

# Comparison of Intravenous Morphine to Unilateral Erector Spine Block in Postoperative Analgesia following Percutaneous Nephrolithotomy

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## Abstract

**Background:** Acute postoperative pain is recently seen following PCNL where an ultrasound-guided block can be advantageous which manages pain along with reduced complication risks and better nerve visualization. Analgesic after PCNL can be delivered with ESP block without severe side effects.

**Aim:** To comparatively assess the safety and efficacy of ultrasound-guided ESP block at the T8 level for intraoperative and postoperative analgesia in subjects undergoing PCNL (percutaneous nephrolithotomy) surgeries.

**Methods:** 120 subjects of ASA-II were divided into 2 groups of 60 subjects each. Following general anesthesia induction, subjects were given an ultrasound-guided Erector Spinae plane (ESP) block before the surgical incision was given. Another 60 age and gender-matched subjects served as controls where general anesthesia without ESP block was given before surgical incision.

**Results:** Intraoperative morphine use was significantly higher in controls compared to Group I subjects with  $p=0.001$ . VAS scores were significantly higher for Group II compared to Group I with  $p<0.05$ . On assessing the consumption of analgesics and additional morphine in the study participants, analgesics consumption was 0 (0-1) for Group I and was significantly higher for group II with 1 (1-2). This was statistically significant with  $p=0.001$ . Overall morphine consumption was also significantly higher in Group II with  $25.68\pm 3.65$  compared to Group I with ultrasound-guided erector spinae plane block with  $15.01\pm 5.27$ mg with  $p<0.001$ .

**Conclusion:** The study concluded that satisfactory analgesic effects are seen with the ultrasound-guided ESP block at T8 transverse level in subjects undergoing PCNL (percutaneous nephrolithotomy). The postoperative pain was higher in controls and morphine was less used with ultrasound-guided ESP blocks.

**Keywords:** Analgesia, ESP block, Intravenous morphine, PCNL, Percutaneous nephrolithotomy.

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## Introduction

PCNL (percutaneous nephrolithotomy) is a removal of large renal calculi. PCNL requires a minimally invasive technique used for the a smaller incision compared to open

nephrolithotomy and requires lesser surgical time along with early ambulation and lesser death rates.[1] However, at the end of PCNL, a nephrostomy tube is placed that causes local inflammation causing discomfort and pain. The source of the acute pain following PCNL is visceral pain from the ureters and kidney as well as somatic pain from the site of the incision. Pain from the renal source pass from T8-T2 from the ureters and from T10 to L1 spinal neurons from the kidney. The site of skin incision and PCNL tract is usually done in the 10<sup>th</sup>-12<sup>th</sup> intercostal space.[2]

Various methods are mentioned in the literature for pain management following PCNL including different regional anesthesia techniques, NSAIDs (non-steroidal anti-inflammatory drugs), and the use of opioids. However, an ideal pain control modality is still under search. NSAIDs and opioid analgesics have shown to be effective in pain control, but their use has been associated with various side effects and has limited use in subjects having renal dysfunction. In regional anesthesia techniques, intercostal nerve blocks, epidural analgesia, paravertebral block, and local infiltration have been effective for pain management. However, these techniques have been associated with unpredictable analgesia duration and technical difficulties.[3]

For abdominal and thoracic surgeries, good postoperative analgesia is provided with the ESPB (erector spinae plane block) which is a basic ultrasound-guided basic fascial plane block. ESPB block provides sensory blockage from L1-L2 and T2 to T4. Previous studies done on cadavers showed that dye reaches the thoracic paravertebral region leading to visceral analgesia. US (ultrasound) guided peritubal infiltration block is a well-established and simple technique that provides effective analgesia from skin to renal capsule along the course of nephrostomy block providing both visceral and somatic analgesia.[4]

Ultrasound-guided peritubal infiltration block has shown as efficacious in providing pain relief post PCNL. However, it has a short

duration of action. Ultrasound-guided ESP block is an interfascial plane block that is found to be useful in managing the pain which is thoracic neuropathic in the recent data.[5] Ultrasound-guided ESP block is an effective, simple, and safe modality when both visceral and sensory analgesia is needed which is provided by blocking both ventral and dorsal rami of spinal nerve roots. Previous literature data has shown that ultrasound-guided ESP block is effective in providing postoperative analgesia after various thoracoabdominal surgeries including PCNL.[6,7]

Considering that providing ultrasound-guided erector spinae plane block can control both visceral and somatic pain caused following PCNL. Few literature studies have shown good pain control after ultrasound-guided ESP block after PCNL. However, data assessing its efficacy after PCNL are scarce in the literature. Hence, the present study was done to comparatively assess the safety and efficacy of ultrasound-guided ESP block at the T8 level for intraoperative and postoperative analgesia in subjects undergoing PCNL (percutaneous nephrolithotomy) surgeries.

