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ORIGINAL CONTRIBUTIONS

Effect of Trocar Site Bupivacaine Administration, Time of First Passage of Flatus, and Duration of the Surgery on Postoperative Pain After Sleeve Gastrectomy: a Case Control Study

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Abstract

Introduction The effect of local anesthetic applications to trocar sites on postoperative pain control has been studied many times, and different results have been obtained. We planned a controlled study evaluating the effect of bupivacaine administration and other contributing factors on postoperative pain following sleeve gastrectomy.

Material and Methods Patients who underwent laparoscopic sleeve gastrectomy were included in the study. Patients were randomized into two groups according to local application as either a local or non-local group. Also, the patients were grouped separately from local group allocation according to time to first passage of flatus (< 12 h, ≥ 12 h) and duration of surgery (> 50 min, ≤ 50 min). A visual analogue scale (VAS) was performed at 4, 8, 12, 24, and 48 h postoperatively. Opioid analgesics (pethidine HCl) were administered if the patient's VAS score was greater than 5. Demographic characteristics, such as age, gender, height, weight, body mass index (BMI), and operative time, were recorded. Demographic characteristics and VAS scores were compared between groups.

Results A total of 168 patients were included in the study. Of these, 84 patients were included in both of the local and non-local groups. The demographic characteristics between groups were similar. There was no significant difference between groups in terms of VAS scores ($p > 0.05$). In the analysis according to the time to first passage of flatus, the 48th-hour VAS scores were lower in the early flatus group ($p = 0.036$). According to the duration of surgery, first flatus was detected earlier, and VAS scores at the 8th and 12th hours were less in the short operation group ($p < 0.001$, $p = 0.005$, $p = 0.031$, respectively).

Discussion Although we did not show any effect of local administration of bupivacaine in LSG on pain, we concluded that other factors like duration of surgery and first flatus time have an impact on this issue.

Keywords Postoperative pain · Trocar site bupivacaine · First passage of flatus

Introduction

Sleeve gastrectomy (SG) is being performed more frequently because it results in fast and dramatic weight loss and affects the treatment of obesity-related diseases [1]. After SG, pain control may prevent potential complications. Patients can be mobilized earlier by effective pain control; consequently, the risk of thrombosis is reduced and the rate of pulmonary complications such as pneumonia-atelectasis is also reduced [2]. Many studies have been conducted in this regard to provide effective postoperative pain control after SG. Some researchers have hypothesized that postoperative pain is predominantly caused by trocar incisions, while others think it is caused by peritoneal injury. In addition, authors have focused on analgesic drugs and have suggested using multiple analgesics that have different mechanisms of action rather than administering a single analgesic [3, 4].

The effect of incisional local anesthetic application on postoperative pain control has been studied several times. Different drugs, different doses, different routes of

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administration, and different combinations have been tried, and different results have been achieved [5, 6]. However, in most of these investigations, a local anesthetic was applied only in the subcutaneous area, and no study was found that involved the application of a long-acting local anesthetic to both the trocar site and preperitoneal area. Studies indicate that these applications have a positive effect on pain control following surgery, such as laparoscopic cholecystectomy and laparoscopic gynecologic operations [7–10]. However, in major interventions such as bariatric surgery, few studies show that local anesthetic applications have a positive effect on postoperative pain control. Also, some investigations conclude that these practices do not affect pain control. Thus, the results of some studies contradict each other.

Gastrointestinal (GI) system (GIS) recovery also has an effect on both postoperative pain and postoperative patient comfort after SG, as for many surgical procedures [11, 12]. The duration of surgery (DOS) may affect GI recovery, and late GI recovery may increase the postoperative pain after surgery. In this case, earlier flatus passage may reduce GIS distension-induced postoperative pain. Therefore, we planned a controlled study to determine the impact of the above factors on postoperative pain after laparoscopic SG (LSG).

