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Randomized Trial

Ultrasound-Guided Techniques for Postoperative Analgesia in Patients Undergoing Laparoscopic Sleeve Gastrectomy: Erector Spinae Plane Block vs. Quadratus Lumborum Block

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Background: Laparoscopic sleeve gastrectomy (LSG) is a common bariatric surgery. Regional anesthetic techniques decrease postoperative pain, narcotic analgesic requirements, and opioid-related adverse effects in patients scheduled for bariatric surgery.

Objectives: The research team conducted this clinical trial to assess the effects of bilateral ultrasound (US)-guided erector spinae plane block (ESPB) on postoperative pain scores and postoperative analgesics consumption compared with bilateral US-guided quadratus lumborum block (QLB) in the first 24 hours following LSG.

Study Design: A randomized, double-blind, prospective, single-center study.

Setting: Ain-Shams University Hospitals.

Methods:
- Patients: One hundred twenty morbidly obese patients were scheduled for LSG.
- Intervention: Were randomly assigned to 3 groups (40 each): bilateral US-guided ESPB, bilateral US-guided QLB, or control (C) group.
- Measurements: The time to first rescue analgesia (ketorolac) was considered as a primary outcome. The time to perform the block, the duration of anesthesia, the time to first ambulation, the visual analog scale (VAS) at rest, VAS at movement, the total nalbuphine consumption (mg), the total requirements of rescue analgesia (ketorolac) over the first 24 hours after surgery and the study safety profile were considered as secondary outcomes.

Results: The time to perform the block and the duration of anesthesia were higher in the QLB group compared to other groups, with significant differences between ESPB and C groups ($P < 0.001$, $P < 0.001$, respectively). The ESPB and QLB groups were superior to the C group as regards the time to first rescue analgesia, the total dose of rescue analgesia, and the total nalbuphine consumption ($P < 0.001$, $P < 0.001$, $P < 0.001$, respectively). In the C group, VAS-R and VAS-M readings were higher in the first 18 hours after surgery ($P < 0.001$, $P < 0.001$, respectively). In the rest 6 hours of 24 hours after surgery, the QLB group had lower VAS-R and VAS-M readings than the C group ($P < 0.001$, $P < 0.001$, respectively). More patients in the C group had higher incidences of nausea and vomiting ($P = 0.011$, $P = 0.002$, respectively). In the C group, the time to first ambulation, the length of PACU stay, and the hospital stay were higher in comparison to the ESPB and QLB groups ($P < 0.001$, $P < 0.001$, $P < 0.001$, respectively). More patients in the ESPB and QLB groups were satisfied with postoperative pain management protocol ($P < 0.001$).

Limitations: The lack of postoperative respiratory assessment (e.g., spirometry) precluded the identification of either ESPB or QLB effects on pulmonary functions in such patients.

Conclusion: Bilateral ultrasound-guided erector spinae plane block and bilateral ultrasound-guided quadratus lumborum block provided adequate postoperative pain control and reduced postoperative analgesic requirements for morbidly obese patients scheduled for laparoscopic sleeve gastrectomy with priority to bilateral erector spinae plane block.

Key words: Obesity, bariatric surgery, ultrasound, erector spinae plane block, quadratus lumborum block, postoperative, pain, analgesia

IRB: (FMASU MS 705/ 2021).

Trial registration number: ClinicalTrials.gov Identifier: NCT05141955

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Obesity was ranked as the 5th cause of preventable death and is associated with certain diseases, e.g., type 2 diabetes mellitus, hypertension, ischemic heart disease, hyperlipidemia, and sleep apnea. Egypt has the world's 18th highest obesity prevalence, according to the World Health Organization (WHO) (1). Bariatric surgery has been advocated for adults with severe obesity for weight reduction purposes and lowering the health risks linked to obesity (2). Laparoscopic sleeve gastrectomy (LSG) is considered an efficient approach to bariatric surgery. LSG provides an apparent weight loss and an improved weight-related quality of life with reduced postoperative morbidity (3). Using regional techniques for postoperative pain management in obese patients tends to reduce the consumption of opioids and early mobilization, which minimizes the risk of deep vein thrombosis (DVT), pressure ulcers, and respiratory impairment (4).

The Enhanced Recovery After Surgery (ERAS) recommendations for bariatric surgery currently advocate the utilization of regional anesthesia techniques, which constitute a valuable component of opioid-sparing multimodal analgesia strategies to reduce intraoperative and postoperative narcotics consumption (5,6). Poorly controlled postsurgical pain is linked to decreased quality of care, surgical complications, prolonged immobility, prolonged rehabilitation, prolonged hospitalization, development of chronic pain, higher treatment costs, and a heavy burden on the healthcare system (7).

In 2016, the ultrasound (US)-guided erector spinae plane block (ESPB) was first described to treat thoracic neuropathic pain. The ESPB local anesthetic injectant into the fascial plane deep to the erector spinae muscle with craniocaudal distribution has an analgesic impact on somatic and visceral pain. It causes both somatic and visceral sensory blockade via acting on the ventral and dorsal rami of spinal nerves (8). The ESPB can provide analgesia to abdominal operations performed at a lower thoracic vertebral level (T7 or T8) (9).

In 2007, the US-guided quadratus lumborum block (QLB) was first reported as an alteration of the transversus abdominis plane (TAP) block. It is an interfascial plane block using a few different techniques. QLB is divided into 4 types based on the site of drug application: the lateral QLB (QLB 1), the posterior QLB (QLB 2), the anterior/transmuscular QLB (QLB 3), and the intramuscular QLB (QLB 4) (10). The local anesthetic distributes along the thoracolumbar fascia (TLF) and the endothoracic fascia into the paravertebral space and cranially to the T10 segment. The QLB analgesia is explained by local anesthetic blockade of pain receptors, the high-threshold and low-threshold mechanoreceptors of sympathetic neurons located in the superficial layer of the TLF (10). The QLB provides postoperative analgesia for cesarean section, renal, abdominal, and orthopedic procedures (11).

The research team conducted this clinical trial to assess the effects of bilateral ESPB on postoperative pain scores and postoperative analgesics consumption compared with bilateral posterior QLB in the first 24 hours following LSG.

Methods

Ethics

This research was prospectively registered at ClinicalTrials.gov (NCT05141955) after approval of the local ethical committee (FMASU MS 705/ 2021). This study followed the regulations of the Helsinki Declaration-2013 and was conducted between 15th of December 2021 and the 15th of June 2022 at Ain-Shams University Hospitals. Written informed consent was obtained from each patient.

Study Population

One hundred twenty patients scheduled for elective LSG with a BMI > 35 kg/m^2 were recruited into this study, of both genders, aged 21-60, with free medical history or controlled hypertension and/or diabetes. Patients with known coagulation defects, hypersensitivity to bupivacaine, non-steroidal anti-inflammatory drugs

(NSAIDS) hypersensitivity, infection at the injection site, or conversion to laparotomy were excluded from this study. Patients were also ruled out if they refused to sign the consent of regional block.

