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Pre-emptive quadratus lumborum block for laparoscopic bariatric surgery: a prospective randomized controlled study

Ahmed S. Omran, Doaa M. KamalELDin and Walid H. Nofal[*]

Abstract

Background: Laparoscopic bariatric surgeries in morbidly obese patients have shown a steep rise recently. Quadratus lumborum block (QLB) has been used to decrease pain in various kinds of surgeries. The purpose of this study is to evaluate the ability of pre-emptive QLB to decrease intra- and postoperative pain and opioid consumption.

Results: Intraoperative HR and MAP were significantly lower in the QLB group starting 20 min after block initiation. Intraoperative additional fentanyl requirements, postoperative NRS scores at rest and with movement, nausea and vomiting and the consumption of rescue analgesia were also significantly lower in the QLB group for 12 h. Early ambulation was recorded in the QLB group.

Conclusions: Our results suggest that bilateral posterior QLB reduced intra- and postoperative pain during laparoscopic bariatric surgeries and decreased opioid requirements and side effects.

Keywords: Quadratus lumborum block, Laparoscopic bariatric surgery, Morbid obesity

Key messages

Quadratus lumborum block proved to be an effective and applicable block in morbidly obese patients undergoing laparoscopic bariatric surgeries. Effective adequate analgesic doses of local anaesthetic need more research in that kind of population.

Background

Obesity incidence is rising steadily worldwide (Kopelman 2000), where patients face variable serious health problems (Lau et al. 2007). Bariatric surgery has been recommended in adults with clinical severe obesity (Steinbrook 2004). Laparoscopic sleeve gastrectomy and laparoscopic gastric bypass surgeries proved to be superior compared to other techniques (Iannelli et al. 2006).

Undertreatment of acute postoperative pain is a burden on the healthcare system, and efforts are required to improve patients' postoperative pain experience (Kim and Mariano 2013). The addition of regional techniques to general anaesthesia showed better pain management and less consumption of opioids compared to the traditional techniques (Kim and Mariano 2013).

Quadratus lumborum block (QLB), first described by anaesthesiologist Dr. Rafael Blanco in 2007 (Blanco 2007), and its other variations (Borglum et al. 2013; Visoiu and Yakovleva 2013) have proved to be effective for different kinds of surgeries such as the following: caesarean section (Blanco et al. 2015, 2016; Sebbag et al. 2017), gynaecological laparoscopic procedures (Ishio et al. 2017) and other abdominal surgeries (Cardoso et al. 2016).

The objective of this study was to determine the effect of pre-emptive quadratus lumborum block on intra- and postoperative pain control and opioid requirements in laparoscopic bariatric procedures.

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Methods

This is a prospective randomized parallel controlled double-blinded study done in a tertiary university hospital. It was designed in adherence to CONSORT guidelines. Ethical approval for this study was provided by the Research Ethics Committee on the 5th of August 2017, reference number FMASU R 18/2017. A written informed consent has been obtained from all participants.

A total of 30 patients were randomly allocated into two groups, 15 patients in each group. Randomization was achieved using sealed envelopes. Allocation of patients to either group was done by an anaesthesiologist who was not involved in the study. The participants and the physician assessing the outcomes were blinded to the group allocation.

Patients included in this study are from both genders, aged 18–50, undergoing laparoscopic bariatric surgery (laparoscopic sleeve gastrectomy or gastric bypass), ASA III, BMI $\geq$ 35 kg/m^2 with comorbidity or $\geq$ 40 kg/m^2 without comorbidity.

Patients excluded from this study were those < 18 years old; patients diagnosed with obstructive sleep apnoea, Pickwickian syndrome, known coagulation defects and known hypersensitivity to bupivacaine; and those with contraindication to the use of NSAIDS and sepsis at the site of injection or conversion to laparotomy. Patients were randomly allocated into two groups: the control (C) group and the QLB (Q) group.