Methods

A case control study was planned. The institutional review board approved the study, and the universal principles of the 1964 Declaration of Helsinki and its later amendments were applied. Patients who had LSG between January 2017 and February 2017 were randomly divided into two groups by blocked randomization. The www.randomization.com web program was used for random group allocation. Local anesthesia was applied to trocar sites prior to incisional disruption in the local group. This was not done in the non-local group.

The time of first flatus passage was examined as another factor that affects postoperative pain. Timing of the first passage of flatus within 12 h after operation constituted the "early flatus" group, and later passage of flatus ($t > 12$ h) constituted the "late flatus" group. DOS was also examined as a possible parameter affecting postoperative pain. The patients were divided into two groups according to DOS (duration of operation) as "short" (≤ 50 min) and "long" (> 50 min) operation groups.

Participants

Patients who were included in the study were between 18 and 60 years of age, had a body mass index (BMI) > 35 kg/m^2, and underwent LSG. Patients who did not give consent to participate in the study and patients who had an allergic condition to drugs to be used in the study were excluded. Patients who did not complete one of the study steps because of co-morbid factors were also excluded from the study. An allergic condition against any of the drugs used in the study was the other exclusion criteria.

Sample Size

The sample size has been identified as 149 to show 50% difference with 8% α error in confidence interval of 95%. Nineteen patients were added to reduce the margin of error, and a total of 168 patients were scheduled for the study.

Anesthesia and Operation

All anesthetic applications and surgeries were performed by the same team. All patients were pre-medicated with diazepam 10 mg (Diazem®, DEVA) 30 min before the operation. General anesthesia started with intravenous fentanyl (Fentanyl citrate®, Abbott) and propofol (Propofol 1% Fresenius®, FRESENIUS KABI) administration and continued with intravenous rocuronium (Myocron®, VEM) and sevoflurane (Sevorane®, Abbott) inhalation after endotracheal intubation. At the end of the resection, 150 μg of fentanyl, 100 mg of paracetamol (Parol®, ATABAY) and 100 mg of tramadol hydrochloride (Contramal®, ABDI IBRAHIM) were administered to all patients for analgesia. A total of 40 ml 0.25% bupivacaine (Marcaine®, AstraZeneca) and 1:200,000 epinephrine (Adrenalin®, Bio Farma) mixture was used for trocar entry sites before incision in the study group. This mixture was obtained by combining 20 ml of a mixture of 0.5 mg epinephrine into 100 ml isotonic liquid and 20 ml bupivacaine. First, a 10 ml local anesthetic mixture was applied to the subcutaneous and prefascial tissue of camera trocar incision, which was placed on the midline and 12 cm below the xiphoid, and a 10-mm camera trocar was inserted. Pneumoperitoneum was formed with CO_2 insufflation under pressure of 14 mmHg, and a camera was inserted. Five milliliters of the local anesthetic mixture was applied to the space between the fascia and parietal peritoneum for the other 5-mm trocar sites, which were located 4 cm left of the camera trocar, front axillary line 2 cm below the costal margin, and 2 cm below xiphoid. Then, 15 ml of the local anesthetic mixture was applied to the preperitoneal area in the same way to the 12-mm trocar site located 4 cm to the right of the camera trocar. Patients underwent standard vertical SG using a 36 F orogastric tube in the 45° Trendelenburg position. No additional support application was applied to the staple line. No leakage tests were performed. A nasogastric tube and urinary catheter were not inserted. A Jackson Pratt drain was put near the remnant stomach in all patients.

