Is a Combination of the Serratus Intercostal Plane Block and Rectus Sheath Block Superior to the Bilateral Oblique Subcostal Transversus Abdominis Plane Block in Laparoscopic Cholecystectomy?

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ABSTRACT

Objective: The serratus intercostal plane block (SIPB) is a recently defined interfascial plane block. The oblique subcostal transversus abdominis plane block (OSTAP) is another type of interfascial plane block, and it is also used as a part of multimodal analgesia in patients undergoing laparoscopic cholecystectomy (LC). In this retrospective study, we evaluated the effects of the bilateral OSTAP and a combination of the right SIPB and bilateral rectus sheath block (RSB) on the postoperative pain and analgesia requirement in patients undergoing LC.

Materials and Methods: Data of the patients who underwent LC between May 2018 and November 2018 were evaluated retrospectively. Postoperative pain was evaluated using the numeric rating scale (NRS), and 24-hour tramadol consumption and rescue analgesia requirements were compared.

Results: Bilateral OSTAP was applied to 47 patients, and SIPB+RSB was applied to 25 patients. Postoperative pain scores were similar between the two groups. In the first 24 hours, tramadol requirement in the SIPB+RSB group was significantly lower than in the OSTAP block group ($p<0.001$). There was no statistically significant difference between the NRS averages at different time frames between the two block groups.

Conclusion: We found that when SIPB is used as a part of multimodal analgesia in a combination with RSB in LS, it improves the quality of analgesia and decreases the analgesic requirement compared to patients undergoing a bilateral OSTAP block. Randomized controlled trials are necessary to compare the effects of SIPB alone and in a combination with other blocks in LC.

Keywords: Anesthesiology, pain management, cholecystectomy, laparoscopic, pain postoperative

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Introduction

Laparoscopic cholecystectomy (LC) is a minimally invasive surgical procedure that leads to less pain when compared to conventional open surgery [1]. However, postoperative pain after LC requires management by anesthesiologists. While opioids and nonsteroidal anti-inflammatory drugs can be used in the treatment of the postoperative pain, regional anesthesia techniques are also used as a part of multimodal analgesia plans [2-4].

First described by Hebard in 2009, the oblique subcostal transversus abdominis plane (OSTAP) block is a regional anesthesia technique used in middle and upper abdominal surgeries [5, 6]. Several studies have demonstrated that OSTAP decreases the postoperative analgesic and opioid requirements and also improves the quality of postoperative pain control [2, 3, 7-9].

Blocking the cutaneous branches of the intercostal nerves in the mid-axillary line (BRILMA) is a recently described block used to provide effective analgesia in breast surgery [10-12]. In modified BRILMA, also called serratus intercostal plane block (SIPB), a local anesthetic is applied more caudally from the 8th rib compared to the usual 4-5th rib. To prevent confusion, we have referred to this block as SIPB.

Apart from a series reporting SIPB as an opioid sparing method in supraumbilical open surgeries that included 52 patients and a case of SIPB in open nephrectomy, there are no further reports of the SIPB use in abdominal surgeries [13, 14]. In a latter case series, SIPB was used in open cholecystectomy, nephrectomies, gastrectomies, and abdominal wall repair (eventroplasty). The authors also reported that the SIPB analgesic effect in gastrectomy was suboptimal, and its effect was not adequate in the midline abdominal area [15]. Therefore, we preferred to combine SIBP with RSB in this study. To the best of our knowledge, the use of SPIB in LC has not been reported.

In this retrospective study we compared a bilateral OSTAP block to the combination of the right SIPB and bilateral rectus sheath block (RSB) with regard to postoperative pain scores and analgesia requirements in LC.

Materials and Methods

Study Design

After the local ethical committee approval and registration at clinicaltrials.gov (NCT03751540), a patient chart review was conducted. The collected data were retrospectively analyzed. Patients aged >18 years undergoing LC in our center between 05.01.2018 and 11.01.2018 were enrolled in the study. Patients undergoing a second procedure together with LC, those with any condition or medication use that would impair evaluation of postoperative pain, patients with technical problems while using patient-controlled analgesia (PCA), and those refusing regional anesthesia techniques were excluded from the study.

