ORIGINAL ARTICLE

Comparison of laparoscopic-guided versus ultrasound-guided TAP block in laparoscopic cholecystectomy

Comparación del bloqueo TAP guiado por laparoscopia frente al ecoguiado en la colecistectomía laparoscópica

*Nilay T. Uzunay[1], Tarkan Mingir[2], Ergin Erginoz[3], Dursun O. Karakas[1], and Emin Kose[3]**

[1]Department of General Surgery, Prof. Dr. Cemil Tascioglu City Hospital; [2]Department of Anesthesiology and Intensive Care; Prof. Dr. Cemil Tascioglu City Hospital; [3]Department of General Surgery, Cerrahpasa Medical Faculty, Istanbul University-Cerrahpasa. Istanbul, Turkey

Abstract

Introduction: *Transversus abdominis plane (TAP) block is a widely used anesthetic technique of the abdominal wall, where ultrasound guidance is considered the gold standard. In this study, we aimed to compare the effectiveness of laparoscopic-assisted TAP (LTAP) block with ultrasound-assisted TAP (UTAP) block for post-operative pain, nausea, vomiting, duration of the block, and bowel function.* **Materials and methods:** *This study included 60 patients who were randomly assigned to two groups to undergo either the LTAP or UTAP block technique after laparoscopic cholecystectomy. The time taken for administering the block, post-operative nausea and vomiting, post-operative pain, respiratory rate, bowel movements, and analgesia requirements were reported.* **Results***: The time taken for the LTAP block was shorter ($p < 0.001$). Post-operative mean tramadol consumption, paracetamol consumption, and analgesic requirement were comparable between the two groups ($p = 0.76$, $p = 0.513$, and $p = 0.26$, respectively). The visual analog scale at 6, 24, and 48 h was statistically not significant ($p = 0.632$, $p = 0.802$, and $p = 0.173$, respectively). Nausea with vomiting and the necessity of an antiemetic medication was lower in the UTAP group ($p = 0.004$ and $p = 0.009$, respectively).* **Conclusion:** *The LTAP block is an easy and fast technique to perform in patients as an alternative method where ultrasound guidance or an anesthesiologist is not available.*

Keywords: *Laparoscopic cholecystectomy. Transversus abdominis plane block. Perioperative analgesia. Visual Analog Scale. Pain.*

Resumen

Antecedentes: *El bloqueo del plano transverso del abdomen (TAP) es una técnica anestésica de la pared abdominal ampliamente utilizada, en la cual la guía ecográfica se considera el método de referencia.* **Objetivo:** *Comparar la efectividad del bloqueo TAP asistido por laparoscopia (LTAP) con el bloqueo TAP asistido por ultrasonido (UTAP) para el dolor posoperatorio, las náuseas y los vómitos, y la función intestinal.* **Método:** *El estudio incluyó 60 pacientes que fueron asignados aleatoriamente a dos grupos para someterse a la técnica de bloqueo LTAP o UTAP después de una colecistectomía laparoscópica. Se informaron el tiempo de administración del bloqueo, las náuseas y los vómitos posoperatorios, el dolor posoperatorio, la frecuencia respiratoria, las evacuaciones y los requerimientos de analgesia.* **Resultados:** *El tiempo de bloqueo LTAP fue menor ($p < 0.001$). El consumo medio de tramadol, el consumo de paracetamol y el requerimiento de analgésicos posoperatorios fueron comparables entre los dos grupos ($p = 0.76$, $p = 0.513$ y $p = 0.26$, respectivamente). El dolor en la escala analógica visual a las 6, 24 y 48 horas no fue estadísticamente significativo ($p = 0.632$, $p = 0.802$ y $p = 0.173$, respectivamente).*

***Correspondence:**
Emin Kose
E-mail: dreminkose@yahoo.com

Date of reception: 02-08-2023
Date of accceptance: 23-10-2023
DOI: 10.24875/CIRU.23000394

Cir Cir. 2024;92(2):174-180
Contents available at PubMed
www.cirugiaycirujanos.com

