

# Comparison of the Post-operative Analgesic Efficacy of Ultrasound-Guided Transversus Abdominis Plane Block versus Ilioinguinal and Iliohypogastric Nerve Block in Adult Patients Following Hernia Surgery

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## Abstract

**Background:** Ultrasound (USG)-guided transversus abdominis plane (TAP) block and combined ilioinguinal iliohypogastric (IIN/IHN) nerve blocks are routinely used for post-operative pain relief in patients undergoing inguinal hernia surgery. This study compares post-operative analgesic efficacy of USG-guided TAP versus IIN/IHN block in adults undergoing inguinal hernia surgery.

**Materials and Methods:** Sixty adult patients between the ages of 20 and 60 with an American Society of Anesthesiologists grade I and II were included in the study. Patients in Group I received USG-guided unilateral TAP block with 0.5% ropivacaine (total volume of 20 mL) after general anesthesia, while those in Group II received IIN/IHN block with 0.5% ropivacaine (total volume of 20 mL). Tramadol (intravenous) IV was used as post-operative rescue analgesia for the first 4 h, followed by oral diclofenac 75 mg. Mean time to the first analgesic request (minutes) was the primary goal, but intraoperative hemodynamics, post-operative pain scores, total analgesia consumption, and patient satisfaction scores were also assessed.

**Results:** The IINB group had lower VAS scores ( $1.58 \pm 0.69$  vs.  $2.10 \pm 0.53$   $P = 0.001$ ) than the TAP block group indicating that the difference in pain scores was statistically significant. Furthermore, mean time to first request of rescue analgesia (min) in the IINB group  $413.10 \pm 118.40$  and  $168.50 \pm 32$  in the TAP block group ( $P = 0.005$ ). The patients satisfaction score did not differ between the two groups.

**Conclusion:** Ultrasound-guided IIN/IHN block was effective in producing post-operative analgesia with delayed need for rescue analgesia and reduced analgesic consumption compared to TAP block after open inguinal hernia repair under general anesthesia.

**Key words:** Iliohypogastric nerve block, Ilioinguinal nerve block, Inguinal hernia, Transversus abdominis plane block, Ultrasound guided

## INTRODUCTION

Inguinal hernia repair is one of the most common surgical procedures,<sup>[1]</sup> and post-operative pain management is

difficult in cases of abdominal surgery. Despite effective pain management techniques, 30–75% of people experience moderate or severe pain.<sup>[2]</sup> The main goal of post-operative pain management is to reduce the analgesic requirement to minimize adverse effects while still providing adequate analgesia. Various pharmacological methods, topical analgesics, epidural analgesia, and non-pharmacological approaches are available to control pain after hernia surgery; however, optimal evidence-based pain therapy remains unknown.<sup>[3]</sup> Post-operative pain management employs a variety of methods and medications. Peripheral

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nerve blocks with local anesthetics are a technique that may be used in inguinal hernia surgeries for both surgery and pain management.<sup>[4]</sup> Regional nerve block techniques provide excellent post-operative pain relief, allowing for the early ambulation and discharge. Inguinal hernia repair under general or regional anesthesia is a common surgical procedure.<sup>[5]</sup> Even in experienced hands, the failure rate with the blind approach is 20–30%. In addition, the blind approach may result in problems. Ultrasound technology has the potential to minimize the incidence of these complications.<sup>[6]</sup> The ilioinguinal and iliohypogastric (IIN/IHN) nerve blocks are among the most commonly used regional blocks for analgesia after inguinal surgery and have been shown to significantly reduce pain associated with herniorrhaphy.<sup>[7,8]</sup> The transversus abdominis plane (TAP) block is an advanced, rapidly developing regional anesthetic technique that gives analgesia to the parietal peritoneum as well as the skin and muscles of the anterior abdominal wall after abdominal surgery. Due to its relative simplicity and effectiveness, it has grown in popularity across the globe. The use of ultrasonography enhances the success rate and precision of nerve blocks while also preventing possible complications.<sup>[9,10]</sup> Several publications have previously compared the effectiveness of TAP and IIN/IHN blocks for post-operative pain after inguinal hernia operations, but the findings are inconsistent.<sup>[11]</sup> Because there have been no clear studies supporting either of the two aforementioned approaches, the current research compares post-operative analgesic efficacy of USG-guided TAP versus IIN/IHN block in adults undergoing inguinal hernia surgery.

