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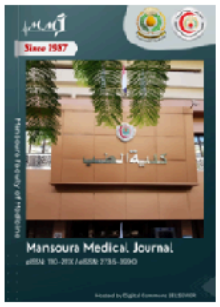

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Ultrasound guided Quadratus lumborum block versus transversus abdominis plane block as postoperative analgesia in patients undergoing abdominal cancer surgery

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ORIGINAL STUDY

Ultrasound-guided Quadratus Lumborum Block Versus Transversus Abdominis Plane Block as Postoperative Analgesia in Patients Undergoing Abdominal Cancer Surgery

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Abstract

Background: **Abdominal surgeries are often linked with postoperative pain (POP). The transverse abdominal plane (TAP) block is an efficient method for POP management in these patients. The quadratus lumborum (QL) block (QLB) is another method for the POP control. The current study aims to assess the efficiency and safety of QLB and TAP block for POP control after abdominal cancer surgeries.**

Patients and methods: **This randomized study included 98 cases scheduled for abdominal cancer surgery under general anesthesia (GA). They were randomly divided into two equal groups: the QL group patients received GA plus bilateral QLB and the TAP group patients received GA plus bilateral TAP block. The total dose of morphine used postoperatively was measured. Visual analog scale and the duration of postoperative analgesia were recorded.**

Results: **There was a statistically significant longer analgesic duration in the QL group than in the TAP group, and there was also a statistically significant decrease in intraoperative fentanyl consumption in the QL group than in the TAP group. Postsurgical morphine consumption was significantly lower in the QL group than in the TAP group. A significantly lower visual analog scale was demonstrated in the QL group than in the TAP group.**

Conclusion: **We concluded that in patients undergoing abdominal cancer surgeries, ultrasound-guided QLB decreased the postsurgical analgesic consumption and prolonged the duration of postsurgical analgesia when compared with the TAP block.**

Keywords: Abdominal cancer surgery, Quadratus lumborum block, Transversus abdominus plane block

1. Introduction

Severe postoperative pain (POP) occurs usually in abdominal surgery cases; this pain not only affects the recovery of cases but also produces several pathophysiological responses (Borglum et al., 2016). As a result, a safe and efficient pain management is very important for these surgeries. Although traditional postsurgical analgesia techniques can offer efficient POP relief; these techniques have a definite risk of adverse events (Wu et al., 2005; Naz et al., 2021; Salicath et al., 2018). Lately, with the improvement in postoperative recovery, nerve blocks are now frequently used in pain management protocols (Wick et al., 2017). As efficient components of multimodal analgesia, quadratus lumborum block (QLB) and transverse abdominal plane (TAP) block are essentially used in abdominal surgery as POP management techniques. QLB is a new practice in the field of peripheral nerve blocks and demonstrated hopeful outcomes, but only a limited number of researches were conducted to confirm its efficiency (Naz et al., 2021). Our study aims to compare QLB and TAB block as regards their analgesic effect.

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2. Patients and methods

2.1. Study design

This prospective, controlled, randomized study was done in Mansoura University hospitals over a period of 1 year. All patients signed informed written consents for inclusion before they participated in the study. Our study design was in agreement with the Declaration of Helsinki and also was approved by IRB (R.22.08.1787.R1) at (16/8/2022) and clinical trials registration NCT05533424 at (9/9/2022).

The CONSORT reporting guidelines was used in this study (Schulz et al. 2010).

2.2. Study participants

2.2.1. Inclusion criteria

Patients included in the study were aged 45–60 years, American Society of Anesthesiologists I and II, and were scheduled for abdominal cancer surgeries using general anesthesia (GA).

2.2.2. Exclusion criteria

Patients with infections at the injection site, coagulation disorders, physical or mental diseases, allergy to local anesthetics, renal failure, or hepatic failure were ruled out.

