Obesity Surgery (2019) 29:3188–3194
https://doi.org/10.1007/s11695-019-03984-4

ORIGINAL CONTRIBUTIONS

Subcostal Transversus Abdominis Plane Block for Laparoscopic Sleeve Gastrectomy, Is It Worth the Time?

Mümin Coşkun[1] · Samet Yardimci[2] · Mustafa Kemal Arslantaş[3] · Gülbin Töre Altun[3] · Tevfik Kıvılcım Uprak[1] · Yalçın Burak Kara[1] · Asim Cingi[1]

Published online: 7 June 2019

Abstract

Background Obesity is a complex and multifactorial disease whose incidence has increased, making it a serious public health issue. Laparoscopic sleeve gastrectomy (LSG) is one of the most common surgical procedures that is chosen for bariatric surgery. Decreasing postoperative pain in these patients which will increase patients' compliance and quality of life will lead to better surgical results. This study aims to compare the effectiveness of trocar site infiltration versus bilateral subcostal transversus abdominis plane block (TAP) in controlling postoperative pain in patients.

Methods Forty-five consecutive patients who have undergone LSG in xxx General Surgery Department have been enrolled in the study. Patients were divided into two groups according to the surgeon's choice. The first group underwent TAP block, while the second group underwent trocar site infiltration. Patients' pain was recorded via visual analogue scale (VAS) in postoperative periods.

Results Twenty-nine female (69%) and 13 (31%) male patients were included in the study. Median age was 41 (18–58) and median BMI was 48 (41.1–68). When the VAS values were compared, in the TAPB group, 6th hour resting and coughing pain was statistically significantly less. Other VAS values measured while resting, coughing, and post-mobilization did not show significant differences. There were no significant differences between the groups' tramadol use.

Conclusions After LSG, TAP block and trocar site infiltration yield similar pain control. Due to the faster application and fewer side effects, we concluded that trocar site infiltration should be the intervention of choice in controlling postoperative pain in LSG.

Keywords Bariatric surgery · Obesity · Postoperative pain · TAP block · LSG

Introduction

Obesity is a complex and multifactorial disease and has become a significant public health problem due to its increased frequency in the last three decades [1, 2]. Due to obesity and accompanying comorbidities, morbidity and mortality of obese individuals increase while their quality of life decreases [3]. Despite sports, diet, lifestyle changes, and medical treatments, the obesity rate continues to increase in the population, and the most effective and durable treatment option for

✉ Mümin Coşkun
emarvinator@gmail.com

Samet Yardimci
sametyardimci@yahoo.com

Mustafa Kemal Arslantaş
mkarslantas@gmail.com

Gülbin Töre Altun
Dr_gulbin@yahoo.com

Tevfik Kıvılcım Uprak
kuprak@gmail.com

Yalçın Burak Kara
Yb_kara@hotmail.com

Asim Cingi
asimcingi@gmail.com

[1] School of Medicine, General Surgery Department Fevzi Çakmak Mah, Marmara University, Mimar Sinan Cad No:41 Üst Kaynarca, Pendik, 34899 İstanbul, Turkey

[2] Medical Park Hospital General Surgery Department Fevzi Çakmak Mahallesi, D100, Cemal Gürsel Cd. No:9, Pendik, 34899 İstanbul, Turkey

[3] School of Medicine, Anesthesiology Department Fevzi Çakmak Mah, Marmara University, Mimar Sinan Cad No:41 Üst Kaynarca, Pendik, 34899 İstanbul, Turkey

morbid obesity is bariatric surgery[4, 5]. Laparoscopic sleeve gastrectomy is accepted as one of the most effective bariatric surgical methods in the treatment of comorbidities related to weight loss and obesity in morbid obesity [6]. Pain in the postoperative period is a factor that increases the risk of deep vein thrombosis, atelectasis, and pulmonary embolism due to increased immobilization and superficial respiration in patients who already have obesity and limited movement [7, 8]. Reduction of postoperative pain improves patient compliance and potentially reduces early postoperative complications, resulting in more successful outcomes. Subcostal transversus abdominalis plane (TAP) block should be performed if analgesia of the abdominal wall above the umbilicus is required.