Conclusiones: *El bloqueo PATL es una técnica fácil y rápida de realizar en pacientes como método alternativo cuando no se dispone de guía ecográfica o anestesióloga.*

Palabras clave**:** *Colecistectomía laparoscópica. Bloqueo del plano transverso abdominal. Analgesia perioperatoria. Escala visual analógica. Dolor.*

Introduction

Post-operative pain following cholecystectomy is an important morbidity and a common reason for prolonged hospitalization. Nearly, 55% of patients experience moderate-to-severe pain and complications may arise in up to one-third of patients within the post-operative 30-day period. A statistically significant association has been shown between post-operative pain and the occurrence of post-operative complications. Post-operative pain impairs mobilization and coughing, thus increasing the risk of respiratory complications such as atelectasis and pulmonary infections. Both post-operative pain and the adverse effects of analgesics may delay oral intake and impair bowel function after surgery[1]. Several intravenous treatments and regional anesthetic techniques have been studied for establishing high-quality post-operative analgesia. Studies showing the effect of post-operative analgesia techniques such as opioids and regional analgesia on morbidity and mortality are also present in the literature[2].

Laparoscopic cholecystectomy offers major benefits to patients such as early mobilization, shorter duration of hospital stay, smaller incisions, fewer wound infection rates, and less post-operative pain. Although laparoscopic cholecystectomy is considered the gold standard procedure, post-operative pain is still associated with moderate-to-severe complications, especially within the first 24 h of surgery[3,4].

Several methods have been studied to decrease post-operative pain following laparoscopic cholecystectomy. These include pre-operative, intraoperative, and post-operative use of analgesics such as NSAIDs, paracetamol, dexamethasone, opioids, the use of a local anesthetic into the wound, establishing a low-pressure pneumoperitoneum, local lavage with saline and suction, and miniport laparoscopic technique[5].

Transversus abdominis plane (TAP) block provides a sensorial block between the internal oblique muscle and transverse abdominis muscle by innervating spinal nerves. The local anesthetic infiltration in the TAP block affects 7-12th thoracic intercostal nerves, the ilioinguinal nerve, the iliohypogastric nerve, and 1-3rd lumbar nerves in the lateral cutaneous branches[6]. TAP block is usually performed under ultrasound guidance while laparoscopic guidance has become an area of interest[7]. Several studies on the use of ultrasound-guided TAP block on pain management are available[8,9]. The aim of this study was is to compare laparoscopic-assisted TAP (LTAP) block with ultrasound-assisted TAP (UTAP) block in patients undergoing elective laparoscopic cholecystectomy.

Materials and methods

Ethics approval was obtained from the Health Sciences University Prof. Dr. Cemil Tascioglu Hospital Ethics Committee (September 24, 2019/1427). This study was performed on patients undergoing elective laparoscopic cholecystectomy between October 2019 and March 2020. Patients older than 18 years of age and those with ASA 1 and 2 participated in the study. Patients with a history of a local anesthetic allergy, history of opioid or alcohol addiction, diagnosis of pre-operative and perioperative acute cholecystitis, a contraindication for laparoscopic surgery, and those with ASA III-IV score were excluded from the study.

This prospective study was performed on 60 patients. The patients were randomly divided into two groups using closed envelopes, where 50% (n = 30) of the patients received LTAP block and the other 50% (n = 30) received UTAP block. At the end of the study, randomization was planned to check that there was no difference between the groups in terms of age, gender, body mass index, ASA score, and comorbidities.

The LTAP block was performed by a single surgeon. A pilot study was done to understand the efficacy of analgesia in ten patients before the study. The UTAP block was performed by a single anesthesiologist with 11 years of experience.

Standardized general anesthesia was applied to all patients. Propofol 2 mg/kg and rocuronium 0.5 mg/kg were utilized for induction. The endotracheal intubation was performed and anesthesia was maintained with 50-50% O_2-air mixture and sevoflurane.