## MATERIALS AND METHODS

### Design and Sampling

#### Design

The study design was a prospective, randomized, and double-blind comparative study.

#### Study Period

The research period lasted 7 months (between January 2022 and September 2022).

#### Study Population

Sixty adult male patients between the ages of 20 and 60 who were scheduled for open inguinal hernia repair surgeries at the Department of Surgery, Government General and Teaching Hospital, Vijayawada, were chosen for the study.

#### Procedure for Sampling

Patients chosen for open inguinal hernia repair surgeries were admitted in the surgery ward, and the diagnosis and patient data were obtained from the patient's case record.

### Justification of Sample Size

The mean time to the first analgesic request was the primary outcome of this study. The sample size was estimated based on the primary outcome of the pilot study, wherein ten patients per group were included and the mean time to first analgesic request in Group I was  $229 \pm 59.47$  min and the Group II was  $428 \pm 116.4$  min representing a  $>20\%$  variation between the groups. Using  $\alpha = 0.05$ ,  $\beta = 0.20$ , and the power of the study being 80%, the sample size was calculated to be 30 per group (using power analysis and sample size software, power and sample size software.com). Hence, 30 patients were recruited per group. The subjects in the pilot study were not included in the original study.

### Ethical Issues

The hospital ethics committee approval was sought. All patients were informed about the anesthetic technique, including its benefits and drawbacks, and written informed consent was obtained.

### Inclusion Criteria

Sixty patients between were included in the study:

1. The age group of 20–60 years
2. ASA status Class 1 and Class II.

### Exclusion Criteria

The following criteria were excluded from the study:

1. Patient refusal
2. BMI of  $>35$  kg/m<sup>2</sup>,
3. Skin infection at the puncture site,
4. A contraindication to anesthetic drugs,
5. Established chronic hepatic failure,
6. Chronic kidney disease Stages IV and V
7. Pre-operative opioid or non-steroidal anti-inflammatory drug use.
8. Pregnancy
9. alcohol or drug abuse

Group-I (n = 30) patients were given ultrasound-guided TAP block with 0.5% ropivacaine (total volume of 20 mL).

Group-II (n = 30) patients were given ultrasound guided ilioinguinal/iliohypogastric nerve blocks with 0.5% ropivacaine (total volume of 20 mL).

During the pre-anesthetic visit in the evening prior to surgery, patients were taught how to use a visual analog scale<sup>[12]</sup> (VAS) (0–10 cm) for pain assessment, where no pain was scored as 0 and worst pain was scored as 10. They were given alprazolam 0.25 mg and ranitidine 150 mg tablets at bedtime and at 2 h before surgery.

Intravenous access was established in the operating room, and standard monitors such as an electrocardiogram (ECG),

non-invasive blood pressure (NIBP), and pulse oximeter SpO<sub>2</sub> were installed. An established anesthetic protocol was followed. The patients were given glycopyrrolate 0.2 mg IV and fentanyl 2 µg/kg<sup>-1</sup> IV before preoxygenation. Propofol 2 mg/kg IV was used to induce anesthesia, and atracurium 0.5 mg/kg IV was used to achieve neuromuscular blockade. After 3 min of isoflurane in oxygen ventilation, an appropriate-sized supraglottic device was used to secure the airway. Anesthesia was maintained with isoflurane 1 minimum alveolar concentration and a 67% nitrous oxide in oxygen mixture. On the side of surgery, the patients received TAP or IIN/IHN block, depending on the group to which the patient was assigned using a computer-generated sequence of random numbers.

