Оригінальна стаття / *Original article*

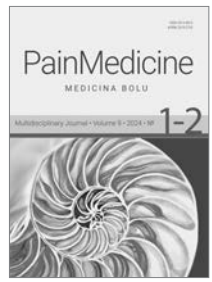
Том 9, № 1–2 • 2024

PainMedicine Journal

Медицина Болю // Медицина Боли

www.painmedicine.org.ua

Міждисциплінарний • Науково-практичний журнал



DOI: 10.31636/pmjua.v9i1–2.4

Comparative Analysis of the Effectiveness of Quadratus Lumborum and Transversus Abdominis Muscle Blocks for Postoperative Pain Relief During Laparoscopic Robot-Assisted Total Hysterectomy

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Abstract. *The purpose of this study was to compare and evaluate the analgesic effectiveness of quadratus lumborum block (QLB) and transversus abdominis plane bloc block (TAPB) after laparoscopic robot-assisted total hysterectomy.*

Materials and methods. *A prospective study of female patients (n = 101), with physical status ASA I–II, who underwent laparoscopic robot-assisted total hysterectomy under multicomponent general anesthesia. In random order, patients were randomized into three groups: the first group (CON, n = 40) — control, where no blocks were performed, the second group (TAPB, n = 30) — a blockade of the transverse abdominis muscle, the third group (QLB, n = 31) — blockade of the quadratus lumborum muscle was performed. After surgery, pain was assessed using a 10-point digital visual analogue scale, and postoperative nausea and vomiting were assessed. (PONV) Average arterial pressure and heart rate were recorded. Additionally, the next morning, a survey was conducted to assess the well-being and satisfaction of patients.*

Results. *There were no differences between the groups in terms of demographic characteristics, duration of surgery, and analgesic consumption during the intraoperative period. The severity of postoperative pain was higher ($p < 0.05$) in the control group than in the blockade groups. Both block groups demonstrated lower pain scores at all time points assessed. The latest need for analgesics was in the QLB group. Mean arterial pressure (MAP) values differed only in the first 2 hours after surgery between the CON and TAPB groups ($p < 0.05$). PONV one hour after surgery was more observed in the control group and less in the QLB group ($p < 0.05$). According to the results of a survey conducted on the day after surgery, the number of patients satisfied with the anesthesia and assistance provided in the recovery room in the groups with blockade (TAPB, QLB) was 2.1–5.3 % higher ($p > 0.05$). More patients from the QLB group ($p < 0.05$) noted very good and good health, and most patients ($p < 0.05$) from the CON and TAPB group noted satisfactory health.*

Conclusion. *The use of interfascial blocks for postoperative pain relief (TAPB, QLB) after laparoscopic robot-assisted hysterectomy improves the quality of pain relief and the well-being of patients. Benefits of QLB include better pain relief, reduced incidence of PONV, and greater patient satisfaction. TARP has shown equally good results, and this method is easier to perform.*

Keywords: *postoperative pain, transversus abdominis plane block, quadratus lumborum block, robot-assisted total hysterectomy*

Introduction

Laparoscopic total hysterectomy (LTH) became the most frequently performed gynecological surgery and, despite the development of minimally invasive surgery, the severity of postoperative pain can reach 6 points out of 10 [1]. Inadequate pain management after LTH can reduce patient satisfaction, increase opioid requirements, treatment costs, and length of hospitalization [2].

Multiple approaches are used for pain relief after LTH. Traditionally, postoperative pain management is carried out by intravenous opioid/non-opioid medications or epidural analgesia [3]. Opioids are initially required as part of a multimodal analgesic regimen to achieve effective analgesia. However, opioids are associated with dose-related side effects, including nausea, vomiting, pruritus, reduced brain arousal, and respiratory depression [4].

According to the ERAS recommendations protocol, regional anesthesia should be included in the multimodal analgesia strategy as a part of the LTH [1, 4]. Development of ultrasound technology increased the ability to perform regional anesthesia safely and widely [5].

Ultrasound (US)-guided transversus abdominis plane block (TAPB) became a common analgesic modality after abdominal surgery. Because TAP block is limited to the somatic anesthesia of the abdominal wall and is highly dependent on interfascial distribution, several new techniques have been proposed to enhance analgesia, either in addition to TAP block or as a separate technique. The quadratus lumborum block (QLB) is another regional anesthetic technique that received attention for its potential benefits in the management of postoperative pain. In particular, various options for QLB blockade were proposed to provide somatic, specifically visceral analgesia after abdominal surgeries. Also, transmuscular QLB may result in wider and longer lasting sensory blockade covering T4–L1 levels compared to TAP block that is distributed over the T6–T12 levels during TAP block [6, 7, 8].

