Agri 2023;35(4):254–264
doi: 10.14744/agri.2022.01709

ORIGINAL ARTICLE

Comparison of the effectiveness of transversus abdominis plane block with laparoscopy or ultrasonography in laparoscopic cholecystectomy operations

Laparoskopik kolesistektomi ameliyatlarında transversus abdominis plan bloğunun laparoskopi veya ultasonografi ile uygulanmasının etkinliğinin karşılaştırılması

İlter SOYTÜRK, Zahide DOĞANAY, Hale KEFELİ ÇELİK

Summary

Objectives: This study aims to compare the effectiveness of the Transversus Abdominis Plane (TAP) block applied to reduce postoperative pain in laparoscopic cholecystectomy surgery by ultrasonography (USG) and laparoscopy.

Methods: A total of 170 patients who underwent laparoscopic cholecystectomy were divided into three groups. Group L received TAP block by laparoscopy, Group U received TAP block by USG, and the control group (Group C) did not receive TAP block. Bilateral subcostal 15 mL 0.5% bupivacaine was used for the TAP block. We recorded patients' demographic data and hemodynamic parameters, surgery time, anesthesia time, time of first postoperative analgesic need, visual analog scale (VAS) scores, time to first flatulence and stool, degree of nausea-vomiting, and the Turkish Revised American Pain Society Patient Outcome Questionnaire (APS-POQ-R-T) scores.

Results: We observed no statistically significant differences between the groups in terms of age, gender, or American Society of Anesthesiologists scores, and body mass index was higher in Group U compared to the other groups ($p<0.05$). The VAS score was significantly higher in the control group at all times compared to the other two groups ($p<0.001$). VAS measurements were higher in Group U at postoperative 1st and 12th h compared to Group L ($p<0.001$). Surgery time and anesthesia time were significantly different between the groups ($p=0.001$). Group C showed high VAS scores, high pain severity by APS-POQ-R-T at the 24th postoperative hour, and low sleep quality and patient satisfaction.

Conclusion: For laparoscopic cholecystectomy surgery, applying TAP block with the help of USG is effective in postoperative pain management. Applying TAP block with laparoscopy is easy since it does not require additional preparation or equipment during the procedure and may be preferred in the absence of a USG device.

Keywords: Cholecystectomy; laparoscopy; subcostal; TAP block; ultrasonography.

Özet

Amaç: Bu çalışmada, laparoskopik kolesistektomi ameliyatlarında ameliyat sonrası ağrıyı azaltmak için uygulanan transversus abdominis plan bloğunun, ultrasonografi ve laparoskopi ile uygulanmasının etkinliğinin karşılaştırılması amaçlandı.

Gereç ve Yöntem: Laparoskopik kolesistektomi operasyonu yapılan 170 hasta üç gruba ayrıldı. Hastalara transversus abdominis plan bloğu Grup L'de laparoskopiyle, Grup U'da ultrasonografiyle uygulanırken kontrol grubunda (Grup K) transversus abdominis plan bloğu uygulanmadı. Transversus abdominis plan bloğu için bilateral subkostal 15 mL %0,5 bupivakain kullanıldı. Hastaların demografik verileri ve hemodinamik parametreleri, ameliyat ve anestezi süresi, postoperatif ilk analjezik ihtiyacının zamanı, görsel analog skala skorları, ilk gaz ve gaitayı çıkarma süresi, bulantı ve kusma derecesi ile Türkçe gözden geçirilmiş Amerikan Ağrı Derneği Hasta Sonuçları Anketi (APS-POQ-R-T) skorları kaydedildi.

Bulgular: Gruplar arasında yaş, cinsiyet ve ASA skorları açısından istatistiksel olarak anlamlı bir fark gözlenmedi, beden kitle indeksi Grup U'da diğer gruplara göre daha yüksek saptandı ($p<0,05$). Kontrol grubunda diğer iki gruba göre tüm zamanlarda görsel analog skala skoru anlamlı yüksek bulundu ($p<0,001$). Grup U'da postoperatif birinci ve 12. saatlerde görsel analog skala ölçümleri Grup L'ye göre daha yüksek tespit edildi ($p<0,001$). Gruplar arasında ameliyat süresi ve anestezi süresi farklı idi ($p=0,001$). Görsel analog skala ölçümlerinin yüksek seyrettiği Grup K'da, APS-POQ-R-T ile operasyon sonrası 24. saatte ölçülen ağrının şiddeti yüksek, uyku kalitesi ve hasta memnuniyeti düşük bulundu.

Sonuç: Laparoskopik kolesistektomi operasyonlarında; ultrasonografi ve laparoskopi yardımıyla transversus abdominis plan bloğu uygulanması postoperatif ağrı tedavisinde etkindir. Laparoskopi ile transversus abdominis plan bloğu uygulaması cerrahi işlem sırasında ek bir hazırlık ve ekipman gerektirmemesi nedeniyle kolay uygulanabilir ve ultrasonografi cihazının bulunmadığı durumlarda tercih edilebilir.

Anahtar sözcükler: Kolesistektomi; laparoskopi; subkostal; transversus abdominis plan bloğu; ultrasonografi.