It will provide analgesia for areas of the upper abdomen that is not usually adequately covered by the landmark or posterior TAP approaches.

Abdominal pain is caused by the abdominal wall and visceral organs. Methods used to reduce abdominal wall pain include systemic analgesic use, long-acting local analgesic infiltration of trocar site, epidural analgesia, and abdominal wall blocks [9].

The purpose of this non-randomized, single-blind study is a comparison of trocar site infiltration and subcostal transversus abdominis plane block for narcotic needs and visual analogue pain scores to provide better pain control after laparoscopic sleeve gastrectomy.

Materials and Methods

The study was conducted between 15.3.2016 and 10.11.2016 in xxxx General Surgical Department. Forty-five consecutive patients who underwent LSG for morbid obesity were included.

Inclusion criteria:

1. Being between the ages of 18–65
2. Having laparoscopic sleeve gastrectomy (LSG) for morbid obesity

Exclusion criteria

1. An advanced allergic reaction to local anesthetic agents
2. Chronic analgesic use
3. Presence of active infection in the planned area of subcostal transversus abdominalis plane block
4. Conversion to open surgery
5. Advanced liver and renal insufficiency
6. Alcohol and narcotic substance dependence

Ethical committee approval was obtained before the study, and informed consent was provided from all of the patients. The age, gender, height, weight, body mass index (BMI), additional diseases, and medications were recorded after. The date of operation and the duration of the operation was recorded during surgery. Patients were divided into two groups according to the preference of the surgeon. The first group was bilateral subcostal transversus abdominalis plane block (TAP), and the second group was trocar site bupivacaine infiltration. The data were collected prospectively.

Subcostal TAP Block Application Technique

After anesthesia induction and intubation, TAP block performed as described by Hebbard et al. [10] by using a 15–20-cm long 22-gauge peripheral block needle (SonoTAP cannula, Pajunk®, Germany) and 20 ml of the local anesthetic mixture (10 ml of 0.5% bupivacaine, 5 ml of 2% lidocaine and 5 ml of saline) was infiltrated on the right side and drug delivery was monitored with the guidance of ultrasonography (Philips C6–2 broadband curved array transducer, Sparq Ultrasound System, Philips Healthcare). Then, the same procedure was applied to the left side of the abdominal wall. After block application, we waited for 30 min for the local anesthetic to be distributed on the transversus abdominal neurofascial plane. Trocar sites were infiltrated with saline.

Trocar Site Bupivacaine Infiltration

At the beginning of the operation, 25 ml (5 ml each site) bupivacaine of 0.25% was injected at the entry points of four trocars and liver retractor in direct view of the camera.

Anesthesia Induction

Anesthesia induction in both groups was performed with 2 mg kg^{-1} propofol, 1 μg kg^{-1} remifentanil ve 0.6 mg kg^{-1} rocuronium and anesthesia is sustained with %50/50 O_2/air %5–7 desflurane ve 0.05–0.1 μgr kg^{-1} min^{-1} remifentanil infusion. At the end of the operation, neuromuscular block reversal was achieved with 4 $mg.kg^{-1}$ sugammadex, and the patients were extubated and transferred to the post-anesthesia care unit.

Operative Technique

Standard 5 port laparoscopic sleeve gastrectomy was done as described by Cingi et al. [11].

Postoperative Pain Control

One gram of acetaminophen intravenously given four times a day and for postoperative pain control was followed by patient-controlled analgesia (PCA) with 90 cc saline (SF)

10 cc 500 mg tramadol. The bolus dose of PCA was set at 10 mg and 10 min lock-in period.

VAS Follow up

In the postoperative period, patients' visual analogue scale (VAS) pain follow-ups were recorded in the normal lying position and after a strong cough on the 1st, 6th, 12th, 24th, 36th, 48th, and after the mobilization and discharge.

VAS follow-ups were performed by general surgery service nurses and anesthesia pain team.

Nurses and doctors who followed the VAS and the anesthesia team who followed the PCA were blind to the study groups. The amount of tramadol used during the hospital stay and postoperative period was recorded.

The Short Form-36 Health Survey (SF-36)

SF-36 has been constructed to represent eight health concepts. It has been referred to as a generic measure since it assesses health concepts that are pertinent to everyone's functional status and well-being. This generic measure can be used in diseased groups as well as general populations. SF-36 also allows comparisons between different disease groups.