According to Blanco et al. QLB provides satisfactory analgesia during the upper and lower abdomen surgeries [7]. There are several variations of QLB that include posterior, lateral, transmuscular and intramuscular [8], but the complexity of implementation of these methods is a major limitation. On the other hand, the intramuscular approach is simple, but its mechanism of action is still unclear [9].

In some studies, preoperative ultrasound guided bilateral QLB blockade did not reduce opioid consumption after LTH [10], so the effectiveness of this method at the end of surgery for postoperative pain relief needs to be further investigated.

The purpose of this study was to compare and evaluate the analgesic efficacy of QLB and TAPB after laparoscopic total hysterectomy.

Materials and Methods

A prospective randomized clinical trial was conducted for two years from (March 2022 — March 2024), after approval of the scientific council and ethical committees. The study involved one hundred one female patients with physical status I and II according to ASA (American Society of Anesthesiology), who underwent laparoscopic robot-assisted total hysterectomy under multicomponent general anesthesia.

Written informed consent was obtained from all patients included in the study. Inclusion criteria: planned laparoscopic robot-assisted total hysterectomy, somatic status I and II on the ASA scale. Exclusion criteria included patient's refusal to participate in the study, body mass index that is equal or more than 35 kg/m^2, moderate to severe cardiopulmonary disease (ASA ≥ III), chronic low back pain, and regular use of analgesics; the presence of a contraindication to the use of NSAIDs, local anesthetics or opioids. Contraindications for QLB and TAPB included coagulopathy, severe thrombocytopenia, allergy to local anesthetic and puncture site infections.

Patients were randomized into three groups: the first group, i.e. the control group, CON group, where patients did not receive any blockades, the second group comprised the patients receiving TAPB for management of postoperative pain, TAPB group, and the third group where patients received QLB as a postsurgical pain management, QLB group. Patients were distributed into groups in a random order.

All patients underwent routine preoperative examination, including history taking, clinical examination, and laboratory tests. All patients were informed about pain management and anesthesia techniques. Before inclusion in the study, each patient signed an informed consent to participate in the study.

Patients of three groups underwent multicomponent general anesthesia. Induction of general anesthesia and tracheal intubation were performed using propofol (2–2.5 mg/kg), fentanyl (1–1.5 μg/kg) and rocuronium (0.6–1 mg/kg). Inhalation anesthesia was conducted with a

GE anesthesia-respiratory apparatus (Datex Omeda). Maintenance of anesthesia was carried by supply of inhalational sevoflurane (MAC 1.0), analgesia with intravenous fentanyl (50–100 mcg for every 20 minutes). The depth of anesthesia was adjusted to maintain a target entropy (GE) ranging between values of 40 and 60. Intraoperative monitoring was carried out in accordance with the Harvard standards (Standard of Basic Anesthetic Monitoring, 1986, Boston) including electrocardiogram (ECG), pulse oximetry (SpO2), non-invasive blood pressure measurement (NIBP), capnography, thermometry from the beginning of anesthesia to the end of surgery until awakening.

At the end of the surgery, patients' blockades were performed in accordance with randomization. Anesthesiologists, postoperative nurses, investigators, and medical experts assessing final results were blinded and randomized and did not have access to patients' data until data analysis was completed.

Technique for Performing the Blockade

Vital parameters including heart rate, electrocardiogram, blood pressure, and pulse oximetry were monitored throughout the procedure. All blocks were performed with a 22-gauge block needle using the same ultrasound machine (GE Vivid-iQ, USA).

When performing TQLB [6], patients were placed in the lateral decubitus position and the skin was disinfected with a 10 % povidone-iodine solution. A convection ultrasound probe (5–2 MHz) was placed in a transverse position just cephalad to the iliac crest, at the level of the posterior axillary line. A needle (22G) for regional anesthesia was inserted into the plane of the sensor in the posterolateral and anteromedial direction until it penetrated the medial part of the m. quadratus lumborum. After confirming the correct position of the needle tip by hydrodissection, 25 ml of 0.4 % ropivacaine solution was injected into the interfascial plane between the quadratus lumborum muscle and the psoas major muscle on the left. The same procedure with the same local anesthetic solution was administered to the right side after the patient was moved to the opposite lateral position.

In the control group, patients did not undergo through placement of the blockades; they were awakened, extubated, and transferred to the recovery room.

Postoperative Management and Assessment

After performance of the blockade, anesthesia was ceased, and the patient was extubated following extubation criteria. All patients were transferred to the recovery room for further observation (0 hours after surgery) for 2 hours. Recovery room nurse instructed patients how to rate the pain using a 10-point digital visual analogue scale (VAS) that ranges from "0" (meaning no pain) to "10" (meaning the worst pain). Pain intensity was assessed at 1, 2, 6, 12 hours and 24 hours postoperatively.