### Anesthetic Techniques and Nerve Block

All patients were educated about anesthesia and post-operative pain management options before surgery. Based on the randomly assigned grouping, IINB or TAP block was performed under US guidance by an experienced anesthesiologist who was not aware of the study protocol, and the intraoperative and post-operative monitoring and recording of the outcome parameters was done by an observer anesthesiologist to ensure double-blinding.

Patients in Group I (n = 30) received TAP block with 0.5% ropivacaine (total volume of 20 mL), while patients in Group II (n = 30) received IIN/IHN block with (total volume of maximum 20 mL) 0.5% ropivacaine. The Sono Site M Turbo ultrasound machine was used, with a high frequency 38 × 13-6 MHz 40 mm broadband linear array probe. The ultrasound probe was placed on the lateral abdominal wall, cephalad to the iliac crest, and caudal to the costal margin at the level of the umbilicus, for TAP block. The probe was tilted in either a cephalad or caudal direction as needed to obtain a clear optimized image of the three lateral abdominal muscles and TAP. The drug was then administered after the needle tip was targeted in the TAP plane between the internal oblique and transversus abdominis muscles using an in-plane technique. For IIN/IHN block, the probe was placed obliquely on a line connecting the anterior superior iliac spine and the umbilicus immediately superior to the anterior superior iliac spine. Following the identification of the plane between the internal oblique and transversus abdominis muscles, the needle tip was placed in the plane and the drug was administered. After the block was administered, the surgery began. At the end of surgery, residual neuromuscular blockade was reversed with appropriate doses of IV neostigmine and glycopyrrolate. When the patient was fully awake and breathing normally, the supraglottic airway device was removed.

Demographic data such as age, weight, and height were collected. Non-invasive blood pressure and heart rate were monitored and recorded before induction, before administering the block, before the incision, and after the incision. They were recorded intraoperatively every 10 min for the first 30 min, and every 15 min after that. In addition to the duration of the surgery, any complications such as vessel puncture, bowel perforation, and femoral anesthesia were recorded.

The VAS score was assessed in the immediate post-operative period, then every 30 min until 2 h, every 2 h until 12 h, and every 6 h thereafter until 24 h postoperatively.

During the first 24 h after surgery, a standard post-operative analgesia regimen was used. If the patients' VAS was ≥4 in the first 4 h after surgery, they were given tramadol 2 mg/kg IV. Patients were given oral tablet diclofenac 75 mg after 4 h if their VAS was ≥4. For post-operative nausea and vomiting, an IV ondansetron (4 mg) injection was administered. The primary goal of the study was to determine the mean time to the first analgesic request in the 24 h post-operative period.

After inquiring about the patient's willingness to have the same analgesia if ever operated on again, the patient satisfaction was measured using a two-point scale.

1. Acceptable: "If I ever need surgery again, I want the same analgesia."
2. Un acceptable: "If I need surgery again, I want a different analgesia."

### Statistical Analysis

All the data collected were entered into Microsoft Excel and statistical analysis was performed using GraphPad.com. Data were expressed as mean, standard deviation, and/or ratio or absolute numbers (%) and compared using the Student's *t*-test, Fisher's exact test, and Chi-square test, as appropriate. *P* < 0.05 was deemed statistically significant and *P* < 0.001 is considered to be highly significant.

## RESULTS

The study included 60 adult male patients who were randomly assigned to one of the two study arms. TAP blocks and ilioinguinal and iliohypogastric IIN/IHN nerve blocks were all successful in all the patients. The mean age, height, weight, and duration of surgery were comparable in both groups. Statistically, there were no significant differences between the groups [Table 1].

The mean heart rate was comparable between the groups perioperatively with no statistically significant difference [Figure 1].

There was no significant difference in MAP between the groups throughout the perioperative period [Figure 2].

The mean duration of first request of rescue analgesia (min) was  $316.20 \pm 112.8$  min in Group I and in Group II was  $413.10 \pm 118.4$  (min) which was greater compared to Group I with a statistically significant difference of  $P = 0.001$  [Table 2 and Figure 3].

