COMPARISON OF ANALGESIC EFFICACY BETWEEN ULTRASOUND -GUIDED ILIOHYPOGASTRIC/ILIOINGUINAL NERVE BLOCK AND WOUND INFILTRATION AMONG PATIENTS UNDERGOING GYNECOLOGIC SURGERY: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Background: Postoperative pain control is essential after surgery to ensure early mobilization, decrease the length of hospital stay and provide patient comfort. Local anesthetic (LA) wound infiltration has been used to reduce postoperative pain. In addition, the bilateral iliohypogastric/ilioinguinal nerve block (IINB) has been used to control pain in abdominal surgery but not in gynecologic or pelvic surgery.

Objectives: This study aimed to evaluate the efficacy of ultrasound-guided iliohypogastric/ ilioinguinal nerve block compared with local anesthetic wound infiltration on postoperative pain control among patients undergoing gynecologic surgery through a Pfannenstiel incision**.**

Methods: In this prospective, double-blinded, randomized controlled trial, 50 patients were allocated to either an IINB group (N=25) or LA group (N=25). In both groups, postoperative IV patient-control analgesia (PCA) was planned 24 hours, postoperatively. The primary outcomes were differences in pain score using a numerical rating scale (NRS) and morphine consumption between both groups immediately following 2, 4, 8, 12 and 24 hours, postoperatively.

Results: The postoperative pain scores were significantly lower in the IINB group than in the LA group at all time points, with $p < 0.05$. Total morphine consumption for 2-24 hours postoperative was significantly lower in the IINB group than in the LA group with $p < 0.001$.

Conclusion: Compared with LA wound infiltration, this study demonstrated that IINB provided better pain control and reduced the consumption of morphine in the first 24 hours among patients undergoing gynecologic surgery through a Pfannenstiel incision.

Keywords: Iliohypogastric/ilioinguinal nerve block, Gynecologic surgery, Local anesthetic, Postoperative pain

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Introduction

The obstetrics and gynecologic surgeries with Pfannenstiel skin incisions are often associated with postoperative pain requiring a well-planned analgesic regimen to ensure early mobilization, decrease the length of hospital stay and provide patient comfort.[1] Any intervention that improves pain relief is worthy of investigation. Multimodal analgesics are often used to treat acute, postoperative pain. The systematic review of randomized trials has confirmed the analgesic efficacy of acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs) and cyclooxygenase-2 inhibitors after surgery. They act on peripheral and central sites and interfere with pain mechanisms that differ from the opioid system. [2, 3]

The iliohypogastric/ilioinguinal nerves are parts of the lumbar plexus.[4] They provide sensation to the pubic area, lower abdomen, inguinal area, medial thigh, and genital organs. The IINB was performed by injecting an LA in the peripheral nerves to block any sensory signal to the spinal cord. It constitutes an effective technique, ensures safety, and reduces pain after surgery. This technique may be complex among patients with obese status and should be performed under an experienced anesthesiologist. The ultrasound-guided iliohypogastric/ilioinguinal nerve block has been increasingly used among patients for perioperative analgesia postabdominal surgery.[5-7] The iliohypogastric/ilioinguinal nerve block reduces opioid requirement, resulting in fewer opioid-mediated adverse effects and reduces the incidence of nausea and vomiting. This technique can reduce pain up to 12 hours postoperative. [8]

Local anesthetic wound infiltration is a common and easy technique to decrease postoperative pain in real-world practice. It involves injecting local anesthesia in the skin, subcutaneous tissue layer, and the surgical incision area, which can reduce pain up to 6 hours after surgery.[9] The authors hypothesized that the iliohypogastric/ilioinguinal nerve block provides superior postoperative pain relief than local anesthetic wound infiltration.

This study aimed to evaluate the efficacy of ultrasound-guided iliohypogastric/ilioinguinal nerve block compared with local anesthetic wound infiltration on postoperative pain control and amount of opioid consumption among patients undergoing gynecologic surgery using a Pfannenstiel incision.

Methods

A double-blinded randomized controlled trial was performed after approval by the Institutional Review Board of the Royal Thai Army Medical Department (ID: IRBRTA S084h/63). The thaiclinicaltrials.org registration number is TCTR20221205001. Written consent was obtained from all patients after receiving a comprehensive explanation of the possible risks and complications of nerve block. In addition, the potential risks and complications which could appear during the study were also explained.