Randomization and Blinding

Patients were randomly assigned to 3 groups (40 each) in a 1: 1: 1 allocation ratio based on postoperative pain management protocol according to computer-generated random numbers which were hidden in sealed opaque envelopes and an anesthesia resident randomly chose the envelope to find out the patient`s appointed group. Patients were assigned to the ESPB group, the QLB group, or the control (C) group.

All patients received general anesthesia. After surgical port closure and before extubation, patients of the ESPB group received bilateral US-guided ESPB and bilateral US-guided sham block at the QLB site; patients of the QLB group received bilateral US-guided QLB, and bilateral US-guided sham block at the ESPB site and patients of the C group received bilateral US-guided sham block at both sites of ESPB and QLB. All blocks were carried out by expert anesthesiologists in regional anesthesia and nerve blocks who had no further role in the study. Every sham block injection was performed under US-guidance to demonstrate the possible injection site of the corresponding block and in the form of a 2 mL subcutaneous injection of normal saline solution. Anesthesia residents, blinded to the patient`s group assignment, assessed and documented the study outcomes.

Study Non-dependent Protocol

All patients underwent routine a preoperative medical check. The research protocol, a fast of 2 hours for clear fluids and 6 hours for solid food, the visual analog scale (VAS) of pain at rest and with movement (12), and nalbuphine patient-controlled analgesia (PCA) device were explained to each patient during the preanesthesia evaluation.

All patients received prophylaxis for pulmonary aspiration preoperatively.

Anesthetic management was standardized for all patients without any sedative premedication. Patients were in the ramping position on the surgical table in the operating room (OR). Standard monitoring and venous access were established. After preoxygenation with 100% oxygen for 5 minutes, induction of general anesthesia was accomplished using a rapid-sequence intubation with propofol (1.0-1.5 mg/kg) (lean body weight (LBW)) (13), rocuronium (0.6 mg/kg) (ideal body weight (IBW)) (13), and fentanyl (1.5-2 mcg/kg) (IBW) (13). Maintenance of anesthesia was achieved with 1-1.5% isoflurane with 50% oxygen in air to keep the bispectral index (BIS) value at 40-60. A top-up dose of muscle relaxant was administered to maintain muscle relaxation throughout the whole surgery. Mechanical ventilation was achieved by putting patients on a controlled mechanical ventilation mode with a tidal volume of 6 mL/kg (IBW) to maintain end-tidal CO_2 between 35 and 40 mmHg. All surgical procedures were accomplished by the same surgeon. Fentanyl (1 mcg/kg) was given as an additional bolus dose if an increase in heart rate (HR) or mean arterial pressure (MAP) was more than 20% from baseline values. Total intraoperative fentanyl consumption was recorded. Prevention of postoperative nausea and vomiting (PONV) was achieved using 4 mg dexamethasone (IV) and 1 mg granisetron (IV) at the end of surgery. All patients obtained 1 g of IV paracetamol 10 minutes before the end of surgery and every 6 hours till 24 hours after surgery. After surgical port closure and before extubation, patients were positioned in the lateral position, and the block site was prepared by a povidone-iodine solution to confirm aseptic injection techniques. The assigned block performance was done by using the suitable US probe and was followed by repositioning the patient to perform the block at the contralateral side. US-guided blocks were performed using M-Turbo US-system (FUJIFILM Sonosite, Inc., Bothell, WA).

After performing the block, isoflurane administration was ceased, and antagonism of neuromuscular blockade was performed using 0.02 mg/kg atropine and 0.05 mg/kg neostigmine intravenously. Awake extubation was established, and patients were transferred to the post-anesthesia care unit (PACU) where they were observed with ECG, NIBP, and pulse oximetry. Patients were referred from PACU to the surgery intermediate care unit when Aldrete's score was more than 9.

Study Dependent Protocol

ESPB Group

After counting down from the 7th cervical vertebra (C7) spinous process to identify the spinous process of the 7th thoracic vertebra (T7) level (at the level of the inferior scapular tip) by palpation, a high-frequency probe (10 MHz) was placed across the T7 spinous process then the probe moved laterally to identify the

transverse process of T7. Thereafter, the probe was moved to a parasagittal plane to visualize the erector spinae muscle just superficial to the transverse process. An 80 mm 22-gauge block needle (Stimuplex® D, B-Braun, Germany) was inserted in-plane to the US-probe in the cranial-to-caudal direction till the tip reached the T7 transverse process. After 2-3 mL of normal saline was injected for hydrodissection to verify the correct needle tip placement, 30 mL of 0.25% bupivacaine was injected deep to the erector spinae muscle. The same technique was repeated on the contralateral side (Fig. 1).

QLB Group

The posterior QLB (QLB 2) was adopted in this study to promote a safe and reliable regional anesthesia technique (10). After sterilization of the skin, a low-frequency convex probe (5-8 MHz) was positioned horizontally in the anterior axillary line halfway between the subcostal margin and the iliac crest then advanced in the cranial direction to visualize the triple abdominal muscle layers (external oblique [EO], internal oblique [IO], transversus abdominis [TA]) and identifying the posterior border of the external oblique muscle (hook sign) with the underlying IO muscle forming a roof over