Postoperative analgesia was carried out using a three-step anesthesia scheme based on the recommendations of the World Health Organization [11], which is introduced into the daily practice of our clinic along with the above-mentioned digital visual analogue scale. Pain relief protocol according to this scheme was: the 1st stage represents VAS from 1 to 4 points (mild pain), and requires NSAIDs (intrafen 800 mg IV drip or ketoprofen 100 mg IM); the 2nd stage reflects VAS from 4 to 6 points (moderate to severe pain) and necessitates use of synthetic opioids (tramadol 100 mg IM) and/or NSAIDs (intrafen 800 mg IV or ketoprofen 100 mg IM); the 3rd stage is represented with VAS from 7 to 10 points, and infers the use of opioids (morphine 10 mg IM) along with NSAIDs.

Postoperative nausea and vomiting (PONV) were assessed using a categorical scoring system: none = 0; mild = 1 (nausea); moderate = 2 (gagging); severe = 3 (vomiting). PONV was treated with antiemetics.

Additional evaluation criteria comprised blood pressure, heart rate and patient's satisfaction state using a questionnaire. The survey was conducted in the morning of the next day after the surgery and included the following questions: satisfaction with the work of the anesthesiologist and nurse, satisfaction with the anesthesia performed according to the following rating: 0 — not satisfied, 1 — not fully, 2 — satisfied, 3 — difficult to answer, as well as the well-being of the patient after surgery according to the scale from 1 to 5 points: 1 — the worst, 2 — bad, 3 — satisfactory, 4 — good, 5 — the best patient's condition.

Statistical Analysis

All statistical analysis was performed using SPSS Statistics (version 26.0; IBM, USA). To assess normalization of the data, Kolmogorov – Smirnov test and visual inspection of histograms were performed. The significance of intergroup differences was assessed using Kruskal – Wallis test for nonparametric data with subsequent correction. Pairwise comparisons in the postoperative period were analyzed applying Mann – Whitney U test. Categorical variables were expressed as numbers (per-

centages), and between-group differences were assessed using the chi-square test.

Results

According to the results of the study, the distribution of patients into groups was adherent to the following pattern: CON group comprised 40 patients, while TAPB group — 30 patients and QLB group — 31 patients. As Table 1 demonstrates, statistical analysis did not reveal significant discrepancies among the groups regarding demographic characteristics of surgery duration and intraoperative analgesics consumption.

Postoperative pain scores are shown in Table 2. Postoperative pain scores at 1, 2, 6, 12, and 24 hours were statistically significantly higher in the control group than in the block groups. Both block groups demonstrated lower pain scores than the control group at all time points assessed.

The comparative pain dynamics is reflected in Diagram 2.

After pain level determination, subsequent need for pain relief is considered. Initial analgesics requirements among the groups and the number of patients requiring analgesics are shown in Table 3. The latest need for analgesics as well as the smaller number of patients requiring analgesics is observed in the QLB group.

Data from the analysis of mean arterial pressure and heart rate are shown in Diagram 3. Mean arterial pressure (MAP) values differed only in the first 2 hours after surgery between the CON and TAPB groups. Further, during the day, the level of systolic blood pressure and heart rate did not differ significantly in all groups.

Postoperative nausea and vomiting one hour postoperatively were more observed in the group without blockades (Table 4). Vomiting was significantly less in the QLB group compared to other groups in the first hour after surgery.

Table 1. Demographic data and surgery duration in the study groups

Variables	Measures	CON (N=40)	TAPB (N=30)	QLB (N=31)	P-value
Age (years)	Mean ± SD	52.46 ± 8.01	50.03 ± 8.21	50.81 ± 5.56	P > 0.05
BMI (kg/m²)	Mean ± SD	30.71 ± 0.9	29.75 ± 5.14	30.02 ± 7.21	P > 0.05
Height, cm	Mean ± SD	16.05 ± 7,54	162.58 ± 6.19	162.03 ± 5.53	P > 0.05
Weight, kg	Mean ± SD	80.44 ± 22.16	77.94 ± 13.95	77.94 ± 16.08	P > 0.05
ASA	Mean ± SD	1.81 ± 0.6	1.84 ± 0.3	1.6 ± 0.48	P > 0.05
Duration (min)	Mean ± SD	94.2 ± 31.8	105.65 ± 57.6	86.56 ± 39.13	P > 0.05
Fentanyl ug/kg (total)	Mean ± SD	5.8 ± 1.84	5.79 ± 1.27	5.46 ± 1.6	P > 0.05