For induction of anaesthesia, patients were given IV anaesthesia by propofol 1–2 mg/kg (according to actual body weight), atracurium (0.5 mg/kg of actual BW) and fentanyl 2 μg/kg (actual BW), and intubation was done in the modified ramped position. Maintenance was done by atracurium guided by nerve stimulator monitoring, isoflurane concentration 1–1.5%, and under controlled mechanical ventilation. Ketorolac 30 mg in 100 ml NS infusion and paracetamol 1 g IV infusion were added for intraoperative analgesia for all patients. Additional intraoperative opioid analgesia was given in the form of incremental doses of fentanyl 50 μg as required with increase in heart rate and mean arterial pressure > 20% of baseline readings. After induction of anaesthesia, a quadratus lumborum block (QLB) was performed using an ultrasound machine (Sonosite EDGE Portable Ultrasound System, SonoSite, Bothell, Washington, USA). A 5–8-MHz curved probe was used with the patient in the supine position. The QLB2 technique was adopted due to its convenience for the anaesthetist and the assisting staff. After sterilizing the abdomen with povidone-iodine solution, the probe was placed at the level of the anterior superior iliac spine and directed cranially until the three abdominal muscles were clearly identified. The external oblique muscle was followed postero-laterally until its posterior border was visualized with the underlying

internal oblique forming a roof over the quadratus lumborum muscle. The probe was tilted down to identify the bright hyperechoic line representing the intermediate layer of the thoracolumbar fascia (Fig. 1). The needle (Sonoplex stim cannula, Pajunk, 21gauge × 100 mm, Nor Cross, Georgia, USA) was inserted in plane from medial (anterior) to lateral (posterior). The optimal point of injection was determined by the hydrodissection where a solution of 0.25% bupivacaine (Sunnypivacaine by Sunny Pharmaceuticals) 0.2 ml/kg (according to lean body weight) was injected on each side with care not to exceed the maximum safe dose. In the control group (C), the same technique was followed and 0.2 ml/kg of normal saline was injected on each side. The anaesthetist observing the patient was blinded. At the end of the surgery, after confirmation of the return of full muscle power, patients were extubated and transferred to HDU for postoperative care. Postoperative analgesia was given on a regular basis as 30 mg ketorolac in 100 ml normal saline every 12 h, as well as paracetamol infusion 1 g every 6 h. Rescue analgesia was given in the form of 5 mg morphine IV whenever NRS $\geq$ 4 up to a maximum of 4 times for the first 24 h.

The primary outcome of this study was the assessment of analgesia intraoperatively and postoperatively for the first 24 h in both groups. Intraoperative analgesia was assessed by intraoperative heart rate, mean arterial pressure and further requirements of fentanyl. Postoperative analgesia was evaluated by numerical rating scale (NRS) at rest and with movement (Blanco et al. 2016). It was conceptualized to the patient as 0 = no pain, 1–3 = mild pain [discomfort, nagging, annoying, interfering little with activities of daily living], 4–6 = moderate pain [interfering significantly with activities of daily living], 7–10 = severe pain [disabling; unable to perform activities of daily living]. Secondary outcomes included time to first analgesic requirement, total morphine requirements during the first 24 h, time to first ambulation, incidence of shoulder pain, adverse effects and incidence of opioid side effects.