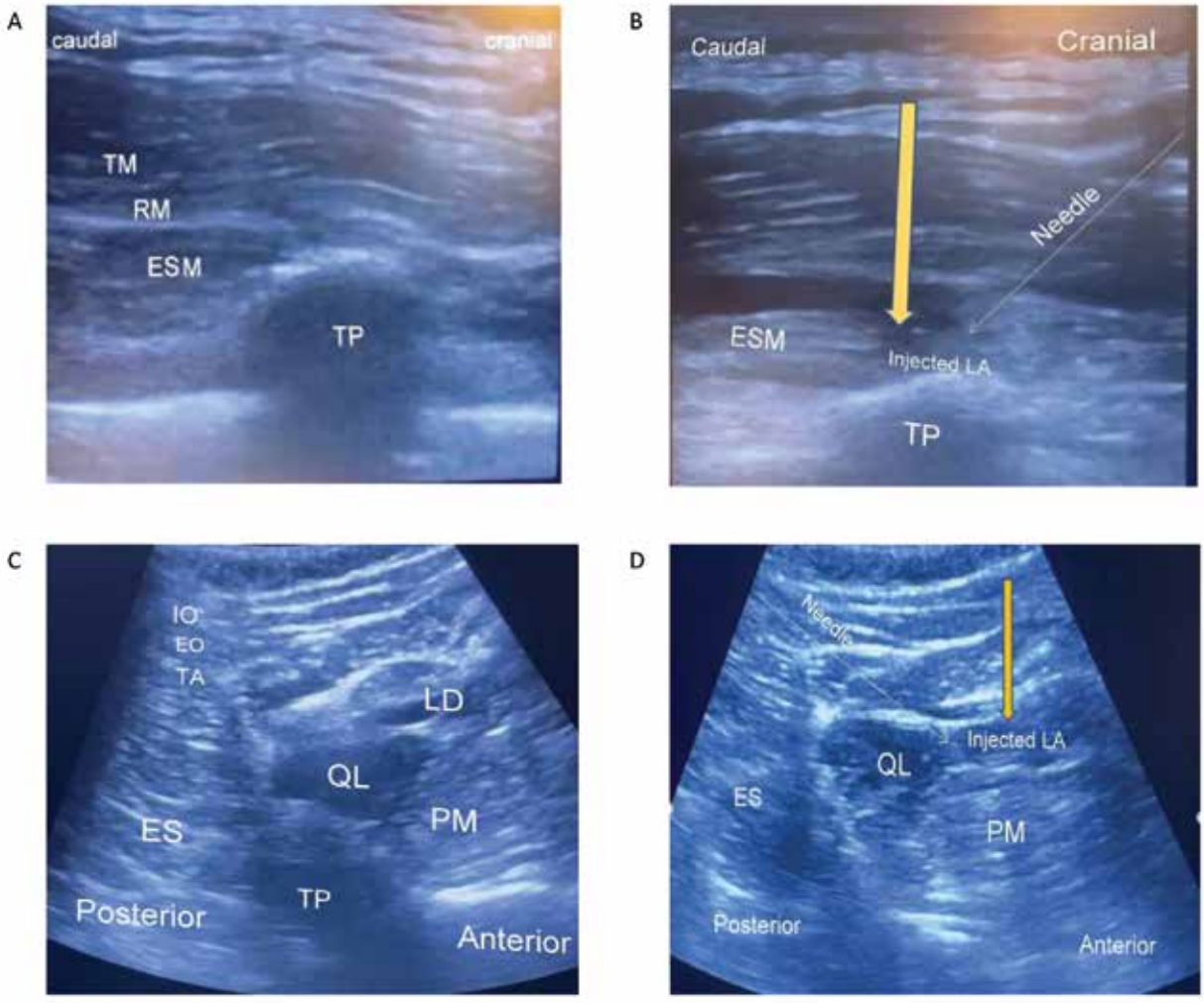

Fig. 1. *A and B; Ultrasound view of ESPB. C and D; Ultrasound view of QLB. The arrow in B and D identifies the site of injection of local anesthetic. ES: erector spinae muscle; IO: internal oblique muscle; LA: local anesthetic; LD: latissimus dorsi muscle; RM: rhomboid major muscle; TM: trapezius muscle; TP: transverse process;, PM: psoas major muscle; QL: quadratus lumborum muscle.*

the QL muscle. The probe was relocated to the posterior axillary line till identifying the middle layer of the TLF as a bright hyperechoic line and the back muscles, which include the QL muscle. The QL muscle could be visualized with its attachment to the lateral edge of the transverse process of the L4 vertebral body.

An 80 mm 22-gauge block needle (Stimuplex® D, B-Braun, Germany) was inserted in-plane to the US-probe in an anterolateral to posteromedial direction via the abdominal wall. The needle tip was placed between the middle layer of the thoracolumbar fascia and the QL muscle. After confirmation of negative blood aspiration, 2-3 mL of normal saline was injected for hydrodissection to verify the correct needle tip placement then 30 mL of 0.25% bupivacaine was injected. The same technique was repeated on the contralateral side (Fig. 1).

Postoperative Analgesia

Postoperative analgesia was maintained by nalbuphine PCA which was started with a loading dose of 2 mg nalbuphine. The nalbuphine accufuser 100 mL was prepared by adding 100 mg nalbuphine (concentration 1 mg/mL) with a background infusion of 2 mL/h (2 mg/h) (48 mL/24h) and a top up of 0.5 mL (0.5 mg) with a lockout period of 15 minutes (maximum of 48 mL/ 24 h). After 24 hours, the remaining volume of the accufuser was aspirated, and the used volume and accordingly the total nalbuphine consumption (mg)/24 h was calculated. Besides 1 g of IV paracetamol every 6 hours for the first 24 hours after surgery which was initiated 10 minutes before the end of surgery, 30 mg of ketorolac (ampoule) diluted in 100 mL of normal saline infusion over 15 minutes was chosen as a rescue analgesia as demanded by patients and not exceeding 120 mg/day.

Parameters and Outcomes

The HR and MAP were recorded at different time points: before induction of anesthesia (baseline) (T0), mean intraoperative values of HR and MBP till performing the block (T1), 20 minutes after performing the procedure (T2), 1 hour postoperative (T3), 2 hours postoperative (T4), 6 hours postoperative (T5), 12 hours postoperative (T6), 18 hours postoperative (T7), and 24 hours postoperative (T8). Perioperative hypotension was defined as a 20% decrease of MAP compared to baseline values lasting at least 2 minutes and was managed by an IV fluid bolus (250 mL of crystalloid) only or in addition to IV boluses of ephedrine (5 mg) as appropriate. Perioperative bradycardia was defined as a HR lower than 45 beats per minute, and the patient received 0.02 mg/kg atropine bolus intravenously.

The time to perform the block was defined as the time from starting needle advancement till the end of injection of local anesthetic (LA), and it was recoded. A failed block was considered if the patient required more than one dose of rescue analgesia in the first postoperative hour. Failed blocks were recorded and excluded from the study.

Postoperative pain was assessed using VAS at rest (VAS-R) and with movement (VAS-M) at 30 minutes postoperative and 2, 4, 6, 8, 12, and 24 hours after surgery. The time to first analgesic request (ketorolac) (minutes) when VAS > 3, the number of patients who were in need of analgesia (ketorolac), the number of rescue doses (of ketorolac) given for each patient, the total dose of rescue analgesia (ketorolac) (mg) and the total nalbuphine consumption (mg) required in a 24-hour period after surgery were documented. All measurements were recorded by anesthesia residents who were blinded to the study intervention allocation.

Any side effects, including PONV, bradycardia, and hypotension, were also recorded and treated in both groups. A rescue dose of IV 10 mg metoclopramide was administered if patients experienced intractable nausea or vomiting. The PACU stay, the duration of hospital stay, and patient's satisfaction regarding postoperative pain management protocol 24 hours after surgery (14) were recorded.

The time to first rescue analgesia (ketorolac) was considered as a primary outcome. The time to perform the block, the duration of anesthesia, the time to first ambulation, VAS-R, VAS-M, the total nalbuphine consumption (mg), the total requirements of rescue analgesia (ketorolac) over the first 24 hours after surgery, and the study safety profile were considered as secondary outcomes.