Data Collection

Data were collected using a standardized regional anesthesia data collection form which is a regular form used for all patients who receive any treatment based on regional anesthesia. An informed consent form was read and signed by each patient who voluntarily participated in this study.

The data were extracted from regional anesthesia data collection form filled for each patient, and they included age, gender, weight, height, surgical procedure, and surgical time. The total use of tramadol via a patient-controlled analgesia device was also recorded. Any analgesic used in routine practice or as a rescue analgesic treatment was noted on the form. The numeric rating scale (NRS) at recovery room (RR) and in the surgical ward was closely followed every 3 hours by trained nurses starting from the time zero

The NRS is a method to translate the patient's perception of pain to a numeric form to assess postoperative pain. It has a point numeric scale ranging from 0 to 10. The patient grades the intensity of the pain between 0, which means no pain, and 10, which is worst pain imaginable. Active and dynamic states of the patient and its effect on pain are recorded at intervals.

Standard Analgesia Protocol

Perioperatively, paracetamol 1 gr and tenoxicam 20 mg are applied to each patient as a part of a routine pain treatment regime. As the postoperative analgesia regime, acetaminophen every 8 hours and tramadol via PCA (basal infusion free, 10 mg bolus, 20 min lock out) were chosen. PCA is commenced in the RR. Patients with the NRS ≥4 in RR are administered 25 mcg fentanyl at 20-minute intervals. This is our standard protocol due to the onset time of blocks and the time taken for tramadol to reach effective plasma concentration. In the ward, any patient who had pain 4 or greater according to the NRS was applied intramuscular diclofenac 75mg, and in case of persisting pain, meperidine 50 mg was applied.

Ultrasonography-Guided Blocks

If patient consents and no contraindication exists, all patients undergoing LC also undergo a regional anesthesia method in concordance with multimodal analgesia. In patients undergoing LC, bilateral OSTAP was routinely used as part of multimodal analgesia until August 2018 when we began routinely performing a combination of right SIPB and bilateral RSP in these patients.

All regional blocks evaluated for this study were applied at the end of the surgery and before the patients woke up. Therefore, all the patients were in the supine position. A local anesthetic (LA) mixture used in all patients was 20 mL bupivacaine 0.5%, 10 mL lidocaine 2%, and 10 mL normal saline.

In OSTAP, 20 mL of LA was applied to the fascia between the rectus abdominis and the transverse abdominis muscles under ultrasound guidance. In the SIPB+RSB combination, SIPB was applied followed by RSB. For SIPB, 20 mL LA was applied with the interfascial plane between the serratus anterior muscle and intercostal muscles from the level of right 8th rib on the mid axillary line (Figure 1). For RSB, 10 mL LA was applied deep to the rectus abdominis muscle into the posterior portion of the sheath, bilaterally. In some of the cases RSB was applied bilaterally by using single needle admone needle method,

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) 16.0 statistical package programmed (SPSS Inc.; Chicago, IL, USA) was used for statistical analysis. Descriptive statistics were expressed as mean±standard deviation, minimum and maximum. A univariate analysis compared means between the groups using a two-sample, independent *t*-test assuming equal variances for continuous variables. Ratios were compared using the chi-squared test. For data without normal distribution, the Mann–Whitney U test was performed. A $p<0.05$ was considered statistically significant. For the NRS scores, statistical significance was adjusted to $p<0.006$, due to measurements from eight time points according to the Bonferroni correction.

Results

The files of 79 patients were reviewed. Six patients refused regional anesthesia, 3 that had technical problems when using PCA, 2 patients undergoing a concurrent second procedure, and 1 patient with a history of corticosteroid use was excluded. The data of 67 patients (45 female, 22 male) were analyzed. Of these, 42 underwent a bilateral OSTAP and 25 SIPB+RSB. There were 37 patients classified as the American Society of Anesthesiologists Class I, 24 as Class II, and 6 as Class III. Patients' age, gender, the ASA class, weight, height, and surgical times are presented in Table 1.