Department of Anesthesiology and Reanimation, Samsun University, Samsun Training and Research Hospital, Samsun, Türkiye

Submitted ***(Başvuru)*** **14.02.2021** **Revised** ***(Revizyon)*** **23.01.2022** **Accepted** ***(Kabul)*** **03.10.2022** **Available online** ***(Online yayımlanma)*** **13.10.2023**

Correspondence: Dr. Hale Kefeli Çelik. Samsun Üniversitesi, Samsun Eğitim ve Araştırma Hastanesi, Anesteziyoloji ve Reanimasyon Kliniği, Samsun, Türkiye.
Phone: +90 - 362 - 311 15 00 **e-mail:** ck_hale@hotmail.com

Introduction

A transversus abdominis plane (TAP) block is a peripheral nerve block applied to reduce postoperative pain after various surgeries. This method can be applied with different methods and in different localizations, and it has taken its place in routine anesthesia management today. A TAP block can be applied quickly, either at the beginning or end of the surgery. Also, it is unlikely to cause complications. The TAP block is applied by blocking the anterior branches of the lower thoracic (T7–12) and first lumbar (L1) nerves for postoperative analgesia, similar to ilioinguinal and iliohypogastric blocks.[1] The subcostal approach of the TAP block is very useful for supraumbilical procedures. The key to the success of this technique is the correct definition of the facial plane between the transversus abdominis and rectus abdominis muscles.[2]

The main indications of cholecystectomy, one of the most common surgeries in general surgery practice, are symptomatic gallbladder stones, gallstone complications, and gallbladder polyps. The gold standard intervention for cholecystectomy is laparoscopy, and laparoscopic cholecystectomy surgeries are performed as a daily procedure in some centers. Postoperative pain management is of importance in this case.[3,4] After a laparoscopic cholecystectomy procedure, pain often develops due to the anterior abdominal wall incision. Recently, interest in TAP block has increased for reducing postoperative pain, opioid consumption, and related side effects after laparoscopic and open abdominal surgeries. Applying TAP block with USG shortens the procedure time, reduces the number of interventions, and prevents complications like gastrointestinal organ injury.[4–6] Applying TAP block with laparoscopy is an effective and safe method for postoperative analgesia without the need for additional radiological equipment.[2,5,7]

This study aims to compare the applicability of the TAP block with laparoscopy and USG. We also aim to determine postoperative pain assessment by the Revised American Pain Society Patient Outcome Questionnaire (APS-POQ-R-T) and to compare its compliance with visual analog scale (VAS) results.

Material and Methods

We obtained approval for the conduct of this research from the Medical Speciality Education Board of HSU (dated April 30, 2019, no. 33646832-771) and the Ethics Committee of Clinical Research of the University of Ondokuz Mayıs (2019/251). We included patients who would undergo elective laparoscopic cholecystectomy operations. According to the power analysis, the study needed 55 patients for each group, considering the mean VAS values. Therefore, we included a total of 170 patients. The inclusion criteria were being older than 18 years of age, being American Society of Anesthesiologists (ASA) 1–2, and having informed consent. Exclusion criteria had emergency surgery, infection in the surgery site, a coagulation disorder, a local anesthetic or opioid drug allergy, an alcohol or substance addiction, being a chronic opioid user, having a body weight below 60 kg, and not giving consent for an open procedure during the course of laparoscopic surgery.

This was designed as prospective, randomized, double-blind research. Patient groups were randomly determined by the sealed envelope method. The sample was divided into three groups according to whether the TAP block was performed with laparoscopy (Group L) or ultrasonography (USG) (Group U), including a control group without the TAP block (Group C). The patients who underwent TAP block were not told which method was used, and they were informed that postoperative pain management would be performed with intravenous pain pump and painkillers. Besides, the assistant researcher who performed the postoperative follow-ups was blinded to the groups.

We recorded patients' preoperative demographic data and performed electrocardiography, peripheral oxygen saturation (SpO_2), non-invasive blood pressure measurement, and end-tidal carbon dioxide monitoring as standard. General anesthesia was provided with propofol 2 mg/kg, rocuronium 0.6 mg/kg, fentanyl 1.5 mcg/kg, 2% sevoflurane, and a 50% oxygen-air mixture. Isotonic 0.9% NaCl was used as the perioperative maintenance fluid.

For Groups U and L, TAP block was applied with a subcostal technique to provide supraumbilical anesthesia. In Group U, TAP block was applied with USG

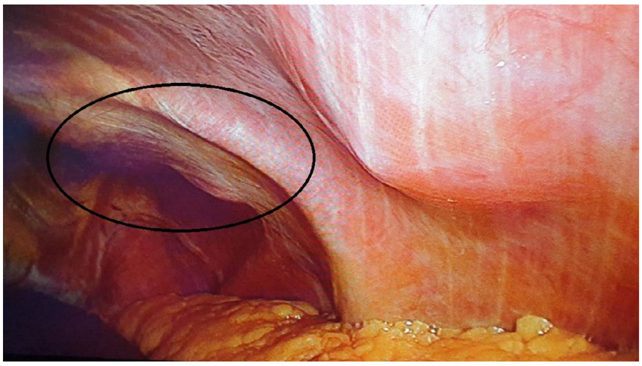

Figure 1. TAP block image from the laparoscopic vision.

