

Effect of Ultrasound-Guided Erector Spinae Plane Block on Postoperative Pain in Patients Undergoing Open Nephrectomy and Pyeloplasty: A Single-Center Observational Study

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Abstract: Background: Effective postoperative pain control is important after open nephrectomy and pyeloplasty. Poor pain management can lead to complications and delayed recovery. The erector spinae plane (ESP) block is a newer regional anesthesia technique that may reduce pain and opioid use. **Objective:** To evaluate the analgesic efficacy of ultrasound-guided erector spinae plane block in patients undergoing open nephrectomy and pyeloplasty. **Methods:** This prospective observational study included 50 patients aged 18 years and above. All patients received an ultrasound-guided ESP block using 30 ml of 0.2% ropivacaine at the T10 level after surgery. Pain was assessed using the Numerical Rating Scale (NRS) at 0, 1, 2, 4, 8, 12, and 24 hours. Opioid consumption, time to first rescue analgesia, patient satisfaction, and hemodynamic parameters were recorded. **Results:** Most patients had no pain in the early postoperative period. At 24 hours, 80% of patients had no or mild pain. A total of 70% of patients did not require any opioid analgesic within 24 hours. Rescue analgesia was not required in 70% of patients, and when required, it was mostly after 12 hours. Patient satisfaction was good in 70% of patients. Hemodynamic parameters remained stable throughout the study period. **Conclusion:** Ultrasound-guided erector spinae plane block provides effective postoperative analgesia in patients undergoing open nephrectomy and pyeloplasty. It reduces pain scores, decreases opioid requirement, prolongs time to rescue analgesia, and maintains stable hemodynamics.

Keywords: Erector spinae plane block, postoperative pain, nephrectomy, pyeloplasty, regional anesthesia, ropivacaine.

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INTRODUCTION

All the open surgeries require aggressive postoperative pain management. Postoperative analgesia methods are essential to avoid respiratory and thromboembolic complications in radical or partial open nephrectomy and pyeloplasty procedures. A multimodal analgesic approach combining different analgesia methods with local or regional anaesthesia to maximize effectiveness is essential. There are many methods for post-surgical pain management after nephrectomy and pyeloplasty that are described in literature. These methods include systemic opioids, systemic non-steroidal anti-inflammatory drugs (NSAIDs) epidural analgesia, surgical site analgesia, paravertebral block and quadratus lumborum block [1-4].

The erector spinae plane block is a novel ultrasound guided regional anaesthetic technique described in 2016 by Forero and colleagues [5]. The ESP block belongs to the family of fascial plane blocks in which local anesthetic is injected into a plane between two layers of fascia and subsequently spreads to nerves located within that plane or within adjacent tissue compartments. Unlike many of the previously described fascial plane blocks that preceded it (e.g. the transverse abdominis plane TAP block or pectoral blocks which are performed in the anterolateral thorax or abdomen) the ESP block may also be characterised as a paraspinous block based on its site of injection over the vertebral transverse processes [3].

The misuse of prescribed opioids leading to the current opioids crisis has put greater emphasis on the

development of non-opioids analgesic techniques to manage post-operative pain [4-6]. The erector spinae plane block has been used clinically by anaesthesiologists as a potential non-opioids analgesic strategy across multiple surgical procedures. The block is considered easy to perform and can be easily implemented in the post-operative period [7-13].

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Anaesthesiology and Critical Care in association with the Department of Urology at Government Medical College, Srinagar. The study was carried out after approval from the Institutional Ethics Committee. Written informed consent was obtained from all patients.

Study Population

A total of 50 patients aged 18 years and above who were scheduled for open nephrectomy and pyeloplasty were included in the study.

Inclusion Criteria

- Patients undergoing open nephrectomy or pyeloplasty
- Age \geq 18 years
- ASA physical status I, II, and III
- Patients with no contraindication to regional anesthesia

Exclusion Criteria

- Patient refusal
- Known allergy to study drugs
- Infection at the site of block

Anaesthetic Technique

All patients were managed under standard general anesthesia. After confirming fasting status, an intravenous line was secured and monitoring was started. Patients received premedication with fentanyl (1 μ g/kg). Induction was done with propofol (1–2 mg/kg) and atracurium (0.5 mg/kg) for muscle relaxation. The airway was secured with an endotracheal tube.

Anesthesia was maintained using a mixture of nitrous oxide (66%), oxygen (33%), and isoflurane (1%). Additional doses of fentanyl and diclofenac were given intraoperatively as required.