Statistical Analysis

Power of the Study

Depending on PASS software version 11(NCSS, LLC. Kaysville, Utah) (15), a sample size of 29 patients in each of ESPB, QLB and control groups satisfied an equivalence test of means using 2-sided tests when the true difference between QLB and ESPB groups regarding time to first rescue analgesia was 13.1 minutes and the standard deviation was 18.5 (16) with equivalence limits between them assumed to be ± 30.0 minutes,

with setting power at 90% and alpha error at 0.017 for 3 groups comparisons (17). The sample size was inflated up to 40 patients per group for possible attrition and block failure.

Data Analysis

Once the research team finished the data-gathering process, the data were analyzed using Statistical Package for Social Sciences (SPSS) version 22.0 (IBM Corporation, Armonk, NY). Quantitative data were explained as mean ± SD (standard deviation), then were compared using ANOVA test (3 independent groups) after being tested for normality using the Shapiro-Wilk test. Qualitative data were explained as number and percentage and were compared using Chi square test as well as Fisher's exact test in cases of variables with small expected numbers. The log-rank test was used to compare the rate of rescue analgesia. The *P*-value < 0.050 was regarded as the level of significance. The Bonferroni post hoc test was used for pairwise comparisons.

Results

Out of 148 patients assessed for eligibility, 120 patients were randomly allocated into the ESPB group, QLB group, or control (C) group (40 each). One hundred one patients completed the study. Block failure was non significantly less frequent in the ESPB group than QLB group (*P* = 0.675) (Fig. 2). Patients' demographics, comorbidities, and operative characteristics were comparable between the study groups (Table 1). The time to perform the block and the duration of anesthesia were higher in the QLB group compared to other groups, with significant differences between the ESPB and C groups (*P* < 0.001, *P* < 0.001, respectively) (Table 2).

The time to first rescue analgesia was significantly

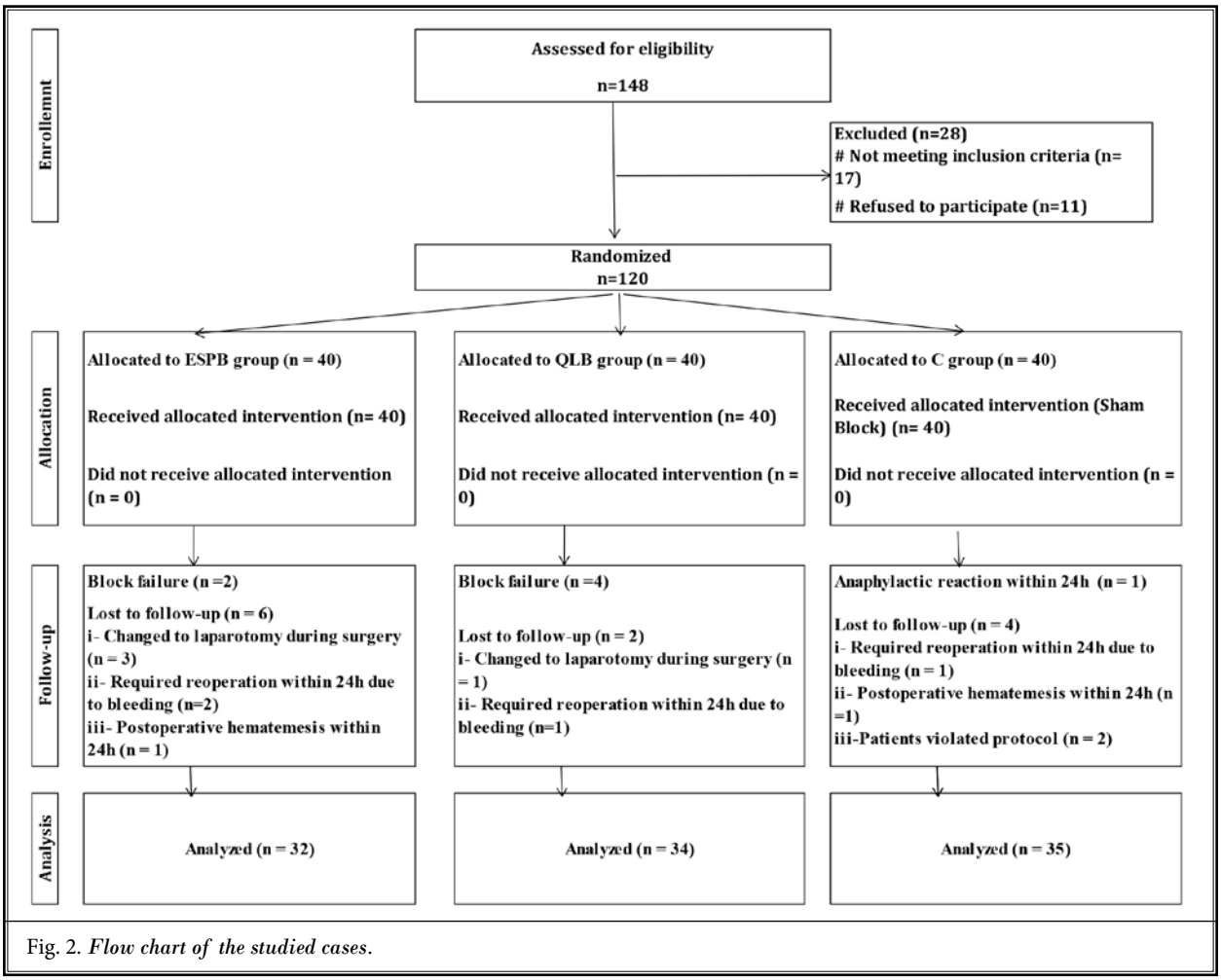

Fig. 2. *Flow chart of the studied cases.*

lower in the C group compared to the ESPB and QLB groups ($P < 0.001$) and nonsignificantly lower in the ESPB group in comparison to the QLB group (Table 2). In the C group, the total nalbuphine consumption, the frequency of patients who needed rescue analgesia, the number of rescue doses given for each patient, and the total dose of rescue analgesia in the first 24 hours after surgery were higher in comparison to the ESPB and QLB groups ($P < 0.001$, $P < 0.001$, $P < 0.001$, $P < 0.001$, respectively), with comparable efficacy between the ESPB and QLB groups (Table 2).

More patients in the ESPB and QLB groups had lower readings of HR and MAP at T2-T6 compared to the C group ($P < 0.001$), with no significant differences between the ESPB and QLB groups (Fig. 3). Alterations of HR and MAP at T0, T1, T7, and T8 were comparable between the 3 groups ($P > 0.05$) (Fig. 3).