Statistical analysis

A sample size of 15 patients per group was found to be sufficient to detect a difference of 1 mark in the NRS score when the variance is 1 mark with 80% power at α = 0.05 level (Fig. 2). Data were analysed using Statistical Package for Social Science (SPSS) version 21.0., Chicago, IL, USA. Quantitative data were expressed as mean $\pm$ standard deviation. Qualitative data were expressed as count and percentage. The independent samples *t*-test was used to compare between means in the two groups. Skewed numerical data are presented as median (range) and independent samples-median test was used to compare between medians in both groups. A chi-square test
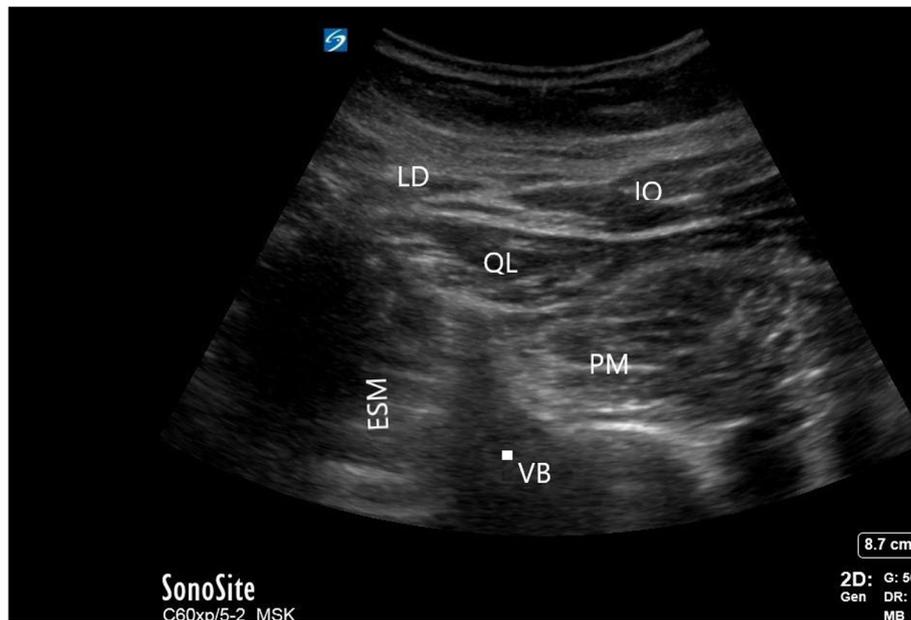
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Fig. 1 ESM erector spinae muscle, IO internal oblique muscle, LD latissimus dorsi muscle, PM psoas major muscle, QL quadratus lumborum muscle, TA transversus abdominis muscle, VB vertebral body and transverse process

was used to compare proportions between two qualitative parameters. $P < 0.05$ was considered significant, and $P < 0.01$ was considered highly significant.

Results

Our results show that there was no significant difference between both groups as regards age, sex, ASA physical status, baseline BMI, duration of surgical procedure and type of surgery (sleeve gastrectomy or gastric bypass) ($P > 0.05$) (Table 1).

Heart rate showed significantly lower values in group Q starting 20 min after initiation of the bock until the end of surgery ($P < 0.05$) (Table 2). Mean arterial blood pressure also showed significantly lower readings in the Q group starting 20 min from initiation of the block until the end of surgery ($P < 0.05$) (Table 3).

Comparison between both groups regarding NRS at rest showed significantly lower median scores in the Q group immediately postoperatively, at 2 h, 4 h, 6 h, 8 h and 12 h. However, at 16 h, 20 h and 24 h postoperatively, NRS at rest was similar in both groups ($P > 0.05$). NRS with movement also showed similar results with significantly lower median values at 6, 8 and 12 h postoperatively with P values (< 0.001); however, at 16, 20 and 24 h, there was no significant difference between both groups regarding NRS with P values ($P > 0.05$) (Table 4).

Regarding analgesic requirements, the additional intraoperative dose of fentanyl given after induction was significantly higher in the control group than group Q

($96.7 \pm 35.2\,\mu g$ and $43.3 \pm 37.2\,\mu g$ respectively) ($P < 0.001$). The postoperative consumption of rescue analgesia in the form of morphine was significantly lower in group Q as compared to the control group (4 ± 4.31 mg and 9.67 ± 4.41 mg respectively) ($P = 0.001$). The time to first analgesic requirement was significantly longer in the QLB group as compared to the control group (11.1 ± 0.97 h and 1.6 ± 1.1 h respectively) ($P < 0.001$), and the median number of rescue doses given to each patient was significantly lower in group Q compared to the control group (1 dose and 2 doses respectively) ($P = 0.027$). The total number of patients who required rescue analgesia was significantly lower in group Q (eight out of 15 (53.3%)) as compared to the control group (14 out of 15 (93.3%)) ($P = 0.013$) (Table 5).

