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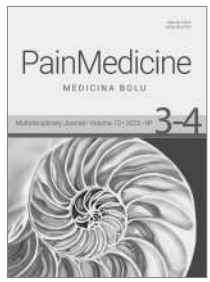

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Comparison of Anterior Quadratus Lumborum Block Versus Lumbar Erector Spinae Plane Block for Postoperative Analgesia in Total Abdominal Hysterectomy: A Randomized Controlled Study

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Abstract

Background: *Total abdominal hysterectomy (TAH) is commonly associated with significant postoperative pain. Multimodal analgesia incorporating regional blocks is now the standard of care. Among these, the lumbar erector spinae plane (ESP) block and anterior quadratus lumborum (AQL) block are frequently used.*

Objectives: *To compare the efficacy of anterior quadratus lumborum (AQL) block and lumbar erector spinae plane (ESP) block in providing postoperative analgesia for patients undergoing TAH.*

Methods: *This prospective, randomized, double-blind interventional study included 44 patients undergoing TAH. Participants were randomly assigned to receive either a bilateral AQL block (Group A) or a bilateral lumbar ESP block (Group B) before surgery, under ultrasound guidance. All patients underwent general anesthesia. Pain was assessed postoperatively at regular intervals over 24 hours using the Visual Analogue Scale (VAS). Additional analgesic requirements and any complications were documented.*

Results: *Group A (AQL block) had a significantly longer mean duration of analgesia (8.5 ± 0.96 hours) compared to Group B (ESP block, 7.5 ± 1.09 hours; $p = 0.00411$). Total analgesic consumption in the first 24 hours was also lower in Group A (mean 2.36 ± 0.49) versus Group B (3.23 ± 0.68; $p < 0.00001$). No block-related complications were noted.*

Conclusion: *The AQL block provided statistically superior postoperative analgesia compared to the lumbar ESP block in patients undergoing TAH. However, the clinical difference in analgesic duration was marginal. Either block may be employed based on clinician expertise and institutional protocol.*

Introduction: Background and objectives

Lower abdominal surgeries have different pain generators compared to upper abdominal surgeries and should be treated accordingly, rather than using conventional methods. Among most prevalent key surgical procedures that is linked to severe postoperative pain is total abdominal hysterectomy (TAH). Multimodal analgesia is standard of care for managing perioperative pain, combining various nerve blocks with systemic drugs to minimize opioid consumption [1,2]. With differing degrees of effectiveness, fascial plane blocks have been utilised, notably Erector Spinae Plane (ESP), Quadratus Lumborum (QL), Transversus Abdominis Plane (TAP) blocks [3]. ESP block is a novel regional analgesic methodology showing efficacy in managing pain for various thoracic and abdominal procedures [4,5,6]. In this method, "local anesthetic is injected beneath the erector spinae muscle group, aiming to affect dorsal and ventral branches of spinal nerves and sympathetic chain near vertebral column. For thoracic and upper abdominal procedures", this method relieves both somatic and visceral pain. However, in cases of lower abdominal surgery, it should be given at lumbar level for better spread of drug to lumbar nerves too. The QL block is another regional analgesic technique widely used for management of postoperative pain in pelvic and abdominal surgeries. QL block can be given at various sites named anterior , lateral and posterior according to drug deposition concerning quadratus Lumborum muscle In anterior QL block, "local anaesthetic is deposited between the quadratus lumborum and psoas major muscles, allowing the drug to spread along the fascial plane to the spinal nerves and sympathetic chain, thereby providing effective somatic and visceral" pain relief [7,8]. Various investigations have evaluated efficacy of these blocks in hysterectomy patients.

Hamed MA et al. assessed the effectiveness of bilateral ESP blocks in TAH patients and reported reduced fentanyl consumption in the first 24 hours postoperatively [9].Similarly, Kamel AA et al. compared ESP and TAP blocks for postoperative analgesia in TAH patients, finding that ESP blocks provided superior pain relief [10,11].

Jiang W et al. ESP and QL blocks were evaluated for the treatment of postoperative pain and opioid use in individuals who had laparoscopic hysterectomy. At 12 hours after surgery, their results showed that QL block group consumed considerably less sufentanil overall than control group. Additionally, QL group had considerably lower pain levels than control group at 4 and 6 hrs after surgery, and by 12 hrs, QL block was more effective than ESP and control groups [11].