In the C group, VAS-R and VAS-M readings were

Table 1. *Patients' demographics, comorbidities, and operative characteristics between the study groups.*

Variables		ESPB group (n = 32)	QLB group (n = 34)	C group (n = 35)	*P* value
Age (years), Mean ± SD		33.8 ± 5.4	34.3 ± 6.8	34.7 ± 6.7	^0.837
Gender (n, %)	Male	6 (18.8%)	5 (14.7%)	6 (17.1%)	#0.907
	Female	26 (81.3%)	29 (85.3%)	29 (82.9%)	
BMI (kg/m^2), Mean ± SD		45.6 ± 4.1	45.2 ± 4.4	44.4 ± 4.8	^0.517
Associated comorbidities (n, %):					
Medically free		10 (31.3%)	14 (41.2%)	12 (34.3%)	#0.687
Comorbidities (HTN and DM only)		22 (68.7%)	20 (58.8%)	23 (65.7%)	#0.687
HTN only		15 (46.9%)	14 (41.2%)	15 (42.9%)	#0.892
DM only		4 (12.5%)	3 (8.8%)	3 (8.6%)	§0.841
HTN and DM		3 (9.4%)	3 (8.8%)	5 (14.3%)	§0.785
Duration of Surgery (min)		103.9 ± 7.3	106.3 ± 6.2	105.1 ± 6.0	^0.329
Intraoperative fentanyl consumption (µg)		231.2 ± 25.4	226.7 ± 18.1	224.2 ± 20.7	^0.411
Intraoperative fluid (mL)		1441 ± 140	1499 ± 155	1490 ± 151	^0.247

Data are presented as mean ± SD or number and (%). ^ANOVA test. #Chi square test. §Fisher's exact test. HTN: hypertension, DM: diabetes mellitus.

Table 2. *Anesthetic profile and postoperative analgesic requirements between the study groups.*

Variables		ESPB group (n = 32)	QLB group (n = 34)	C group (n = 35)	*P* value
Time to perform the block (min)		8.5 ± 1.7 [a]	14.6 ± 2.2 [b]	4.6 ± 1.0 [c]	^< 0.001*
Duration of Anesthesia (min)		125.6 ± 7.3 [a]	137.8 ± 6.1 [b]	109.6 ± 6.2 [c]	^< 0.001*
Total Nalbuphine Consumption (mg)/24 h	Mean±SD	64.4 ± 12.4 [a]	57.1 ± 13.8 [a]	77.5 ± 15.7 [b]	^< 0.001*
	Range	48.0–96.0	48.0–96.0	48.0–96.0	
Patients who needed rescue analgesia, (n, %)		11 (34.4%) [a]	9 (26.5%) [a]	35 (100%) [b]	#< 0.001*
		n = 11	n = 9	n = 35	
Time to first rescue analgesia (h)	Mean±SD	21.4 ± 1.6 [a]	22.1 ± 1.1 [a]	0.7 ± 0.2 [b]	^< 0.001*
	Range	18.0-24.0	21.0-24.0	0.4-1.0	
Number of rescue doses (of ketorolac) given for each patient (n, %)	One	7 (63.6%) [a]	8 (88.9%) [a]	0 (0.0%) [b]	§< 0.001*
	Two	4 (36.4%)	1 (11.1%)	20 (57.1%)	
	More than two doses	0 (0.0%)	0 (0.0%)	15 (42.9%)	
Total dose of rescue analgesia (ketorolac) (mg) /24 h	Mean±SD	40.9 ± 15.1 [a]	33.3 ± 10.0 [a]	79.7 ± 25.1 [b]	^< 0.001*
	Range	30.0–60.0	30.0–60.0	60.0–120.0	

Data are presented as mean ± SD or number and (%). ^ANOVA test. #Chi square test. §Fisher's exact test. *Significant. Homogenous groups had the same symbol (a,b,c) based on a post hoc Bonferroni test.

higher in the first 18 hours after surgery compared to the ESPB and QLB groups, with comparable efficacy between the ESPB and QLB groups ($P < 0.001$, $P < 0.001$, respectively). In the rest 6 hours of 24 hours after surgery, the QLB group patients had lower VAS-R and VAS-M readings than the C group patients ($P < 0.001$, $P < 0.001$, respectively) with no significant differences between the ESPB and QLB groups (Fig. 4).

In the C group, the rate of requirements of rescue analgesia over 24 hours after surgery was higher in comparison to the ESPB and QLB groups ($P < 0.001$), with comparable efficacy between the ESPB and QLB groups (Fig. 5).

Incidences of shoulder pain, bradycardia, and hypotension were comparable between the 3 groups (Table 3).

More patients in the C group had higher incidences of PONV in comparison to the ESPB and QLB groups ($P = 0.011$, $P = 0.002$, respectively) with no significant differences between the ESPB and QLB groups (Table 3).

In the C group, the time to first ambulation, the length of PACU stay, and the hospital stay were higher in comparison to the ESPB and QLB groups with comparable efficacy between the ESPB and QLB groups ($P < 0.001$, $P < 0.001$, $P < 0.001$, respectively) (Table 3). More patients in ESPB and QLB groups were satisfied with postoperative pain management protocol in comparison to the C group ($P < 0.001$), with no significant differences between ESPB and QLB groups (Table 3).

Discussion

This study confirmed the efficacy of both ESPB and QLB in providing efficient postoperative analgesia with minimal side effects in morbidly obese patients undergoing LSG; despite, the QLB patients had a relatively prolonged postoperative analgesia compared to ESPB, yet, QLB is more difficult to perform and more time-consuming in comparison to ESPB. To the best of our knowledge, the research team is the first to compare the efficiency and safety of ESPB with QLB for postoperative pain management in bariatric surgery.

Postoperative multimodal pain management strategies are encouraged in bariatric surgery patients to reduce postoperative opioid consumption and, con-

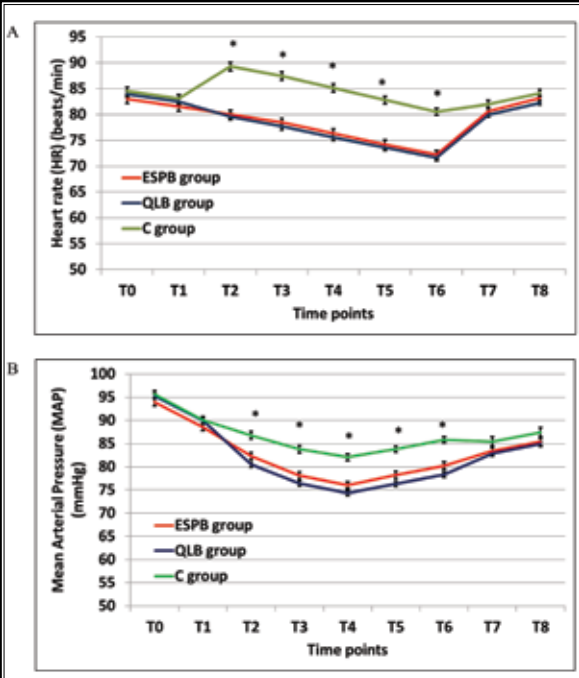

Fig. 3. *Intraoperative and postoperative hemodynamic variables between the study groups. a; Heart rate (HR), b; Mean arterial pressure (MAP).*
* Significant