Comparison of postoperative events showed that the time to first ambulation was significantly shorter in group Q as compared to the control group (4.1 ± 0.1 h and 4.7 ± 0.3 h respectively) ($P < 0.001$). The incidence of shoulder pain was similar in both groups (12 out of 15 patients in group Q (80%) compared to 11 out of 15 (73.7%) patients in group C) ($P = 0.666$). The incidence of nausea and vomiting was significantly lower in group Q, only two patients 13.3% as compared to seven patients 46.7% in the control group ($P = 0.046$). The incidence of other opioid adverse effects, such as itching, respiratory depression and sedation, was lower in group Q (33.3%) as compared to the control group (80%), but this was statistically a non-significant difference ($P = 0.069$) (Table 6).
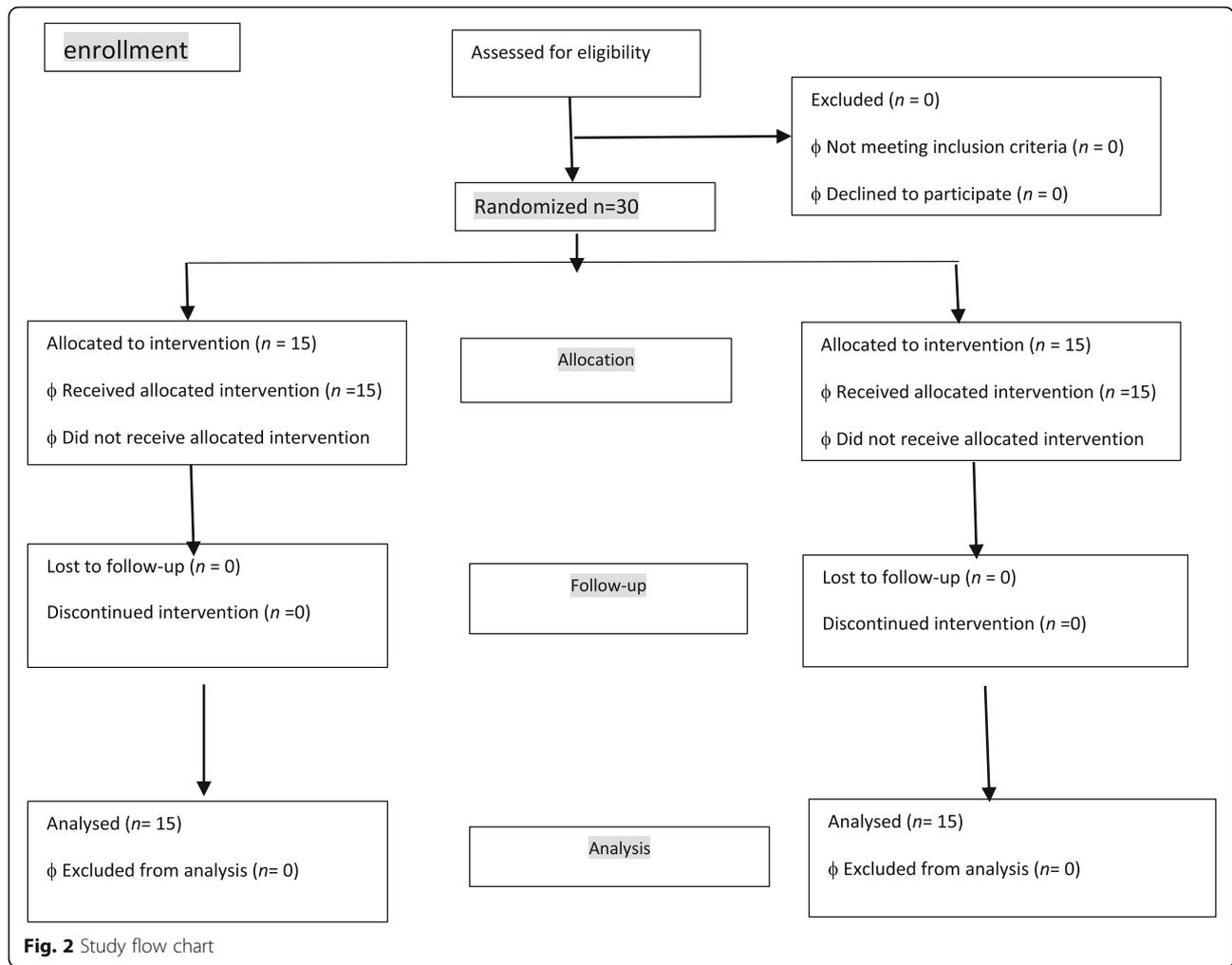
Fig. 2 Study flow chart

