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Comparative Study between Bilateral and Unilateral Erector Spinae Plane Block in Managing Postoperative Pain in Laparoscopic Cholecystectomy

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ABSTRACT

Background: Postoperative pain after laparoscopic cholecystectomy remains as an important problem, with two components: somatic and visceral. Surgical incisions lead to somatic pain, while abdominal inflation and diaphragm irritation leads to visceral pain. Erector spinae plane block is a newly described interfascial plane block.

Aim: to compare bilateral versus unilateral erector spinae plane block for postoperative analgesia in laparoscopic cholecystectomy

Patients and Methods: The study involved 50 patients scheduled for elective laparoscopic cholecystectomy. Patients were randomly assigned in to two equal groups each with 25 patients: unilateral and bilateral erector spinae plane block. Numerical Pain score and need for analgesia during all time points to 12 hr post recovery; hemodynamic indices at baseline, during all time poins from full recovery to 12 hr post recovery were recored.

Results: there were no significant differences between the two groups in hemodynamic indices. At 12thhr post operation, 36%, 12% and 36% of patients in unilateral group demonstrated mild, moderate and required rescue analgesia, respectively compared with 28%, 8% and 20% of patients in bilateral group with a statistically significant difference. at 3rdhr post operation, 12% and 8% of patients in unilateral group need paracetamol and tramal, respectively, compared 4% and 0%, respectively in bilateral group, with a significant difference. Additionally, at 12thhr post operation, 34% and 12% of patients in unilateral group need paracetamol and tramal, respectively, compared 28% and 8%, respectively in bilateral group, with a significant difference.

Conclusions: Unilateral and bilateral erector spinae plane block seem to have no serious impact hemodynamic indices. Bilateral block is associated with lower pain score and need for postoperative analgesia than unilateral block.

KEYWORDS: Laparoscopic cholecystectomy, Erector spinae plane block, Numerical rating scale.

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INTRODUCTION

The erector spinae plane (ESP) block was described in 2016 making it one of the "newest kids on the block" in terms of regional anaesthesia. The ESP block technique was demonstrated in the management of chronic and acute analgesia of the thoracic dermatomes.[1] Specifically, it was used in the treatment of patients suffering from chronic thoracic neuropathic pain and patients undergoing thoracoscopic surgery.[2] Subsequently, the technique was expanded craniocaudally along the interfascial plane with equivalent analgesic efficacy for cervical, thoracic and lumbar dermatomes.The novel ESP block challenges many of the older techniques with its profound versatility, simplicity and wide range of applications.[3]

Laparoscopic cholecystectomy (LC) is the most common intra-abdominal surgical procedure globally. Despite improvements in anaesthesia and surgery, postoperative pain is still a crucial problem after LC.[4] Perioperative pain management goals are to alleviate suffering, obtain early mobilisation and rapid discharge, and improve patient

satisfaction. Traditional pain management with opioids increases the incidence of side-effects, such as over-sedation, respiratory depression, postoperative nausea and vomiting (PONV), and impaired recovery quality.[5] Therefore, multimodal analgesia strategies are often preferred to achieve adequate pain control with minimizing opioid-related side effects.

It was demonstrated adequate analgesia with ESPB as evidenced by lower numerical pain rating scale (NRS) scores at rest in the first 3 h and reduced analgesic requirement in the first 24 h in comparison with a control group.[6] Although ESPB cannot provide better analgesia than oblique subcostal TAP block after LC, it has been shown to offer comparable analgesia to the quadratuslumborum block.[7]

Statistically meaningful increases in postoperative analgesia and reductions in opioid intake, however, can only be clinically significant if they promote a better recovery quality.[8] Whether a relationship exists between ESPB and postoperative recovery quality is still unknown.

Postoperative recovery after surgery and anaesthesia is a complex and multidimensional process.[9] Inadequate recovery quality negatively influences both the patient and the healthcare givers. Although a delayed return to normal activities may produce dissatisfaction with the medical service received, prolonged recovery or delayed discharge also significantly impacts the medical team‟s resource utilization.