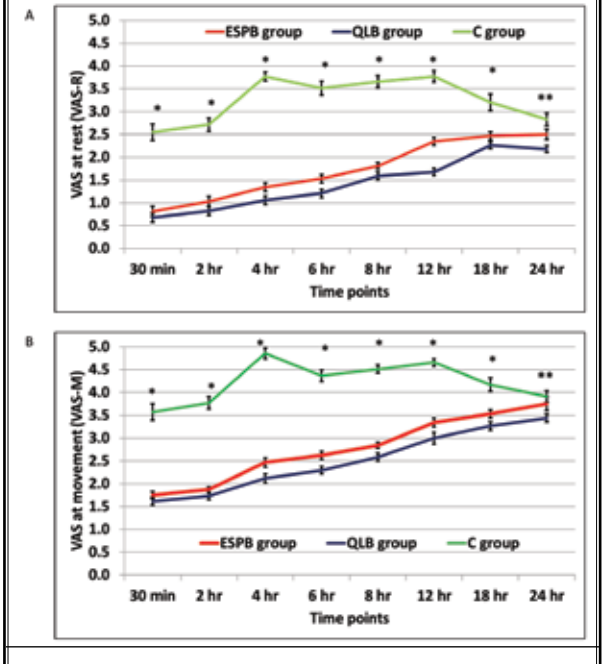

Fig. 4. *A; VAS at rest (VAS-R), B; VAS at movement (VAS-M) between the study groups*
(* significant for C group only with no significant differences between ESPB and QLB group, ** significant between C and QLB groups with no significant difference between ESPB and each of QLB and C groups).

sequently, decrease both PONV and the time to early ambulation (5). Nevertheless, these strategies can avoid opioid-induced respiratory depression, which is a major concern in such patients (4).

Many regional anesthetic techniques have been used to control postoperative pain in laparoscopic abdominal surgeries. The trocar site local anesthetic infiltration has been tried. However, it has a limited efficacy in visceral pain control and a short duration of action (5,18). Thoracic epidural anesthesia (TEA) did not show any advantages over PCA using intravenous (IV) morphine in a retrospective study of morbidly obese patients scheduled for elective gastric bypass surgery (19) and it did not improve the study outcomes nor pulmonary functions of patients compared with PCA (20). Moreover, the choice of TEA as a postoperative pain management strategy is compromised due to technical difficulties associated with its application in morbidly obese patients and a greater risk of wound infection (19). Tian et al (6) has recommended the transversus abdominis plane (TAP) block as a part of multimodal analgesia for ERAS in patients scheduled for bariatric surgery because TAP block decreased pain, narcotic use, and time to ambulation. On the contrary, Albrecht et al documented that bilateral TAP blocks didn`t add additional analgesic benefits to postoperative analgesia protocol for patients scheduled for laparoscopic gastric-bypass surgery. TAP block is useful only for somatic pain of the abdominal wall and not deep visceral pain (21).

The research team chose to evaluate the post-surgical analgesic efficacy of the bilateral US-guided ESPB compared with the bilateral US-guided QLB because both regional techniques block both the somatic and visceral components of pain after laparoscopic surgeries (8,10).

The ESPB was first applied in cases of severe thoracic neuropathic pain by Forero et al (22). Uses of the ESPB have evolved since then in painful surgical (23) and non-surgical conditions (24), making the ESPB a promising regional anesthetic procedure for analgesia in both neuropathic pain as well as acute postoperative pain (22). Being remote from vital structures, the ESPB is considered a relatively safe regional anesthetic technique with minimal clinical expertise requirements in interfascial plane blocks (4). When the local anesthetic is injected in the fascial plane deep to the erector spinae muscle at T7 vertebral level, it spreads cranially and caudally to block the dorsal and ventral rami of

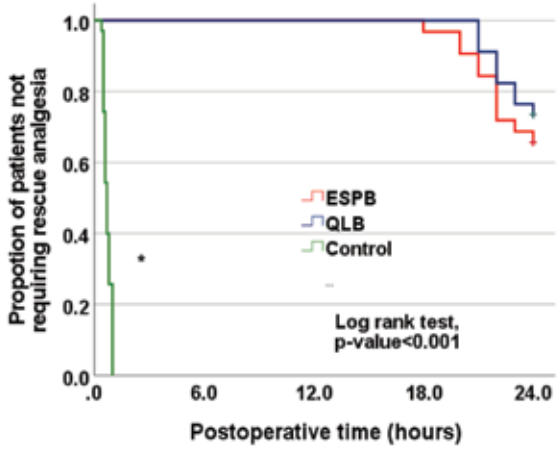

Fig. 5. *Kaplan Meier curve for requirements of rescue analgesia over 24 hours between the study groups (* significant for C group only with no significant differences between ESPB and QLB group).*

Table 3. *Postoperative data and side effects between the study groups.*

Variables	ESPB group (n = 32)	QLB group (n = 34)	C group (n = 35)	*P* value
Shoulder pain	3 (9.4%)	2 (5.9%)	5 (14.3%)	§0.548
Bradycardia	3 (9.4%)	5 (14.7%)	1 (2.9%)	§0.206
Hypotension	2 (6.3%)	4 (11.8%)	1 (2.9%)	§0.340
Nausea	12 (37.5%) [a]	11 (32.4%) [a]	23 (65.7%) [b]	#0.011*
Vomiting	4 (12.5%) [a]	3 (8.8%) [a]	14 (40.0%) [b]	#0.002*
Time to first ambulation (h)	2.9 ± 0.9 [a]	2.5 ± 0.5 [a]	4.4 ± 0.7 [b]	^< 0.001*
Length of PACU stay (min)	27.7 ± 1.7 [a]	26.8 ± 1.3 [a]	30.9 ± 1.7 [b]	^< 0.001*
Hospital stay (days)	1.6 ± 0.3 [a]	1.4 ± 0.3 [a]	2.2 ± 0.3 [b]	^< 0.001*
Patient Satisfaction Score (1-5) 24 hours postoperatively	3.9 ± 0.6 [a]	4.2 ± 0.4 [a]	1.6 ± 0.6 [b]	^< 0.001*

Data are presented as mean ± SD or number and (%). §Fisher's exact test. #Chi square test. ^ANOVA test. *Significant. Homogenous groups had the same symbol (a,b) based on post hoc Bonferroni test.

spinal nerves of the lower thoracic (T7–T12) and lumbar levels that innervate the abdomen. Moreover, the local anesthetic spreads to the paravertebral space and has a blocking effect on both the intercostal nerve branches and the sympathetic chain. Thus, the ESPB provides both somatic and visceral blockade (8,25).