### Materials and Methods

The present study was done to comparatively assess the safety and efficacy of ultrasound-guided ESP block at the T8 level for intraoperative and postoperative analgesia in subjects undergoing PCNL (percutaneous nephrolithotomy) surgeries. The study was done at Department Of Anaesthesiology, Deccan College Of Medical Sciences, Hyderabad, Telangana after clearance was given by the concerned Ethical committee. The study population was comprised of the subjects undergoing percutaneous nephrolithotomy at the Institute. After explaining the detailed study design, informed consent was taken from all the study participants.

The study included 120 subjects in the age range of 18-60 years, in ASA grades I and II, undergoing PCNL at the institute, and was willing to participate in the study. These 120 subjects were divided into 2 groups of 60

subjects each. After the subjects were shifted to the operating room, blood pressure, pulse oximetry, and electrocardiography were done on all the subjects. Anesthesia was given using 0.1mg/kg morphine, 0.5mg/kg atracurium, and 2mg/kg propofol. A cuffed endotracheal tube was placed followed by 0.1mg/kg atracurium and 1.2 MAC isoflurane for anesthesia maintenance.

Group I included 60 subjects that received unilateral erector spinae plane block. In those subjects, general anesthesia was given after placing subjects in the prone position and locating the 8<sup>th</sup> rib using ultrasonography. The skin was sterilized with betadine. Any change in the rib shape was assessed by transversely moving the linear probe at the 8<sup>th</sup> rib level from lateral to the medial side and TP (transverse process) was traversed. At the transverse process level of T8, a needle was inserted into the erector spinae and trapezius in the cephalad to the caudal direction in-plane technique. 0.25% of 20 ml bupivacaine was injected along with 1% xylocaine.

For the control group, after general anesthesia induction, 0.1mg/kg morphine was given. The subjects were then transferred to the postoperative unit for complete recovery and were monitored following the surgery. Dynamic ambulation and resting scores were evaluated at 30 and 60 minutes postoperatively followed by assessment at 2-, 6-, 12-, and 24 hours using VAS (visual analog scale) scores.

All subjects were given 1gm IV paracetamol every 8 hours for the first 24 hours postoperatively. In cases when VAS was higher than 4, reference analgesia was given in form of 0.05 mg/kg morphine. Data gathered postoperatively were hemodynamic parameters (mean arterial blood pressure and heart rate), gender, weight, and age of all the subjects every 15 minutes till completion of the surgery and at 15, 30, and 60 minutes, and 2, 6, 12, and 24 hours postoperatively.

Also, total morphine consumption in rescue bolus was assessed 24 hours postoperatively. VAS scores were assessed at 15, 30, and 60

minutes, and at 2, 6, 12, and 24 hours postoperative. Analgesia duration was assessed as the time between local anesthetic delivery end and the need for the first rescue analgesic intravenous morphine. The complications assessed were nerve injury/paresthesia, local anesthesia (LA) toxicity, and hematoma formation. LA toxicity was assessed as neurologic manifestations including coma, unconsciousness, and convulsions, twitching. Also, in form of cardiovascular toxicity including cardiovascular collapse, syncope, hypotension, palpitations, and/or chest pain.

The data gathered were statistically analyzed using logistic regression and multivariate statistical techniques. The data were presented in tabulated and descriptive format. SPSS version 22.0, 2013, Armonk, NY: IBM Corp and chi-square and Man-Whitney U test. The data were expressed as mean and standard deviations and as percentages and numbers with a 0.05% significance level.

## Results

The present study was done to comparatively assess the safety and efficacy of ultrasound-guided ESP block at the T8 level for intraoperative and postoperative analgesia in subjects undergoing PCNL (percutaneous nephrolithotomy) surgeries. The study included 120 subjects divided into two groups where Group I included 60 subjects that received unilateral erector spinae plane block following PCNL and Group II had 60 subjects served as controls 0.1mg/kg morphine was given. The demographic data of the two study groups are listed in Table 1. The mean age of the study subjects was 48.4±9.6 and 49.5±11.4 years for groups I and II respectively which was statistically non-significant with p=0.56. There were 63.3% (n=38) males and 36.6% (n=22) females in Group I and 60% (n=36) males and 40% (n=24) females in group II which was non-significant with p=0.77. Hospital stay was non-significant with p=0.72 for both groups. Surgery time and the stone burden were non-significant between the two

groups with  $p=0.41$  and  $0.10$  respectively. PCNL sheath diameter was also non-significant for Group I and II with  $p=0.13$ . ASA scores I and II also showed a statistically non-significant difference between the two groups with  $p=0.23$  as shown in Table 1.