The average dose of diclofenac tablet consumption was significantly lesser in Group II  $168.50 \pm 32.86$

compared to Group I  $194.04 \pm 34.98$  ( $P = 0.005$ ) [Table 2].

In the immediate post-operative period and up to 2 h, there is no significant difference in VAS score between Group I and Group II. However, from 2 h to 8 h post-operative period, a statistically significant difference was found between the groups with higher VAS scores in Group I compared to Group II. After 8–24 h post-operative, VAS scores in both the groups were similar [Table 3].

Patient satisfaction scores were comparable with 22 patients in Group II and 18 individuals in Group I satisfied with the block without any statistically significant difference between the groups ( $P = 0.411$ ) [Table 4 and Figure 3].

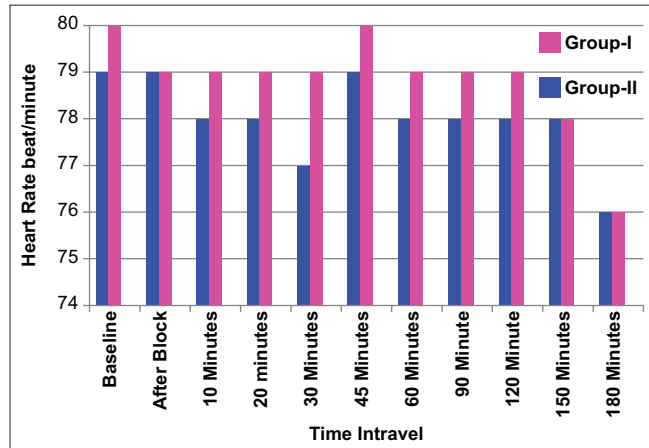


Figure 1: Comparison of heart rates (HR)

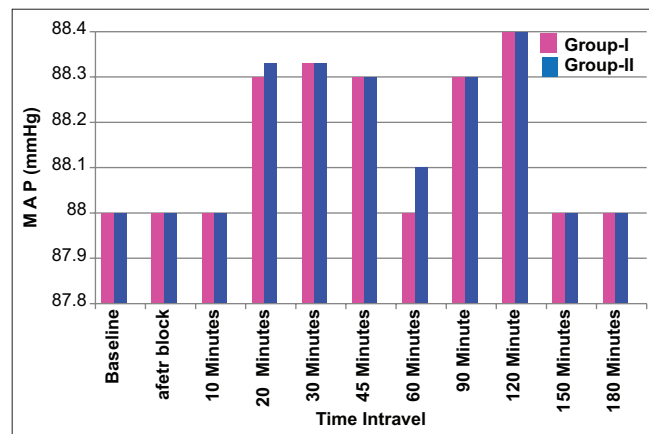


Figure 2: Comparison of mean arterial pressure (mmHg)



Figure 3: Time of first request of analgesic (min)

Table 1: Demographic data of the patients

Parameters	Mean±standard deviation (n=30)		P-value
	Group I	Group II	
Age in years	38.81±10.16	40.02±9.92	0.591
Weight in kgs	55.43±5.8	56.20±5.49	0.539
Height in cms	159.65±6.92	159.83±6.70	0.906
ASA I/II	20/10	12/8	0.789*
Duration of surgery (min)	106.35±25.01	104.72±26.21	0.776

Data expressed as mean (SD) or ratio or absolute numbers, Student-t-test, \*Chi-square test/Fisher exact test

Table 2: Comparison of outcome parameters

Parameters	Mean±standard deviation (n=30)		P-value
	Group I	Group II	
Mean duration of rescue analgesic requirement (min)	316.20±112.80	413.10±118.40	0.001*
Mean dose of tablet diclofenac required per patient (mg)	194.04±34.98	168.50±32.86	0.005*

Data expressed as mean (SD) or ratio or absolute numbers, Studentttest, \*P<0.05 Statistically significant