The investigators of this clinical trial chose to perform the ESPB at T7 vertebral level with 30 mL of 0.25% bupivacaine for each side (8) to ensure the adequate block for visceral pain, Also, the investigators performed the block at the end of surgery and before extubation to assess the effects of bilateral ESPB on postoperative pain scores and on postoperative analgesics consumption compared with bilateral posterior QLB in the first 24 hours following LSG.

The current study concluded that the bilateral ESPB provided postoperative analgesia up to 18 hours following LSG. As far as the authors know, only a few studies were performed to evaluate the efficacy of the bilateral ESPB to provide adequate analgesia in bariatric surgeries. Abdelhamid et al found that the ESPB, which was carried out after induction of general anesthesia and before the skin incision, was superior to the other 2 groups regarding postoperative pain scores and comparable difference regarding the total postoperative pethidine consumption and the total postoperative paracetamol consumption in comparison to the TAP block group 24 hours following LSG. This could be attributed to the level of the ESPB at the T9 vertebral level or the injected local anesthetic volume (15 mL of 0.25% bupivacaine for each side) (26). Partially consistent with our results, Zengin et al recorded that patients who received preemptive bilateral ESPB at T9 vertebral level had lower VAS scores, and no patients required additional analgesia in the 24 hours following laparoscopic bariatric surgery (4). Furthermore, Mostafa et al (27), recorded that the preemptive bilateral ESPB (at T7 vertebral level) group had lower pain scores in the first 8 postoperative hours only and lower 24-hour postoperative morphine consumption in comparison to the sham block group following the laparoscopic bariatric surgery.

The bilateral ESPB provided an adequate postoperative analgesia in a variety of upper and lower abdominal laparoscopic procedures e.g., laparoscopic cholecystectomy, laparoscopic inguinal hernia repair, and laparoscopic Nissen fundoplication (8).

The concept of the QLB was proposed by Blanco in 2007 (28). Since then, the use of QLB block has been awash in many laparoscopic and open abdominal surgeries suggesting that the QLB is an effective option for postoperative analgesia (10,11). Liu et al (11) found that QLB was superior to the TAP block in prolonging the duration of postoperative analgesia (up to 24 hours) and in reducing the postoperative opioid requirements in patients undergoing abdominal surgeries. Partially consistent with the current study, Omran et al (29) concluded that the QLB decreased the postoperative pain scores in the first 12 hours after surgery and decreased the total postsurgical opioid requirements in comparison to the control group in patients undergoing laparoscopic bariatric surgeries.

The investigators of this clinical trial were the first to compare the ESPB to the QLB in the LSG. However, previous researchers made a comparison between these 2 blocks in patients scheduled for open nephrectomy, and they recorded that the ESPB had a comparable analgesic effect with QLB III, and patients of both blocks had lower postoperative narcotic requirements compared to control group (16). Kang et al (9) also compared both blocks in patients undergoing laparoscopic liver resection. Patients of both blocks had comparable pain scores and comparable total opioid consumption at 24, 48, and 72 hours postoperatively. They confirmed the adequacy of both blocks in providing comparable patient satisfaction with pain relief protocol 24 hours after surgery. So, the outcomes of that study did not show the superiority of the analgesic effect of QLB over that of ESPB. In contrast to our clinical practice, they recorded that the QLB performance was easy because it was done in a supine position and patients were not obese, while changing the patient's posture from supine to lateral to perform the ESPB was risky for fear of patient`s fall (9).

The investigators of this clinical trial reported a reduced incidence of postoperative shoulder pain due to the use of low insufflation pressure during the surgical intervention. In this research, the number of patients who experienced PONV was higher in the C group in comparison to the other groups in spite of receiving 2 antiemetics before the end of surgery to overcome the high incidence of PONV reported in the LSG (26). This was attributed to increased total nalbuphine consumption compared to the ESPB and the QLB groups. Nalbuphine is a Kappa (κ)-opioid receptor agonist (30). Opioid-induced nausea and vomiting (OINV) stimulate the chemoreceptor trigger zone (CTZ), the vestibular apparatus (VA), and receptors in the gastrointestinal tract (31). The research team did not report any cases of local anesthesia toxicity, hematoma formation or opioid-related respiratory depression.

This study had certain limitations; first, the lack of postoperative respiratory assessment (e.g., spirometry) precluded the identification of either ESPB or QLB effects on pulmonary functions in such patients. Second, the performance of US-guided interfacial plane blocks in morbidly obese patients encounters technical difficulties such as positioning patients under general anesthesia, US-settings, and ergonomics. Those difficulties could be minimized by proper device quality, suitable device settings, practitioner`s experience of US-guided interventions , and providing adequate personnel in operating rooms to ensure proper patient positioning without compromising his/her safety. Third, the investigators believe that this study protocol could be repeated on high number of patients and at different bariatric surgery centers, especially with the surge in the number of patients undergoing bariatric surgeries. Fourth, this study lacks the documentation of loss of sensation distribution in ESPB and QLB. However, being a study limitation, it was necessary to keep the double-blind design of this study.

The goal of postsurgical pain control is to alleviate pain while keeping adverse effects to a minimum. The interfacial plane blocks constitute an important part of multimodal analgesia and provide postoperative analgesia for morbidly obese patients after bariatric surgery with lower needs of parenteral opioids (32). Efficiency, safety, superiority in terms of analgesic provision, and variation in techniques were addressed in this study. Inadequate postoperative pain control with interfacial plane blocks is multifactorial. The lack of proper US-guided blocks training programs, block failure, fear of complications, and poor pain assessment are among the causes (32). Maintaining vigilance over time coupled with knowledge is optimal to achieve optimal postoperative analgesia in terms of efficacy and safety.

The research team recommends further studies to test the efficacy of ESPB and QLB in different bariatric surgeries using adjuvant drugs to local anesthetics and different local anesthetics volumes.

Conclusion

Bilateral ultrasound-guided erector spinae plane block and bilateral ultrasound-guided quadratus lumborum block provided adequate postoperative pain control and reduced postoperative analgesic requirements for morbidly obese patients scheduled for laparoscopic sleeve gastrectomy with priority to bilateral erector spinae plane block. Being an easy technique to perform with a low rate of complications, anesthesia trainees experiencing a short course of regional block skills can achieve competence and develop true expertise needed to practice ultrasound-guided erector spinae plane block.