Postoperative Analgesia Procedure and Pain Follow-up

Postoperative pain assessment was performed with a visual analogue scale (VAS) [VAS 0: no pain, VAS 10: severe pain] in all patients. This scale was explained in detail to all patients preoperatively. The VAS data were obtained by questioning four times on the operation day (0–4th, 4th–8th, 8th–12th, and 12th–24th hours). VAS was evaluated one more time on each of postoperative days 1 and 2. All patients were mobilized at the 4th hour. Respiratory physiotherapy was started at the postoperative 2nd hour and continued hourly. Postoperative analgesic application was started by intravenous paracetamol 1 g in the postoperative 4th hour and continued 3 × 1/day in 8-h intervals. In addition, 50 mg dexketoprofen trometamol 2 × 1/day was administered starting at the postoperative 8th hour. Patients who had a VAS score > 5 were administered an opioid analgesic (50 mg of pethidine HCl). Postoperative VAS score records and analgesic administrations were performed by nurses of general surgery clinic, who were working "blind" regarding the patient group.

Data Collection

Demographic values such as age, gender, weight, and height of patients were recorded before the operation. The BMI values were calculated by dividing the weight in kilogram by the square of height in meters. Patients' VAS scores, opioid requirements and amounts, time to first passage of flatus, and DOS were recorded.

Statistics

Statistical calculations were performed using IBM SPSS 22 (IBM SPSS, USA). Variables are expressed as mean ± standard deviations (SD) or medians (interquartile range) depending on their distribution. Normality was assessed by means of the Kolmogorov-Smirnov test. Categorical variables were expressed as frequencies and percentages. Fisher's exact test was used for comparison of categorical variables. The *t* test was used for comparison of parametric variables with normal distribution, and the Mann-Whitney *U* test for parametric variables without normal distribution. The statistical results were presented with a 95% confidence interval (CI). The differences were considered statistically significant if the *p* value was less than 0.05.

Results

A total of 176 patients were evaluated for eligibility. Eight patients were excluded, and a total of 168 patients were therefore included in the study. A flow diagram of the study is shown in Fig. 1. Eighty-four patients were included in both local and non-local groups. The demographic characteristics between the groups were similar ($p = 0.150$). When the patients' height, weight, and BMI values were examined, it was seen that both groups had similar measurements ($p = 0.591$, 0.841, and 0.497). It was determined that local anesthetic application did not affect the DOS ($p = 0.983$). Postoperative VAS score analysis at the 4th, 8th, 12th, 24th, and 48th hours postoperatively showed no significant difference between the local and non-local groups at any time ($p = 1$, 0.983, 0.591, 0.591, and 0.358, respectively). There was no difference in postoperative opioid requirement and total opioid dose used in both groups ($p = 1$ and 0.658, respectively) (Table 1).

In postoperative follow-up, 60 patients had first passage of flatus within 12 h (early flatus), while 108 had not (late flatus). The comparison of flatus groups and VAS scores showed that the VAS scores at 48th hour were significantly lower in the early flatus group ($p = 0.036$). No significant difference was found with the time to first passage of flatus and 4-, 8-, 12-, and 24-h VAS scores ($p = 0.957$, 0.735, 0.083, and 0.696). Also, it was observed that the operation time was significantly shorter in the early flatus group ($p = 0.048$) (Table 2).

In analyzing of duration of surgery, no difference was found between short and long operation groups according to demographic parameters (age, gender). Although BMI and the height of patients did not affect DOS, there was significant difference according to weight between the DOS groups. We also found that time to first passage of flatus was shorter in short operation time group ($p < 0.001$). Short operation time had also associated with low VAS scores only at 8th and 12th hours, significantly ($p = 0.05$ and 0.031) (Table 3).

Discussion

Postoperative pain after laparoscopic surgery may be of somatic and visceral origin. Somatic pain is usually well localized, delivered to the cortex by the spinal nerves from the parietal peritoneum or mesodermal structures of the abdominal wall. Visceral pain is transmitted to the posterior horn of the medulla spinalis by the nerve fibers located in the walls of hollow organs and capsules of solid organs [13].

The sources of pain after LSG are the surgical trauma created in the intra-abdominal region and trocar incisions in the abdominal wall from the skin to the parietal peritoneum. Surgical trauma contains the pressure caused by the insufflation, damage to the visceral peritoneum by cutting the stomach with staples, and pressure on the phrenic nerve. Visceral pain occurs because of these traumatic events. Trocar site incisions are the cause of parietal pain.