The patients were evaluated with Short Form-36 (SF-36) at hospital discharge to compare functional status and well-being of the patients [12].

Statistical Analyses

Statistical analyses were performed using the IBM SPSS Statistics 23 program. Two-tailed chi-square or Fisher exact tests were used to compare categorical variables.

Independent two-sample *t* test was used for continuous variables with normal distributions. The Mann-Whitney *U* test was used for the ordinal data and the variables whose distribution was not normal. A *P* value < 0.05 was considered statistically significant.

Results

A total of 45 patients, 31 female and 14 male, were included in the study.

One patient from the bupivacaine group was excluded from the study because of intraoperative diagnosis of cirrhosis. In the TAP block group, two patients were removed from the study because the operation was performed with four trocars in one patient and the other's PCA was removed 8 h after the operation.

Twenty-nine (69%) women and 13 (31%) men were included in the study. The median age of the patients was 41 (18–58), and the median BMI of the patients was 48 (41.1–68).

There was no significant difference between the TAP block group and the bupivacaine group regarding age, sex, and comorbidities (Table 1).

When the VAS values of the two groups were compared, a significant difference was found in favor of TAP block in VAS values measured at rest and coughing at the 6th hour (Table 2) (Fig. 1).

No statistically significant difference was found between the groups at 1st, 3rd, 12th, 24th, 36th, and 48th hours resting, coughing, and mobilization VAS measurements (Table 2).

There was no significant difference between the two groups in terms of SF 36 score (Table 3).

However, when the SF 36 scores of the patients taken into the study were compared with the averages of Turkey, it was observed that the scores were lower than the Turkey average in eight sub-categories [12].

There was no significant difference between the two groups when tramadol needs were compared (Fig. 2).

Mean tramadol needs in the first 24 h were 294.5 ± 161 mg in the TAP group and 266.1 ± 108 mg in the bupivacaine group, and no significant difference was found (p 0.51).

On the second day after the operation, there was no significant difference in the tramadol requirement (72.5 ± 71 mg) in the TAP block group and 66.9 ± 70 mg in the bupivacaine group ($p = 0.53$).

When the initial mobilization periods of the patients were compared, the mean mobilization duration in the TAP block group was 6.35 ± 1.40 h and 7.35 ± 2.52 h in the bupivacaine group, and no significant difference was found ($p = 0.181$).

When the duration of operation was compared, the TAP block group was calculated as 144.5 ± 31 min and the bupivacaine group as 141.2 ± 28 min and no significant difference was found ($p = 0.72$).

When the duration of the anesthesia was compared, the TAP block group was calculated as 188 ± 31.5 min and bupivacaine group as 141.2 ± 28 min, and a significant difference was found in favor of the bupivacaine group ($p = 0.001$).

The hospital stay was 3 ± 0.5 days in the TAP block group and 3 ± 1.2 days in the bupivacaine group ($p = 0.93$). When the groups were compared regarding complication and re-

Table 1 Demographic features of the participants

	TAP block	Bupivacaine	*p* value
Female/male	17/4	12/9	0.095
Age	42.4 ± 9.2	38.7 ± 10.4	0.25
Diabetes mellitus	5(%23.8)	3(%14.3)	0.69
Hypertension	6(%28.6)	6(%28.6)	1
Hypothyroidism	1(%4.8)	2(%9.5)	0.56
BMI	50.24 ± 7.2	48.4 ± 7.2	0.43
Weights (kg)	134.18 ± 21.1	133.3 ± 22.1	0.59
Height (cm)	163.2 ± 8.5	165.8 ± 9.5	0.65