2.3. Sample size calculation

Power Analysis and PASS, version 21.0.3, were used to calculate the appropriate number of cases. According to a preceding research (Schulz et al. 2010), the mean ± SD of overall morphine consumption in the TAP block group was 6.45 ± 3.26 mg. Assuming an alpha error of 0.05, beta error of 0.2, with a mean difference of 1.9; about 30%, 45 cases are required in each group. Allowing 10% dropout, 98 cases will be required ($n = 49$).

In all, 98 cases were haphazardly divided into two groups ($n = 49$).

(1) Group QL (49 patients): GA plus bilateral QLB.
(2) Group TAP (49 patients): GA plus bilateral TAP block.

Randomization: randomization was done using a computer system by listing of number; each number represented one of the two groups. Each number was placed in a sealed envelope. After that, the patient selected an envelope, and the number was revised from the software-generated list and assigned to the resulting group.

Blinding: the patients and the anesthesiologists who collect the data were blinded to the group allocation.

Preoperative assessment by history taking, examination, and laboratory investigations was done. In the operative theater, monitoring by ECHO, blood pressure (BP), pulse oximetry, and capnography was done. Basal readings such as BP, pulse, and O_2 saturation were documented too. Insertion of intravenous (i.v.) line was done, and infusion of i.v. fluid was initiated. With regard to the studied groups, GA induction was done using i.v. fentanyl (1 μg/kg) and propofol (2 mg/kg), followed by atracurium (0.5 mg/kg) for endotracheal intubation. Mechanical ventilation was used to keep the end-tidal CO_2 values around 35 mmHg. Maintenance of anesthesia with isoflurane 2% in 100% O_2 atracurium (0.1 mg/kg) was given every 30 min or when required.

2.4. Interventions

After the intubation and preoperative, the block technique was done by an anesthesiologist. Both blocks were done under complete asepsis using US with HF linear probe enclosed with a sterile sheath and 100 mm needle. As regards the QL group, the patient was positioned in supine position with a lateral tilt, and the transducer was positioned at the ASIS level and then moved in a cranial manner till reaching the three abdominal wall muscles. The external oblique muscle was posterolateral till its posterior margin was identified, leaving beneath the internal oblique muscle (IOM), as a roof above the QL muscle. The US probe was angled downward to detect a bright hyperechoic line, which signified the thoracolumbar fascia (TLF). Then the needle was initiated from AL to PM. Its tip was located between the TLF and the QL muscle, and following negative aspiration, the proper needle position was confirmed by an injection of 5 ml of NaCl 0.9% to approve the space using hypoechoic images and hydrodissection. A measure of 20 ml of 0.25% bupivacaine was administrated and the same procedure was performed on the opposite side.

With regard to the TAP group, the probe was placed at the umbilicus level at the anterior axillary line, between the iliac crest and the lower costal border, and then identification of external oblique muscle, internal oblique muscle, and the transverse abdominis muscle was done. In-plane approach was used, and the needle tip was processed between the internal oblique muscle and transverse abdominis muscle. Following negative suction (to rule out intravascular injection), 20 ml of 0.25% bupivacaine was injected. The same procedure was used on the contralateral side.

Intraoperative injection of fentanyl 1–2 μg/kg was done, if either the BP or the HR rises by more than 20% above the basal values. Thirty minutes before the termination of the operation, acetaminophen 1 g i.v. was administrated. Cessation of isoflurane inhalation at the end of the operation was followed by neostigmine 0.05 mg/kg and atropine 0.01 mg/kg to overcome the effect of muscle relaxant. Following awakening from anesthesia and accomplishing a proper degree of conscious level, the patient was transported to the postanesthesia care unit. Visual analog scale (VAS) was used to measure the POP; if VAS more than 3, i.v. morphine was given and recorded. All adverse effects were documented such as hypotension, dysrhythmia, bradycardia, vomiting, or muscle weakness.

2.5. Primary outcome

The total morphine dose used postoperatively was measured.