All patients aged between 20 and 80 were scheduled for elective gynecologic surgeries under general anesthesia with endotracheal intubation at Phramongkutklao Hospital, Bangkok, Thailand. Patients were eligible for enrollment after categorizing as the American Society of Anesthesiologists (ASA) I to III and having good consciousness and communication ability. Exclusion criteria included patients with known allergy to bupivacaine, emergency surgeries, BMI $\geq$35 kg/m^2, renal impairment, liver impairment, known case chronic pain with potent opioids and inability to communicate with patients.

The sample size was calculated based on a related study by Sivapurapu et al.[10] A p-value less than 0.05 was considered significant at a power of 0.80. The number of anticipated patients was 22 in each group. Assuming a drop-out ratio of 10%, the sample size was 25 in each group.

Study design

From March 2021 to February 2022, a double-blinded randomized controlled trial study included patients scheduled for elective gynecologic surgeries for benign conditions such as total abdominal hysterectomy with or without bilateral salphingo-oophorectomy through a Pfannenstiel

incision; informed consent was obtained from 50 patients. General anesthesia with endotracheal intubation was performed in all cases. The baseline characteristics: age, BMI and the American Society of Anesthesiologists (ASA) category, were collected at the time of enrollment. **Figure 1** shows a CONSORT diagram of study participants (N= 50) meeting the inclusion criteria for the study. A computer-generated random number of randomized patients to either undergo iliohypogastric/ilioinguinal nerve block (IINB group) or receive local anesthetic infiltration in the surgical incision (LA group). The patients and investigators enrolling the patients were blinded to the intervention. On arrival at the operating room, patients were monitored using electrocardiogram, noninvasive blood pressure and pulse oximetry. All patients received a standardized induction of general anesthesia with fentanyl 1-2 µg/kg, propofol 1-2 mg/kg and cisatracurium 0.1 to 0.2 mg/kg. Endotracheal intubation was performed. Anesthesia was maintained using sevoflurane and 50% oxygen.

In the IINB group (N=25), the bilateral iliohypogastric/ilioinguinal nerve block was performed using an aseptic technique at the end of the operation by two regional anesthesia specialists and two trainees under the supervision of specialists. In the supine position, a linear ultrasound probe with high frequency (10 to 12 MHz) was placed obliquely along a line joining the anterior superior iliac spine (ASIS) and the umbilicus immediately superior and medial to the ASIS. In this location, the ilioinguinal and iliohypogastric nerves in between the transverses abdominus and internal oblique are defined as shown in **Figure 2**. The B Braun Stimuplex, a 22-gauge 80 mm needle, was inserted using an in-plane technique. The correct location of the needle tip is confirmed by an injection of 1 to 2 ml of normal saline to hydro-dissect the appropriate plane. After negative aspiration of blood, 20 ml of 0.25% bupivacaine was administrated in this plane. The procedure was repeated on the other side of ASIS to achieve a bilateral blockade.