There was no statistically significant difference between the NRS averages at different time frames between two block groups ($p>0.006$)

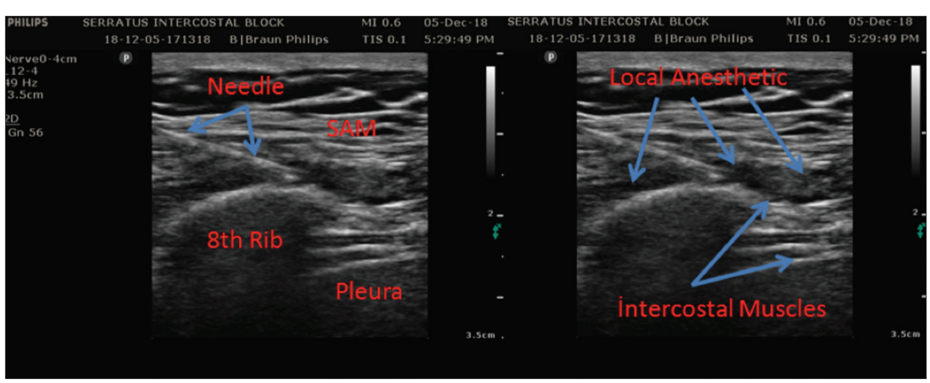

Figure 1. Demonstration of a serratus intercostal plane block.
SAM: serratus anterior muscle

Table 1. Comparison of demographic data between groups (SD, standard deviation)

	OSTAP (n)	SIPB+RSB (n)	p
Gender (F/M)	27/15	18/7	0.515
ASA (I/II/III)	20/18/4	17/6/2	0.249
	OSTAP (Mean, SD)	SIPB+RSB (Mean, SD)	p
Age (years)	47±15	52±12	0.246
Time of surgery (min)	53±7	57±8	0.442
Weight (kg)	73±11.5	73.5±9.5	0.321
Height (cm)	164±7.5	165±8.2	0.601

OSTAP: oblique subcostal transversus abdominis plane block; SIPB: serratus intercostal plane block; RSB: rectus sheath block

Table 2. Median NRS scores during rest and passive movement, for Group B and Group C at various time points of follow-up

NRS SCORES	OSTAP (n:42)	SIPB+RSB (n:25)	p
0 hour	2 (1-3)	1 (0-4)	0.212
1st hour	1 (1-1)	1 (1-1.75)	0.552
3rd hour	1 (1-2)	1(1-2)	0.270
6th hour	1 (1-2)	1.5 (1-2)	0.481
9th hour	1 (1-2)	2 (1-2)	0.643
12th hour	2 (1-2)	2 (2-3)	0.032
18th hour	2 (1–2)	2 (1-2)	0.066
24th hour	1 (1-2)	2 (1-2)	0.045

NRS: numeric rating scale; OSTAP: oblique subcostal transversus abdominis plane block; SIPB: serratus intercostal plane block; RSB: rectus sheath block
Data are expressed as median (percentiles 25-75).

Table 3. Comparison of analgesia requirements between the groups for the first 24 postoperative hours

	OSTAP (n:42)		SIPB+RSB (n=25)		
Consumption	Mean±SD	(Min–Max)	Mean±SD	(Min–Max)	p
Opioid in RR (mcg)	17.85±21.5	(0-75)	10±19.1	(0-50)	0.092
Tramadol consumption (mg/day)	125±50	(40-230)	69±50	(0-150)	<0.001

OSTAP: oblique subcostal transversus abdominis plane block; SIPB: serratus intercostal plane block; RSB: rectus sheath block

(Table 2). Fentanyl requirement in RR was similar between groups ($p>0.05$). However, when 24-hour tramadol consumption was compared, patients in the SIPB+RSB group required significantly less tramadol when compared to patients in the OSTAP group (69±50 mg vs. 125±50 mg, $p<0.001$) (Table 3). Rescue analgesia was required in 7 patients in the OSTAP and 1 patient in the SIPB+RSB group (p=0.169)

Discussion

Considering pain scores, this study has demonstrated that a combination of SIPB and RSB is as effective as bilateral OSTAP. However, our findings indicated that SIPB+RSB decreases the 24-hour analgesia requirement more than bilateral OSTAP.