Discussion

Ultrasound-guided QLB was first introduced by Dr. Blanco in 2007 (Blanco 2007). The true mechanism of QLB needs to be fully clarified (Akerman et al. 2018). It was postulated that the spread of the local anaesthetic along the thoracolumbar (TLF) and the endothoracic fascia till the paravertebral space may explain the

analgesic effect. Another mechanism was the effect of local anaesthetics on the mechanoreceptors and pain receptors located in the thoracolumbar fascia (Carney et al. 2011; Benetazzo et al. 2011).

In our study, we postulated that the performance of QL block prior to laparoscopic bariatric surgery may improve intraoperative and postoperative analgesia and

Table 1 Descriptive analysis of the demographic and surgical data in each group

Variable	Group Q	Group C	*P* value
Sex (M/F)	4/11	6/9	0.439*
Age (years)	33.00 ± 8.51	31.33 ± 9.96	0.626°
ASA (II/III)	9/6	10/5	0.544*
BMI	50.46 ± 7.79	46.50 ± 6.76	0.148°
Duration of surgery (min)	131.33 ± 26.96	130.33 ± 28.81	0.923°
Type of surgery (sleeve/bypass)	7/8	11/4	0.136*

Data presented as mean ± SD or count
° Measured by the independent *t*-test
*Measured by the chi-square test

Table 2 Comparison between heart rate in the control (C) group and the QLB (Q) group

	Group	Mean	Std. deviation	P value
HR 10 min after start of surgery	Group Q	85.93	5.80	0.456
	Group C	87.67	6.74	
HR 20 min after start of surgery	Group Q	85.20	5.28	0.035
	Group C	89.47	5.28	
HR 30 min after start of surgery	Group Q	84.80	5.53	0.036
	Group C	89.47	6.03	
HR 40 min after start of surgery	Group Q	80.33	5.63	0.002
	Group C	87.33	5.55	
HR 50 min after start of surgery	Group Q	77.53	6.13	0.001
	Group C	85.80	5.55	
HR 60 min after start of surgery	Group Q	76.80	6.29	0.026
	Group C	82.27	6.43	
HR 70 min after start of surgery	Group Q	78.73	5.99	0.001
	Group C	89.87	4.47	
HR 80 min after start of surgery	Group Q	75.00	6.73	0.001
	Group C	88.20	6.45	
HR 90 min after start of surgery	Group Q	79.47	4.66	0.001
	Group C	90.53	4.09	
HR 100 min after start of surgery	Group Q	80.53	4.07	0.001
	Group C	89.07	4.62	
HR 110 min after start of surgery	Group Q	79.73	5.93	0.001
	Group C	91.07	4.35	
HR 120 min after start of surgery	Group Q	80.00	3.68	0.001
	Group C	91.87	3.87	
HR 130 min after start of surgery	Group Q	86.80	3.08	0.038
	Group C	83.73	4.50	

Data were analysed utilizing an independent *t*-test. $P < 0.05$ is considered significant

reduce intra- and postoperative opioid consumption. To the best of our knowledge, this is the first double-blinded randomized, prospective study of QLB for laparoscopic bariatric surgeries in morbidly obese patients with a pre-emptive approach.

The observations in our study are divided between the intraoperative and the postoperative periods. Our study showed a marked difference intraoperatively between both groups regarding heart rate and mean arterial pressure. Both HR and MAP were significantly lower in the QLB group starting 20 min after injection until the end of surgery. The QLB group also showed significantly lower consumption of additional doses of fentanyl intraoperatively. The adequacy of intraoperative analgesia provided in our study may also suggest some degree of visceral pain blockade.