(Esaote My Lab 30 Gold®, Davis, USA) before pneumoperitoneum was created, using a 100-mm, 22-gauge peripheral nerve block needle (Vygon echoplex®, Vygon, France). The linear ultrasound probe was placed by the same senior anesthesiologist on the anterior abdominal wall parallel to the lower and margin of the rib, after disinfection, and in the supine position. The rectus abdominis muscle was defined medially, and then the probe was moved laterally to define the external oblique, internal oblique, and transversus abdominis muscles. The needle was placed in the posterolateral position using the in-plane approach and advanced anteromedially to the end of the fascial plane between the rectus abdominis and transversus abdominis muscles. For patients with imaging difficulties, we used the out-of-plane approach or a convex probe. 1–2 mL of local anesthetic was administered to confirm the location of the needle. We injected bilateral 15 mL 5% bupivacaine and observed the accumulation of the local anesthetic in the TAP, located below the rectus abdominis muscle or the internal oblique muscle and above the transversus abdominis muscle.

In Group L, after general anesthesia, the surgeon who performed the surgery created pneumoperitoneum under direct laparoscopic vision and positioned the TAP block in the lateral abdominal wall region, where local anesthetic infiltration would be performed using a laparoscopic camera. Localization was confirmed after observing swelling caused by a bilateral 15-ml 5% bupivacaine injection (Fig. 1).

The anesthesia time was defined as the time from the induction to the extubation. The surgery time was defined as the time from the first incision of the surgeon to the last suture. USG-assisted block was not included in surgery time, but laparoscopic-assisted block was included. For postoperative analgesia, all patients received 0.8 mg/kg tramadol IV push and 6 mg/kg/day IV tramadol infusion with a pain pump for 2 days.

Pulse and mean blood pressure were recorded preoperatively, after anesthesia, after the block, every 10 min during the operation, and after the patient was awakened. We recorded the surgery time, anesthesia time, time to first postoperative analgesic need, time to first flatulence and stool, and degree of nausea-vomiting (0: none, 1: nausea, 2: need antiemetics, 3: vomiting). A researcher blinded to the groups recorded VAS scores at rest at the 1st, 6th, 12th, and 24th h during the follow-up and the time until the first need for painkillers.[8] We asked our patients the questions in the Turkish Revised American Pain Society Patient Outcome Questionnaire (APS-POQ-R-T) at the postoperative 24th h.[9,10] The questionnaire consists of 13 questions, inquiring about the severity and frequency of pain, the effect of pain on mood (comfort), whether the pain is an obstacle to activity (function), side effects, informing the patient about pain, the use of additional methods other than painkillers, whether the doctor or nurse encouraged these methods, and whether the patient received help while filling out the questionnaire. Of the 170 patients included in the study, 5 patients, 3 in Group C and 2 in Group L, refused to participate in the questionnaire. Therefore, the questionnaire was applied to the remaining 165 patients. The questionnaires were filled in either by the patient or the researcher at the patient's decision, and this parameter was recorded as well.

Statistical Analysis

The data were analyzed using the IBM SPSS V23 software. Conformity to the normal distribution was examined by the Kolmogorov–Smirnov test. The Chi-squared test was used to compare categorical variables between the groups. To compare quantitative variables between the two groups, we used the independent sample t-test for data with a normal distribution and the Mann–Whitney U test for data with a non-normal distribution. For comparisons between all groups, we used the one-way analysis of variance for data with a normal distribution and the Kruskal–Wallis test for data with a non-normal distribution. To examine the changes in the param-

Table 1. Demographic data and comparison of groups in terms of duration of surgery and anesthesia

	Grup C (n=56)	Grup L (n=59)	Grup U (n=55)	Total (n=170)	Test statistics	p
Gender, (n%)					χ^2=2.783	0.249
Male	14 (25%)	23 (39%)	16 (29.1%)	53 (31.2%)		
Female	42 (75%)	36 (61%)	39 (70.9%)	117 (68.8%)		
ASA, (n%)					χ^2=1.142	0.565
1	16 (28.6%)	14 (23.7%)	18 (32.7%)	48 (28.2%)		
2	40 (71.4%)	45 (76.3%)	37 (67.3%)	122 (71.8%)		
Age (years)	50 (22–71)	50 (20–77)	55 (24–79)	51 (20–79)	F=1.107	0.333
BMI	28.1 (21.3–44)	27.8 (21.4–47.6)	30.3 (22–41.2)	28.5 (21.3–47.6)	F=3.184	**0.044**
Operation time (min)	38 (27–63)	41 (32–65)	36 (24–58)	40 (24–66)	F=7.584	**0.001**
Anesthesia time (min)	52 (38–78)	56 (42–75)	60 (44–75)	55 (38–78)	F=9.091	<**0.001**

χ^2: Chi-square test statistics; F: Analysis of variance test statistics; ASA: American Society of Anesthesiologists, BMI: Body mass index.

eters over time, we used repeated measure analysis for data with a normal distribution and the Friedman test for data with a non-normal distribution. The results of the analysis are presented as mean±standard deviation and median (minimum-maximum) for quantitative data and frequency (percentage) for categorical data. The significance level was determined as p<0.05.

RESULTS

Of the 170 patients included in our study, 56 were in the control group, 59 were in the laparoscopic TAP block group, and 55 were in the USG TAP block group. 68.8% (n=117) of the patients were female, 31.2% (n=53) were male, and 28.2% were in ASA 1 and 71.8% were in ASA 2 status. There were no significant differences between the groups in terms of sex, age, or ASA score, but there were statistically significant differences in terms of body mass index (p=0.044), surgery time (p=0.001), and anesthesia time (p<0.001) (Table 1).