Baran O et al. conducted a comparative study evaluating anterior QL blocks and ESP in patients having a complete laparoscopic hysterectomy. Both groups demonstrated reduced tramadol consumption in comparison to control group, although ESP and QL groups weren't significantly different [12]. In a subsequent study in 2024, Baran O et al compared ESP and QL blocks for postoperative pain relief and opioid consumption in TAH patients, concluding that both techniques were equally effective[13]. For reducing postoperative pain and lower overall opioid consumption in patients receiving TAH under general anaesthesia, current research compares and assesses the effectiveness of anterior QL blocks and lumbar ESP. We hypothesized that anterior QL block and the lumbar ESP block would have comparable efficacy in controlling postoperative pain in TAH patients.

Materials and Methods: Methodology

The institutional ethics and research committee approved the conduct of this prospective, double-blind, comparative interventional investigation. Observing the ethical principles of the Declaration of Helsinki for human subjects' medical research, research has been carried out. Research has been carried out between July 2022 and August 2024. Patients scheduled for elective total abdominal hysterectomy (TAH) between ages of 30 and 60 were recruited. Patients who declined participation, had a history of allergies, major cardiac diseases, local site infections, or coagulopathy were excluded from study. Applying Cochran's method, the sample size was determined depending on 2.6 % prevalence of hysterectomy procedures, having 80 % power, 95 % confidence level. 40 was the very minimum sample size needed. 44 patients were enrolled and divided into two groups of 22 each employing a computer-generated random number approach, taking into consideration a 10 % dropout rate. Individual who was not participating in research used an opaque envelope technique to hide allocation. A research was undertaken following the consolidated standards of reporting Trials (CONSORT) (Fig. 1).

Group A: Bilateral anterior quadratus lumborum (AQL) block group (n=22).

Group B: Bilateral lumbar erector spinae plane (ESP) block group (n=22).

All patients underwent preoperative anaesthesia fitness assessments, and informed consent have been obtained. Process, visual analogue scale(VAS), and numerical rating pain scale(NRS) were explained to them.

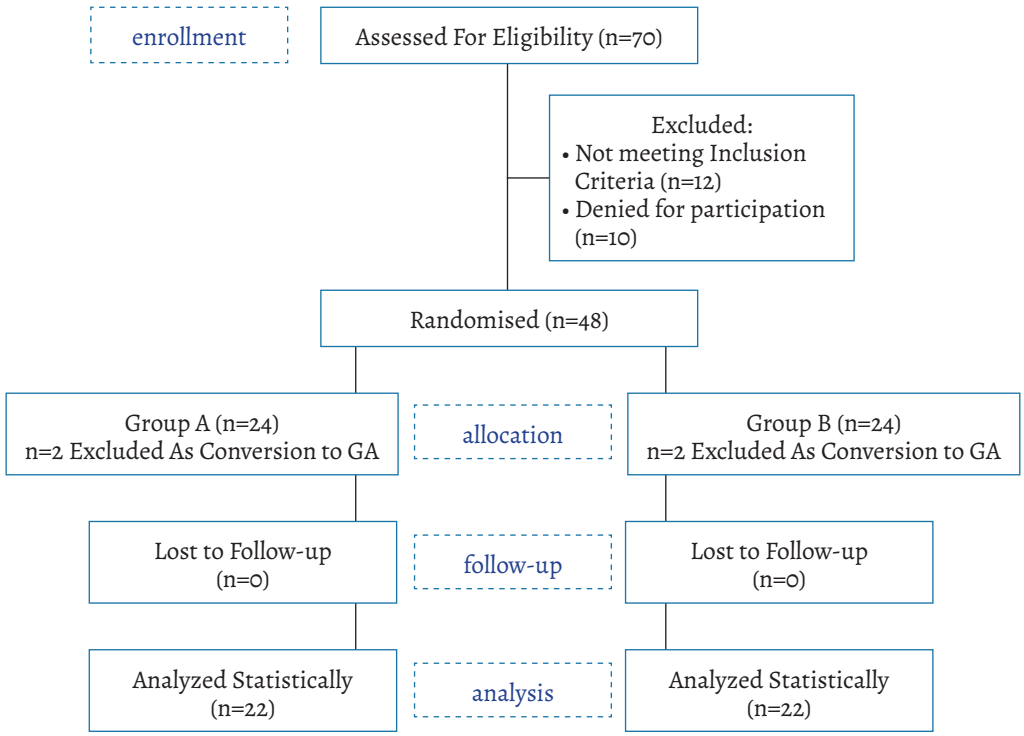

Figure 1. Consort Flow Diagram depicting patient enrollment, randomization, and follow-up

Standardized preoperative protocols for nil-by-mouth (NBM) guidelines and intraoperative monitoring were followed. On the day of surgery, after making safe intravenous (IV) access and attaching standard multiparameter monitors, sedation with fentanyl (2μg/kg IV) and midazolam (0.04mg/kg IV) was administered. Oxygen (4L/min) was delivered via nasal prongs. Under aseptic precautions, an ultrasound-guided block have been administered in lateral position based on assigned group. Procedure was carried out by the same person experienced in regional anaesthesia.