In studies on postoperative pain control in bariatric surgery, the aim is to reduce postoperative pain with local anesthetics

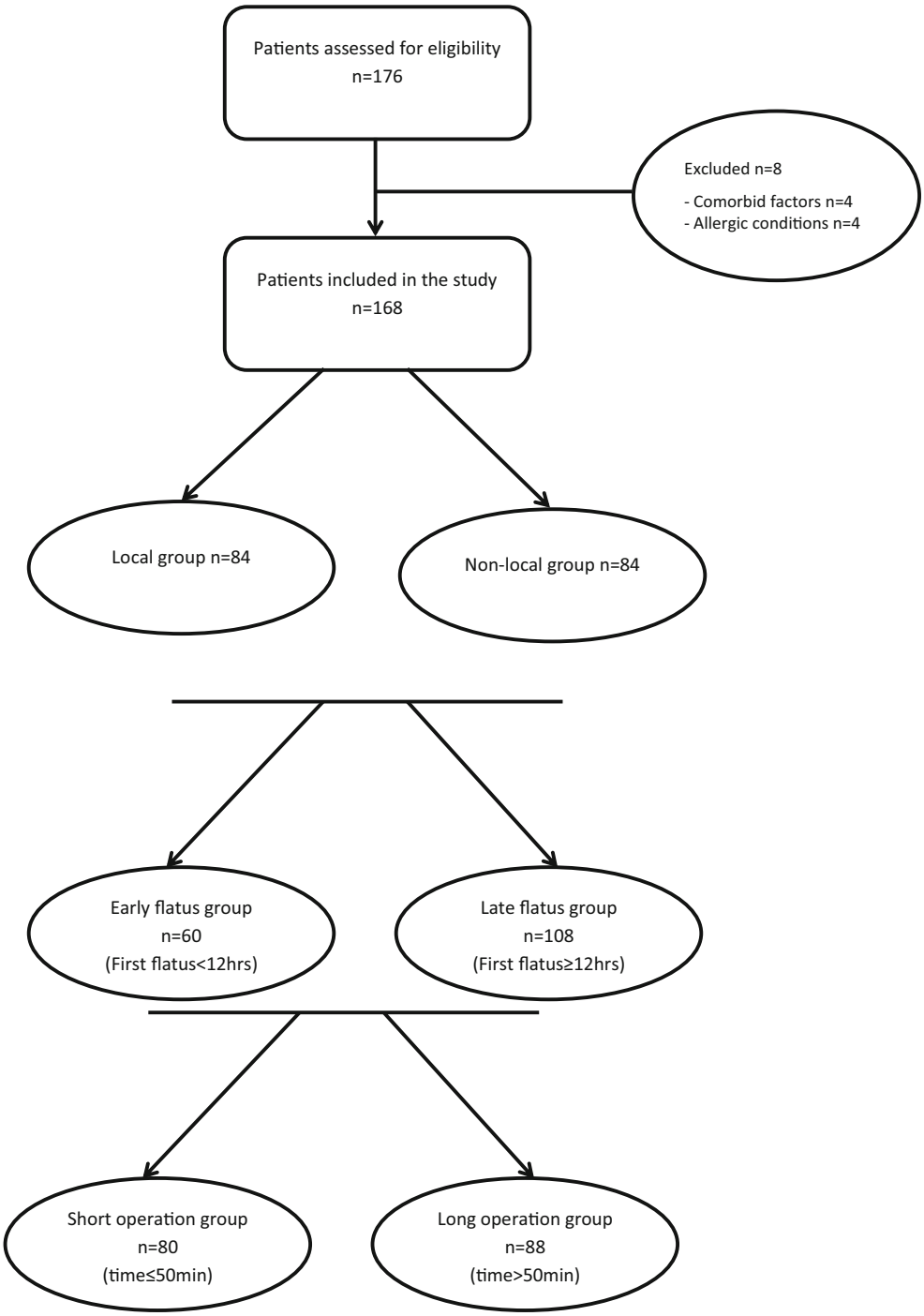

Fig. 1 Flow diagram of the study

applied to the intraperitoneal area, intrathecal area, and subcutaneous area as well as via intravenous systemic analgesics [14–16]. The efficacy of multimodal analgesic applications in the control of perioperative pain has also been established. For example, the use of tramadol in multimodal analgesic applications is appropriate, effective, safe, and associated with the best perioperative outcomes in bariatric surgery [17]. For this reason, we applied a combination of fentanyl-paracetamol-tramadol as perioperative multimodal analgesia in our study.

Each of the drugs used as a local anesthetic has a different activity time. Different local anesthetics have been preferred in several studies about local anesthetic applications to trocar regions. In our study, we preferred bupivacaine administration with longer duration of action in combination with epinephrine. It has been shown that the local anesthetic effect lasts for 6–8 h with a mixture of 0.25% bupivacaine and 1:200,000 epinephrine. In a retrospective study by Moncada et al., the effect of pre-incisional bupivacaine on trocar sites on

Table 1 Patients demographic characteristics, VAS scores, and opioid usages in local and non-local groups

	Local group ($n = 84$)	Non-local group ($n = 84$)	p
Age (mean ± SD)	31.9 ± 8.3	35.57 ± 7.8	0.150[1]
Gender (M/F)	20/64	16/68	1.000[2]
	Median (interquartile range)	Median (interquartile range)	p[3]
BMI	39.2 (8.9)	41.2 (6)	0.497
Height	162.0 (16.0)	163.0 (9.0)	0.591
Weight	111.1 (19.7)	109.4 (20.7)	0.841
Duration of surgery (min)	52.0 (15)	52.0 (14)	0.983
First flatus time (h)	16 (8)	18 (12)	0.296
VAS analyses			
VAS 4th hour	4 (4)	4 (4)	1.000
VAS 8th hour	3 (2)	3 (2)	0.983
VAS 12th hour	3 (4)	2 (2)	0.591
VAS 24th hour	3 (2)	3 (2)	0.591
VAS 48th hour	2 (1)	2 (2)	0.358
	n (%)	n (%)	
Number of patients required opioids	40 (47.6)	40 (47.6)	1.000[2]
	Mean ± SD	Mean ± SD	
Used opioid dose (mg)	28.5 ± 33.8	38.1 ± 47.2	0.658[3]

[1] t test, [2] Fisher's exact test, [3] Mann-Whitney U test