Group L showed statistically significant differences for pulse values between preoperative, post-anesthesia, 1st min after block, 10th min after block, 20th min after block, 30th min after block, and post-waking measurements (p<0.001). Again, Group U demonstrated statistically significant differences for pulse values between preoperative, post-anesthesia, 1st min after block, 10th min after block, 20th min after block, 30th min after block, and post-waking measurements (p<0.001).

Group L showed statistically significant differences in mean blood pressure between preoperative, post-anesthesia, 1st min after block, 10th min after block, 20th min after block, 30th minute after block, and post-waking measurements (p<0.001). Similarly, Group U had statistically significant differences in mean blood pressure between preoperative, post-anesthesia, 1st min after block, 10th min after block, 20th min after block, 30th min after block, and post-waking measurements (p<0.001). However, there was no significant difference between the groups in terms of mean blood pressure or pulse values (p<0.05). The mean SpO_2 values differed statistically significantly at the 1st minute after the block (p=0.026), but not at other times (Table 2).

The control group demonstrated statistically significant differences for median VAS scores between 1st h, 6th h, 12th h, and 24th h measurements (p<0.001). These differences were also observed in terms of median VAS scores measured at 1st h, 6th h, 12th h, and 24th h for Groups L and U, and VAS values at 1st h were found to be higher in all groups (p<0.001). There was a statistically significant difference between the groups in terms of VAS scores at the 1st, 6th, 12th, and 24th h (p<0.001). VAS scores were higher in the control group at all times compared to the other two groups and higher in Group U than Group L at all times (Table 3).

There was no difference between the groups in terms of time to first flatulence and stool, although there were statistically significant differences

Table 2. Demographic data and comparison of groups in terms of duration of surgery and anesthesia

	Grup C Median (Min–Max)	Grup L Median (Min–Max)	Grup U Median (Min–Max)	Total Median (Min–Max)	p
HR (beat/min)					
Preoperative	82 (52–116)	83 (62–106)	80 (54–117)	81 (52–117)	0.218
Postanetshesia	74 (48–117)	75 (60–122)	75 (50–112)	75 (48–122)	0.162
After block 1st min	74 (50–109)	72 (52–108)	74 (54–99)	73 (52 - 999)	0.611
After block 10th min	68 (55–118)	68 (52–95)	69 (55–86)	68 (52–118)	0.903
After block 20th min	64 (51–126)	66 (52–87)	66 (52–83)	66 (51–126)	0.847
After block 30th min	64 (52–103)	65 (37–86)	64 (53–84)	64 (37–103)	0.990
Post-wake	79.5 (63–159)	83 (67–111)	82 (66–112)	82 (63–159)	0.097
p	<**0.001**	<**0.001**	<**0.001**		
MBP (mmHg)					
Preoperative	100.5 (78–135)	109 (71–154)	105 (65–139)	104.5 (65–154)	0.087
Postanetshesia	83 (60–149)	90 (66–149)	89 (62–144)	88 (60–149)	0.532
After block 1st min	82 (52–128)	80 (51–126)	85 (59–133)	83 (51–179)	0.181
After block 10th min	79.5 (57–120)	78 (53–125)	85 (60–121)	82 (53–125)	0.138
After block 20th min	78 (47–107)	82 (44–122)	86 (47–117)	80 (44–122)	0.099
After block 30th min	77 (49–125)	85 (54–116)	80 (57–123)	81 (49–125)	0.207
Post-wake	111.5 (75–163)	109 (86–144)	106 (60–146)	110 (60–163)	0.708
p	<**0.001**	<**0.001**	<**0.001**		
SpO_2 (%)					
Preoperative	99 (94 -100)	99 (94–100)	98 (96–100)	98 (94 -100)	0.061
Postanetshesia	99.5 (94–100)	99 (96–100)	99 (95–100)	99 (94–100)	0.127
After block 1st min	100 (96–100)	100 (96–100)	99 (96–100)	100 (96–99)	**0.026**
After block 10th min	100 (95–100)	100 (95–100)	99 (97–100)	100 (95–100)	0.736
After block 20th min	100 (96–100)	100 (96–100)	100 (97–100)	100 (96–100)	0.598
After block 30th min	100 (96–100)	100 (96–100)	99 (97–100)	100 (96–100)	0.523
Post-wake	99 (94–100)	99 (96–100)	99 (94–100)	99 (94–100)	0.098
p	>**0.5**	>**0.05**	>**0.05**		

Min: Minimum; Max: Maximum; HR: Heart rate; MBP: Mean blood pressure; SpO_2: Oxygen saturation.

Table 3. Comparison of Visuel Analog Scale within and between groups

	Grup C Median (Min–Max)	Grup L Median (Min–Max)	Grup U Median (Min–Max)	Test statistics*	p
Postoperative 1st h	7 (4–10)aA	6 (2–9)bB	7 (3–10)aB	χ^2=23.752	<**0.001**
Postoperative 6th h	5 (2–9)aB	3 (0–6)bA	4 (0–8)bA	χ^2=38.435	<**0.001**
Postoperative 12th h	4 (0–7)aC	2 (0–5)bA	3 (0–6)cA	χ^2=34.337	<**0.001**
Postoperative 24th h	2 (0–4)aD	0 (0–3)bC	1 (0–4)bB	χ^2=26.575	<**0.001**
Test statistics**	χ^2=159.393	χ^2=163.328	χ^2=151.610		
p	<**0.001**	<**0.001**	<**0.001**		

Min: Minimum; Max: Maximum; *χ^2: Kruskal Wallis test statistic; **χ^2: Friedman test statistic; a–c: There is no difference between groups with the same letter; A–D: There is no difference between times within groups with the same letter.