Table 2 VAS score and results

VAS	TAP block (min-max)	Bupivacaine (min-max)	*p* value
1st hour resting	7(4–10)	8(4–10)	0.26
1st hour coughing	8(3–10)	9(5–10)	0.1
3rd hour resting	5(1–9)	6(2–10)	0.161
3rd hour coughing	6(3–10)	8(5–10)	0.11
After mobilization	5(2–8)	5(2–10)	0.67
6th hour resting	4(1–7)	5(2–8)	0.001
6th hour coughing	5(1–9)	6(3–10)	0.012
12th hour resting	4(2–10)	4(2–10)	0.54
12th hour coughing	4(3–8)	6(2–10)	0.1
24th hour resting	3(1–7)	4(1–9)	0.17
24th hour coughing	3(1–7)	4(1–9)	0.63
36th hour resting	2(1–7)	3(1–6)	0.68
36th hour coughing	2(1–7)	3(1–6)	0.26
48th hour resting	1(1–8)	1(1–7)	0.76
48th hour coughing	1(1–8)	2(1–7)	0.44
When discharged	1(1–3)	1(1–3)	1

admission to the hospital, minor pulmonary emboli developed in one patient in the bupivacaine group and three patients had re-admission to the hospital. There was no complication and hospitalization in the TAP block group. There was no significant difference between the two groups. The surgeries of all patients who were included in the study were completed laparoscopically. There was no leakage, bleeding, re-operation, or mortality in any patients. There were no complications due to TAP block administration. Respiratory depression, a decrease in saturation, and hypoventilation due to tramadol usage did not occur (Table 4).

Discussion

Obesity is one of the most critical health problems of our time. Obesity-related diseases increase in morbidity and mortality, and also the quality of life decreases.

Bariatric surgeries for the treatment of obesity and obesity-related comorbidities are in an increasing trend.

In obese patients, sleep apnea, limitation of mobilization, and susceptibility to DVT increase the risk of complications in the postoperative period. Improper control of pain may result in immobilization of patients, inability to perform respiratory physiotherapy, and consequently increase the incidence of pulmonary complications.

Studies have shown that after cholecystectomy, RYGB, and gastrectomy, TAP block reduces the use of narcotic analgesics for pain control [13, 15]. Trocar site bupivacaine inflation has also been shown to reduce the need for narcotic analgesia in pain control after cholecystectomy, colorectal surgery, and ventral hernia [16–19] .

In the literature, the study comparing these two methods for pain control after LSG has not been performed until our study.

According to the findings of this study, the median VAS scores in the first 12 h after surgery were lower in the TAP block group than in the bupivacaine group, but no statistical significance was determined except the 6th hour VAS measurement.

In the case of tramadol needs 8th, 12th, 18th, 24th, 36th, and 48th hour after the operation, there was no difference between groups.

There was no difference between the first mobilization period and hospitalization time. The VAS scores at the 6th hour in the TAP block group was lower than in the bupivacaine group, which may be due to the longer duration of the TAP block effect than the trocar site infiltration.

When Michael Wassef and colleagues performed single-port sleeve gastrectomy, TAP block was performed in the