The UTAP block was performed after intubation. The probe was placed below the 12th costal margin and rectus abdominis muscles, and the posterior

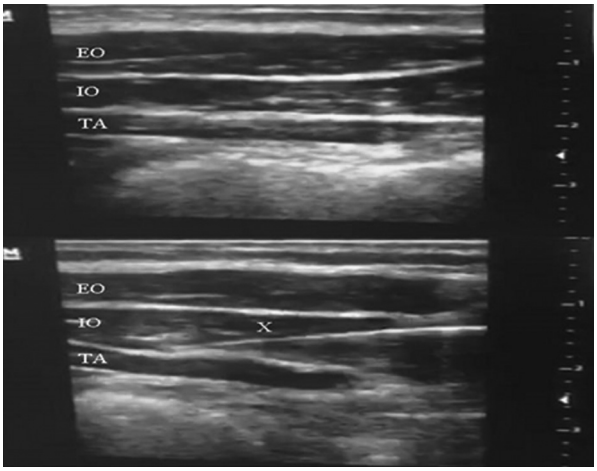

Figure 1. *Administration of bupivacaine into the transversus abdominis plane.*

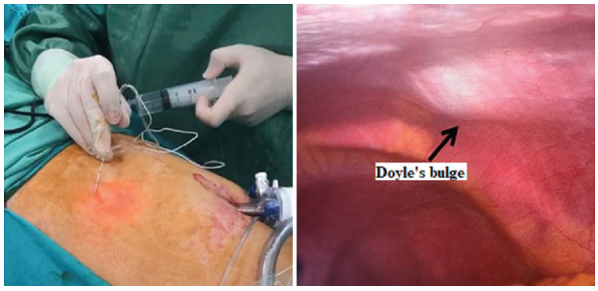

Figure 2. *Visualization of the Doyle's bulge after local anesthetic infiltration.*

Table 1. Comparison of patient characteristics

Parameters	LTAP (n = 30)	UTAP (n = 30)	p-value
Age*	43.7 ± 15.54	48.97 ± 13.68	0.16
Sex			1
Male	6	6	
Female	24	24	
BMI*	28.33 ± 5.11	27.33 ± 3.46	0.377
ASA class			0.44
I	15	18	
II	15	12	
Comorbidities			0.3
DM	6	4	
HT	7	4	
DM and HT	2	3	
Operation Time (min)*	46.83 ± 10.70	45.03 ± 8.38	0.419

*Mean ± standard deviation. LTAP: laparoscopic TAP block; UTAP: ultrasound TAP block; BMI: body mass index; DM: diabetes mellitus; HT: hypertension; min: minute.

rectus sheath and transversus abdominis muscles were identified. Block needle of 100 mm, 22G (Stimuplex Pajunk, Germany) was targeted in the TAP (Fig. 1). Bupivacaine 20 mL of 0.25% was administered bilaterally.

After induction of general anesthesia, the first 10-mm trocar was inserted and an abdominal pressure of 12 mmHg was established. Puncture with a 100 mm 22G block needle (Stimuplex Pajunk, Germany) was performed at the intersection point of the midclavicular line and the 12th costa bilaterally. Under the view of laparoscopy, 20 mL of 0.25% bupivacaine was administered and Doyle's bulge, which is a local anesthetic infiltration where the peritoneum is pushed internally, was seen by visualizing laparoscopic camera (Fig. 2)[10,11]. After both methods, standard cholecystectomy was performed. No perioperative complications were observed in the patients.

All patients received tramadol of 1 mg/kg before extubation and were taken to the recovery room. Nausea and vomiting were evaluated in the recovery room. Post-operative pain scores at 6th, 24th, and 48th h were documented using the VAS score. The patients received 1 g of paracetamol when the VAS score was >4. Post-operative respiratory rates at 6th, 24th, and 48th h, time of passage of first flatus and stool, nausea, vomiting, the necessity of antiemetic medication use, and analgesic consumption were collected and recorded.