postoperative pain was evaluated. They used three different pain questionnaires, including VAS scoring, but none of them found a statistically significant effect of bupivacaine administration on postoperative pain. Similar to this study, although our study was prospective, we did not find a statistically significant positive effect of bupivacaine administration on VAS scores at any postoperative time [18].

Ruiz-Tovar et al. have shown that intra-operative intraperitoneal ropivacaine infusion in patients undergoing bariatric surgery is significantly associated with postoperative pain reduction, reduced morphine requirement, early mobilization, and shorter hospital stay. This study argues that the main source of pain after bariatric surgery is the visceral component [15]. Cohen et al. reported that bupivacaine, administered to the study group with a pump placed in the intraperitoneal area for 48 h, had a statistically significant decrease in the postoperative opioid requirement in this group compared with the control group. In the same study, no difference was found between the groups in both VAS scores and duration of hospitalization for postoperative pain [14]. A similar prospective study by Sherwinter et al. examined the effects of 48 h of bupivacaine, administered into the intraperitoneal area via a pump, on both postoperative pain and morphine requirement, after performing lap-band surgery in patients. Contrary to Cohen et al., they found no significant change in the requirement for postoperative morphine when postoperative pain decreased significantly in the intraperitoneal bupivacaine-treated group [4]. In our study, there were no observed differences between the groups regarding the number of patients requiring postoperative opioids. When the total opioid doses used in the groups were examined, although fewer opioids were used in the local group, no statistically significant difference was obtained. Also, local anesthetic administration time and application method are important for local anesthetic application to the trocar regions. In our study, we applied bupivacaine to all layers, reaching the preperitoneal area, and at increasing doses parallel to trocar sizes. We thought that this application might affect postoperative pain, but it did not produce statistically significant results on postoperative pain by applying increasing doses of the drug according to trocar dimension and to all layers from the preperitoneal area to the skin.