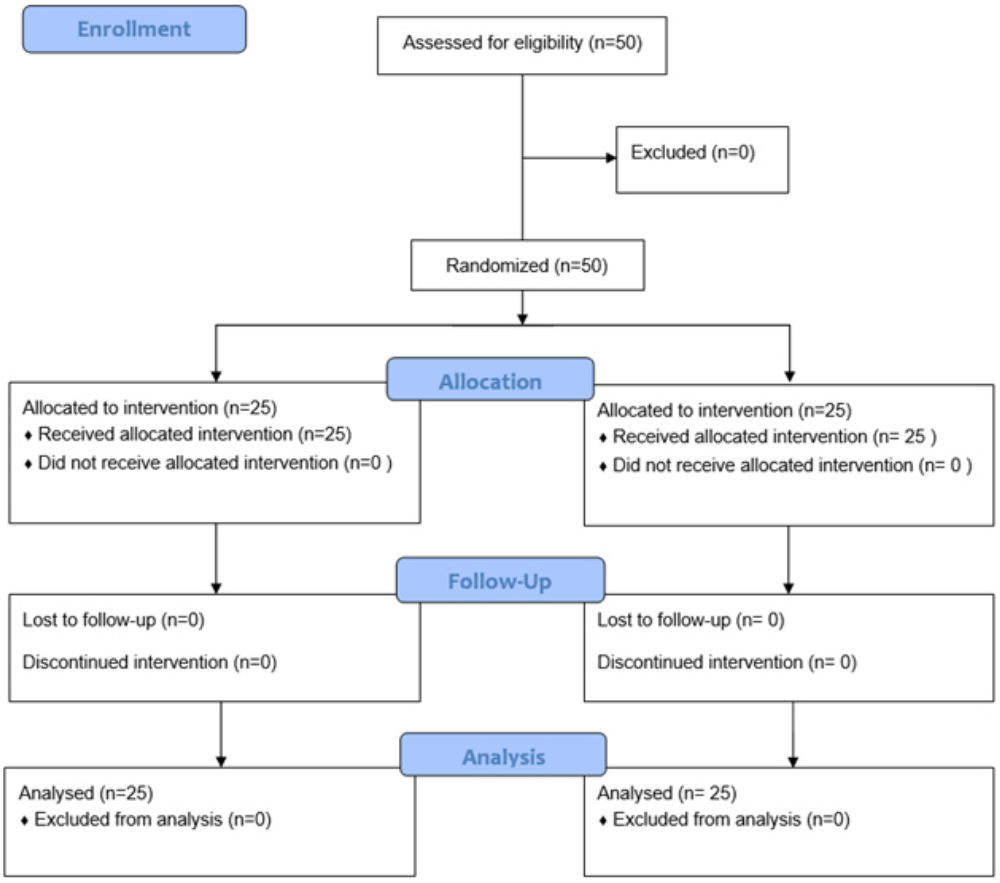

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) diagram

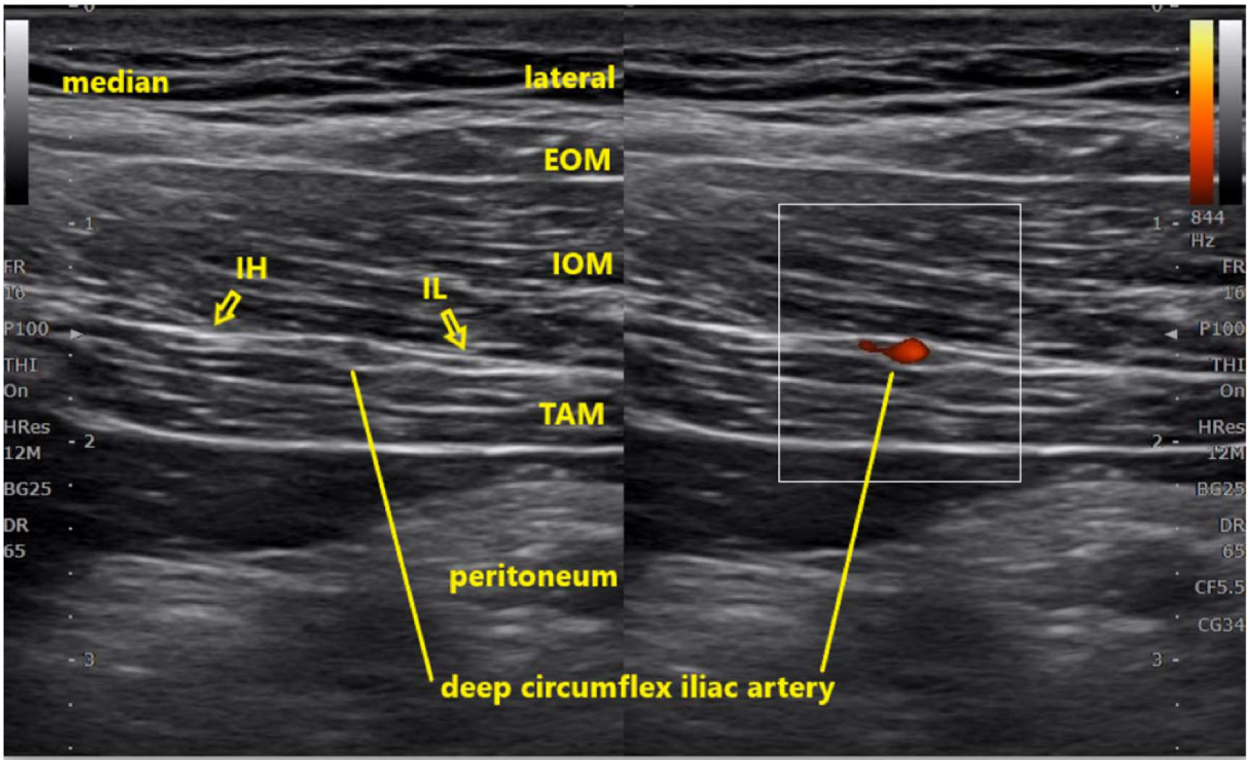

Figure 2. Ultrasound anatomy of the abdominal wall layers. EOM, external oblique muscle; IOM, internal oblique muscle; TAM, transverse abdominis muscle; IH, iliohypogastric nerve; and IL, ilioinguinal nerve

The LA group (N=25) was similar to the IINB group, under aseptic conditions. The surgeon administered the local infiltration with 20 ml of 0.5% bupivacaine at the end of the surgery. In addition, Ketorolac 30 mg and acetaminophen 1 g were administered intravenously to both groups 30 minutes before the end of surgery. All patients were connected to an intravenous patient-controlled analgesia (IVPCA) system. The PCA protocol was as follows: a loading bolus of 1 mg IV morphine, 1 mg for the subsequent bolus, followed by a lockout period of 5 min, with a maximal dosage of 20 mg within 4 hours. Patient-controlled analgesia continued 24 hours postoperatively. Additionally, the patients in both groups were given a postoperative analgesic regimen of injection ketorolac IV 30 mg 8 hourly up to 24 h.

At the end of the surgery, patients were awakened and taken to the recovery room. Postoperative pain scores using the Numerical Rating Scale (NRS, 0: no pain, 10: most severe pain to be estimated) and all parameters including adverse effects such as nausea, vomiting, hypotension, arrhythmia, pruritus and bradycardia, were assessed at 0, 2, 4, 8, 12 and 24 hours, postoperatively as shown in **Figure 3.** All data were collected by the same anesthesiologist blinded to the study group.

Statistical analysis

Statistical analysis was performed using computer software; STATA Statistical Software: Release 14. College Station, TX: StataCorp LP. The primary outcome was the difference in postoperative pain scores between the IINB and LA groups. The secondary outcome was the difference in morphine consumption in 24 hours postoperation between the IINB and LA groups. Demographic data were analyzed using an independent t-test and chi-square test. Pain scores (numerical rating scale), with paired comparisons at each time interval, were performed using the independent t-test. The 24-hour morphine requirement was analyzed using an independent t-test. The Shapiro-Wilks test was used to test the normality of data. Normally distributed data were presented as mean ± standard deviation (SD); $p < 0.05$ was considered statistically significant.