Erector Spinae Plane Block Technique

At the end of surgery, patients were placed in the lateral position. Under ultrasound guidance, a linear probe was

placed at the **T10 level** and moved laterally to identify the transverse process.

The trapezius muscle and erector spinae muscle were identified. An **18–20 G needle** was inserted using an in-plane technique. After confirming correct needle placement with saline, **30 ml of 0.2% ropivacaine** was injected in increments with repeated aspiration.

Outcome Measures

Primary Outcomes

- Postoperative pain assessed using the Numerical Rating Scale (NRS) (0 = no pain, 10 = worst pain)
- Opioid consumption within 24 hours
- Time to first rescue analgesia

Secondary Outcomes

- Postoperative complications (nausea and vomiting)
- Patient satisfaction
- Hemodynamic parameters (heart rate, blood pressure, mean arterial pressure, oxygen saturation)

Data Collection

Pain scores were recorded at 0, 1, 2, 4, 8, 12, and 24 hours postoperatively. The duration of pain-free period and time to rescue analgesia were noted. Total opioid consumption in the first 24 hours was recorded.

Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were monitored at different time intervals.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 23. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were presented as numbers and percentages. Statistical tests such as independent t-test or ANOVA were used where appropriate. A p-value $<$ 0.05 was considered statistically significant.

RESULTS

Most patients were in the 46–55 years age group (38%). The majority had weight between 61–70 kg (50%). Males were more common than females. Most patients belonged to ASA grade II (48%). Pyeloplasty was slightly more common than nephrectomy. Most surgeries lasted 2–2.5 hours (60%) [Table 1].



Table-1: Demographic and Baseline Characteristics

Variable	Category	Number of Patients	Percentage
Age	≤25 years	2	4.0%
	26–35 years	12	24.0%
	36–45 years	4	8.0%
	46–55 years	19	38.0%
	>55 years	13	26.0%
Weight (kg)	≤60	8	16.0%
	61–70	25	50.0%
	71–80	16	32.0%
	>80	1	2.0%
Gender	Male	29	58.0%
	Female	21	42.0%
ASA Grade	I	20	40.0%
	II	24	48.0%
	III	6	12.0%
Type of Surgery	Nephrectomy	21	42.0%
	Pyeloplasty	29	58.0%
Duration of Surgery	≤1.5 hours	8	16.0%
	1.5–2 hours	7	14.0%
	2–2.5 hours	30	60.0%
	>2.5 hours	5	10.0%

Most patients had **no pain in the early postoperative period**. Even at 24 hours, **40 patients had no pain**. Only a small number developed moderate to severe pain. The change in pain score over time was **statistically significant (p < 0.05)** [Table 2].

Table-2: Postoperative Pain Scores (NRS) at Different Time Intervals

Time	No Pain (0)	Mild (1–3)	Moderate (4–6)	Severe (7–10)
0 hr	50	0	0	0
1 hr	47	3	0	0
2 hr	47	3	0	0
4 hr	45	3	2	0
8 hr	42	5	3	0
12 hr	40	5	3	2
24 hr	40	5	2	3

Most patients (**70%**) did not require any opioid after the block. Only a small number required one or two doses. This shows reduced opioid requirement [Table 3].

Table 3: Opioid Consumption (First 24 Hours)

Dose	Number of Patients	Percentage
0 dose	35	70%
1 dose	8	16%
2 doses	7	14%

In most patients (**70%**), rescue analgesia was not required. Among those who required it, the majority

needed it **after 12 hours**, showing prolonged analgesic effect [Fig 1].

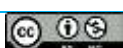




Fig-1: prolonged analgesic effect

Most patients (70%) reported good satisfaction with pain management. No patient reported poor satisfaction [Fig 2].

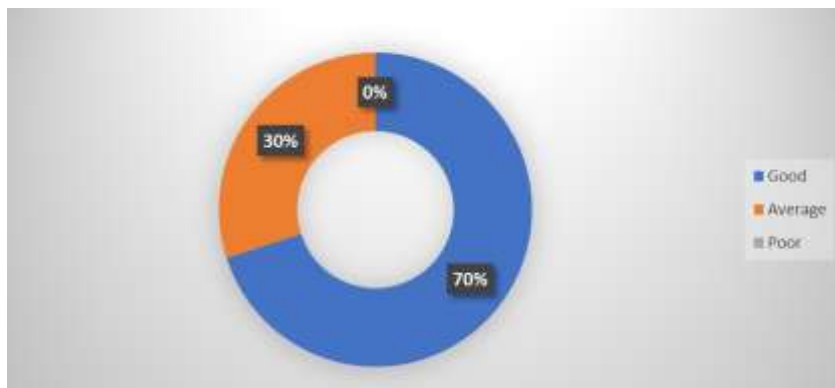


Fig-2: High patient satisfaction with postoperative pain management

All haemodynamic parameters remained stable throughout the postoperative period. Heart rate showed a temporary increase immediately after surgery (0–1 hr) but returned close to baseline later. Systolic blood pressure showed mild fluctuations but remained within