Hartwig et al. investigated the effects of BMI, young age, gender, and pre-existing pain on postoperative pain in bariatric surgery to test the hypothesis that postoperative pain might differ according to patient-related demographic characteristics. They found that all these variables were associated with increased postoperative pain risk and that in a multivariate analysis, only young age and pre-existing pain were independent risk factors for postoperative pain [11]. In our study, we did not find any difference between local and non-local groups for age and gender. We did not question pre-existing pain and did not analyze the effect of this demographic data on pain because it would deviate from our objective. This issue may be considered a limitation of our study. Accordingly, new and well-designed prospective studies will be of interest.

In our study, when we investigated the relationship between timing of first flatus passage and postoperative pain, we determined that the timing of first flatus passage did not affect the early postoperative pain profile but patients who did

Table 2 Patients demographic characteristics and VAS scores according to time to first passage of flatus

	Early flatus group $n = 60$ (first flatus < 12 h)	Late flatus group $n = 108$ (first flatus ≥ 12 h)	p
Age (mean ± SD)	31.6 ± 7.9	34.8 ± 8.17	0.212[1]
Gender (M/F)	12/48	24/84	0.596[2]
	Median (interquartile range)	Median (interquartile range)	p[3]
BMI	39.2 (3.5)	41.6 (9.4)	0.180
Height (cm)	163.0 (12.0)	162.0 (15.0)	0.511
Weight (cm)	105.1 (22.4)	109.7 (16.3)	0.581
Duration of surgery (min)	48.0 (8)	55.0 (13)	0.048
VAS analyses			
VAS 4th hour	4 (4)	4 (4)	0.957
VAS 8th hour	3 (2)	3 (1)	0.735
VAS 12th hour	2 (1)	3 (2)	0.083
VAS 24th hour	3 (1)	3 (2)	0.696
VAS 48th hour	2 (1)	2 (3)	0.036

[1] t test, [2] Fisher's exact test, [3] Mann-Whitney U test

not have a flatus in the first 12 h had significantly more pain at the 48th hour. However, when the 12th-hour pain profiles were compared, although not statistically significant, the result indicated the pain was greater than the others in cases without early passage of flatus. Similar to our study, in some studies examining the relationship between recovery of GIS functions and postoperative pain, it has been shown that factors that provide early return of GIS functions have positive effects on postoperative pain [19–21]. Long DOS means more anesthetic drugs and more surgical stress. Both these factors affect recovery of GIS. Therefore, short DOS may be associated with an early first passage of flatus. In our study, we have obtained parallel results.

We found low VAS scores in the early postoperative period in the short DOS group. We think that these patients who receive less doses of anesthetic drugs recover faster postoperatively, and they may have less pain in the early postoperative period due to early and comfortable mobilization and less nausea-vomiting.

Some limitations are present in our study. We could not find any positive effect of local anesthetic application. The limited number of patients and study design may be the main problem in this issue. With greater number of patients and a prospective design, there possibly would be a different result. Also, we studied second main statistical analysis for flatus status in grouped cases according to local anesthesia application. However, first analysis showed no effect of local procedure on pain. Therefore, we think that performing these nested analyses should not be counted as bias. New studies for approving our flatus and DOS data will be needed.