Group A: Bilateral AQL block at the L2–L3 level using 20mL of 0.25 % bupivacaine + 100 μg adrenaline on each side (Fig. 2). Curvilinear probe and 10 cm 22g stimuplex needle was used. Shamrock sign on monitor was obtained and the needle was introduced in plane from posterior side. Drug was placed between psoas major and quadratus lumborum [14] (Fig. 3).

Group B: Bilateral ESP block at L1 level utilizing 20mL 0.25 % bupivacaine + 100 μg adrenaline on each side (Fig 4). Curvilinear probe and 10 cm 22g stimuplex needle was used. During L1 vertebra transverse process, drug was placed in fascial plane closer to erector spinae muscle (Fig. 5).

Patients in both groups subsequently received general anaesthesia with endotracheal intubation and controlled mechanical ventilation as per institutional protocol. Propofol was used as IV induction agent, vecuronium as muscle relaxant, and sevoflurane 1MAC for maintenance. Intraoperatively all patients received tramadol (100 mg IV) towards surgery end. After procedure, patients have been extubated following the administration of reversal agents and transferred to the recovery unit.

Observations and Results

Postoperative pain was determined at 0, 4, 8, 12, 20, and 24 hours employing numerical rating pain scale. Pain assessments were performed by an on-duty nurse who was not involved in research and was trained in using the numerical rating scale and VAS score. Patients reporting pain with a VAS score >4, were administered analgesics in the following order, as required: IV paracetamol (1 g), tramadol (100 mg in 100mL NS as IV drip), intramuscular diclofenac sodium (75 mg). Pain scores and analgesic administration were recorded. Patients were monitored for 24 hours for pain, total analgesic requirement in 24 hrs, and any procedural complications. No complications, such as injection site pain, redness, swelling, induration, or neurological deficits, were observed.

Statistical Analysis

Data were compiled into a master chart using Microsoft Excel 2007 and analysed utilizing SPSS “software

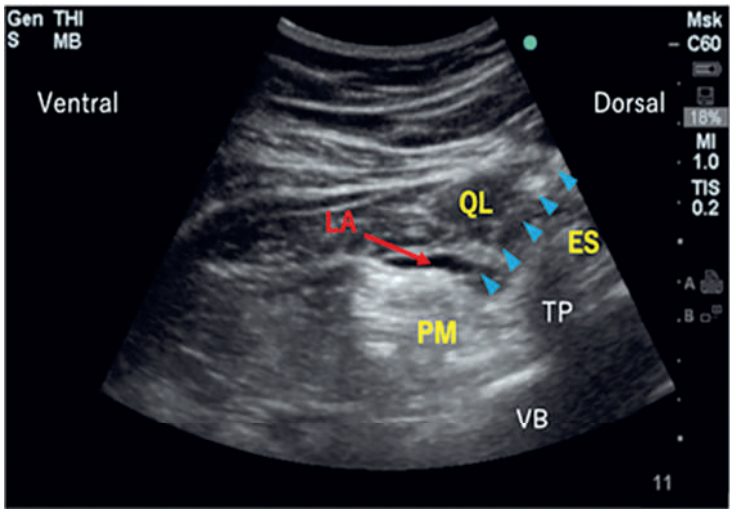

Figure 2. Ultrasound image of anterior quadratus lumborum block (QLB). Triangles indicate needle path. Abbreviations: ES — erector spinae muscle, LA — local anesthetic, PM — psoas major muscle, QL — quadratus lumborum muscle, TP — transverse process, VB — vertebral body