Table 4. Comparison of quantitative variables by groups

	Grup C Median (Min–Max)	Grup L Median (Min–Max)	Grup U Median (Min–Max)	Total Median (Min–Max)	Test statistics	p
Postoperative noise-vomiting score	1 (0–3)[a]	1 (0–3)[b]	1 (0–3)[a]	1 (0–3)	χ^2=8.1335	**0.017**
Time to first analgesic need (hour)	2 (1–8)[a]	3.5 (1–8)[b]	2 (1–8)[a]	2 (1–8)	χ^2=19.488	**0.001**
Time to first flatulence (hour)	8 (1–20)	8 (2–20)	7 (1–20)	8 (1–20)	χ^2=3.200	0.202
Time to first stool (hour)	12 (3–24)	10 (4–20)	12 (1–24)	12 (1–24)	χ^2=2.176	0.337
Patient satisfaction (1–10 point)	6 (1–10)[a]	9 (2–10)[b]	10 (1–10)[b]	8 (1–10)	χ^2=29.445	<**0.001**

Min: Minimum; Max: Maximum; χ^2: Kruskal Wallis test statistic; a–b: There is no difference between times within groups with the same letter.

in terms of postoperative nausea-vomiting (p=0.017), time to first analgesic need (p=0.001), and patient satisfaction (p<0.001) (Table 4).

Considering the distribution of answers to the APS-POQ-R-T by surgical patients, there were statistically significant differences in terms of the mean scores for question 1 (p<0.001), question 2 (p=0.001), question 3 (p=0.01), question 4c (p=0.012), question 4d (p=0.001), question 5b (p=0.004), question 8 (p=0.046), and question 9 (p<0.001). The mean scores for the other questions did not differ between the groups (4a, 4b, 5a, 5c, 5d, 6a, 6b, 6c, 6d, and 7) (Table 5)

According to the first three questions, the severity and frequency of pain were higher in the control group compared to the other groups. We found that the control group had significant problems compared to the other two groups in questions 4c and 4d, related to activity-obstructing pain and sleep quality. Regarding the questions about the effect of pain on mood and emotions, sadness in question 5b was higher in the control group. Questions 6, 7, and 8 about patients' participation in pain management decisions were similar across all groups. Considering Section 9, satisfaction was low in the control group. For questions 10, 11, and 12, which inquired about postoperative pain, 81.8% of our patients were informed about pain management, and 63% did not use any method other than drugs for pain relief. 31.5% of the patients were occasionally encouraged to use non-drug methods by their physicians. Also, 58.8% of the patients received help to fill the questionnaire (Table 6).

We found that 36.1% of our patients mostly used distraction for non-drug pain relief. 37.5% of the patients in Group C used distraction, 65% of the patients in Group L walked, and 35.3% of the patients in Group U used deep breathing and distraction for pain relief (Table 7).

DISCUSSION

For postoperative analgesia after laparoscopic cholecystectomy, TAP blocks are often applied with USG. Laparoscopic-assisted TAP block has been proposed as an alternative to USG-guided block since it takes less time and does not require additional equipment.[1,11–13] Laparoscopic-assisted TAP block was first applied and defined in laparoscopic nephrectomies in 2011. Chetwood et al.[7] applied this block by positioning the laparoscopic camera to the lateral abdominal region after creating pneumoperitoneum under direct laparoscopic vision in the method they called "semi-blind." Our study gives the opportunity to compare the results of successful applications of a TAP block using laparoscopy or USG in recent years.

Pain is the most important factor affecting discharge in patients undergoing laparoscopic cholecystectomy. Many methods have been followed to reduce pain, including reducing the trocar size, using low insulation pressure, using nitrous oxide instead of carbon dioxide, actively discharging the gas by manual compression or suction, or using humid gas instead of dry gas. Epidural analgesia and multimodal analgesia, which involve using incisional and intraperitoneal local anesthetics and prophylactic nonsteroidal anti-inflammatory drugs or intravenous lidocaine, are the common methods for pain relief in patients undergoing this surgery.[13]