2.6. Secondary outcome

(1) VAS for pain (from 0 to 10, in which 0 no pain and 10 maximal pain) was assessed at 30 min and 2 h, 4 h, 6 h, 12 h, and 24 h postoperative.
(2) Duration of postsurgical analgesia (from the recovery to the initial analgesic dosage).
(3) Patient's hemodynamics.

2.7. Statistical analysis

The collected data were analyzed using the IBM SPSS software program for Windows, version 25, (SPSS Inc., Armonk, New York, USA).

Data were extracted as numbers and percentages and after that compared by the χ^2 test. Continuous data were stated as mean ± SD in cases with normal distribution of data, while expression of abnormally distributed data as median and range. The previous data were compared using the one-way analysis of variance test; however, the latter were compared by using the Kruskal–Wallis test. In the context of all the previously used tests, P was considered significant when its value was less than 0.05.

3. Results

In all, 105 cases were eligible for the study; however, seven patients were ruled out as they did not meet the inclusion criteria; 98 patients were included in the study and were divided randomly into 49 patients in each of the studied groups as shown in Fig. 1.

There was no statistically significant difference between both groups regarding age and sex distribution as shown in Table 1.

No significant difference between groups in heart rate at 2, 4, 6, 9, and 12 h postoperative as shown in Table 2.

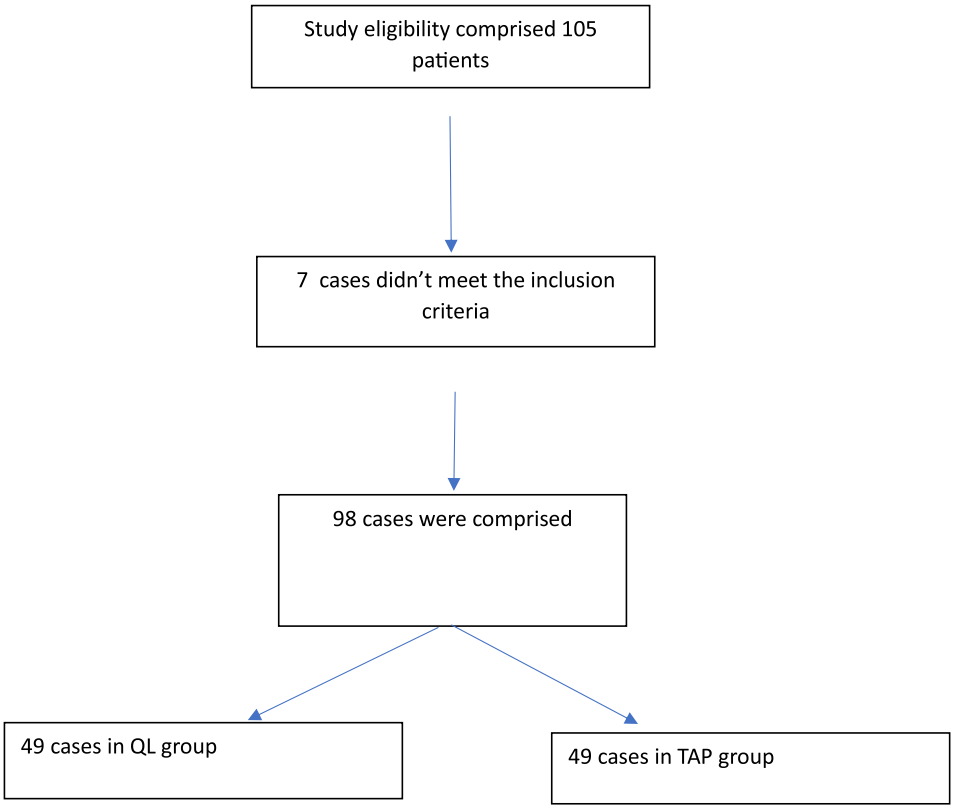

Fig. 1. CONSORT patient flow diagram.