Statistical analysis was performed using the SPSS program. Age, gender, body mass index, ASA, comorbidities, and operation times were evaluated and compared within the groups. The Student's t-test was used to compare, the time taken for the block, the time of passage of first flatus and stool, post-operative pain scores, post-operative respiratory rates, and perioperative and post-operative analgesic consumption. A Chi-square test was used to compare post-operative nausea and vomiting and antiemetic use, amount of analgesic consumption in the post-operative period, and nausea and vomiting in the recovery room. $p < 0.05$ was considered to be statistically significant.

Results

The demographic data of the patients are shown in table 1. The mean time taken for performing the LTAP group was 3.57 ± 0.47 min and that in the UTAP group was 8.09 ± 1.55 min. The difference between the groups was statistically significant ($p < 0.001$) (Table 2 and Fig. 3). The VAS score at 6 h was found to be 5.13 ± 1.279 in the LTAP group and 4.97 ± 1.402 in the UTAP group. The VAS score at 24 h was found to be 2.97 ± 1.732

Table 2. Comparison of time taken for block, post-operative analgesic requirements (tramadol), post-operative analgesic requirements (paracetamol), and time of passage of first stools

Parameters	LTAP	UTAP	p-value
Time taken for block (min)*	3.57 ± 0.47	8.09 ± 1.55	< 0.001
Post-operative analgesic requirements (Tramadol) (mg)*	73.33 ± 12.954	72.33 ± 12.229	0.76
Post-operative analgesic requirements (Paracetamol) (gr)*	1.03 ± 0.765	0.90 ± 0.803	0.513
Time of passage of first stools (hour)*	12.03 ± 2.834	11.20 ± 2.074	0.199

*Mean ± standard deviation.
min: minute; mg: milligram; gr: gram; LTAP: laparoscopic TAP block; UTAP: ultrasound TAP block.

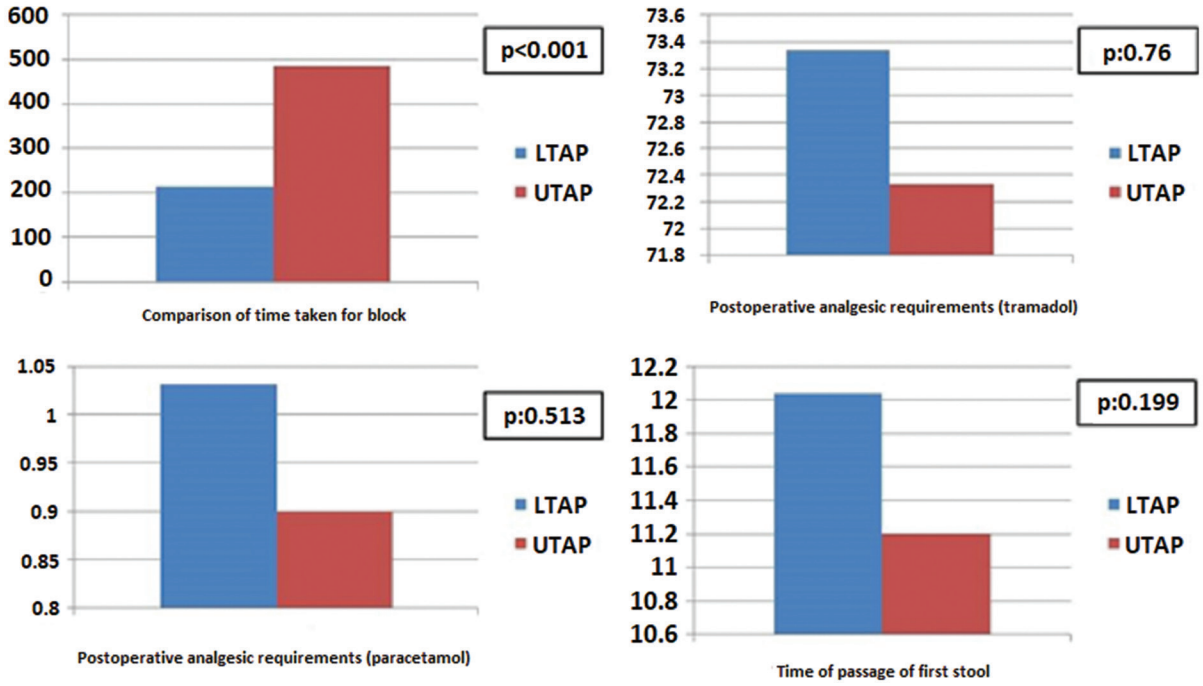

Figure 3. *Comparison of time taken for block, post-operative analgesic requirements (tramadol), post-operative analgesic requirements (paracetamol), and time of passage of first stools.*