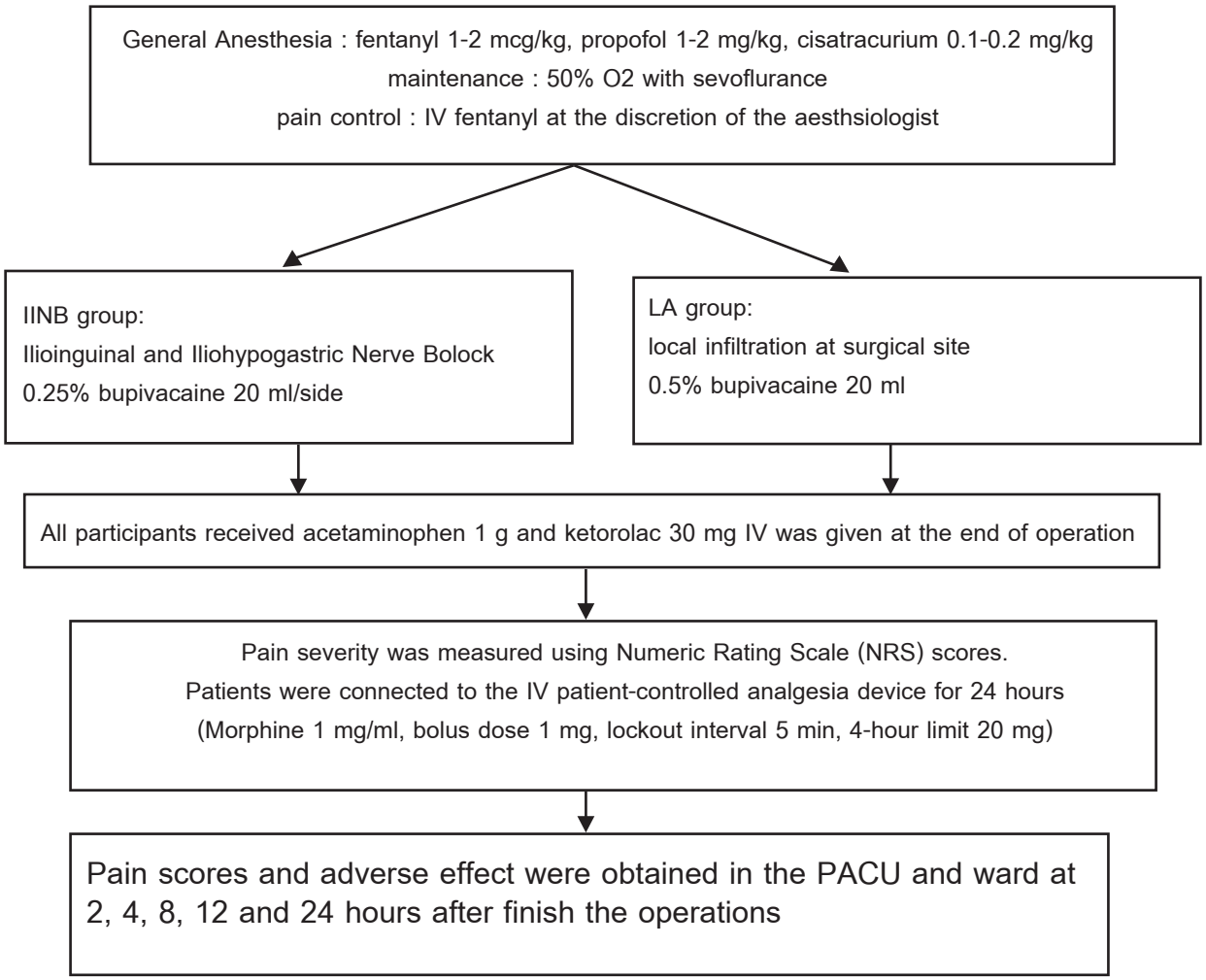

Figure 3. Flow chart represented method
IINB=iliohypogastric/ilioinguinal nerve block group, LA=local anesthetic wound infiltration group

Table 1. Demographic characteristics of the patients

Characteristics	IINB* (n=25)	LA# (n=25)
Age, yrs., mean (SD)	49.4 (4.2)	50.0 (4.2)
ASA**, number		
1	15 (60%)	9 (36%)
2	10 (40%)	16 (64%)
Weight, kg. mean (SD)	60.2 (6.9)	61.4 (7.9)
Height, cm. mean (SD)	158.3 (3.5)	158.6 (4.4)
BMI***, kg/m^2 mean (SD)	23.9 (2.2)	24.3 (2.3)

*IINB=iliohypogastric/ilioinguinal nerve block group, #LA=local anesthetic wound infiltration group,
**ASA=American Society of Anesthesiologists, ***BMI=body mass index., SD=standard deviation.
Pearson correlation coefficient, statistically significant at $p<0.05$

Results

A total of 50 randomized patients were recruited and allocated in two groups of 25 each. Both groups were comparable in the distribution of age, weight, height, body mass index (BMI) and ASA classification. No significant differences were noted regarding demographic data. All cases were benign and underwent transabdominal hysterectomy with or without bilateral salpingo-oophorecomy. The operative time was between 2 and 3 hours. **Table 1** summarizes the demographic characteristics of the patients.