Table 2. Average VAS value at the definite time interval

Time	Measures	CON (N = 40)	TAPB (N = 30)	QLB (N = 3 1)	P-value
Hour-1	Mean ± SD	4.46 ± 1.54	3.42 ± 1.07	1.65 ± 1.44	P < 0.05
Hour-2	Mean ± SD	1.88 ± 1.44	1.39 ± 1.8	0.84 ± 1.46	p > 0.05
Hour-6	Mean ± SD	2.9 ± 1.5^{QLB}	2.62 ± 1.2^{QLB}	1.72 ± 1.24^{TAPB}	P < 0.05
Hour-12	Mean ± SD	2.7 ± 1.3^{QLB}	2.3 ± 1.3^{QLB}	1.38 ± 1.47$^{CON, TAPB}$	P < 0.05
Hour-24	Mean ± SD	1.93 ± 1.07^{QLB}	1.62 ± 0.89^{QLB}	0.94 ± 1.11$^{CON, TAPB}$	P < 0.05

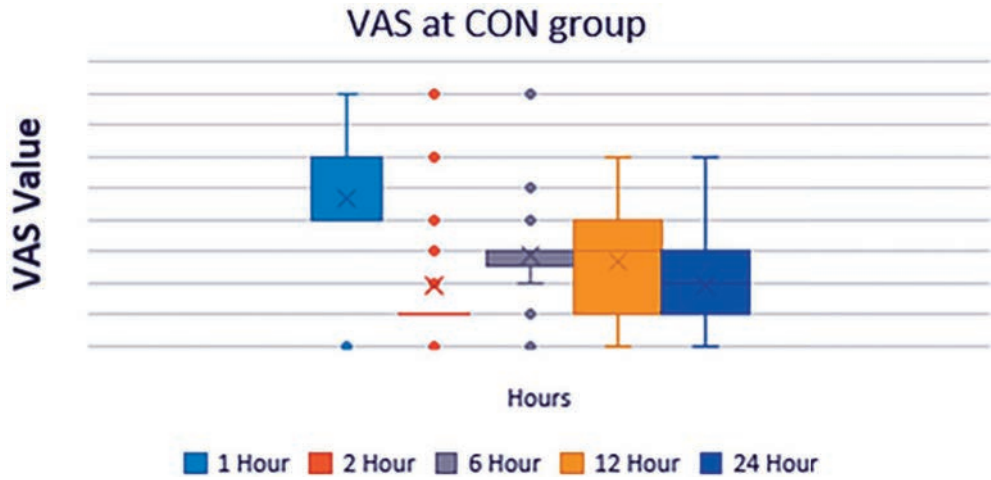

Diagram 1. A

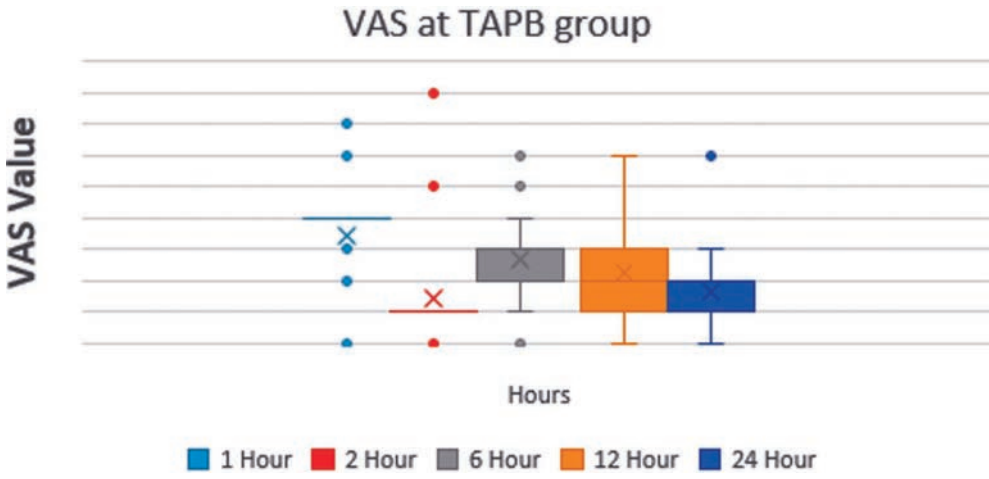

Diagram 1. B

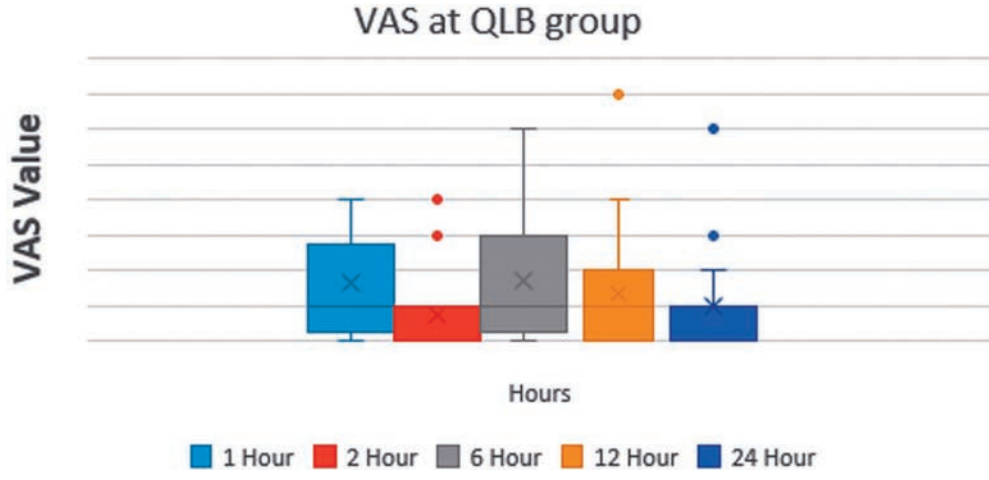

Diagram 1. C

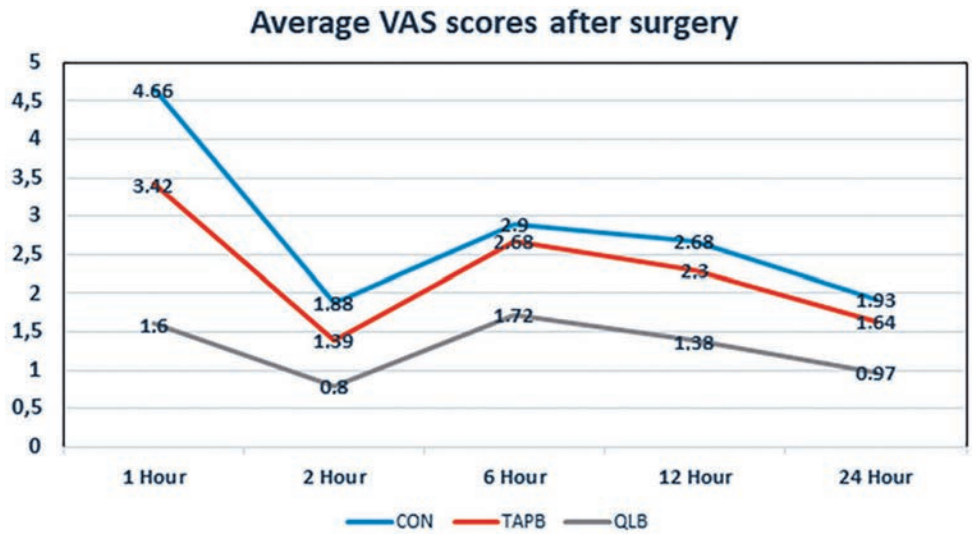

Diagram 2. Average pain score dynamics according to VAS in groups

Table 3. Time of the initial analgesics' requirement and the number of patients receiving analgesics

	CON (N = 40)	TAPB (N = 30)	QLB (N = 31)
Time of the initial analgesics' requirement in awakening room, hour	1.11 ± 0,32	1.14 ± 0.3	1.15 ± 0.3
Time of the initial analgesics' requirement in specialized department, hour	5.79 ± 2.8[1, 3]	7.1 ± 2.8	8.32 ± 3.1
Number of patients who received NSAIDs: ketoprofen or intrafen, abs. (%)	25 (62.5 %)	22 (73.3 %)	11 (35.5 %)
Number of patients who received tramadol, abs. (%)	8 (20 %)	2 (6.7 %)	0 (0 %)
Number of patients receiving morphine, abs. (%)	7 (17.5 %)	3 (10 %)	1 (3.2 %)
Note: 1.3 — $p < 0.05$			