Table 5. Comparison of the questions in the APS-POQ-R-TR for patients by groups

	Grup C	Grup L	Grup U	Total	Test statistics	p
Question 1						
Mean±SD	3.4±1.9[a]	2.1±2.1[b]	2.1±1.8[b]	2.5±2	F=8.984	**<0.001**
Median (Min–Max)	4 (0–8)	1 (0–8)	1 (0–7)	2 (0–8)		
Question 2						
Mean±SD	7.8±1.9[a]	6.4±1.9[b]	6.6±2.4[b]	6.9±2.1	F=7.839	**0.001**
Median (Min–Max)	8 (4–10)	6 (2–10)	7 (0–10)	7 (0–10)		
Question 3						
Mean±SD	54.5±22.1	53.1±22	42.5±23	50.1±22.8	F=4.720	**0.010**
Median (Min–Max)	50 (0–100)	60 (0–90)	40 (0–90)	50 (0–100)		
Question 4a						
Mean±SD	4.6±2.9	4.5±2.6	4.7±3	4.6±2.8	F=0.069	0.933
Median (Min–Max)	4 (0–10)	4 (0–10)	4 (0–10)	4 (0–10)		
Question 4b						
Mean±SD	4.6±2.7	4.8±2.6	4.9±3.1	4.8±2.8	F=0.122	0.886
Median (Min–Max)	5 (0–10)	4 (1–10)	5 (0–10)	4 (0–10)		
Question 4c						
Mean±SD	4.2±2.6[a]	3.5±2.2[ab]	2.8±2.7[b]	3.5±2.5	F=4.528	**0.012**
Median (Min–Max)	4 (0–10)	4 (0–10)	2 (0–10)	3 (0–10)		
Question 4d						
Mean±SD	4.4±2.8[a]	3.5±2.3[ab]	2.5±2.7[b]	3.4±2.7	F=7.362	**0.001**
Median (Min–Max)	4 (0–10)	4 (0–10)	2 (0–10)	3 (0–10)		
Question 5a						
Mean±SD	3.8±2.5	3.3±2.4	3.1±3.1	3.4±2.7	F=0.894	0.411
Median (Min–Max)	4 (0–9)	3 (0–10)	2 (0–10)	3 (0–10)		
Question 5b						
Mean±SD	3.8±2.6[a]	2.7±2.1[ab]	2.2±2.4[b]	2.9±2.4	F=5.732	**0.004**
Median (Min–Max)	4 (0–9)	3 (0–8)	2 (0–9)	3 (0–9)		
Question 5c						
Mean±SD	4±2.8	2.9±2.4	2.9±3.1	3.2±2.8	F=2.942	0.056
Median (Min–Max)	4 (0–9)	3 (0–10)	2 (0–10)	3 (0–10)		
Question 5d						
Mean±SD	3.7±2.6	2.7±2.4	2.8±3	3±2.7	F=2.345	0.099
Median (Min–Max)	4 (0–9)	2 (0–8)	2 (0–10)	3 (0–10)		
Question 6a						
Mean±SD	3.1±2.2	2.5±2.8	3.4±3	3±2.7	F=1.648	0.196
Median (Min–Max)	3 (0–8)	2 (0–10)	3 (0–10)	3 (0–10)		
Question 6b						
Mean±SD	1.8±1.8	1.4±1.9	1.4±2.4	1.6±2.1	F=0.815	0.445
Median (Min–Max)	2 (0–6)	0 (0–8)	0 (0–10)	1 (0–10)		
Question 6c						
Mean±SD	1.6±1.9	1.3±1.9	0.8±1.3	1.2±1.8	F=2.792	0.064
Median (Min–Max)	0 (0–6)	0 (0–8)	0 (0–5)	0 (0–8)		
Question 6d						
Mean±SD	2.4±2.3	1.5±1.9	1.8±2.4	1.9±2.2	F=2.235	0.110
Median (Min–Max)	2 (0–10)	1 (0–8)	1 (0–8)	1 (0–10)		
Question 7						
Mean±SD	47.9±28.5	55.6±25.9	58.7±27.3	54.1±27.4	F=2.355	0.098
Median (Min–Max)	40 (0–100)	50 (0–100)	60 (0–100)	50 (0–100)		
Question 8						
Mean±SD	4.1±2.8[a]	4.7±2.9[ab]	5.5±3.2[b]	4.8±3	F=3.137	0.056
Median (Min–Max)	3 (0–10)	4 (0–10)	5 (0–10)	4 (0–10)		
Question 9						
Mean±SD	5.9±2.9[a]	8.2±2.1[b]	8.4±2.1[b]	7.5±2.6	F=17.737	**<0.001**
Median (Min–Max)	6 (1–10)	9 (2–10)	10 (1–10)	8 (1–10)		

SD: Standard deviation; Min: Minimum; Max: Maximum; F: Analysis of variance test statistics; a–b: There is no difference between times within groups with the same letter.

Table 6. Descriptive statistics for categorical variables in questions 10, 11 and 12

	n=165	%
Has any information been given about options for treating your pain?		
No	30	18.2
Yes	135	81.8
Have you used any method other than medication to relieve your pain?		
No	104	63.0
Yes	61	37.0
How often did the doctor or nurse encourage you to use non-drug treatment methods?		
Never	41	24.8
Rarely	52	31.5
Sometimes	37	22.4
Often	34	20.6
Did you get help filling out this questionnaire?		
No	97	58.8
Yes	68	41.2

Table 7. Descriptive statistics for multiple answers for Question 11

	Grup C		Grup L		Grup U		Total	
	n	%	n	%	n	%	n	%
Deep breathing	5	20.8	1	5	6	35.3	12	19.7
Linger with other things	9	37.5	7	35	6	35.3	22	36.1
Dreaming of	2	8.3	1	5	2	11.8	5	8.2
Listen to music	3	12.5	2	10	0	0	5	8.2
Praying	5	20.8	1	5	4	23.5	10	16.4
Doing relaxation movements	5	20.8	1	5	1	5.9	7	11.5
Walking	4	16.7	13	65	2	11.8	19	31.1

In laparotomy, patients experience parietal pain originating mainly from the abdominal wall. Pain after laparoscopic cholecystectomy consists of various components, like parietal, visceral, and shoulder (somatic), experienced at different severity and times. Moreover, the patient's functional status may be affected undesirably, and their overall quality of life may be impaired due to inadequate management of acute postoperative pain or if this pain becomes chronic.[14]

Local anesthetics are part of the multimodal approach to provide intraoperative and postoperative pain management. However, traditional amide-structured and ester-structured local anesthetics normally have a duration of action limited to only a few hours. Bupivacaine binds more strongly to sodium channels than other local anesthetics and is very slowly separated from sodium channels. Thus, sodium channels cannot fully return to their original state, and the message is blocked.[15,16] We preferred bupivacaine in our study because its duration of action was long, lasting 6–12 h in peripheral blocks. We applied the TAP block immediately after anesthesia induction due to the slow rate of effect onset. The recommended concentration for bupivacaine in peripheral blocks ranges from 0.25% to 0.5%. We used bupivacaine at a concentration of 0.5%.