in the LTAP group and 2.87 ± 1.306 in the UTAP group. The VAS score at 48 h was found to be 0.90 ± 1.470 in the LTAP group and 0.50 ± 0.572 in the UTAP group. The differences were statistically not significant when compared between the two groups (Table 3 and Fig. 4).

The mean post-operative paracetamol consumption in the LTAP group was 1.03 ± 0.765 gr which was comparable with a mean value of 0.90 ± 0.803 gr in the UTAP group. No statistically significant difference was found between the two groups (p = 0.513) (Table 2 and Fig. 3). In the study, 18 patients did not require post-operative analgesia management. Groups were evaluated according to the patients' VAS scores at 6, 24, and 48th h. Paracetamol of 1 g as rescue analgesia was given to patients having VAS score > 4. In the study, 37 patients who had a VAS score > 4 at 6 h received 1 g of paracetamol, seven patients who had a VAS score > 4 at 24 h received 1 g of paracetamol, and two patients who had a VAS score >4 at 48 h received 1 g of paracetamol. In each group, one patient received an additional 1 g of paracetamol.

The post-operative mean respiratory rate at 6 h in the LTAP group was 23.07 ± 3.290 and in the UTAP group, it was 23.40 ± 3.883 with no significant difference (p = 0.721). The post-operative mean respiratory rate at 24 h in the LTAP group was 21.60 ± 3.510 and in the UTAP group, it was 20.70 ± 3.436 with no significant difference (p = 0.320). The post-operative mean respiratory rate at 48 h in the LTAP group was 19.77 ± 3.170 and in the UTAP group, it was

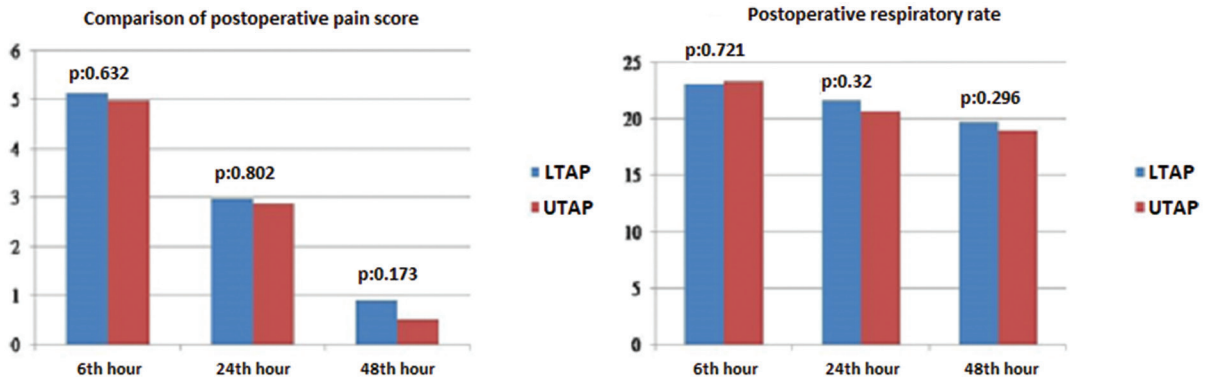

Figure 4. *Comparison of post-operative pain scores and post-operative respiratory rate.*

Table 3. Comparison of post-operative pain scores and post-operative respiratory rate

Parameters	Post-operative pain scores*			Post-operative respiratory rate*		
	LTAP	UTAP	p-value	LTAP	UTAP	p-value
6th h	5.13 ± 1.279	4.97 ± 1.402	0.632	23.07 ± 3.290	23.40 ± 3.883	0.721
24th h	2.97 ± 1.732	2.87 ± 1.306	0.802	21.60 ± 3.510	20.70 ± 3.436	0.32
48th h	0.90 ± 1.470	0.50 ± 0.572	0.173	19.77 ± 3.170	19.00 ± 2.407	0.296

*Mean ± Standard deviation.
LTAP: laparoscopic TAP block; UTAP: ultrasound TAP block.