For the intraoperative parameters, antiemetics were not used by any subject of group I where ultrasound-guided erector spinae plane block was used whereas one subject of Group II which was a significant difference with  $p=0.002$ . Intraoperative fentanyl use was also significantly higher in controls compared to Group I subjects with  $p=0.001$ . Mean arterial pressure in Group I was  $83.77-101.73$  and for Group II was  $79.77-95.3$ . This difference in mean arterial pressure was statistically non-significant with  $p=0.22$ . Also, the mean heart rate for Group I was  $77.3$  beats/minutes, and for Group II was  $83.3$  beats/minutes. This difference was statistically non-significant with  $p=0.43$  as depicted in Table 2.

Concerning the VAS scores in the two groups of study subjects, at 2 hours VAS scores were significantly higher for Group II,  $6.2\pm 0.24$  compared to Group I where it was  $4.2\pm 0.34$ . At 4 hours also VAS was significantly higher for Group II,  $5.3\pm 0.43$  compared to Group I with  $4.2\pm 0.22$ . At 6 hours, VAS scores were similar

for both the groups with  $4.1\pm 0.46$ . At 12 hours, again VAS increased significantly for Group II,  $4.1\pm 0.66$ , and decreased for Group I,  $3.2\pm 0.62$ . At 24 hours, VAS scores did not change for either group. Overall, VAS scores were significantly higher for Group II compared to Group I with  $p<0.05$  as shown in Table 3.

On assessing the consumption of analgesics and additional morphine in the study participants, analgesics consumption was  $0$  ( $0-1$ ) for Group I and was significantly higher for group II with  $1$  ( $1-2$ ). This was statistically significant with  $p=0.001$ . Overall morphine consumption was also significantly higher in Group II with  $25.68\pm 3.65$  compared to Group I with ultrasound-guided erector spinae plane block with  $15.01\pm 5.27$ mg with  $p<0.001$ .

Also, at 2 hours and 6 hours morphine intake was significantly higher for Group II compared to Group I with  $p=0.001$  and  $0.008$  respectively. At 12 hours, the intake of morphine was non-significantly higher for Group II with  $p=0.06$ . At 24 hours postoperative, morphine intake was non-significantly higher for Group II compared to Group I with  $p=0.16$  as summarized in Table 4.

**Table 1: Demographic characteristics of the study participants**

Characteristics	Group I n=60 (%)	Group II n=60 (%)	p-value
Mean age (years)	$48.4\pm 9.6$	$49.5\pm 11.4$	0.56
Gender			
Males	38 (63.3)	36 (60)	0.77
Females	22 (36.6)	24 (40)	
Hospital stay (days)	3.4	3.4	0.72
Surgery time (mins)	90.4	100.2	0.41
Stone burden (mm <sup>2</sup> )	400.6	350.4	0.10
PCNL sheath diameter (mm)			
14	6	16	0.13
16	20	14	
20	16	22	
30	18	8	
ASA scores			
I	22 (36.6)	24 (40)	0.23
II	38 (63.3)	36 (60)	

**Table 2: Intraoperative parameters of the study participants**

Intraoperative parameters	Group I n=60 (%)	Group II n=60 (%)	p-value
Antiemetic use	0 (0-0.23)	1 (0-1)	0.002
Heart rate (beats/min)	77.3	83.3	0.43
Mean arterial pressure (mmHg)	83.77-101.73	79.77-95.3	0.22

**Table 3: VAS scores in two groups of study subjects at the different time intervals**

VAS Scores (hours)	Group I n=60 (%)	Group II n=60 (%)	p-value
2	4.2±0.34	6.2±0.24	<0.05
4	4.2±0.22	5.3±0.43	
6	4.1±0.46	4.1±0.46	
12	3.2±0.62	4.1±0.66	
24	3.2±0.62	4.1±0.66	

**Table 4: Consumption of Morphine and additional analgesics by the two study groups**

VAS Scores (hours)	Group I n=60 (%)	Group II n=60 (%)	p-value
Analgesic consumption (gm)	0 (0-1)	1 (1-2)	0.001
Morphine consumption (mg)			
Overall	15.01±5.27	25.68±3.65	<0.001
2	1.3 (1-3)	3.8 (4-5)	0.001
6	3.2 (1.73-4)	4 (4-4)	0.008
12	3 (2-5)	4.2 (3.73-5.23)	0.06
24	3.3 (2-5)	4.2 (3-4.23)	0.16