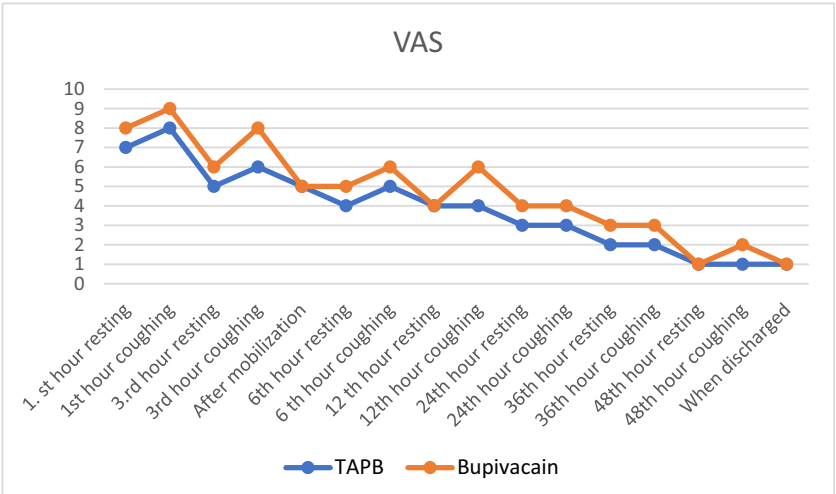

Fig. 1 Tab block and bupivacaine groups 48-h VAS follow ups

Table 3 SF 36 results and Turkey average

SF 36	TAP block	Bupivacaine	*p* value	Turkey average
Physical functioning	42.2 ± 21.3	49.5 ± 22.3	0.29	80.6 ± 21.7
Role limitations due to physical health	25 ± 35.35	46.8 ± 46.4	0.1	82.9 ± 28.6
Role limitations due to emotional problems	53.37 ± 42.4	68.2 ± 42	0.27	89 ± 22.5
Energy/fatigue	53 ± 19	53.8 ± 22.4	0.9	63.4 ± 13.7
Emotional well-being	70.5 ± 15.2	72.9 ± 14	0.6	70.1 ± 11.4
Social functioning	56.7 ± 27.3	60 ± 30	0.67	90.1 ± 12.9
Pain	63.25 ± 25	64.7 ± 27.6	0.85	81. ±20.2
General health	62.7 ± 13.2	59 ± 19.4	0.47	69.1 ± 16.9

study group; no trocar site infiltration was performed in the control group. In the early postoperative period, the VAS scores of the patients were found to be lower, and the analgesic requirements decreased. However, no difference was found in the amount of analgesic used after 24 h [14].

Aparna Sinha and colleagues reported that their results with laparoscopic gastric bypass patients, pain scores and analgesic requirements were found to be lower in the first 24 h [13]. However, in both studies, the TAP block was performed at the end of the operation or in the postoperative resting unit, and the trocar site infiltration was not performed in the control group.

TAP block is an expected result of better pain control than no local anesthetic applied.

In our study, it has been shown that TAP block administration does not have superiority to local anesthetic infiltration of the trocar site. This may be due to the local anesthetic dose we use. There are similar studies using 20–30 ml of local anesthetic in the literature. Some of these studies showed effective analgesia; some studies showed no difference in analgesia [20]. In our study, we preferred 20 ml local anesthetic for each side and similar efficacy for pain control was observed in the tap block group and trocar infiltration group.

Trocar infiltration is easy to apply and is done in a short time without the need for additional equipment.

TAP block can be performed by the surgeon under direct vision but as-performing blocks in obese patients is challenging and visualizing the block needle by ultrasound device increases the block success. Also, TAP block administration takes longer time than trocar site infiltration and when TAP block is performed after induction, anesthesia time becomes longer, because of waiting for 30 min for the local anesthetic to be distributed on the transversus abdominal neurofascial plane.

Although there was no TAP block-related complication in our study, complications such as liver hematoma, peritoneal punctures, infection at the block site, and nerve ischemia were reported in the literature [21].

In the study of Eric Albrecht and his colleagues with RYGB patients, TAP block was performed before the incision and trocar site infiltration was applied to the control group. As a result of this study, there was no difference in the pain scores, analgesic requirements, the first mobilization period, and the stay in hospital between the TAP block group and trocar site infiltration [22]. These findings are consistent with our study.

Studies in cholecystectomy patients showed that patients who underwent TAP block had fewer pain scores and fewer analgesic requirements in the first 8 h, whereas control groups had not undergone trocar site infiltration [15]. In the study where trocar site infiltration was performed in the control group, there was no