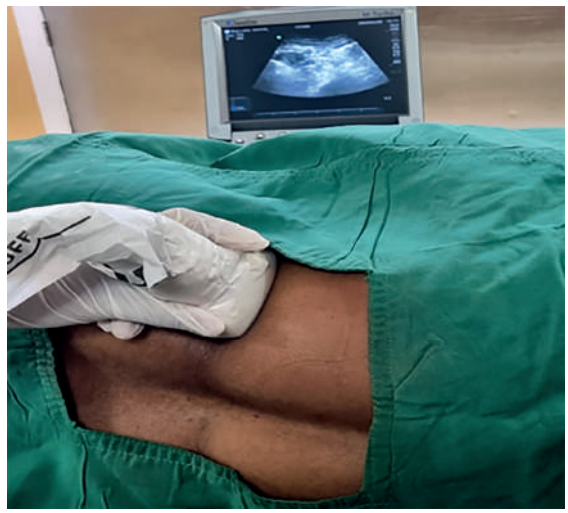

Figure 3. USG-guided anterior QL block showing patient positioning, probe placement, and ergonomics

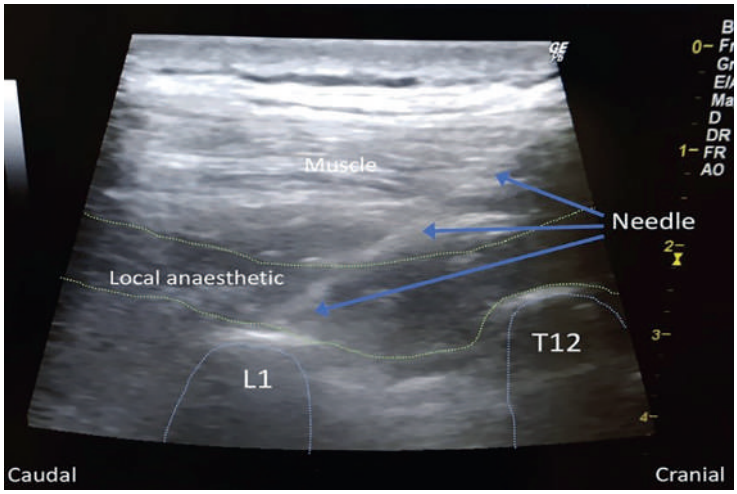

Figure 4. Ultrasound image of lumbar ESP block at L1 level showing L1 and T12 transverse processes

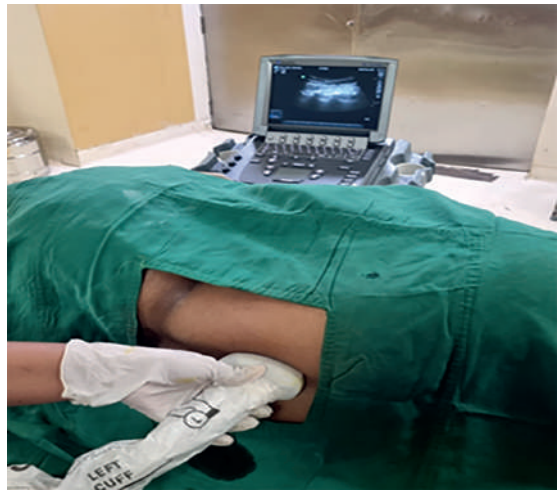

Figure 5. USG-guided ESP block demonstrating patient positioning and ergonomics

(version 23.0). The unpaired t-test has been employed to investigate quantitative data, while chi-square tests and Fisher's exact test were incorporated to assess qualitative variables. Statistical significance was identified at p< 0.05 and strong significance at" p <0.001.

Results

The "demographic profiles of both groups have been discovered to be similar at baseline. Mean age in Group A was 46.9±8.9yrs, while Group B had a mean age of 45.81±9.11yrs. Other variables like body weight, ASA classification, and duration of surgery were also comparable across two" groups (Table 1).

Postoperatively, "pain scores at 0,4,8 & 12 hrs have been significantly lower in Group A in comparison with Group B. Although pain scores remained lower in Group A in comparison to group B. At" 20 & 24 hrs, difference was less pronounced (Table 2).

Group A had analgesia for mean of 8.5±0.96 hrs, considerably longer than Group B's (7.59±1.09 hours), having p-value 0.00411 (Table 3).

Total 24-hour analgesic consumption significantly less in Group A (mean: 2.36 ± 0.49) compared to Group B (mean: 3.23 ± 0.68), having p<0.00001 (Table 4).