## Discussion

The study included 120 subjects divided into two groups where Group I included 60 subjects that received unilateral erector spinae plane block following PCNL and Group II had 60 subjects served as controls. 0.1mg/kg morphine was given. The demographic data of the two study groups are listed in Table 1. The mean age of the study subjects was 48.4±9.6 and 49.5±11.4 years for groups I and II respectively which was statistically non-significant with p=0.56. There were 63.3% (n=38) males and 36.6% (n=22) females in Group I and 60% (n=36) males and 40% (n=24) females in group II which was non-significant with p=0.77. Hospital stay was non-significant with p=0.72 for both groups. Surgery time and the stone burden were non-significant between the two groups with p=0.41 and 0.10 respectively. PCNL sheath diameter was also non-significant for Group I and II with p=0.13. ASA scores I and II also showed statistically non-significant differences between the two groups with

p=0.23. These data were similar to the studies by Gurkan Y *et al* [8] in 2018 and Selvi O [9] in 2018 where authors assessed subjects with demographic data similar to the present study. Antiemetics were not used by any subject of group I where ultrasound-guided erector spinae plane block was used whereas one subject of Group II was a significant difference with p=0.002. Intraoperative fentanyl use was also significantly higher in controls compared to Group I subjects with p=0.001. Mean arterial pressure in Group I was 83.77-101.73 and for Group II was 79.77-95.3. This difference in mean arterial pressure was statistically non-significant with p=0.22. Also, the mean heart rate for Group I was 77.3 beats/minutes, and for Group II was 83.3 beats/minutes.

This difference was statistically non-significant with p=0.43. These operative parameters were consistent with the studies of Tulgar S *et al* [10] in 2019 and Gultekin MH *et al* [11] in 2020 where antiemetics and fentanyl

use was significantly higher in subjects who did not get ultrasound-guided erector spinae plane block.

For the VAS scores in the two groups of study subjects, at 2 hours VAS scores were significantly higher for Group II,  $6.2 \pm 0.24$  compared to Group I where it was  $4.2 \pm 0.34$ . At 4 hours also VAS was significantly higher for Group II,  $5.3 \pm 0.43$  compared to Group I with  $4.2 \pm 0.22$ . At 6 hours, VAS scores were similar for both the groups with  $4.1 \pm 0.46$ . At 12 hours, again VAS increased significantly for Group II,  $4.1 \pm 0.66$ , and decreased for Group I,  $3.2 \pm 0.62$ . At 24 hours, VAS scores did not change for either group.

Overall, VAS scores were significantly higher for Group II compared to Group I with  $p < 0.05$ . These results were in agreement with the previous studies of Kim E *et al* [12] in 2018 and Liu Y *et al* [13] in 2016 where VAS scores were significantly lesser when subjects were given ultrasound-guided erector spinae plane block after the PCNL procedure.

Concerning the consumption of analgesics and additional morphine in the study participants, analgesics consumption was 0 (0-1) for Group I and was significantly higher for group II with 1 (1-2). This was statistically significant with  $p = 0.001$ . Overall morphine consumption was also significantly higher in Group II with  $25.68 \pm 3.65$  compared to Group I with ultrasound-guided erector spinae plane block with  $15.01 \pm 5.27$  mg with  $p < 0.001$ . Also, at 2 hours and 6 hours morphine intake was significantly higher for Group II compared to Group I with  $p = 0.001$  and  $0.008$  respectively. At 12 hours, the intake of morphine was non-significantly higher for Group II with  $p = 0.06$ . At 24 hours postoperative, morphine intake was non-significantly higher for Group II compared to Group I with  $p = 0.16$ . These data were in line with the studies of Ibrahim M *et al* [14] in 2019 and Adhikary SD *et al* [15] in 2018 where morphine and analgesic consumption was higher in controls compared to subjects who received ultrasound-guided

erector spinae plane block following percutaneous nephrolithotomy.

## Conclusion

Considering its limitations, the present study concludes that satisfactory analgesic effects are seen with the ultrasound-guided ESP block at T8 transverse level in subjects undergoing PCNL (percutaneous nephrolithotomy). The postoperative pain was higher in controls and morphine was less used with ultrasound-guided ESP blocks. The limitations of this study were smaller considered population, shirt monitoring, and biased related to the geographic location warranting further long-term studies planned longitudinally.

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