Table 4. Comparison of nausea and vomiting in the recovery room

Parameters	Yes (%)	No (%)	p-value
0th min			
LTAP	7 (23.3)	23 (76.7)	0.754
UTAP	6 (20)	24 (80)	
10th min			
LTAP	5 (8.3)	25 (41.7)	1
UTAP	5 (8.3)	25 (41.7)	
20th min	3 (5)	27 (45)	
LTAP	1 (1.7)	29 (48.3)	0.306
UTAP			
30th min			
LTAP	2 (3.3)	28 (46.7)	0.5
UTAP	3 (5)	27 (45)	

min: minute; LTAP: laparoscopic TAP block (n: 30); UTAP: ultrasound TAP block (n: 30).

Table 5. Comparison of post-operative nausea vomiting, nausea requiring an antiemetic medication, and post-operative analgesic requirements

Parameters	LTAP (n = 30) (%)	UTAP (n = 30) (%)	p-value
Post-operative nausea vomiting			0.004
Yes	19 (63.3)	8 (26.7)	
No	11 (36.7)	22 (73.3)	
Nausea requiring antiemetic			
Yes	18 (60)	8 (26.7)	0.009
No	12 (40)	22 (73.3)	
Post-operative analgesic requirements			
Yes	23 (76.7)	19 (63.3)	0.26
No	7 (23.3)	11 (36.7)	

LTAP: laparoscopic TAP block; UTAP: ultrasound TAP block.

19.00 ± 2.407 with no significant difference (p = 0.296) (Table 3 and Fig. 4). However, post-operative nausea and vomiting at patient wards and the necessity of using an antiemetic medication between the two groups were found to be statistically significant. Nausea, vomiting, and the necessity of using an antiemetic medication were found less in the UTAP group when compared with the LTAP group (p = 0.004 and p = 0.009, respectively). There was no statistical significance between the two groups for nausea and vomiting in the recovery room (Table 4). Post-operative analgesia requirements between the two groups were not found to be statistically significant (p = 0.260) (Table 5).

Discussion

Ravichandran et al. have reported that the mean time taken for the LTAP block was 5.38 min, while the mean time taken for the UTAP block was 13.6 min and the difference between the two groups was found to be statistically significant[9]. In our study, the time taken for the blocks was the most significant difference between the two techniques. The mean LTAP block time was 3.57 ± 0.47 min and the mean UTAP block time was 8.09 ± 1.55 min. The difference between the groups was statistically significant ($p < 0.001$). This leads to the conclusion that the LTAP technique leads to a shorter duration of medication administration, which is advantageous for the patient.

The most significant advantage of TAP block is reducing the consumption of opioids and thereby its associated adverse effects. In several studies evaluating the efficacy of LTAP and UTAP blocks after laparoscopic cholecystectomy, morphine was used as an opioid analgesic, and TAP block provided better pain scores and a reduced intake of morphine. Some studies in the literature compared LTAP with UTAP blocks and reported that the total consumption of morphine was less in the UTAP block group[8,9]. Bhatia et al. reported that the 24-h analgesic requirement was 125 mg opioid in the control group, 89 mg opioid in ultrasound-guided posterior TAP block, and 27 mg opioid in ultrasound-guided subcostal TAP block and a standard post-operative analgesic regime consisting of intravenous paracetamol of 1 g every 6 h was used in all patients[12]. In our study, the mean tramadol and paracetamol consumption and the number of patients who received analgesics in the LTAP group were higher than the UTAP group; however, the post-operative analgesia requirements reduced similarly in both two groups.