In a recent review, De Oliveira declared that the question of,``Could patients have better compilations when these new blocks are applied?`` needs to be answered.[10] Anaesthesiologists are in charge of developing new techniques that provide high- quality postoperative recovery while minimizing morbidity and the time required to resume daily activities.[11] Therefore, ESPB could also provide a better quality of recovery in patients who underwent LC, as it allows effective postoperative pain control.[12]

Three RCTs have been found: the first with 76 patients, comparing the ESP block vs. TAP block, showed that the POP use of tramadol and pain scores were significantly lower in the ESP group.[7] The second study compared the same regional techniques in 72 patients in terms of the NRS score, paracetamol and tramadol consumption and the need for rescue analgesia and it showed that pain intensity was similar between the two groups in the first 3 hours, while the consumption of additional analgesics was comparable.[13] A third RCT with 36 patients compared the ESP block vs. multimodal analgesia and showed that pain on the NRS was lower in the ESP block group during the first 3 hours, with no differences after that time; in turn, tramadol consumption and additional analgesic requirements were lower in the ESP group. These conclusions were also supported by a meta-analysis.[6]

PATIENT AND METHODS

This is a prospective single clinical trial included 50 consecutive patients scheduled for elective laparoscopic cholecystectomy during the period from October 2022 to November 2023 in the operation room / Al-hilla general Teaching Hospital. The study protocol was approved by Scientific council of Anesthesia and Intensive care/Iraqi Board for Medical specializations.

Inclusion Criteria

- age 18-60 years
- Have elective laparoscopic cholecystectomy
- Have American Society of Anesthesiologists (ASA) I or II

Exclusion Criteria

- Patients refusal
- Patients with obesity (body mass index > 35 kg/m2),
- Known allergies to any of the study drugs
- Patients with bleeding disorders
- Patients already on analgesic drugs
- Patients with infection at the site of injection

A written consent from each participant was obtained prior to data collection after explaining the aim of study.

A complete preoperative assessment including detailed history, clinical examination was done to hemodynamic parameters. Patients were randomly assigned into two equal groups each with 25 patients: unilateral and bilateral erector spinae plane block.

The following data were collected from all patients:

- Demographic characteristic of the patients including age, gender, weight and ASA.
- Numerical Pain score and need for analgesia at 1 hr, 3 hr, 6 hr and 12 hr post operation.
- Vital signs including SBP, DBP, MBP, HR and SPO2 at baseline, full recovery, 1 hr, 3 hr, 6 hr and 12 hr post operation.

Standared patients monitoring was using pulse oximetry (pulse rate and Sp02), noninvasive arterial blood pressure (NIABP),five leads ECG monitoring ,capnography.

Anesthesia was induced with propofol (1-2.5mg/kg)(anesthetizing dose), fentanyl (1mcg/kg) and rocuronium (0.6 mg/kg). Isoflurane 1.2 MAC for anesthesia maintenance with Oxygen 100%. Pneumoperitoneum was performed with CO_2 and maintained at a range of 10-12 mmHg. During surgery, tramadol (1-2 mg/kg) and paracetamol (15mg/kg) IV were administered. Ondansetron 8 mg IV was also administered to prevent postoperative nausea and vomiting.

All the patients received preoperative bilateral or unilateral ESP block at the T8 level according to their groups. All the blocks have been done 20 minutes before the surgery in a separate room. All blocks were performed by me under the US guide.

All patients were premedicated with midazolam 0.02-0.03mg/kg intravenous. Ultrasound guided (diagnostic ultrasound system,ezono 3000)was used for all block applications. After appropriate skin disinfection, the probe was placed longitudinally 3 cm lateral to the T8 level. Following identification of the transverse process and erector spinae muscle, the needle(insulated echogenic needle ,22G,80mm)was inserted with in-plane approach from cranial to caudal direction. Bupivacaine 0.25% (20 mL) was administered on the right side in unilateral group and bilaterally at the T8 level in bilateral group. The spread of the injectate beneath the erector spinae muscle was visualized in both the cranial and caudal directions.