The subcostal approach to the TAP block was first defined by Hebbard.[6] This technique provides blockage of T8 nerve segments and upper abdominal analgesia.[17,18] One research with 80 patients in elective cholecystectomy operations compared the application of a 4-point laparoscopic-assisted TAP block, bilateral subcostal and petit triangle, and the periportal infiltration method. The group where laparoscopic-assisted TAP block was applied showed lower pain scores at the 1st, 3rd, and 6th h, but similar pain scores at the 12th and 24th h.[19] Ravichandran et al.[13] found no statistically significant difference between the laparoscopic-assisted TAP block group and the USG-guided TAP block group in terms of VAS scores at the postoperative 6th, 24th, or 48th h. In the present study, we applied the TAP block with the subcostal approach and used the VAS ruler for postoperative pain evaluation. Accordingly, VAS scores at the 6th, 12th, and 24th h were higher in the control group compared to the USG and laparoscopy groups, indicating the success of TAP block in pain management. VAS scores measured at the 6th, 12th, and 24th h were less than 4 in Groups U and L, indicating that both methods were effective in postoperative analgesia.

Park et al.[20] reported no significant difference between laparoscopy and USG in terms of surgery time or anesthesia time. However, Ravichandran et al.[13] found shorter times for laparoscopic-assisted TAP blocks compared to USG-assisted TAP blocks and concluded that the time problem for the USG method could only be prevented when the block was applied in a pre-anesthetic operating room. We recorded surgery time and anesthesia time to determine how much the block affected exposure. Accordingly, we found shorter surgery times for Group U since the TAP block process was excluded from the measurement. The longer surgery time in Group L resulted from including the TAP block process in the measurement. The control group had shorter anesthesia times due to the absence of any block. This parameter did not differ significantly between Groups U and L. This shows that applying the TAP block with USG does not cause patients to be exposed to more anesthetic agents compared to the laparoscopic-assisted approach when performed by experienced clinicians, even though the former requires more equipment and additional sterilization.

Ravichandran et al.[13] reported no difference between the USG group and the laparoscopy group in terms of the time to the first analgesic need. In our study, the first analgesic need occurred earlier in the control group compared to the other two groups. We found no statistically significant difference between the laparoscopy and USG groups regarding this parameter. Similarly, patient satisfaction was higher in the TAP block groups compared to the control group.

We applied the APS-POQ-R-T, consisting of 13 questions, to evaluate pain management. According to questions 1 and 2, the most severe pain in the first 24 h was higher in Group C compared to Groups L and U, indicating that TAP block reduces the severity of pain in either method. Based on answers to question 3 about the frequency of pain, the patients in the control group were exposed to pain at a higher frequency, even though the difference was not statistically significant. According to question 4, consisting of 4 sub-questions, the negative effects of postoperative pain on sleep quality were more intense in the control group, although there was no difference between the groups in terms of in-bed or out-of-bed movements. Considering question 5, which investigated postoperative mood, anxiety, fear, and despair, results were similar across all groups. Given that the control group showed higher pain severity and sadness and lower sleep quality, we conclude that mood was affected by inadequate pain management.

Question 9 inquired about satisfaction with pain management, and the patients' answers revealed more positive results in the TAP block groups, which show the success of the TAP block in pain management. Evidently, there were some deficiencies in patient information, as only 71.8% of the patients stated that they were informed about their options for pain management (question 10). We believe that ensuring better patient information is associated with a higher rate of patient satisfaction.

According to research on 60 patients that examined the effectiveness of relaxation exercises on postoperative pain management after upper abdominal surgery, relaxation exercises helped reduce pain levels compared to patients using the same analgesics without exercise.[21] In the current study, 104 of the patients who participated in the questionnaire stated not using any non-drug method to reduce pain. This may be because the patients were not adequately informed about non-drug methods, and there are limited options for these methods. On the other hand, the frequency of walking was higher in Group L, where postoperative pain was lower. Besides, regarding question 12 about the encouragement of non-drug methods, 31.5% of the patients said they were encouraged occasionally.

Given that the APS-POQ-R-T was filled in at the 24^{th} postoperative hour, it would be more accurate to compare the answers with the VAS scores at the 24^{th} h. Accordingly, the control group had higher scores on the questions about pain severity and higher VAS scores. Still, this group reported more pronounced sleep problems, higher sadness scores, and more negative answers regarding satisfaction with pain management and participation in pain management decisions. These findings suggest that patients with high pain severity experience sleep problems and express these problems as sadness. The lower satisfaction levels among patients with high pain scores indicate how important pain management is, even in the absence of complications due to anesthesia or surgery.