Table 1. Demographic Variables of Study Groups

Demographic Variable	Group A (AQL Block)	Group B (ESP Block)	p-value
Age (yrs)	46.9 ± 8.9	45.8 ± 9.11	0.3451
Weight (kg)	62.1 ± 8.9	59.2 ± 9.2	0.278
BMI (kg/m²)	24.8 ± 2.5	25.1 ± 2.3	0.68
ASA I / II	13 (59 %) / 9 (41 %)	12 (55 %) / 10 (45 %)	1.0
Duration of Surgery (min)	116.4 ± 22.3	119.1 ± 22.6	0.344
Duration of Block Procedure (min)	16 ± 4.8	18.6 ± 6.2	0.128

*Values are presented as mean ± SD or number of patients (%). *Independent t-test; **Fisher's exact test.*

Table 2. Comparison of VAS Scores at Various Time Intervals

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
0 Hours	0.91 ± 0.68	2.31 ± 0.65	< 0.00001
4 Hours	1.18 ± 0.73	2.41 ± 0.67	< 0.00001
8 Hours	1.22 ± 0.75	2.45 ± 0.91	< 0.0001
12 Hours	1.36 ± 0.65	2.18 ± 0.66	< 0.0001
20 Hours	1.45 ± 0.80	2.09 ± 0.81	0.0061
24 Hours	1.5 ± 0.86	2.55 ± 0.85	0.00011

Values are presented as Mean ± SD. P-values indicate statistical significance.

Discussion

In this research, "the effectiveness of Anterior Quadratus Lumborum (AQL) block and Lumbar Erector Spinae Plane (ESP) block for postoperative analgesia in patients having total abdominal hysterectomy (TAH) under general anaesthesia was compared. A multimodal approach to postoperative pain treatment was highlighted in the" 2006 publication of the Procedural Specific Postoperative Pain treatment (PROSPECT) guidelines for abdominal and vaginal hysterectomy [15].

Quadratus Lumborum block is a regional analgesia technique discovered by Blanco (2007), broadly utilized for postoperative pain relief in abdominal and pelvic surgeries, it has added advantage by covering visceral pain which is not observed in TAP block [16]. Forera developed "Erector Spinae Plane ESP) Block procedure in 2016 for thoracic neuropathic pain. Now, it has been"

Table 3. Duration of Effective Analgesia

Group	Duration (hours)	P value
Group A (AQL)	8.5 ± 0.96	0.00411
Group B (ESP)	7.5 ± 1.09	

Table 4. Total Analgesic Requirement in 24 Hours

Group	Mean ± SD (Doses)	P value
Group A	2.36 ± 0.49	< 0.00001
Group B	3.23 ± 0.68	

Values are presented as Mean ± SD. P-value shows statistically significant difference.

broadly employed by many anesthesiologists for being simple for performing and covering various procedures from thoracic to abdominal surgeries. Like QL block, it also covers visceral pain [17].

The effectiveness of ESP blocks, which are typically administered at the T4 level for thoracic pain and at the T10 level for upper abdominal pain, is somewhat in doubt when it comes to lower abdominal procedures. Pain generators for lower abdominal surgeries like total abdominal hysterectomy arise from somatic nerves, "ilioinguinal (L1), iliohypogastric(L1), genitofemoral (L1,2) nerves", as well as visceral nerves like hypogastric plexus (T10-L2), pelvic splanchnic (S2-S4) nerves, and sacral plexus (L4-S4). Covering such a wide area may not be feasible with conventional ESP block administered at the T10 level. Therefore, we decided to study the effect of the Lumbar ESP block, which is administered at L1 level. The QL block, which can be administered at various sites, including anterior, posterior, and lateral approaches. We decided to use anterior approach for better spread and effect.

In this study we included 44 subjects divided into 2 groups Viz Group A, AQL (n = 22) Group B, ESP (n = 22). The groups demographic characteristics were similar. Our results demonstrated consistently lower VAS scores in the anterior QL block group across all time points postoperatively than in ESP block group. This suggests that anterior QL block may provide superior analgesia than ESP block till 24 hrs. post-operatively in TAH patients. These findings are consistent with the studies where QL and ESP blocks are compared for other surgical procedures like laparoscopic nephrectomy, colorectal surgeries, hip surgeries [17,18,19,20, 21,22]. When we compare our results with other studies where QL and ESP blocks are equated for post operative pain in hysterectomy procedure our results are similar to them [23,13,24].

Jiang et al (2023) found ESP block superior as in their study they utilized lateral QL block rather than anterior QL [25]. In anterior QL block there are more chances that drug will spread to paravertebral space more uniformly and we will get prolonged analgesia. ESP block has more efficacy than QL block when it is utilized for upper abdominal surgeries and in laparoscopic surgeries pain generators are from whole abdomen that may explain it.