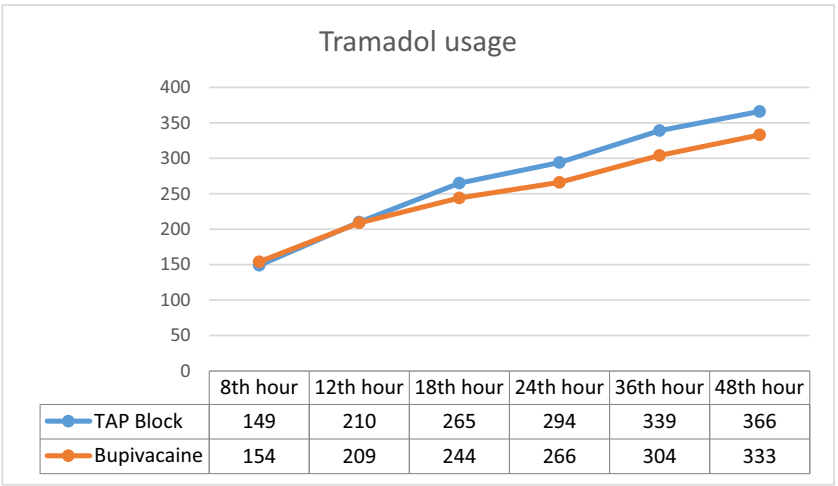

Fig. 2 TAP block and bupivacaine groups 48-h tramadol usage chart

Table 4 Forty-eight-hour Tramadol usage of TAP block and bupivacaine groups

PCA tramadol	TAP block ± sd	Bupivacaine ± sd	*p* value
8th hour	149 ± 90 mg	154.2 ± 75 mg	0.84
12th hour	210 ± 126 mg	209 ± 91 mg	0.97
18th hour	265 ± 146 mg	244 ± 103 mg	0.6
24th hour	294 ± 161 mg	266 ± 108 mg	0.51
36th hour	339 ± 171 mg	304 ± 131 mg	0.47
48th hour	366 ± 189 mg	333 ± 151 mg	0.53

difference in analgesic requirement for pain score. The only statistical difference between the two groups was the duration of anesthesia. These findings are also consistent with our study.

We used the SF 36 questionnaire to measure the quality of life of patients. When we compared the results of the survey with the average of the community, we found that they had low scores in eight sub-categories. It is expected that the emotional functions and energy scores of the physical functions are low because the study population is obese patients. No statistical significance was found when the TAP block group and bupivacaine group SF 36 scores were compared. This may indicate that there is no patient selection bias.

In the literature review, the only study that used VAS score and SF 36 questionnaire, comparing TAP block and bupivacaine infiltration for pain control in patients with laparoscopic sleeve gastrectomy, is our study.

There are studies in favor of liposomal bupivacaine usage for postoperative pain management, but as we do not have it in our country, we could not use it in our study.

Although the study was conducted non-randomly, the study group and the control group demographics and SF-36 scores are similar; this may reduce the limitation of the study.

Because TAP block was performed after the intubation of the patient, dermatomal examination of the patients was not performed, and block level could not be determined.

The chronically raised intra-abdominal pressure in this population, which was subsequently further increased by peritoneal insufflation and combined with reverse Trendelenburg positioning, may have limited cephalad spread of the local anesthetic injectate and thus decrease the analgesic effect of the TAP block [22]. To reduce this possibility, we waited 30 min before insuflation and positioning.

According to the findings in our study, TAP block and trocar site infiltration have similar efficacy for pain control after laparoscopic sleeve gastrectomy.

Intraoperative infusion of high-dose remifentanil can cause early postoperative hyperalgesia [23].

In our study, intraoperative remifentanil infusion dosage was not high enough to cause hyperalgesia as stated in the literature, and the infusions were ceased gradually to prevent abrupt cassation. Like in similar studies, no cases of analgesic overconsumption were registered in our study. [24]

In our study, we preferred tramadol PCA because, in bariatric surgery, postoperative pain management is efficaciously and safely provided with tramadol. Multimodal analgesia with tramadol causes less postoperative vomiting, less postoperative hypopnea, and early ambulation [25].

Local anesthesia filtration should be the method of choice, given that it is easier to apply, takes less time, has potentially lower procedural complication rates, and does not require extra teams and equipment. Future studies in this field may suggest that TAP block should be performed at the end of the operation or local anesthetic use with a longer half-life.

Compliance with Ethical Standards

Ethical committee approval was obtained before the study, and informed consent was provided from all of the patients.

Conflict of Interest The authors declare that they have no conflict of interest.