normal limits. Diastolic blood pressure showed a gradual decreasing trend over time. Mean arterial pressure remained fairly constant, indicating good overall stability [Fig 3].

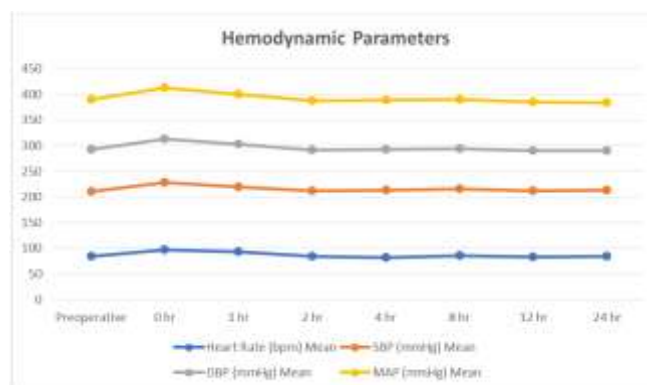


Fig-3: Postoperative haemodynamic stability with minor transient variations

DISCUSSION

With the introduction of portable ultrasound machine in the operating theatres, the practice of regional anaesthesia has seen a transition from landmark-based techniques to regional blocks administered under direct vision through the new eye of the anaesthetist- the ultrasound machine. The introduction of real-time ultrasound has allowed the peripheral nerves, planes,

and plexuses of the trunk to be located more accurately and has improved the success rate of truncal blocks [14].

In this study, most common age group affected was 46–55 years i.e. 19 (38%) patients while the least number of patients were aged between 36–45 years i.e. 4 (8%) and upto 25 years only 2 i.e. (4%). 17 (34%) patients



weighed between 66–70 kgs and only 1 (2%) patient weighed >80 kgs. Males were predominant with 58% against 42% females. 40% patients belonged to ASA grade I, 48% patients were ASA II and rest 6% patients were ASA grade III.

Sahin A and Baran O (2022) [15] did a study on 60 participants with a mean age of 55.4 ± 7.9 years were included in the analysis, and 33 (55.0%) were men and 27 (45.0%) were women. Each group included 30 participants. The groups were similar in age (57.0 ± 6.5 vs. 53.8 ± 8.9 years for ESP and non-ESP block groups, respectively) and sex distribution (17 [56.7%] men and 13 [43.3%] women vs. 16 [53.3%] men and 14 [46.7%] women in the ESP and non-ESP block groups, respectively). However, the participants' mean BMI in the ESP block group was significantly higher in the ESP block group compared with that in the non-ESP block group (30.6 ± 4.9 vs. 27.6 ± 3.3 kg/m², $p=0.008$). These results are consistent with the findings in our study.

In our study, Pyeloplasty was the done in 29 (58%) patients and Nephrectomy in 21 (42%). Surgery lasted for 2 to 2.5 hours in majority of patients i.e. 30 (60%). Bindra S et al., (2023) [16] evaluated the efficacy of ultrasound-guided Erector Spinae Plane Block (ESPB) as a part of multimodal analgesia for postoperative pain in patients undergoing open nephrectomy ($n=48$). The patients were divided into two groups [Controls ($n=24$) and ESPB ($n=24$)]. Duration of surgery in Controls was 111.57 ± 27.67 minutes compared to 121.57 ± 33.85 minutes in ESPB group. Patients in Control group remained pain free for 111.15 ± 28.12 minutes while as the patients in ESPB group remained pain free for 121.80 ± 31.55 minutes. Hacibeyoglu G et al., (2022) [17] also compared duration of surgery in Control group (234.4 ± 43 minutes) compared to 216.2 ± 38.2 minutes in ESP group. The findings of the above studies are consistent with the results of the present study.