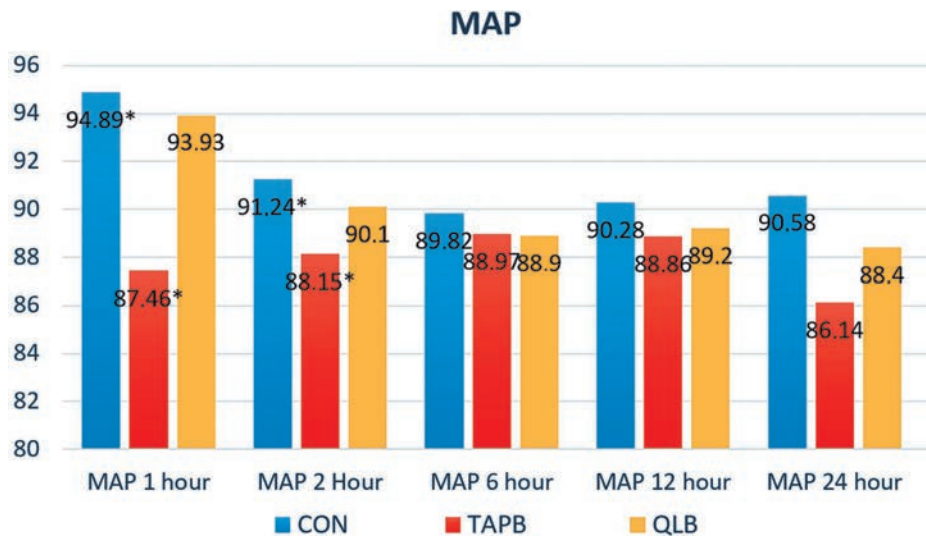

Diagram 3. * $p < 0.05$ between CON and TAPB

Table 4. PONV 1 hour after surgery

Complications	CON (N = 40)	TAPB (N = 30)	QLB (N = 31)
None	52.5 %	60 %	80.6 %
	21	18	25
Nausea	7.5 %	6.7 %	12.9 %
	3	2	4
Gagging	5 %	10 %	3.2 %
		2	
		3	
		1	
Vomiting	35 %	23.3 %	3.2 %
	14	7	1

P < 0,05 between CON and QLB, TAPB and QLB.
P > 0,05 between CON and TAP.

According to Table 5, PONV at the 2nd hour postoperatively was also less in the QLB group. There were no significant differences between the other groups.

Table 5. PONV 2 hours after surgery

Complications	CON (N = 40)	TAPB (N = 30)	QLB (N = 31)
None	72,5 %	86,7 %	93,5 %
	29	26	29
Nausea	27,5 %	6,7 %	6,5 %
	11	2	2
Gagging	0 %	10 %	0 %
	0	1	0
Vomiting	0 %	10 %	0 %
	0	1	0

P < 0,05 between CON and QLB.
p > 0,05 between TAP and QLB, CON and TAP.

Quantity of PONV events 6 hours after surgery (Table 6) was lower in the QLB and TAPB groups compared to the control group by 18.3 % (p < 0.05).

Table 6. PONV 6 hours after surgery

Complications	CON (N = 40)	TAPB (N = 30)	QLB (N = 31)
None	75 %	93.3 %	93.5 %
	30	28	29
Nausea	12.5 %	6.7 %	3.2 %
	5	2	1
Gagging	2.5 %	0 %	3.2 %
	1	0	1
Vomiting	10 %	0 %	0 %
	4	0	0

P < 0,05 between CON and TAP, CON and QLB.
P > 0,05 TAP and QLB.

Regarding the frequency of PONV 12 hours and 24 hours postoperatively, there were no significant differences between the groups and the incidence of PONV decreased over time.

No postoperative allergic reactions, psychogenic or local complications were registered in the study groups.

According to the results of a survey conducted the day after the surgery, there were no statistically significant differences in the degree of satisfaction with the work of the doctor and nurse, satisfaction with the anesthesia performed, and overall satisfaction with the care provided in the recovery room (Diagram 4). Despite the absence of differences, the number of patients satisfied with anesthesia and assistance provided in the recovery room in the groups with blockades (TAPB, QLB) was 2.1–5.3 % higher (p>0.05).

Upon detailed analysis of the questionnaire, 5 % of patients in the CON group, were not fully satisfied and 10 % of this group found it difficult to answer. Also, in the TAPB group, 6.7 % of patients were not fully satisfied and 10 % found it difficult to answer. Of the QLB group, only 3.2 % were not fully satisfied and 9.7 % found it difficult to answer.