References

1. Angrisani L, Santonicola A, Iovino P, et al. Bariatric surgery worldwide 2013. Obes Surg. 2015;25(10):1822–32.
2. OECD. Health at a Glance 20172017.
3. Whitlock G, Lewington S, Sherliker P, et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet. 2009;373(9669):1083–96.
4. Douglas IJ, Bhaskaran K, Batterham RL, et al. Bariatric surgery in the United Kingdom: a cohort study of weight loss and clinical outcomes in routine clinical care. PLoS Med. 2015;12(12):e1001925.
5. Alamuddin N, Bakizada Z, Wadden TA. Management of obesity. J Clin Oncol Off J Am Soc Clin Oncol. 2016;34(35):4295–305.
6. Rosenthal RJ, Diaz AA, Arvidsson D, et al. International sleeve gastrectomy expert panel consensus statement: best practice guidelines based on experience of >12,000 cases. Surg Obes Relat Dis. 2012;8(1):8–19.
7. Alsina E, Ruiz-Tovar J, Alpera MR, et al. Incidence of deep vein thrombosis and thrombosis of the portal-mesenteric axis after laparoscopic sleeve gastrectomy. J Laporendoc Adv Surg Tech A. 2014;24(9):601–5.
8. Atilla N, Arpag H, Bozkus F, et al. Can we predict the perioperative pulmonary complications before laparoscopic sleeve gastrectomy: Original research. Obes Surg. 2017;27:1524–8.
9. Thorell A, MacCormick AD, Awad S, et al. Guidelines for perioperative care in bariatric surgery: enhanced recovery after surgery (ERAS) society recommendations. World J Surg. 2016;40(9):2065–83.
10. Hebbard P et al. Subcostal transversus abdominis plane block under ultrasound guidance. Anesth Analg. 2008;106(2):674–5.
11. Cingi A, Yardimci S, Yavuz D, et al. One hundred twenty-eight consecutive sleeve gastrectomies, short-term outcomes, and impacts on type 2 diabetes mellitus. Indian J Surg. 2018;80:410–4.
12. Demiral Y, Ergor G, Unal B, et al. Normative data and discriminative properties of short form 36 (SF-36) in Turkish urban population. BMC Public Health. 2006;6(1):247.

13. Sinha A, Jayaraman L, Punhani D, et al. Efficacy of ultrasound-guided transversus abdominis plane block after laparoscopic bariatric surgery: a double blind, randomized, controlled study. Obes Surg. 2013;23(4):548–53.
14. Wassef M, Lee DY, Levine JL, 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.
15. Basaran B, Basaran A, Kozanhan B, et al. 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.
16. Lee I-O, Kim S-H, Kong M-H, et al. Pain after laparoscopic cholecystectomy: the effect and timing of incisional and intraperitoneal bupivacaine. Can J Anesth. 2001;48(6):545–50.
17. Lee KC, Lu CC, Lin SE, et al. Infiltration of local anesthesia at wound site after single-incision laparoscopic colectomy reduces postoperative pain and analgesic usage. Hepato-gastroenterology. 2015;62(140):811–6.
18. Randall JK, Goede A, Morgan-Warren P, et al. Randomized clinical trial of the influence of local subcutaneous infiltration vs subcutaneous and deep infiltration of local anaesthetic on pain after appendicectomy. Colorectal Dis. 2010;12(5):477–9.
19. Bellows CF, Berger DH, et al. Infiltration of suture sites with local anesthesia for management of pain following laparoscopic ventral hernia repairs: a prospective randomized trial. JSLS. 2006;10(3):345–50.
20. Baeriswyl M, Kirkham KR, Kern C, et al. The analgesic efficacy of ultrasound-guided transversus abdominis plane block in adult patients: a meta-analysis. Anesth Analg. 2015;121(6):1640–54.
21. Lissauer J, Mancuso K, Merritt C, et al. Evolution of the transversus abdominis plane block and its role in postoperative analgesia. Best Pract Res Clin Anaesthesiol. 2014;28(2):117–26.
22. Albrecht E, Kirkham KR, Endersby RVW, et al. Ultrasound-guided transversus abdominis plane (TAP) block for laparoscopic gastric-bypass surgery:a prospective randomized controlled double-blinded trial. Obes Surg. 2013;23(8):1309–14.
23. Kim D, Lim HS, Kim MJ, et al. High-dose intraoperative remifentanil infusion increases early postoperative analgesic consumption: a prospective, randomized, double-blind controlled study. J Anesth. 2018;32(6):886–92.
24. Kontrimaviciute E, Sipylaite J, Aksionova D, et al. Comparison of different anesthetic regimens in patients undergoing laparoscopic adjustable gastric banding operations: a prospective randomized trial. Medicina (Kaunas, Lithuania). 2012;48(12):613–8.
25. Bamgbade OA, Oluwole O, Khaw RR, et al. Perioperative analgesia for fast-track laparoscopic bariatric surgery. Obes Surg. 2017;27(7):1828–34.