Post-operative pain and opioids can also induce bowel dysfunction and constipation. Ravichandran et al. reported that the mean time taken for patients to notice the passage of the first flatus postoperatively was 30.2 h in the LTAP group and 32.17 h in the UTAP group. They observed that the mean time taken for passage of first stools was 42.8 h in the UTAP group and 51.3 h in the LTAP group. The difference between the two groups was found to be statistically significant[9]. In our study, the time of passage of first stools was less in the UTAP group when compared with the LTAP group.

Post-operative pain and opioid use have been related to post-operative nausea, vomiting, and requiring the use of antiemetic medication. Ravichandran et al. have reported that in the LTAP group, 53.3% did not have nausea, 10% of the patients had nausea, 16.7% had experienced vomiting, and 20% had the necessity of antiemetic medication usage. In the UTAP group, 50% of the patients did not have nausea, 30% of patients had nausea, 16.7% of the patients had nausea requiring an antiemetic medication, and 3.3% of the patients experienced vomiting[9]. In our study, we found that in the LTAP group, 63.3% of the patients had nausea, and 60% of the patients had nausea requiring an antiemetic medication. On the contrary, in the UTAP group, 26.7% of patients had nausea, and 26.7% of patients had nausea requiring an antiemetic medication. No statistical significance between the two groups for nausea and vomiting was observed in the recovery room. Although LTAP block reduced nausea and vomiting in the early post-operative period, it did not reduce vomiting and the requirement of an antiemetic medication in the following hours.

Another side effect of post-operative pain is that increases the risk of pulmonary complications by reducing coughing and deep inspiration. Some studies have reported that patients in the UTAP group had a higher peak expiratory flow rate when compared with the LTAP group[9,13]. In our study, the efficacy of TAP block on respiratory system evaluated with respiratory rate showed comparable results between the two groups.

According to a meta-analysis by Peng et al. which compared UTAP block and a control group in laparoscopic cholecystectomy, significantly lower pain scores at all times were reported in patients receiving TAP blocks compared with those receiving conventional treatment, except for the data at post-operative 6th h[14]. Elamin et al. observed that the VAS score at 3rd and 6th h was significantly different in the LTAP group; however, VAS scores at 12th and 24th h were not statistically significant between the LTAP and the control group[15]. Tihan et al. reported that patients in the LTAP group had lower VAS scores at 24 h when compared with the control group and this difference was statistically significant[16]. Ravichandran et al. reported that patients in the UTAP group had lower VAS scores at 6th and 24th h when compared with the LTAP group. However, this difference was not statistically significant[9]. Venkatraman et al. evaluated that patients in the UTAP group had a lower VAS score at 8 h than the LTAP group, a higher VAS score at 8-18 h, and a lower VAS score at 18 h[8]. Studies that compared UTAP block or LTAP block with control groups have shown that TAP block decreased pain scores. In our study, we compared LTAP block with UTAP block and

we have noticed that patients in the UTAP group had lower pain scores, although this finding was not statistically significant.

This study has some limitations. First, there are a relatively small number of patients. Second, the investigator who evaluated the results of the study knew which technique was used for TAP block in patients. Another limitation is that there was not a control group in the study.

Conclusion

Pain management after laparoscopic cholecystectomy has been an important criterion for early mobilization, recovery, discharge, and return to daily activities. Similar to the current literature, no significant difference was observed between TAP block groups in most of the parameters evaluated in our study. The UTAP block has some disadvantages such as a longer duration of time, the necessity of an experienced physician, and requires additional equipment. In addition, it is difficult to perform UTAP block in patients with high body mass index. In light of these, an alternative method, the LTAP block, is equally efficacious, faster, and easy to perform in patients than UTAP block and does not require additional equipment and an experienced anesthesiologist.

Funding

The authors declare that no funding was received.

Conflicts of interest

The authors have no conflicts of interest to declare.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained approval from the Ethics Committee for analysis and publication of routinely acquired clinical data and informed consent was not required for this retrospective observational study.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript nor for the creation of images, graphics, tables, or their corresponding captions.