It is important to understand the trigger and source of postoperative pain in LC. In addition to somatic pain caused by surgical incision, the patients suffer from visceral pain. Somatic pain is caused by trocar entry incisions, resection of the gall bladder, and peritoneal distention. Meanwhile, the sources of the visceral pain are diaphragm irritation due to a high intra-abdominal pressure and the distention of CO_2 insufflation [16, 17]. Even though surgical times are decreasing, and laparoscopic procedures are being performed under lower insufflation pressures, postoperative pain still requires effective management in LC.

It is generally believed that OSTAP, RSB, and SIPB affect the somatic pain only. However, it should be kept in mind that these blocks disseminate in cutaneous fibers and therefore block somatic pain and occasionally scatter its effect on all parietal components from skin to parietal peritoneum. Therefore, theoretically, these blocks may have effect on visceral pain as well.

OSTAP is used as an effective regional anesthesia technique for middle and upper abdominal surgeries. Many studies have demonstrated that OSTAP leads to improved analgesia quality and decreased analgesia requirement in LC [2, 3]. However a recently published study reported that OSTAP led to a 90% blockage of the mid-abdominal and a 26% blockage of the lateral abdominal surface area, causing the sensorial block between the Th7 and Th12 dermatomes [18]. In light of this finding, and considering the anatomy of the surgical field, we believe that OSTAP may be insufficient in some patients undergoing LC. Many studies report on the bilateral use of OSTAP or its use in combination with other blocks [19].

SIPB is the blockage of the intercostal nerves at the midaxillary line. A successful use of SIPB has been reported in supraumbilical surgeries. However, a suboptimal analgesia effect of SIPB in gastrectomies may suggest that it is insufficient for mid-abdominal surgeries [13]. A cadaveric study has shown that LA in SIPB may spread to the lateral cutaneous and anterior cutaneous branches of the intercostal nerves [10]. In a porcine model, dermatomal spread of LA in BRILMA was shown to be associated with LA volume [20]. Fernández Martín et al. [13] reported that when SIPB was performed from the 8th rib to the interfascial plane between the serratus anterior and intercostal muscles, 3 mL of LA per dermatome was adequate. In LC, we targeted the dermatomal blockage between Th6 and Th11. We therefore performed SIPB with 20 mL of LA. We combined RSB to improve the effectiveness and quality of analgesia in the mid abdomen. To the best of our knowledge, this is the first report of SIPB in LC and the first of a SIPB and RSB combination.

Our study has some limitations, the most important of which is the retrospective design. Despite rigorous care during data collection and analysis, the retrospective design may have led to bias. We did not perform a routine dermatomal sensorial blockage or the anesthesia surface area analysis in our patients. Also, all blocks were performed under general anesthesia. We therefore had to include lidocaine in LA for a fast onset. A pure or diluted single local anesthetic may have been more appropriate for use in these blocks.

A combination of the right SIPB and bilateral RSB is as effective as bilateral OSTAP for the effective management of postoperative pain in LC. The SIPB+RSB led to a decrease in analgesia requirement when compared to bilateral OSTAP. Studies evaluating the relationship between the volume-level-sensorial blockage distribution of these blocks are required. These should then be followed by randomized controlled trials where block effects are demonstrated in different types or surgeries. Randomized control trials are needed to compare the effects of SIPB alone and in combination with other blocks in LC to the erector spinae plane block, quadratus lumborum block, and other newer block techniques.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Maltepe University.

Informed Consent: Informed consent is not necessary due to the retrospective nature of this study.

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