Table 3 Patients demographic characteristics and VAS scores according to duration of surgery

	Short operation group $n = 80$ (time ≤ 50 min)	Long operation group $n = 88$ (time > 50 min)	p
Age (mean ± SD)	31.3 ± 9.2	37.0 ± 5.6	0.210[1]
Gender (M/F)	12/68	24/64	0.610[2]
	Median (interquartile range)	Median (interquartile range)	p[3]
BMI	39.8 (1.7)	43.4 (10.9)	0.401
Height (cm)	162.5 (8.8)	168.0 (17.0)	0.231
Weight (cm)	105.6 (17.1)	120.1 (32.2)	0.060
First flatus time (h)	13.5 (7)	22.0 (12)	< 0.001
VAS analyses			
VAS 4th hour	7 (4)	7 (1)	0.513
VAS 8th hour	3 (2)	4 (4)	0.005
VAS 12th hour	3 (2)	3.5 (4)	0.031
VAS 24th hour	3 (2)	4 (2)	0.917
VAS 48th hour	2 (2)	2 (1)	0.850

[1] t test, [2] Fisher's exact test, [3] Mann-Whitney U test

Conclusion

No significant difference in postoperative VAS scores after local anesthetic application to trocar entry sites in bariatric surgery suggests that the source of pain after these operations is multifactorial and may have mainly a visceral component. Early onset of flatus and short duration of operation, which may be related with GIS recovery, may also affect postoperative pain. However, these implications need to be supported with prospective randomized trials.

Compliance with Ethical Standards

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

Ethical Approval Ethics committee approval was obtained for this study.

Informed Consent Informed consent was obtained from the patients.