At PACU, patients were asked to report their pain based on the 10-pointnumerical rating scale.

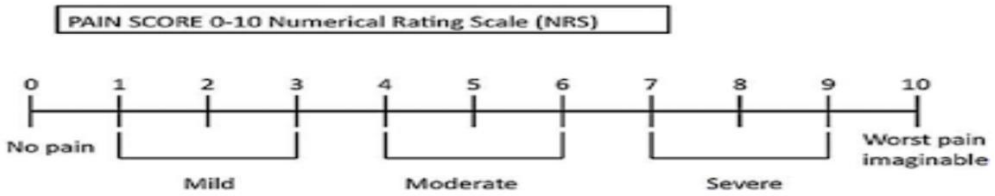

Fig.1: Numerical rating Scale (NRS)

The incidences of shoulder pain, nausea, and vomiting in the postoperative first 12 hours were also recorded. Patients were asked if they were satisfied with the anesthesia technique using a 5-point score system (1= very dissatisfied, 2=somewhat dissatisfied, 3=neither satisfied no dissatisfied, 4=somewhat satisfied, 5 = very satisfied).

Data were analyzed using IBM SPSS version 24 (SPSS Inc., Chicago, Illinois, USA) and excel Microsoft office 2016. Numerical data were expressed as mean± standard deviation (SD) or median and range, as appropriate and analyzed with Student t-test. A p-value less than 0.05 was considered significant.

RESULTS

This study included a total of 50 patients. The mean age of the patients in unilateral group was 37.28±6.44 years compared with 42.68±13.0 years in bilateral group with no statistically significant difference. Similarly, there was no statistically significant difference between the two groups regarding the distribution of gender and ASA. The duration of surgical operation was slightly longer in bilateral than unilateral group (67.34±13.2 min vs. 62.7±12.11 min; however, the difference was not statistically significant (Table 1).

Table 1: Demographic characteristics of the Patients

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
Age, years			
Mean±SD	37.28±6.44	42.68±13.0	0.069
Range	23-44	23-75	
Gender			
Male	10(40%)	6(24%)	0.225
Female	15(60%)	19(76%)	
ASA			
I	16(64%)	12(48%)	0.254
II	9(36%)	13(52%)	
Weight, kg			
Mean±SD	75.09±12.0	76.04±10.07	0.766
Range	54-100	52-94	
Duration of surgery, min			
Mean±SD	62.7±12.11	67.34±13.2	0.420
Range	42-91	45-95	

The baseline hemodynamic indices of patients of unilateral and bilateral group is presented in(table 2). The two groups were comparable in all included indices with no statistically significant differences.

Table 2: Baseline hemodynamic characteristics of the patients

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
SBP, mmHg	126.64±17.68	122.44±16.66	0.312
DBP, mmHg	79.12±9.61	75.52±10.3	0.105
MAP, mmHg	93.84±8.24	90.2±12.22	0.243
HR, beats/min	81.13±8.35	79.33±10.2	0.316
SPO2, %	95.23±1.2	94.7±1.18	0.530

The time trend of SBP in unilateral and bilateral groups is shown in(table 3) and (figure 2). During all time points from full recovery to 12 hour post operation, patients in unilateral group showed slightly higher mean SBP than those in bilateral group; however, the differences were not statistically significant.

Table 3: Time trend of SBP (mmHg) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
Full recovery	116.4±10.38	111.44±10.07	0.401
1sthr	117.21±1.64	115.63±15.22	0.122
3rdhr	121.4±11.68	117.82±15.6	0.211
6thhr	122.16±14.06	118.27±13.24	0.198
12thhr	126.76±12.55	123.12±14.6	0.423