TAP block has an important place in clinical practice as an effective and simple method that reduces the need for postoperative analgesia, thus offering a low risk of complications. In laparoscopic cholecystectomy operations, applying TAP block with USG guidance or with direct laparoscopic vision is effective for postoperative pain relief. TAP block with laparoscopy shortens the anesthesia time since it does not require additional preparation or equipment during the procedure. Centers where a USG device is not available can safely apply TAP blocks with direct laparoscopic vision for postoperative pain management. We believe that our research raises awareness regarding postoperative pain methods and about ensuring that surgical imaging methods are used in pain management.

Peer-rewiew: Externally peer-reviewed.

Ethics Committee Approval: Ondokuz Mayıs University Clinical Research Ethics Committee (number: 2019/251) and HSU Medical Speciality Education Board (date: 30.04.19, number: 33646832-771) approved this study.

Conflict-of-interest issues regarding the authorship or article: None declared.

References

1. Hadzic A, Carrera A, Clark TB, Gadsden J, Karmakar MK, Sala X, et al. Hadzic periferik sinir blokları ve ultrason eşliğinde rejyonel anestezi için anatomi. In: Hadzic A, editör. Kurt E, çeviri editörü. Istanbul: Güneş Tıp Kitabevi; 2012. p.460–2.
2. Farag E, Mounir-Soliman L, Brown DL. Brown's atlas of regional anesthesia. 5th ed. Amsterdam: Elsevier; 2016. p.251–3.
3. Oprea AD. Laparoskopik ve robotik cerrahide anestezi. In: Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC, Ortega R, et al, editors. Yıldız K, çeviri editörü. Klinik anestezi temelleri. Istanbul: Güneş Tıp Kitabevi; 2017. p.509–16.
4. Kirk RM. Genel cerrahi ameliyatları. Beşinci Baskı. In: Kırk RM, editör. Nursal TZ, çeviri editörü. Adana: Nobel Tıp Kitabevi; 2008. p.235–9.
5. Shibata Y, Sato Y, Fujiwara Y, Komatsu T. Transversus abdominis plane block. Anesth Analg 2007;105:883. [CrossRef]
6. Hebbard PD, Barrington MJ, Vasey C. Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: Description of anatomy and clinical technique. Reg Anesth Pain Med 2010;35:436–41.[CrossRef]
7. 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. [CrossRef]
8. Özyalçın NS. Akut ağrı. Istanbul: Güneş Kitabevi; 2005. p.40–6.
9. Gordon DB, Polomano RC, Pellino TA, Turk DC, McCracken LM, Sherwood G, et al. Revised American Pain Society Patient Outcome Questionnaire (APS-POQ-R) for quality improvement of pain management in hospitalized adults: Preliminary psychometric evaluation. J Pain 2010;11:1172–86. [CrossRef]
10. Erden S, Karadağ M, Güler Demir S, Atasayar S, Opak Yücel B, Kalkan N, et al. Cross-cultural adaptation, validity, and reliability of the Turkish version of revised American Pain Society patient outcome questionnaire for surgical patients. Agri 2018;30:39–50. [CrossRef]
11. Wassef M, Lee DY, Levine JL, Ross RE, Guend H, Vandepitte C, et al. Feasibility and analgesic efficacy of the transversus abdominis plane block after single-port laparoscopy in patients having bariatric surgery. J Pain Res 2013;6:837–41.
12. Tran DQ, Bravo D, Leurcharusmee P, Neal JM. Transversus abdominis plane block: A narrative review. Anesthesiology 2019;131:1166–90. [CrossRef]
13. 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. [CrossRef]
14. Işık B, Erkoç SK. Abdomen (Karın) Ultrasonografik Değerlendirilmesi. In: Kurtipek Ö, Alkış N, Işık B, Alanoğlu Z, editörler. Klinik Anestezide Ultrasonografi. Istanbul: Akademisyen Kitabevi; 2018. p.111–26.

15. Robert N. Lokal Anestezik ve Adjuvanlar. In: Atchabahian A, Gupta R, editors. Alanoğlu Z, Abdullayev R, çeviri editörleri. Anestezi Kılavuzu. İstanbul: Nobel Kitabevi; 2017. p.505–8.
16. Jowza M, Minehart RD. Lokal Anestezikler. In: Levine WC, Allain RM, Alston TA, Dunn PF, Kwo J, Rosow CE, editors. Turan IÖ, çeviri editörü. Massachusetts General Hospital Klinik Anestezi Uygulamaları. İstanbul: Güneş Tıp Kitabevi; 2014. p.208–13.
17. Lee TH, Barrington MJ, Tran TM, Wong D, Hebbard PD. Comparison of extent of sensory block following posterior and subcostal approaches to ultrasound-guided transversus abdominis plane block. Anaesth Intensive Care 2010;38:452–60. [CrossRef]
18. Milan ZB, Duncan B, Rewari V, Kocarev M, Collin R. Subcostal transversus abdominis plane block for postoperative analgesia in liver transplant recipients. Transplant Proc 2011;43:2687–90. [CrossRef]
19. Elamin G, Waters PS, Hamid H, O'Keeffe 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.
20. Park SY, Park JS, Choi GS, Kim HJ, Moon S, Yeo J. Comparison of analgesic efficacy of laparoscope-assisted and ultrasound-guided transversus abdominis plane block after laparoscopic colorectal operation: A randomized, single-blind, non-inferiority trial. J Am Coll Surg 2017;225:403–10.
21. Topcu SY, Findik UY. Effect of relaxation exercises on controlling postoperative pain. Pain Manag Nurs 2012;13:11–7. [CrossRef]