Table 2. Postoperative pain scores of the iliohypogastric/ilioinguinal nerve block and local anesthetic wound infiltration groups at various postoperative time points

Postoperative time points (hour)	Pain score, mean (SD)		*p*-value
	IINB* n=25	LA# n=25	
0	4.8 (1.1)	6.7 (1.5)	<0.001
2	3.8 (0.7)	6.3 (1.4)	<0.001
4	2.9 (0.9)	5.4 (1.3)	<0.001
8	2.0 (1.0)	4.6 (1.3)	<0.001
12	0.8 (0.9)	3.2 (1.0)	<0.001
24	0.4 (0.6)	2.6 (0.6)	<0.001

*IINB=Iliohypogastric/ilioinguinal nerve block group, #LA=Local anesthetic wound infiltration group. Postoperative Numeric Rating Scale (NRS) scores. Independent t-test, statistically significant at $p<0.05$

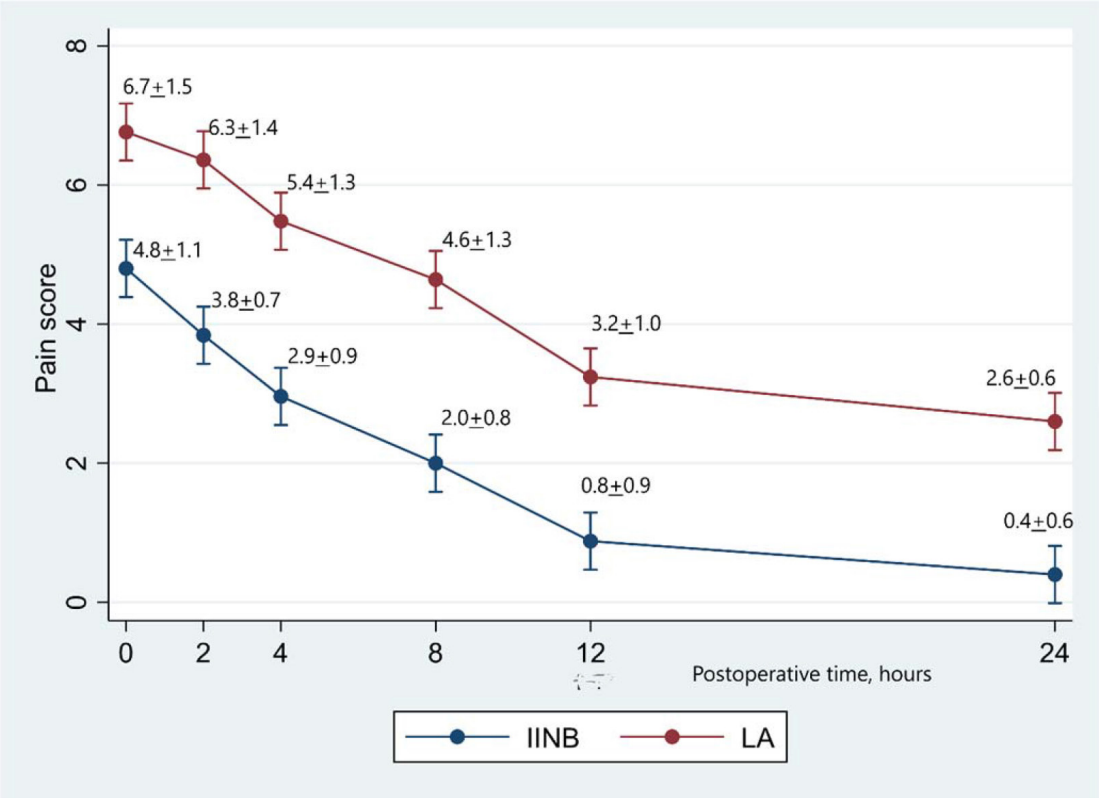

Figure 4. Postoperative pain scores of the iliohypogastric/ilioinguinal nerve block and local anesthetic wound infiltration groups at various postoperative time points
IINB=Iliohypogastric/ilioinguinal nerve block group,
LA=Local anesthetic wound infiltration group

The pain scores were significantly lower in the iliohypogastric/ ilioinguinal group than in the local anesthetic wound infiltration group at 0 hour (4.8±1.08 vs. 6.76±1.48), 2 hours (3.84±0.69 vs.6.37±1.38), 4 hours (2.96±0.93 vs. 5.48±1.29), 8 hours (2.0±1. vs. 4.64±1.29), 12 hours (0.88± 0.93 vs. 3.24±1.05) and 24 hours (0.4±0.65 vs. 2.6±0.65), postoperatively. (**Table 2, Figure 4)**

Table 3. Postoperative morphine consumption of the iliohypogastric/ilioinguinal nerve block and local anesthetic wound infiltration groups at various postoperative time points.