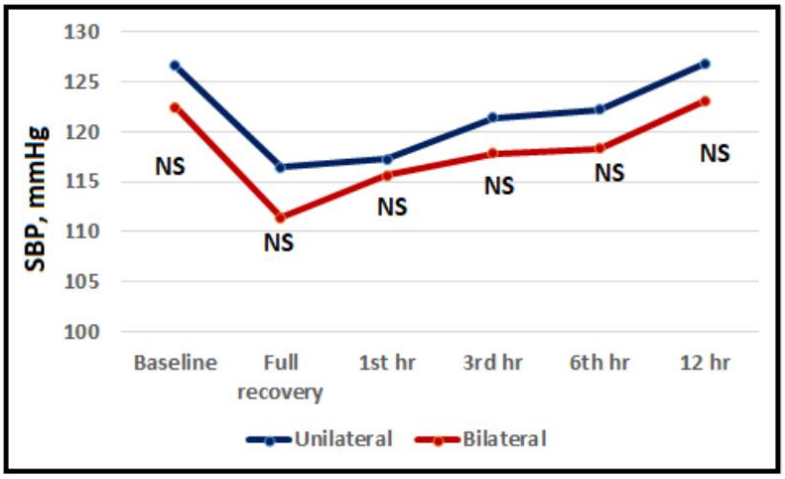

Fig.2: Time trend of SBP (mmHg) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block, NS: non- statistically significant

The time trend of DBP in unilateral and bilateral groups is shown in(table 4) and (figure 3). Like in SBP, in all time points from full recovery to 12 hr post operation, there were no statistically significant differences between the two groups in the mean DBP, despite that patients in unilateral group had higher values.

Table 4: Time trend of DBP (mmHg) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
Full recovery	74.53±8.22	71.15±9.84	0.117
1st hr	73.69±8.16	71.8±9.86	0.214
3rd hr	76.21±8.45	73.74±8.53	0.435
6th hr	75.45±7.42	72.64±7.69	0.184
12th hr	76.32±6.9	74.5±9.12	0.317

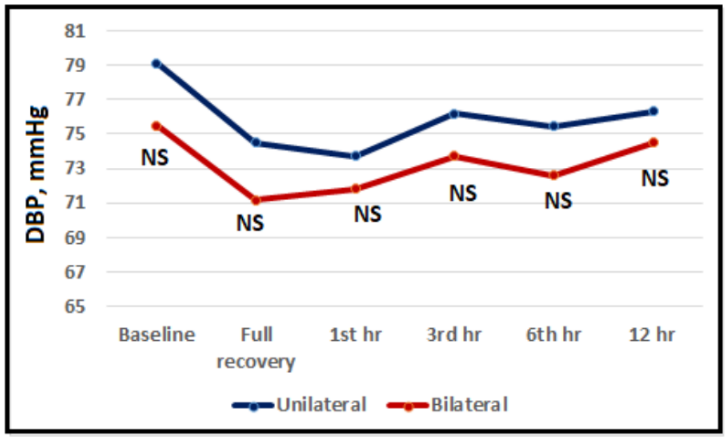

Fig.3: Time trend of DBP (mmHg) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block. NS: non- statistically significant

Mean arterial pressure took exactly the pattern of SBP and DBP in which there was no statistically significant difference between the two groups at all included time points (Table 5),(figure 4).

Table 5: Time trend of MAP (mmHg) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
Full recovery	86.4±9.31	83.63±12.26	0.288
1st hr	88.57±10.6	86.78±11.52	0.311
3rd hr	90.72±8.94	87.11±9.16	0.308
6th hr	92.47±6.88	89.73±8.61	0.289
12th hr	92.82±8.51	92.13±9.74	0.712

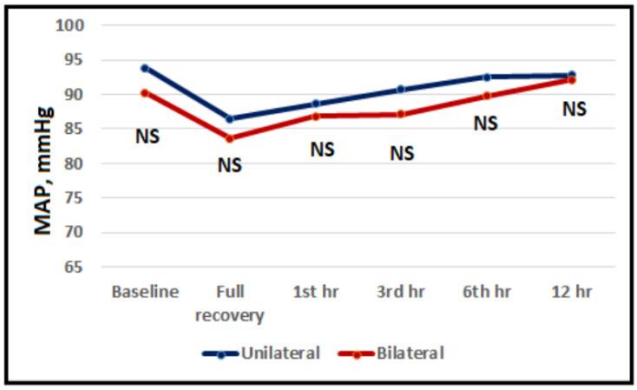

Fig.4: Time trend of MAP (mmHg) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block. NS: non- statistically significant

Generally, the HR values were comparable between the two groups in all time trends with no statistically significant differences (Table 6), (figure 5).