Regarding the postoperative period, the NRS at rest and with movement remained significantly lower in the QLB group until 12 h postoperatively. However, NRS was similar in both groups beyond this time period. Morphine consumption as rescue analgesia was significantly lower in the QLB group with significantly lower opioid adverse effects, and significantly earlier ambulation in the QLB group.

The period of analgesia in our study may not agree with other previous studies that showed that the analgesic effect of QLB may last up to 48 h postoperatively (Blanco et al. 2015; Ishio et al. 2017; Ökmen et al. 2018). This difference may be explained by the fact that the volume of drug administered in our study was calculated according to the lean body weight which may raise the question about the adequate dose needed to achieve longer and safe analgesia in the morbidly obese patients.

A number of previous studies have investigated the efficacy of QLB in laparoscopic surgeries. Ökmen et al. studied the effect of bilateral QLB in laparoscopic

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Table 3 Comparison between the QLB (Q) group and the control (C) group regarding blood pressure intraoperatively

	Group	Mean	Std. deviation	*P* value
MBP 10 min after start of surgery	Group Q	82.27	3.97	0.249
	Group C	84.07	4.40	
MBP 20 min after start of surgery	Group Q	82.33	7.16	0.544
	Group C	83.67	4.40	
MBP 30 min after start of surgery	Group Q	80.53	4.07	0.007
	Group C	84.80	4.04	
MBP 40 min after start of surgery	Group Q	82.07	6.12	0.009
	Group C	87.27	3.83	
MBP 50 min after start of surgery	Group Q	74.53	4.44	0.001
	Group C	80.87	4.50	
MBP 60 min after start of surgery	Group Q	78.00	5.43	0.015
	Group C	83.00	5.09	
MBP 70 min after start of surgery	Group Q	78.07	5.34	0.001
	Group C	84.53	3.11	
MBP 80 min after start of surgery	Group Q	77.33	4.52	0.001
	Group C	83.27	4.11	
MBP 90 min after start of surgery	Group Q	77.33	4.91	0.001
	Group C	85.27	2.34	
MBP 100 min after start of surgery	Group Q	78.53	5.14	0.007
	Group C	83.73	4.67	
MBP 110 min after start of surgery	Group Q	75.20	4.04	0.001
	Group C	85.40	7.08	
MBP 120 min after start of surgery	Group Q	74.80	3.14	0.001
	Group C	85.53	6.85	
MBP 130 min after start of surgery	Group Q	76.80	2.78	0.001
	Group C	83.80	4.75	

P < 0.05 is considered significant

cholecystectomy, and their results showed significantly lower pain scores and postoperative opioid consumption that lasted 24 h (Ökmen et al. 2018), as compared to only 12 h in our study. A possible explanation for this difference may be that the dose of local anaesthetic used in their study was 0.3 ml/kg 0.25% bupivacaine on each side as compared to 0.2 ml/kg of lean body weight given in our study. This suggests that a higher volume may be required for morbidly obese patients. Two patients in the Ökmen et al. study developed sensory loss in the anterior aspect of the thigh and motor weakness in the lower limb. They suggested the effect of pneumoperitoneum as a possible explanation for altering the spread of local anaesthetic injected (Ökmen et al. 2018). It is worth noting that none of the patients in our study suffered such a complication.

Similarly, Ishio et al. studied the effectiveness of postoperative posterior quadratus lumborum block in 35 female patients undergoing gynaecological laparoscopy. They injected 20 ml of 0.375% ropivacaine on each side after the end of surgery. Their results demonstrated effective analgesia and significantly lower NRS scores at rest and with movement for 24 h postoperatively as compared to 12 h in our study. They also recorded lower postoperative analgesic consumption, earlier ambulation and a significantly lower incidence of nausea and vomiting in the QLB group (Ishio et al. 2017), which goes with our results.