Table 1. Demographic data of the studied groups.

	Group QL ($N = 49$)	Group TAP ($N = 49$)	95% CI	P
Age (years)	45.86 ± 9.305	43.41 ± 10.386	−1.51, 6.40	0.222
Sex [*n* (%)]				
Male	27 (55.1)	23 (46.9)	–	0.419
Female	22 (44.9)	26 (53.1)		

QL, quadratus lumborum; TAP, transverse abdominal plane.
P value less than 0.05 is significant.
Data are mean±SD or numbers and percentage

Table 2. Heart rate follow-up of the studied groups.

Heart rate (bpm)	Group QL ($N = 49$)	Group TAP ($N = 49$)	95% CI	P
Basal	74.61 ± 3.451	74.53 ± 2.509	−1.13, 1.29	0.894
2 h	75.78 ± 2.435	75.57 ± 2.693	−0.83, 1.23	0.695
4 h	75.43 ± 2.236	75.94 ± 2.503	−1.46, 0.44	0.290
6 h	75.27 ± 2.325	75.12 ± 2.563	−0.84, 1.12	0.773
9 h	75.43 ± 2.965	74.96 ± 2.226	−0.58, 1.52	0.378
12 h	76.76 ± 1.910	76.98 ± 1.664	−0.94, 0.49	0.537

CI, confidence interval; QL, quadratus lumborum; TAP, transverse abdominal plane.
P value less than 0.05 is significant.
Data are mean ± SD.

There was no statistically significant difference between both groups in mean arterial BP at 2, 4, 6, 9, and 12 h postoperatively as shown in Table 3.

VAS follow-up as represented in Table 4. There was a statistically significant decrease in the QL group compared with the TAP group at (4, 6, 12, 24 h) postoperative.

There was statistically significant longer duration of analgesia (9.18 ± 4.060) in the QL group than in the TAP group (5.65 ± 3.004). Also, there was statistically significant decrease in intraoperative fentanyl consumption in the QL group than in the TAP group. Postsurgical morphine consumption was significantly lower in the QL group than in the TAP group as shown in Table 5.

4. Discussion

In the current study, the QLB group showed a longer analgesic duration than the TAP blockade group. This result is parallel to the results of Kumar et al. (2018) who compared the analgesic duration produced by the TAP blockade with the QLB using 0.25% ropivacaine and demonstrated a significant longer analgesic duration with the QLB than the TAP block in lower abdominal operations. In the same

Table 3. Mean arterial pressure follow-up of the studied groups.

MAP (mmHg)	Group QL ($N = 49$)	Group TAP ($N = 49$)	95% CI	P
Baseline	78.63 ± 5.567	77.47 ± 2.930	−0.62, 2.95	0.199
2 h	78.43 ± 4.113	77.24 ± 2.454	−0.17, 2.54	0.087
4 h	77.33 ± 4.552	76.98 ± 3.031	−1.20, 1.90	0.658
6 h	78.84 ± 6.145	77.18 ± 2.713	0.25, 3.56	0.088
9 h	77.59 ± 3.973	78.43 ± 3.458	−2.33, 0.66	0.269
12 h	78.59 ± 4.769	78.43 ± 3.367	−1.49, 1.82	0.845

CI, confidence interval; QL, quadratus lumborum; TAP, transverse abdominal.
P value less than 0.05 is significant.
Data are mean ± SD.

Table 4. Visual analog scale score follow-up of the studied groups.