References

1. van Boekel RL, Warlé MC, Nielen RG, Vissers KC, van der Sande R, Bronkhorst EM, et al. Relationship between postoperative pain and overall 30-day complications in a broad surgical population: an observational study. Ann Surg. 2019;269:856-65.
2. Liu SS, Wu CL. Effect of postoperative analgesia on major postoperative complications: a systematic update of the evidence. Anesth Analg. 2007;104:689-702.
3. Takrouri MS. Anesthesia for laparoscopic general surgery. A special review. Middle East J Anesthesiol. 1999;15:39-62.
4. Gerbershagen HJ, Aduckathil S, van Wijck AJ, Peelen LM, Kalkman CJ, Meissner W. Pain intensity on the first day after surgery: a prospective cohort study comparing 179 surgical procedures. Anesthesiology. 2013;118:934-44.
5. Barazanchi AW, MacFater WS, Rahiri JL, Tutone S, Hill AG, Joshi GP, et al. Evidence-based management of pain after laparoscopic cholecystectomy: a PROSPECT review update. Br J Anaesth. 2018;121:787-803.
6. Şahin AS, Ay N, Şahbaz NA, Akay MK, Demiraran Y, Derbent A. Analgesic effects of ultrasound-guided transverse abdominis plane block using different volumes and concentrations of local analgesics after laparoscopic cholecystectomy. J Int Med Res. 2017;45:211-9.
7. Magee C, Clarke C, Lewis A. Laparoscopic TAP block for laparoscopic cholecystectomy: description of a novel technique. Surgeon. 2011;9:352-53.
8. Venkatraman R, Saravanan R, Dhas M, Pushparani A. Comparison of laparoscopy-guided with ultrasound-guided subcostal transversus abdominis plane block in laparoscopic cholecystectomy - a prospective, randomised study. Indian J Anaesth. 2020;64:1012-7.
9. Ravichandran NT, Sistla SC, Kundra P, Ali SM, Dhanapal B, Galidevara I. Laparoscopic-assisted tranversus abdominis plane (TAP) block versus ultrasonography-guided transversus abdominis plane block in postlaparoscopic cholecystectomy pain relief: randomized controlled trial. Surg Laparosc Endosc Percutan Tech. 2017;27:228-32.
10. Chetwood A, Agrawal S, Hrouda D, Doyle P. Laparoscopic assisted transversus abdominis plane block: a novel insertion technique during laparoscopic nephrectomy. Anaesthesia. 2011;66:317-8.
11. Hassan AM, Nashed GA, Ibrahim AK, Balamoun HA. Efficacy of laparoscopic-guided TAP block in postoperative pain management of laparoscopic bariatric patients. Egypt J Surg. 2022;41:279-86.
12. Bhatia N, Arora S, Jyotsna W, Kaur G. Comparison of posterior and subcostal approaches to ultrasound-guided transverse abdominis plane block for postoperative analgesia in laparoscopic cholecystectomy. J Clin Anesth. 2014;26:294-9.
13. Basaran B, Basaran A, Kozanhan B, Kasdogan E, Eryilmaz MA, Ozmen S. Analgesia and respiratory function after laparoscopic cholecystectomy in patients receiving ultrasound-guided bilateral oblique subcostal transversus abdominis plane block: a randomized double-blind study. Med Sci Monit. 2015;21:1304-12.
14. Peng K, Ji FH, Liu HY, Wu SR. Ultrasound-guided transversus abdominis plane block for analgesia in laparoscopic cholecystectomy: a systematic review and meta-analysis. Med Princ Pract. 2016;25:237-46.
15. Elamin G, Waters PS, Hamid H, O'Keefe HM, Waldron RM, Duggan M, et al. Efficacy of a laparoscopically delivered transversus abdominis plane block technique during elective laparoscopic cholecystectomy: a prospective, double-blind randomized trial. J Am Coll Surg. 2015;221:335-44.
16. Tihan D, Totoz T, Tokocin M, Ercan G, Calikoglu TK, Vartanoglu T, et al. Efficacy of laparoscopic transversus abdominis plane block for elective laparoscopic cholecystectomy in elderly patients. Bosn J Basic Med Sci. 2016;14:139-44.