Table 3: Variation of visual analogue scale

Time interval	Group I	Group II	P-value
	Mean±standard deviation n=30	Mean±standard deviation n=30	
0 min (baseline)	0.63±0.42	0.48±0.38	0.152
30 min	0.65±0.50	0.62±0.42	0.802
1 h	0.80±0.54	0.73±0.47	0.594
2 h	1.09±0.59	0.78±0.53	0.036*
4 h	1.54±0.63	1.02±0.58	0.001*
6 h	2.10±0.53	1.58±0.69	0.001*
8 h	3.08±0.58	2.51±0.76	0.001*
10 h	3.48±0.68	3.10±0.89	0.062
12 h	3.56±0.78	3.20±0.96	0.292
18 h	3.79±0.82	3.54±0.98	0.288
24 h	3.86±0.86	3.62±0.99	0.320

Data expressed as mean (SD) or ratio or absolute numbers, Studentttest, \*P<0.05 Statistically significant

**Table 4: Patients satisfaction score (two points score)**

Parameters	Absolute numbers (n=30)				P-value
	Group I		Group II		
	Acceptable	Un acceptable	Acceptable	Un acceptable	
Patients satisfaction score	18	12	22	08	0.411*

Data expressed ratio or absolute numbers, \*Chi-square test/Fisher exact test,  $P < 0.05$  Statistically not significant

In Group I, a single individual developed hematoma (3.3%). No patients in either group experienced any further complications.

## DISCUSSION

The purpose of this study was to compare the post-operative analgesic efficacy of TAP block versus IIN/IHN block in patients undergoing unilateral inguinal hernia repair surgery under general anesthesia.

The literature identifies anatomical landmark and ultrasound guided techniques for IH/II nerve block. Traditional anatomical landmark techniques are rarely used due to the high volumes of local anesthetics used and the high failure rates.<sup>[13,14]</sup> The application of ultrasound guidance for ilioinguinal or iliohypogastric nerve blocks was found to be more effective and to cause fewer complications.<sup>[8,9]</sup>

O' Dwyer *et al.*<sup>[15]</sup> conducted a randomized trial with 276 patients undergoing open hernia repair under local versus general anesthesia. They proposed that the decision between local and general anesthesia should be made jointly by the surgeon and the patient; accordingly, we selected patients undergoing surgery under general anesthesia as per the surgeon's choice in current study.

Pain management is critical for improving patient care quality. Regional nerve block techniques provide excellent post-operative pain relief, allowing for early ambulation and discharge. Ultrasound can improve success rates by allowing for more precise placement of smaller volumes of local anesthetic agents closer to the targeted nerves.<sup>[16,17]</sup>

Kamal *et al.*<sup>[18]</sup> conducted a study on 60 patients who had undergone inguinal hernia repair, comparing US TAP block versus IIN/IHN block, and observed no clinically or statistically significant difference between the two groups in terms of heart rate and respiratory rate. In our study, also we observed no clinically or statistically significant difference between the two groups in terms of heart rate and the respiratory rate which is in agreement with his study.

Kamal *et al.*, in their study, used 0.75% ropivacaine for US guided TAP block and IIN/IHN block, whereas we used

0.5% ropivacaine in our study. They found that the mean duration of rescue analgesic requirement was prolonged and the average dose of diclofenac tablet consumption was reduced in IIN/IHN block compared to TAP block in their study. Our findings correlate with their study.

Regarding the VAS scores from 2 h to 8 h post-operative period, a statistically significant difference was found between the groups with higher VAS scores in Group I compared to group II. The results of present study are in contrast to the study of Aveline *et al.*, where they compared ultrasound-guided TAP block to blind IIN/IHN block for analgesia after open inguinal hernia repair and concluded that post-operative VAS scores were lower in the TAP group compared to the IIN/IHN block group. The reduced efficacy of the IIN/IHN block may be due to the blind technique followed. In our study, patient satisfaction scores were similar in both groups.

## CONCLUSIONS

Ultrasound-guided IIN/IHN block was effective in producing post-operative analgesia with delayed need for rescue analgesia and reduced analgesic consumption compared to TAP block after open inguinal hernia repair under general anesthesia.

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