Group A vs. 4.26% in Group B, $p = 1.000$).

DISCUSSION

The present study found a markedly lower requirement for rescue analgesia in Group A (34.04% vs 82.98% in Group B; $p < 0.0001$) and a significantly longer mean time to first rescue (281.25 ± 323.27 min vs 158.46 ± 119.79 min; $p = 0.036$). These findings are consistent with a substantial body of literature showing that the addition of an effective regional / multimodal analgesic technique in the perioperative period reduces the proportion of patients needing postoperative rescue opioids and prolongs the time to first analgesic request. Several meta-analyses and systematic reviews have demonstrated that transversus abdominis plane (TAP) blocks and other targeted regional techniques produce an opioid-sparing effect and extend time to first analgesic demand in a variety of abdominal and lower-limb procedures (De Oliveira et al., Zhao et al., Abdallah et al.).[11–13] Johns et al. and Ripollés et al. similarly concluded that TAP and related regional techniques reduce 24–48 h opioid consumption and decrease the number of patients requiring rescue analgesia in many abdominal procedures, although the magnitude of benefit varies by approach, timing (pre- versus post-incision), and type of surgery.[14,15] More recent series and pooled analyses confirm these trends in laparoscopic and bariatric populations, where regional techniques were associated with fewer patients requiring postoperative opioids and shorter time to recovery/discharge.[16,17] In contrast, when systemic non-opioid regimens (for example, IV paracetamol alone) or differing analgesic agents are compared head-to-head, the results may be more mixed: for example, a recent randomized trial comparing intranasal tapentadol with IV paracetamol found superior pain scores with tapentadol but variable differences in rescue medication use depending on the setting and rescue protocol used, underscoring that rescue-use outcomes are sensitive to study protocol, pain thresholds, and rescue thresholds.[18] A number of single-centre randomized trials also report a lower immediate postoperative opioid demand and fewer rescue doses when a regional block is used, although some trials find no difference in later time points (≥24 h), which likely reflects the limited duration of single-shot blocks and heterogeneity of surgical pain (somatic vs visceral).[19,20] Overall, your results — fewer patients requiring rescue, fewer subsequent rescue doses, and a longer median time to first rescue in Group A — align well with prior evidence that an appropriately chosen regional/multimodal strategy substantially lowers early postoperative opioid requirements and delays the need for supplemental analgesia; differences in absolute effect size between studies are most likely due to variation in block type, local anaesthetic dose/approach, concurrent intraoperative opioids (all your patients received fentanyl 2 µg/kg), rescue analgesic protocol, and the surgical population studied.

CONCLUSION

We conclude that, based on the study findings, the demographic distribution of patients in both groups was comparable, eliminating age as a confounding factor. All patients received standard intra-operative analgesia, ensuring uniformity of baseline pain control. However, significant differences were noted in postoperative analgesic requirements. Patients in Group A demonstrated superior analgesic efficacy, with fewer requiring rescue medication, delayed onset of first rescue analgesia, and a lower overall need for subsequent doses compared to Group B. These results indicate that the analgesic strategy employed in Group A provided more sustained and effective postoperative pain control. Thus, Group A can be considered a better modality for achieving prolonged analgesia and minimizing postoperative opioid consumption, thereby potentially enhancing recovery and patient comfort.

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