Baran et al (2023) points out that ESP block has less procedural time. Our research didn't discover such difference as ESP at T10 level is a deep block and takes comparable time as AQL block. ESP block is more beneficial for upper abdominal surgeries, and QL block for pelvic and lower abdominal surgeries being to their anatomical orientation. In our investigation, the QL block group's initial rescue analgesic time remained significantly longer, indicating prolonged duration of block which can be explained by broader distribution of drug and ability to inhibit sympathetic fibres when the drug gets embedded in the thoracolumbar fascia, which connects the lumbar and thoracic spines. Whereas in ESP block drug is deposited in paravertebral space where it has to pass through tough costo- transverse ligament which sometimes limits its spread to anterior sympathetic chain. Another significant observation is reduced total analgesic consumption in 24 hrs in QL block group this not only underscores efficacy of QL block but also suggests potential benefit in terms of opioid sparing. These findings are in accordance with the previous studies. In our study, we found both techniques were safe, and no complications were reported.

We acknowledge certain limitations of the study. As we conducted study in only one medical facility to extrapolate our results multicentric trials are required with large sample size for more robust and generalizable results. The study sample size may not reflect variation in ethnicity, comorbidity, and body mass index, which could influence the outcomes. It would be better if these variables were compared to have fair results, reducing the biases. Longer follow up time rather than mere 24 hrs will be beneficial to see prolonged duration of effect and potential late onset problems. VAS and NRS are subjective measures of pain and can vary from individual to individual, additional objective measures of analgesia could provide more comprehensive assessment. With our study we recommend incorporation of anterior QL block or lumbar ESP as a regional analgesia technique in context of multimodal pain management for TAH operations.

Further studies could explore continuous catheter techniques with these blocks to assess whether prolonged analgesia and opioid-sparing effects can be extended beyond the first 24 hours. Additionally, studies comparing anterior QL to ESP in terms of patient satisfaction, time to ambulation, and hospital discharge metrics could offer a more comprehensive understanding of their overall impact on perioperative outcomes.

Conclusion

The study comes to the conclusion that although anterior QL block is statistically superior than lumbar ESP block in delivering post-operative analgesia, difference lacks significant clinical relevance. Therefore, either

block can be utilized for postoperative analgesia within TAH patients as per skill and preference of the anesthesia provider.

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Порівняння переднього блоку квадратного м'яза попереку та люмбального блоку площини виросткового м'яза спини для післяопераційної аналгезії після тотальної абдомінальної гістеректомії: рандомізоване контрольоване дослідження

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Анотація

Передумови: *Тотальна абдомінальна гістеректомія (ТАГ) часто супроводжується значним післяопераційним болем. Мультимодальна аналгезія, що включає регіонарні блоки, нині є стандартом лікування. Серед таких методів люмбальний блок площини виросткового м'яза спини (ESP) та передній блок квадратного м'яза попереку (AQL) застосовуються найчастіше.*

Мета: *Порівняти ефективність переднього блоку квадратного м'яза попереку (AQL) та люмбального ESP-блоку у забезпеченні післяопераційної аналгезії у пацієнток, яким проводили ТАГ.*

Методи: *У це проспективне, рандомізоване, подвійне сліпе інтервенційне дослідження включили 44 пацієнтки, які проходили ТАГ. Учасниць випадковим чином розподілили на дві групи: група А отримала двобічний AQL-блок, група В — двобічний люмбальний ESP-блок перед операцією, під контролем ультразвуку. Усі пацієнтки отримували загальну анестезію. Інтенсивність болю оцінювали після операції протягом 24 годин за візуально-аналоговою шкалою (VAS). Додаткові потреби в аналгетиках та ускладнення реєстрували.*

Результати: *Група А (AQL-блок) мала значно довшу середню тривалість аналгезії (8,5 ± 0.96 годин), ніж група В (ESP-блок — 7,5 ± 1.09 годин; p = 0.00411). Загальне споживання аналгетиків протягом перших 24 годин було також нижчим у групі А (2.36 ± 0.49), порівняно з групою В (3.23 ± 0.68; p < 0.00001). Ускладнень, пов'язаних із блоками, не зафіксовано.*

Висновок: *AQL-блок забезпечив статистично кращу післяопераційну аналгезію порівняно з люмбальним ESP-блоком у пацієнток після ТАГ. Однак клінічна різниця в тривалості аналгезії була незначною. Обидва методи можуть застосовуватися залежно від досвіду клініциста та протоколів медичного закладу.*