Postoperative time points (hour)	Morphine consumption (mg), mean (SD)		*p*-value
	IINB* n=25	LA# n=25	
0	0 (0)	0 (0)	N/A
2	3.5 (1.3)	6.3 (2.3)	<0.001
4	6.0 (1.6)	10.5 (4.1)	<0.001
8	7.8 (1.9)	13.3 (6.5)	<0.001
12	8.8 (2.5)	15.8 (7.2)	<0.001
24	9.2 (3.0)	18.4 (8.4)	<0.001

*IINB=iliohypogastric/ilioinguinal nerve block group, #LA=local anesthetic wound infiltration group, Independent t-test was statistically significant at $p<0.05$

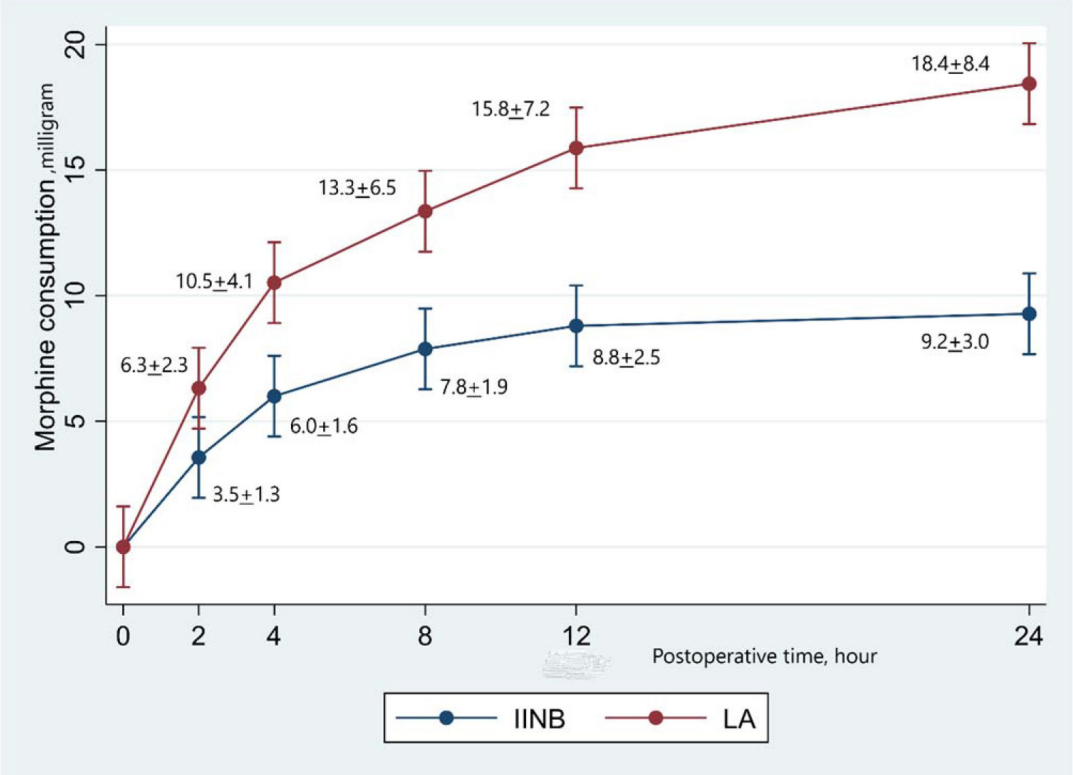

Figure 5. Postoperative morphine consumption of the iliohypogastric/ilioinguinal nerve block and Local anesthetic wound infiltration groups at various postoperative time points.
IINB=Iliohypogastric/ilioinguinal nerve block group,
LA=Local anesthetic wound infiltration group

Total morphine consumption is shown in **Table 3** and **Figure 5**. Consumption in the iliohypogastric/ilioinguinal group was lower than the local anesthetic wound infiltration group at 0, 2, 4, 8, 12 and 24 hours, postoperatively (p<0.05). Additionally, no reported cases of bleeding, swelling, or bruising at the iliohypogastric/ilioinguinal group injection site, nor were there episodes of excess sedation requiring medical review or removal of the PCA machine. Prophylaxis of postoperative nausea and vomiting with 8 mg ondansetron IV 30 minutes before the end of surgery was effective. No postoperative nausea, vomiting, or other adverse effects occurred among 50 patients.