Table 6:Time trend of HR (beats/min) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
Full recovery	78.33±9.68	77.48±9.8	0.411
1st hr	77.12±8.48	74.27±9.04	0.181
3rd hr	78.43±9.53	76.1±7.81	0.168
6th hr	75.81±6.42	73.5±7.65	0.279
12th hr	81.33±9.56	78.61±6.97	0.092

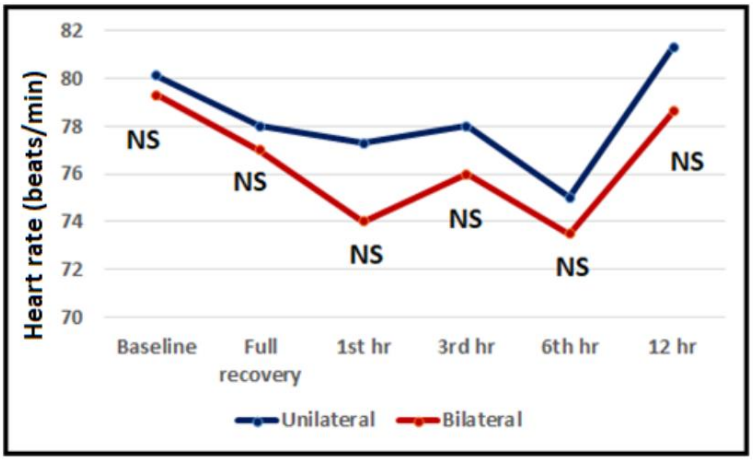

Fig.5: Time trend of HR (beats/min) in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block. NS: non-statistically significant

The mean SPO2 was very close between the two groups (range between 94.7% to 98.67%) in all included time points with no statistically significant differences (Table 7),(figure 6).

Table 7: Time trend of SPO2 (%) in in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block

Variables	Unilateral (n=25)	Bilateral (n=25)	p-value
Full recovery	98.67±1.3	97.57±1.32	0.797
1st hr	97.46±1.7	97.2±1.4	0.895
3rd hr	96.9±1.48	98.36±1.15	0.895
6th hr	96.2±0.95	95.64±1.11	0.597
12th hr	96.43±0.92	96.0±0.01	0.712

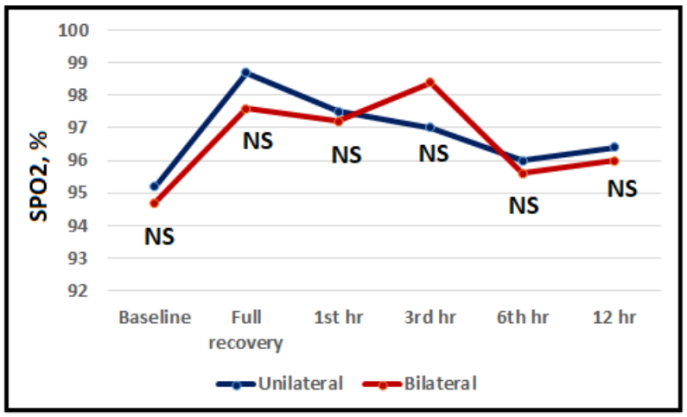

Fig.6: Time trend of SPO2 (%) in in patients undergoing laparoscopic cholecystectomy under unilateral and bilateral erector spinae plane block. NS: non- statistically significant

The majority of patients in unilateral and bilateral groups (80 and 84%, respectively) had no pain during the 1sthr postoperatively. During 3rd and 6 th our post operation, 60% and 48%, respectively of patients in unilateral group had no pain, compared with 80% and 60%, respectively of patients in bilateral group, with no significant differences. However, at 12thhr post recovery, 36%, 12% and 36% of patients in unilateral group demonstrated mild, moderate and required rescue analgesia, respectively compared with 28%, 8% and 20% of patients in bilateral group with a statistically significant difference (Table 8).