References

1. Aboulghate M, Elaghoury A, Elebrashy I, et al. The burden of obesity in Egypt. *Front Public Health* 2021; 9:718978.
2. Senol K, Ferhatoglu MF, Kocaeli AA, Dundar HZ, Kaya E. Clinical features and short-term outcomes of bariatric surgery in morbidly obese patients: Institutional experience at a rural hospital. *Bariatr Surg Pract Patient Care* 2021; 16:61-67.
3. Hussein AH, Khaled I, Faisal M. The role of the surgical resection distance from the pylorus after laparoscopic sleeve gastrectomy: A prospective cohort study from an academic medical center in Egypt. *Patient Saf Surg* 2020; 14:42.
4. Zengin SU, Ergun MO, Gunal O. Effect of ultrasound-guided erector spinae plane block on postoperative pain and intraoperative opioid consumption in bariatric surgery. *Obes Surg* 2021; 31:5176-5182.
5. 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; 40:2065-2083.
6. Tian C, Lee Y, Oparin Y, Hong D, Shanthanna H. Benefits of transversus abdominis plane block on postoperative analgesia after bariatric surgery: A systematic review and meta-analysis. *Pain Physician* 2021; 24:345-358.
7. Chou R, Gordon DB, de Leon-Casasola OA, et al. Management of postoperative pain: A clinical practice guideline from the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *J Pain* 2016; 17:131-157.
8. Tulgar S, Ahiskalioglu A, De Cassai A, Gurkan Y. Efficacy of bilateral erector spinae plane block in the management of pain: Current insights. *J Pain Res* 2019 ; 12:2597-2613.
9. Kang R, Lee S, Kim GS, et al. Comparison of analgesic efficacy of erector spinae plane block and posterior quadratus lumborum block in laparoscopic liver resection: A randomized controlled trial. *J Pain Res* 2021; 14:3791-3800.
10. Akerman M, Pejčić N, Veličković I. A Review of the quadratus lumborum block and ERAS. *Front Medicine (Lausanne)* 2018; 5:44.
11. Liu X, Song T, Chen X, et al. Quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia in patients undergoing abdominal surgeries: A systematic review and meta-analysis of randomized controlled trials. *BMC Anesthesiol* 2020;

20:53.

12. Moon HY, Baek CW, Choi GJ, et al. Palonosetron and aprepitant for the prevention of postoperative nausea and vomiting in patients indicated for laparoscopic gynaecologic surgery: A double-blind randomised trial. *BMC Anesthesiol* 2014; 14:68.
13. Ashoor TM, Kassim DY, Esmat IM. A randomized controlled trial for prevention of postoperative nausea and vomiting after laparoscopic sleeve gastrectomy: Aprepitant/dexamethasone vs. mirtazapine/dexamethasone. *Anesthesiol Res Pract* 2022; 2022:3541073.
14. Belay Bizuneh Y, Fitiwi Lema G, Yilkal Fentie D, Woldegerima Berhe Y, Enyew Ashagrie H. Assessment of patient's satisfaction and associated factors regarding postoperative pain management at the University of Gondar Compressive Specialized Hospital, Northwest Ethiopia. *Pain Res Manage* 2020; 2020:8834807.
15. Hintze J. Power analysis sample size system (PASS) quick start manual: Kaysville, Utah USA: NCSS; 2011.
16. Abd Ellatif SE, Abdelnaby SM. Ultrasound guided erector spinae plane block versus quadratus lumborum block for postoperative analgesia in patient undergoing open nephrectomy: A randomized controlled study. *Egypt J Anesth* 2021; 37:1,123-134.
17. Jaccard J, Becker MA, Wood G. Pairwise multiple comparison procedures: A review. *Psychol Bull* 1984; 96:589-596.
18. Barazanchi AWH, MacFater WS, Rahiri JL, et al. Evidence-based management of pain after laparoscopic cholecystectomy: A PROSPECT review update. *Br J Anaesth* 2018; 121:787-803.
19. Charghi R, Backman S, Christou N, Rouah F, Schricker T. Patient controlled i.v. analgesia is an acceptable pain management strategy in morbidly obese patients undergoing gastric bypass surgery. A retrospective comparison with epidural analgesia. *Can J Anesth* 2003; 50:672-678.
20. Levy BF, Scott MJ, Fawcett W, Fry C, Rockall TA. Randomized clinical trial of epidural, spinal or patient-controlled analgesia for patients undergoing laparoscopic colorectal surgery. *Br J Surg* 2011; 98:1068-1078.
21. Albrecht E, Kirkham KR, Endersby RV, et al. Ultrasound-guided transversus abdominis plane (TAP) block for laparoscopic gastric-bypass surgery: A prospective randomized controlled double-blinded trial. *Obes Surg* 2013; 23:1309-1314.
22. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: A novel analgesic technique in thoracic neuropathic pain. *Reg Anesth Pain Med* 2016; 41:621-627.
23. Chen N, Qiao Q, Chen R, Xu Q, Zhang Y, Tian Y. The effect of ultrasound-guided intercostal nerve block, single-injection erector spinae plane block and multiple-injection paravertebral block on postoperative analgesia in thoracoscopic surgery: A randomized, double-blinded, clinical trial. *J Clin Anesth* 2020; 59:106-111.
24. Tekin E, Ahiskalioglu A, Aydin ME, Sengun E, Bayramoglu A, Alici HA. High-thoracic ultrasound-guided erector spinae plane block for acute herpes zoster pain management in emergency department. *Am J Emerg Med* 2019; 37:375.e1-375.e3.
25. Chin KJ, Adhikary SD, Forero M. Erector Spinae Plane (ESP) Block: a New Paradigm in Regional Anesthesia and Analgesia. *Curr Anesthesiol Rep* 2019; 9: 271-280.
26. Abdelhamid BM, Khaled D, Mansour MA, Hassan MM. Comparison between the ultrasound-guided erector spinae block and the subcostal approach to the transversus abdominis plane block in obese patients undergoing sleeve gastrectomy: A randomized controlled trial. *Minerva Anestesiol* 2020; 86:816-826.
27. Mostafa SF, Abdelghany MS, Abu Elyazed MM. Ultrasound-guided erector spinae plane block in patients undergoing laparoscopic bariatric surgery: A prospective randomized controlled trial. *Pain Pract* 2021; 21:445-453.
28. Blanco R. Tap block under ultrasound guidance: The description of a "no pops" technique: 271. *Reg Anesth Pain Med* 2007; 32:130.
29. Omran AS, KamalELDin DM, Nofal WH. Pre-emptive quadratus lumborum block for laparoscopic bariatric surgery: A prospective randomized controlled study. *Ain-Shams Journal of Anesthesiology* 2021; 13:21.
30. Cohen SE, Ratner EF, Kreitzman TR, Archer JH, Mignano LR. Nalbuphine is better than naloxone for treatment of side effects after epidural morphine. *Anesth Analg* 1992; 75:747-752.
31. Imam MZ, Kuo A, Ghassabian S, Smith MT. Progress in understanding mechanisms of opioid-induced gastrointestinal adverse effects and respiratory depression. *Neuropharmacology* 2018; 131:238-255.
32. Gürkan Y, Kuş A. Fascial plane blocks in regional anaesthesia and new approaches. *Turk J Anesthesiol Reanim* 2017; 45:85-86.