In our study, pain was assessed using NRS scale (Numerical Rating Scale) at 0, 2, 4, 8, 12 and 24 hours. At first hour mean NRS was 0.14 ± 0.36 . The mean NRS was lower and majority of patients were pain free. The mean NRS was 0.31 ± 0.47 at 2 hours, and mean NRS was 0.51 ± 0.78 at 4 hours and at this time rescue analgesia was given to 2 patients. At 8 hours the mean NRS 1.11 ± 1.16 and rescue analgesia was needed by 3 patients. At 12 hours the mean NRS 2.89 ± 1.75 and 5 patients needed rescue analgesia. At 24 hours the mean NRS was 0.57 ± 0.85 and 5 patients were given rescue analgesia, out of which 3 patients had severe pain. Similar findings were seen in study conducted by Sahin A and Baran O [15] on patients undergoing nephrectomy. In their study NRS score for pain during the postoperative follow-up between hours 1 and 24 were significantly higher in the non-ESP block compared with those in the ESP-block group ($p<0.05$).

Bindra S et al., [16] used NRS scoring system to assess the intensity of pain at 30 minutes after the block, followed by assessments at 2, 4, 6, 8, 12, 18, and 24 hours. The NRS scores in the ESPB group consistently decreased compared to the control group during the follow-up period. The findings are in agreement with the results in the present study.

In our study analgesia given was Tramadol (1–2 mg/kg). 35 (70%) patients required no rescue analgesia, 8 (16%) patients required 1 dose in first 24 hours. 7 (14%) patients required two doses of Tramadol. We concluded that the analgesia required was lower in our study. Altiparmak B et al., [18] conducted a study and concluded that mean postoperative tramadol consumption was 100 ± 19.2 mg in patients undergoing ultrasound guided ESP block. In our study, the mean duration of analgesia of USG guided Erector Spinae Plane Block was 15.6 ± 5.13 SD (6–24 hrs). Petsas D et al., [19] found that from surgery up to 6 hours after the ESP block the patient was totally pain free. Six hours after the nerve block the patient mentioned having a NRS pain score of 2–3 on deep breath or movement but desired no pain medication. The first dose of on demand pain medication was given 10 hours after the ESP block when the patient had a pain score of NRS 4–5.

Wadood MA et al., [20] assessed the efficacy and the dynamics of erector spinae plane block (ESPB) in adult patients undergoing open nephrectomy. In their study, before the incision, in Group A patients intraoperative heart rate was substantially lower than that of Group B. After incision, at 30 min, 1 h, and 1.5 h heart rates were statistically equivalent ($P = 0.030, 0.013, 0.034, 0.003$ and 0.039 respectively) and was insignificantly different at baseline, 2 h, 2.5 h and between the two groups after the conclusion of operation. As compared to Group B, intraoperative MAP was significantly lower in Group A before surgical incision, after surgical incision, at 30 min, 1 h, and 1.5 h ($P = 0.011, <0.001, <0.001, <0.018,$ and <0.001 respectively), but there was no difference between the two groups at baseline, 2 h, 2.5 h, or at the conclusion of surgery. Postoperative HR was insignificantly different between both groups except at 6 h and 12 h, as ESPB group values were substantially higher than TEA group values ($P = 0.001$ and <0.043 , respectively), but the differences were statistically not significant. Except at 6 and 12 h, when the ESPB group's postoperative MAP was considerably higher than the TEA group's, there was no statistically significant difference between the two groups ($P < 0.001, 0.035$ respectively).

Postoperative complications like nausea and vomiting was observed only in 10 (20%) patients in our study which is in agreement with the findings of Shim JG et al., [21].



CONCLUSION

In this study, ultrasound-guided erector spinae plane block provided effective postoperative pain relief in patients undergoing open nephrectomy and pyeloplasty. Most patients had minimal or no pain in the early postoperative period, and pain scores remained low over the first 24 hours.

The need for opioid analgesics was significantly reduced, with the majority of patients not requiring any rescue analgesia. When analgesia was required, it was usually delayed, indicating a prolonged duration of action of the block. Patient satisfaction was also high, with most patients reporting good pain control.

In addition, the block was associated with stable hemodynamic parameters and a low incidence of postoperative complications such as nausea and vomiting.

Overall, ultrasound-guided erector spinae plane block is a safe, effective, and useful technique for postoperative pain management in abdominal surgeries like nephrectomy and pyeloplasty. It can be considered as an important part of multimodal analgesia to improve patient comfort and reduce opioid use.

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