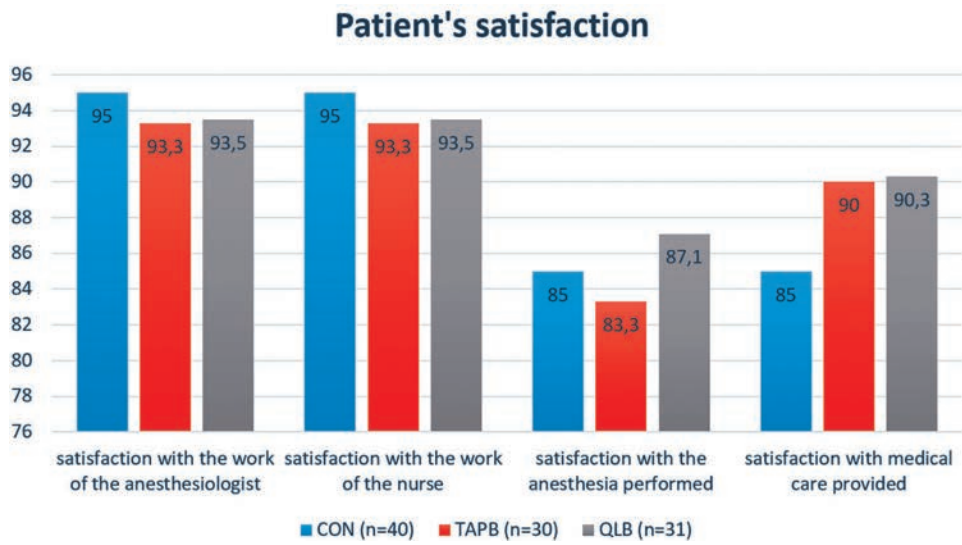

Diagram 4

The analysis of the patients' well-being on the first postoperative day is presented on the Diagram 5.

More patients from the QLB group ($p < 0.05$) noted very good health condition postoperatively. Majority patients ($p < 0.05$) from the CON and TAPB groups in turn noted satisfactory health condition. From the control group, 1 patient complained regarding very poor health condition due to postoperative pain and PONV.

Discussion

Postsurgical pain is the main indication for postoperative multimodal analgesia. In addition, the Early Recovery Assistance Program (ERAS) recommends inclusion of regional anesthesia in a multimodal general anesthesia strategy [12].

There are different methods of regional analgesia and anesthesia that can reduce surgical stress and postoperative pain [1, 2, 4, 12]. Reviewing current literature, studies related to regional techniques have yielded varying results [1, 4, 10, 12, 13] and have emerged as a promising treatment for postoperative pain after gynecologic laparoscopic surgeries, including total hysterectomy.

In our study, we applied TAPB and QLB regional analgesia methods. The data obtained on pain assessment in the first postoperative hours showed that QLB was

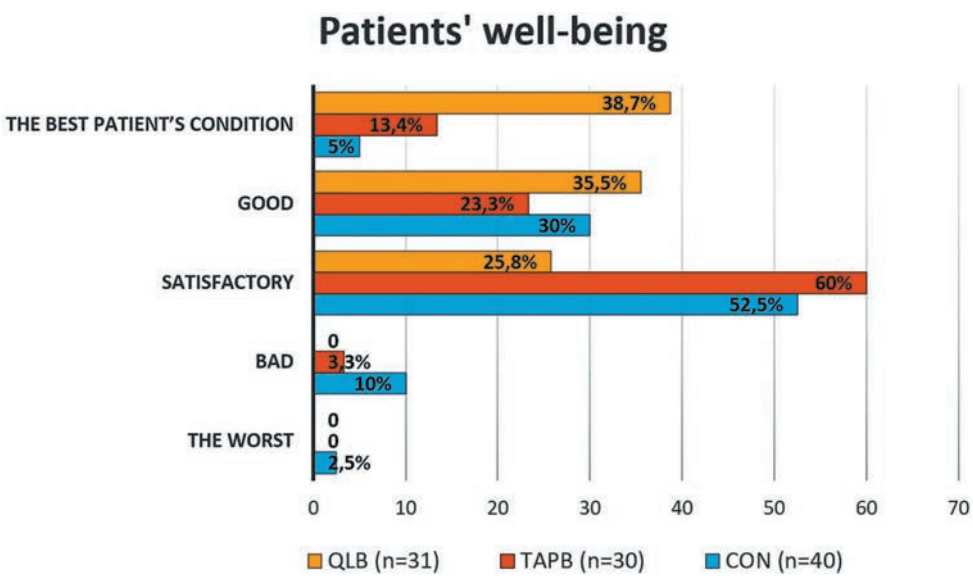

Diagram 5

more effective ($p < 0.05$) reducing pain in comparison with the control group and TAPB. Conversely, the study conducted by Lea Penuela et al. demonstrates TAPB as being more effective [13]. Nonetheless, the study by Jiang W et al supports our current data [14]. Other studies have reported the effectiveness of QLB in abdominal hysterectomy and cesarean section [15,16]. Jadon A. et al. also provide data on the effectiveness of QLB [17], but all measurements were conducted only with the assessment of VAS and the frequency of PONV, whereas we additionally assessed patient's satisfaction and the degree of patient's well-being after pain relief.

In our work, QLB was effective in terms of the duration of the analgesic effect over 24 hours and the time of initial need for opioid analgesics, which corresponds to the data of other authors [18]. The main advantage of the QLB block compared to the TAPB block is the spread of local anesthetic beyond the plane of the transversus abdominis muscle into the thoracic paravertebral space [16].