Discussion

In this randomized, double-blind clinical trial, patients receiving bilateral iliohypogastric/ilioinguinal nerve blocks had significantly less postoperative pain and reduced morphine requirements compared with local anesthetic wound infiltration with bupivacaine. Local anesthetic wound infiltration is effective in postoperative pain management following obstetrics surgery with a Pfannenstiel incision. Still, in this study, the iliohypogastric/ilioinguinal nerve block appeared to be more effective. [9]

Pain in the postoperative period impedes recovery from surgery and anesthesia, and after gynecologic surgery through a Pfannenstiel incision, patients usually require strong analgesics for 24 to 48 hours. Potential analgesic methods include intraperitoneal, incisional or epidural injections of local anesthetics.[11] The iliohypogastric/ilioinguinal nerve block is another method at the time of a number of abdominal surgical procedures.[4-6]

The somatic or cutaneous pain from a Pfannensteil incision is principally conducted by the iliohypogastric and ilioinguinal nerves supplying afferent coverage to the L1-2 dermatome. The ilioinguinal nerve comprises fibers from the L1 nerve root with a contribution of fibers from the T12 nerve root in approximately 25% of patients.[12] Exiting from the lateral border of the psoas muscle, the ilioinguinal nerve follows a curvilinear course that takes it from the L1 and occasionally T12 somatic nerves to pass along the inside of the concavity of the ilium. The ilioinguinal nerve continues to pass anteriorly as it runs within a fascial plane between the internal oblique and transverse abdominis muscles. Within this fascial cleft the ilioinguinal nerve is identified with ultrasound scanning. At this point, the nerve is easily blocked using ultrasound-guided needle placement. [13]

In a related study, the efficacy of the transversus abdominis plane block and iliohypogastric/ilioinguinal nerve block in lower abdominal surgery was supported by randomized controlled trials.[14] On the contrary, a systematic review and meta-analysis demonstrated that transversus abdominis plane block did not significantly reduce morphine requirements compared with local anesthetic wound infiltration 24 hours after surgery. [15]

The local anesthetic is deposited in the plane between the internal oblique and the transverse abdominis muscle in the transversus abdominis plane block and the iliohypogastric/ilioinguinal nerve block. The ultrasound-guided iliohypogastric/ilioinguinal nerve block could target the ilioinguinal and iliohypogastric nerve more accurately and offers the advantage of direct visualization of the nerves and the adjacent anatomical structures.[4] Therefore, in this study, we chose an iliohypogastric/ilioinguinal nerve block to compare with local anesthetic wound infiltration.

Thus, the US-guided iliohypogastric/ilioinguinal nerve block is considered superior to local anesthetic wound infiltration, as proven by better pain relief scores and an opioid sparing analgesic efficiency. Moreover, the iliohypogastric/ilioinguinal nerve block easily achieved satisfactory quality ultrarasonographic visualization in the clinical setting. No adverse event occurred in this study in both group, similar to the related study. [16]

The study encountered several limitations. First, we did not record the intraoperative opioid consumption (intravenous fentanyl) and the last dose that might have affected the pain control postoperative period. Second, the study was performed on the postoperative pain score

and opioid use for only 24 postoperative hours. Third, the numeric rating pain scale was not objective, and there could have been some variability in the patient's ability to use this scale. Fourth, we did not perform pinprick or cold tests to determine sensorial block distribution to confirm the anesthetic level of the iliohypogastric/ilioinguinal nerve block. Lastly, this research was conducted at a training center in a single institution. Therefore, limitations were encountered regarding experienced anesthesiologists. It remains a not widely used technique in general hospitals.

Conclusion

The present study demonstrated that ultrasound-guided iliohypogastric/ilioinguinal nerve block achieved a comparably good analgesic effect and reduced morphine consumption in the first 24 hours after gynecologic surgery.

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Potential conflicts of interest

The authors declare they have no conflicts of interest.

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