The possible mechanisms of action of QLB remain to be clarified, where different approaches show different patterns of spread (Carline et al. 2016). The effect of induced pneumoperitoneum in laparoscopic surgeries and positioning should be more investigated as it was postulated as a cause for the unexpected spread of local anaesthetic to L1, L2 and L3 spinal nerves resulting in motor weakness of the

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Table 4 Comparison between the 2 groups regarding the medians of the NRS score

Variable	Group Q	Group C	P value
NRS at rest			
Immediate postoperatively	3 (2–3)	5 (3–6)	0.017
2 h postoperatively	3 (2–3)	4 (3–5)	0.001
4 h postoperatively	3 (2–3)	4 (2–4)	0.001
6 h postoperatively	3 (2–3)	4 (2–5)	0.002
8 h postoperatively	3 (3–5)	4 (2–6)	0.001
12 h postoperatively	2 (2–4)	3 (2–4)	0.043
16 h postoperatively	3 (2–4)	3 (2–5)	1.000
20 h postoperatively	4 (2–5)	3 (2–5)	0.245
24 h postoperatively	3 (2–3)	2 (2–3)	0.123
NRS with ambulation			
6 h postoperatively	1 (0–2)	4 (2–5)	< 0.001
8 h postoperatively	1 (0–1)	4 (3–4)	< 0.001
12 h postoperatively	1 (0–1)	4 (3–5)	< 0.001
16 h postoperatively	3 (1–3)	3 (3–5)	0.101
20 h postoperatively	3 (2–4)	4 (3–5)	0.483
24 h postoperatively	4 (3–4)	4 (3–4)	n/a*

Data presented as median (range). All *P* value measured by independent samples-median test

*The medians of NRS at 24 h postoperatively with ambulation are the same across both groups

lower limb in the case report by Wikner (2017). In our study, none of the patients reported motor weakness.

This study has some limitations worth noting. Firstly, the block was performed after induction of anaesthesia, so a preoperative sensory block was not possible to be evaluated. Secondly, the volume of drug injected in our study was calculated as 0.2 ml/kg of lean body weight on each side which may have provided limited analgesia for a shorter period of time than was expected. Volume calculation in morbidly obese patients needs further re-evaluation.

Table 5 Comparison for narcotic consumption intra- and postoperative between the Q group and the C group

Variable	Group Q	Group C	P value
Consumption of fentanyl (μg)	43.3 ± 37.2	96.7 ± 35.2	< 0.001
Consumption of morphine (mg)	4 ± 4.31	9.67 ± 4.41	0.001
Time to first dose of morphine (hours)	11.1 ± 0.97	1.6 ± 1.1	< 0.001
Number of rescue doses given for each patient	1 (0–2)	2 (0–3)	0.027
Number of patients who needed rescue analgesia	8 (53.3)	14 (93.3)	0.013

Data presented as mean ± SD, median (range) or count (%)

Table 6 Comparison between both groups regarding postoperative events

Variable	Group Q	Group C	P value
Time to first ambulation (hours)	4.1 ± 0.1	4.7 ± 0.3	< 0.001°
Patients with shoulder pain	12 (80)	11 (73.3)	0.666
Patients with side effects from morphine	5 (33.3)	12 (80)	0.069
Patients who had nausea and vomiting	2 (13.3)	7 (46.7)	0.046

Data presented as mean ± SD, count (%). *P* < 0.05 is considered significant. All other *P* values measured by the chi-square test

°*P* value measured by an independent *t*-test

Conclusion

Our results suggest that QLB significantly reduced intra- and postoperative pain and opioid requirements as well as opioid side effects and provided earlier ambulation in laparoscopic bariatric surgeries in morbidly obese patients.

Abbreviations
ASA: American Society of Anesthesiologist; BMI: Body mass index; HDU: High dependency unit; HR: Heart rate; MBP: Mean blood pressure; NRS: Numerical rating scale; QLB: Quadratus lumborum block

Declarations

Ethics approval and consent to participate
Ethical approval for this study was provided by the Research Ethics Committee Faculty of Medicine Ain Shams University, Cairo, Egypt, on the 5th of August 2017, reference number FMASU R 18/2017; this study is also registered in clinicaltrial.gov, trial registration: registered 14 February 2020—retrospectively registered, http://www.clinicaltrials.gov/NCT04294329. All participants gave a written informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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