References

1. Torres-Landa S, Kannan U, Guajardo I, Pickett-Blakely OE, Dempsey DT, Williams NN, Dumon KR. The surgical management of obesity. Minerva Chir. 2017 Dec 14. doi: https://doi.org/10.23736/S0026-4733.17.07588-5. [Epub ahead of print]
2. Badaoui R, Chentoufi YA, Hchikat A, et al. Outpatient laparoscopic sleeve gastrectomy: first 100 cases. Journal of Clinical Anesthesia. 2016;34:85–90.
3. El Sherif FA, Othman AH, Abd El-Rahman AM, et al. Effect of adding intrathecal morphine to a multimodal analgesic regimen for postoperative pain management after laparoscopic bariatric surgery: a prospective, double-blind, randomized controlled trial. Br J Pain. 2016;10(4):209–16. https://doi.org/10.1177/2049463716668904.
4. Sherwinter DA, Ghaznavi AM, Spinner D, et al. Continuous infusion of intraperitoneal bupivacaine after laparoscopic surgery: a randomized controlled trial. Obes Surg. 2008;18:1581–6. https://doi.org/10.1007/s11695-008-9628-2.
5. Tam T, Harkins G, Wegrzyniak L, et al. Infiltration of bupivacaine local anesthetic to trocar insertion sites after laparoscopy: a randomized, double-blind, stratified, and controlled trial. J Minim Invasive Gynecol. 2014;21(6):1015–21. https://doi.org/10.1016/j.jmig.2014.04.013. Epub 2014 May 2
6. Einarsson JI, Sun J, Orav J, et al. Local analgesia in laparoscopy: a randomized trial. Obstet Gynecol. 2004;104(6):1335–9.
7. Kim JE, Shim SH, Dong M, et al. Port site infiltration of local anesthetic after laparoendoscopic single site surgery for benign adnexal disease. Obstet Gynecol Sci. 2017;60(5):455–61. https://doi.org/10.5468/ogs.2017.60.5.455. Epub 2017 Sep 18
8. El Hachem L, Small E, Chung P, Moshier EL, Friedman K, Fenske SS, Gretz HF 3rd. Randomized controlled double-blind trial of transversus abdominis plane block versus trocar site infiltration in gynecologic laparoscopy. Am J Obstet Gynecol. 2015 212(2):182.e1–9. doi: https://doi.org/10.1016/j.ajog.2014.07.049.
9. Alper I, Ulukaya S, Yüksel G, et al. Laparoscopic cholecystectomy pain: effects of the combination of incisional and intraperitoneal levobupivacaine before or after surgery. Agri. 2014;26(3):107–12. https://doi.org/10.5505/agri.2014.42650.
10. Cantore F, Boni L, Di Giuseppe M, et al. Pre-incision local infiltration with levobupivacaine reduces pain and analgesic consumption after laparoscopic cholecystectomy: a new device for day-case procedure. Int J Surg. 2008;6(Suppl 1):S89–92. https://doi.org/10.1016/j.ijsu.2008.12.033. Epub 2008 Dec 24
11. Hartwig M, Allvin R, Bäckström R, et al. Factors associated with increased experience of postoperative pain after laparoscopic gastric bypass surgery. Obes Surg. 2017 Jul;27(7):1854–8. https://doi.org/10.1007/s11695-017-2570-4.
12. Xu SQ, Li YH, Wang SB, et al. Effects of intravenous lidocaine, dexmedetomidine and their combination on postoperative pain and bowel function recovery after abdominal hysterectomy. Minerva Anestesiol. 2017;83(7):685–94. https://doi.org/10.23736/S0375-9393.16.11472-5.
13. Basak F, Hasbahceci M, Sisik A, et al. Glisson's capsule cauterisation is associated with increased postoperative pain after laparoscopic cholecystectomy: a prospective case-control study. Ann R Coll Surg Engl. 2017;99(6):485–9. https://doi.org/10.1308/rcsann.2017.0068.
14. Cohen AR, Smith AN, Henriksen BS. Postoperative opioid requirements following Roux-en-Y gastric bypass in patients receiving continuous bupivacaine through a pump system: a retrospective review. Hosp Pharm. 2013;48(6):479–83. https://doi.org/10.1310/hpj4806-47.
15. Ruiz-Tovar J, Gonzalez J, Garcia A, et al. Intraperitoneal ropivacaine irrigation in patients undergoing bariatric surgery: a prospective randomized clinical trial. Obes Surg. 2016;26(11):2616–21. https://doi.org/10.1007/s11695-016-2142-z.
16. Ruiz-Tovar J, Muñoz JL, Gonzalez J, et al. Postoperative pain after laparoscopic sleeve gastrectomy: comparison of three analgesic schemes (isolated intravenous analgesia, epidural analgesia associated with intravenous analgesia and port-sites infiltration with bupivacaine associated with intravenous analgesia). Surg Endosc. 2017;31(1):231–6. https://doi.org/10.1007/s00464-016-4961-3.
17. Bamgbade OA, Oluwole O, Khaw RR. Perioperative analgesia for fast-track laparoscopic bariatric surgery. Obes Surg. 2017;27(7):1828–34. https://doi.org/10.1007/s11695-017-2562-4.
18. Moncada R, Martinaitis L, Landecho M, et al. Does pre-incisional infiltration with bupivacaine reduce postoperative pain in laparoscopic bariatric surgery? Obes Surg. 2016;26(2):282–8. https://doi.org/10.1007/s11695-015-1761-0.
19. Torensma B, Oudejans L, van Velzen M, et al. Pain sensitivity and pain scoring in patients with morbid obesity. Surg Obes Relat Dis. 2017;13(5):788–95. https://doi.org/10.1016/j.soard.2017.01.015.
20. Cho JS, Kim HI, Lee KY, et al. Comparison of the effects of patient-controlled epidural and intravenous analgesia on postoperative bowel function after laparoscopic gastrectomy: a prospective randomized study. Surg Endosc. 2017;31(11):4688–96. https://doi.org/10.1007/s00464-017-5537-6.
21. Conde SM, del Agua IA, Moreno AB, et al. Postoperative pain after conventional laparoscopic versus single port sleeve gastrectomy: a prospective, randomised, controlled clinical trial. Surg Obes Relat Dis. 2017;13(4):608–13. https://doi.org/10.1016/j.soard.2016.11.012.