VAS score	Group QL ($N = 49$)	Group TAP ($N = 49$)	95% CI	P
30 mins (PACU)	0.67 ± 0.625	0.84 ± 0.657	−0.42, 0.09	0.211
2 h	0.94 ± 0.719	1.16 ± 0.717	−0.51, 0.06	0.125
4 h	1.51 ± 0.545*	2.18 ± 0.565	−0.90, −0.45	<0.001
6 h	1.61 ± 0.571*	2.73 ± 0.446	−1.33, −0.92	<0.001
12 h	3.20 ± 0.577*	4.37 ± 0.602	−1.40, −0.93	<0.001
24 h	3.90 ± 0.653*	4.67 ± 0.474	−1.00, −0.55	<0.001

CI, confidence interval; PACU, postanesthesia care unit; QL, quadratus lumborum; TAP, transverse abdominal plane; VAS, visual analog scale.
P value less than 0.05 is significant.
Data are mean ± SD.
* Statiscillay significant compared to TAP group

Table 5. Intraoperative and postoperative analgesic profile of the studied groups.

	Group QL ($N = 49$)	Group TAP ($N = 49$)	95% CI	P
First analgesic requirement (h)	9.18 ± 4.060*	5.65 ± 3.004	2.10, 4.96	<0.001
Intraoperative fentanyl consumption (μg)	80.41 ± 13.838*	87.14 ± 13.229	−12.16, −1.31	0.016
Postoperative morphine consumption (mg)	4.80 ± 1.414*	8.47 ± 1.569	−4.27, −3.07	<0.001

CI, confidence interval; QL, quadratus lumborum; TAP, transverse abdominal plane.
$P < 0.05$ is significant.
Data are mean ± SD.
* Statistically significant compared to the TAP group

line, Yousef (2018) observed that the analgesic time in the QLB group was considerably more than the TAP block group in total abdominal hysterectomy surgeries using 0.25% bupivacaine.

The analgesic action of QLB following a caesarean section was studied by Blanco et al. (2015). In another study, they compared the QLB and the TAP block and detected that better results occurred with the QLB than the TAP blockade remaining from 6 to 48 h (Blanco et al., 2016). The explanation of the better analgesic effect in the QLB group than in the TAP group may be due to the fact that the QLB could help the spread of local anesthetic into the paravertebral space, hypothetically and that the distribution of local anesthetic to the sympathetic nerves in the TLF results in the prolonged analgesic action (Yang et al., 2018). Four techniques of QLB have been explained (Ueshima et al., 2017). The analgesic duration is mainly dependent on the procedure, or the blockade type, the operation type, and the dose of the drugs utilized in the blockade.

Our study noted that the analgesic consumption was fewer in the QLB compared with the TAP block. A study by Krohg et al. (2018) showed a 41% opioid-sparing effect of the QLB 24 h postoperatively in females undergoing a cesarean section when given with multimodal analgesia.

McDonnell et al. (2008) found that the group received TAP block had an opioid-sparing effect of 70% in comparison with the controls.

A study compared postoperative analgesic action of QLB with the TAP block in cesarean delivery. Its results demonstrated that the QLB group received less morphine after surgery than the TAP block group, which is comparable to the results of this study (Blanco et al., 2016).

Our results revealed that the VAS scores were significantly lower in the QL group than in the TAP group. This is counter to the results of Blanco et al. (2015) who did not find a considerable difference between both studied groups.

Oksuz et al. (2017) observed that the group received QLB had lower pain score than the TAP block group. In addition, Kumar et al. (2018) found superior analgesic effect in the QLB group than in the TAP block group at all postsurgical follow-up periods. These findings are in the same line with the current study. We revealed the QLB is superior to the TAP block at different time intervals postoperatively. The approach of the blocks and the concentration of the drugs used might be responsible for the variations in the results in different trials. There was no significant difference in the incidence of postoperative complications among the studied groups.

We concluded that ultrasound-guided QLB decreased the postsurgical analgesic consumption and prolonged the duration of postsurgical analgesia when compared with the TAP block. These blocks are not associated with complications. More studies are recommended to assess the dose, volume, and approach for QLB for best results.

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Registration

The study was approved from MFM-IRB (R.22.08.1787.R1) registered in Clinicaltrials.gov (NCT05533424).

Conflicts of interest

There are no conflicts of interest.

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