The incidence of PONV after surgery was significantly lower in the QLB group at 1, 2 and 6 hours after the surgery. TAPB blockade showed no less effective results in the prevention of PONV. Corresponding results for cesarean section were reported by Elkady M et al. [19, 20, 21]. In addition, Preethy Mathew et al. provide data on the effectiveness of TAPB block in abdominal and laparoscopic hysterectomy [22, 23]. On the contrary, Daniela Ghisi et al., provide data on the low effectiveness of TAPB during laparoscopic hysterectomy and inability of the method to reduce the need for opioids [24].

Additional evaluation of pain management methods from the patient's perspective, such as patient satisfaction and well-being after surgery, showed equally important findings. In general, all patients noted satisfaction with the pain relief methods performed. According to Fujimoto H. et al. QLB after laparoscopic gynecological surgery did not improve the quality of life and postoperative pain according to the results of the questionnaire (QoR-40) [25]. However, according to our data, more patients in the QLB group reported very good postoperative health condition. This could be due to such important factors as reduced postoperative pain and incidence of PONV. There are not many studies on the effectiveness of analgesia methods during laparoscopic total hysterectomy according to the above parameters.

The strengths of the current work are randomized, controlled, blinded study and the homogeneous nature of the study population, procedures, and study protocols, which are as close as possible to real-life anesthesia practice in our country. Limitations of our study relate to the lack of a double-blind study as we did not use placebo in the control group.

Conclusion

The use of interfascial blocks for postoperative pain relief such as TAPB and QLB after laparoscopic hysterectomies improves the quality of pain relief and the well-being of patients in the early postoperative period. The advantages of ultrasound guided QLB include better pain relief, reduced incidence of PONV, and greater patient's satisfaction. TAPB demonstrated equally good results, and this method is easier to perform.

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Порівняльний аналіз ефективності блокади квадратного м'яза попереку та площинної блокади поперечного м'яза живота для полегшення післяопераційного болю при лапароскопічній робот-асистованій тотальній гістеректомії

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Анотація. *Метою цього дослідження було порівняти та оцінити ефективність знеболення за допомогою блокади квадратного м'яза попереку (QLB) та площинної блокади поперечного м'яза живота (TAPB) після лапароскопічної робот-асистованої тотальної гістеректомії.*

Матеріали та методи. *Проведено проспективне дослідження жінок (n = 101), з фізичним статусом ASA I–II, які перенесли лапароскопічну робот-асистовану тотальну гістеректомію під багатокомпонентною загальною анестезією. Пацієнтки були розподілені у довільному порядку на три групи: перша група (CON, n = 40) — контрольна, де блокади не проводилися, друга група (TAPB, n = 30) — площинна блокада поперечного м'яза живота, третя група (QLB, n = 31) — блокада квадратного м'яза попереку. Після операції біль оцінювався за 10-бальною цифровою візуальною аналоговою шкалою, а також оцінювалися післяопераційна нудота та блювання (PONV). Реєстрували середній артеріальний тиск і частоту серцевих скорочень. Крім того, наступного ранку проводилося опитування для оцінки самопочуття та задоволеності пацієнток.*

Результати. *Між групами не було різниці у демографічних характеристиках, тривалості операції та споживанні анальгетиків під час внутрішньоопераційного періоду. Вираженість післяопераційного болю була вищою ($p < 0,05$) у контрольній групі, ніж у групах з блокадами. Обидві блокадні групи продемонстрували нижчі показники болю у всіх оцінюваних часових точках. Найпізніша потреба в анальгетиках виявлена у групі QLB. Середні значення артеріального тиску (MAP) відрізнялися лише протягом перших 2-х годин після операції між групами CON і TAPB ($p < 0,05$). PONV через годину після операції частіше спостерігалися у контрольній групі та менше у групі QLB ($p < 0,05$). За результатами опитування, проведеного на наступний день після операції, кількість пацієнток, задоволених анестезією та доглядом у післяопераційній палаті, в групах з блокадами (TAPB, QLB) була на 2,1–5.3 % вищою ($p > 0.05$). Більше пацієнток із групи QLB ($p < 0,05$) відзначили дуже хороше та гарне самопочуття, а більшість пацієнток із груп CON і TAPB ($p < 0.05$) відзначили задовільне самопочуття.*

Висновок. *Застосування міжфасціальних блокад для полегшення післяопераційного болю (TAPB, QLB) після лапароскопічної робот-асистованої гістеректомії покращує якість знеболення та самопочуття пацієнтів. Переваги QLB включають краще знеболення, зниження частоти PONV та більшу задоволеність пацієнтів. TAPB також показав хороші результати, і цей метод легше виконувати.*

Ключові слова: *післяопераційний біль, площинна блокада поперечного м'яза живота, блокада квадратного м'яза попереку, робот-асистована тотальна гістеректомія*