Table 8:Pain score in unilateral and bilateral group during different time points

Pain score	Unilateral (n=25)	Bilateral (n=25)	p-value
At 1hr post operation			
No pain	20(80%)	21(84%)	1.00
Mild	5(20%)	4(16%)	
At 3hr post operation			
No pain	15(60%)	20(80%)	
Mild	3(12%)	1(4%)	0.112
Moderate	2(8%)	0(0%)	
Rescue analgesia	5(20%)	4(16%)	
At 6hr post operation			
No pain	12(48%)	15(60%)	0.954
Mild	4(16%)	4(16%)	
Moderate	1(4%)	2(8%)	
Rescue analgesia	8(32%)	4(16%)	
At 12hr post operation			
No pain	4(16%)	11(44%)	**0.033**
Mild	9(36%)	7(28%)	
Moderate	3(12%)	2(8%)	
Rescue analgesia	9(36%)	5(20%)	

Consistent with pain score, there was no need for analgesia in majority of patients in unilateral and bilateral groups (80% and 84%, respectively) had no pain during the 1sthr post recovery. At 3rdhr post recovery, 12% and 8% of patients in unilateral group need paracetamol and tramal, respectively, compared 4% and 0%, respectively in bilateral group, with a significant difference. Furthermore, at 12thhr post recovery, 34% and 12% of patients in unilateral group need paracetamol and tramal, respectively, compared 28% and 8%, respectively in bilateral group, with a significant difference. (Table 9).

Table 9: Need for analgesia in unilateral and bilateral group during different time points

Pain score	Unilateral (n=25)	Bilateral (n=25)	p-value
At 1hr post operation			
No need	20(80%)	21(84%)	0.717
Paracetamol	5(20%)	4(16%)	
At 3hr post operation			
No need	20(80%)	24(96%)	**0.021**
Paracetamol	3(12%)	1(4%)	
Tramal	2(8%)	0(0%)	
At 6hr post operation			
No need	20(80%)	19(76%)	0.618
Paracetamol	4(16%)	4(16%)	
Tramal	1(4%)	2(8%)	
At 12hr post operation			
No need	13(52%)	16(64%)	**0.046**
Paracetamol	9(36%)	7(28%)	
Tramal	3(12%)	2(8%)	

DISCUSSION

The present study aimed to compare bilateral versus unilateral erector spinae plane block for postoperative analgesia in LC.

According to the result of the study, there were no significant differences between unilateral versus bilateral groups in terms of demographic characteristics and duration of surgery. Thus, any variation in pain score, need for analgesia and hemodynamic indices are exclusively attributed to the type of technique.

In the present study, there were no significant variation between the two technique in all included hemodynamic indices at all included time points. This is in accordance with Ali study which included 60 patients scheduled for emergency laparotomy under GA. Bilateral ultrasound erector spinae plane block provides more hemodynamic stability compared with controls group without such anesthesia.[14]

The present result also in consistence with Jin et al.,[15] who studied the efficacy of ultrasound guided ESPB for pain control in lumber laminoplasty and they found that, patients who received this block had more stable hemodynamics than those using general anesthesia alone. Furthermore, Singh et al.[16] used ultrasound guided ESPB for postoperative pain control in modified radical mastectomy and they found that there was no significant difference between ESPB group and control group with respect to HR, and MAP during the perioperative period.

Thus, it is reasonable to assume that both unilateral and bilateral thoracic erector spinae plane are safe regarding hemodynamic indices.

In this study the post-operative pain score and the need for analgesia were in favor of bilateral block. This is in accordance with many previous studies worldwide [Falnelli et al.[17]; Huang et al.[18]; Cai et al.[19] ; Kendall et al.[20] who demonstrated that the ESPB group had significantly lower pain scores, lower 24-h cumulative opioid consumption and longer time to first rescue analgesia. However, these studies analyzed various surgeries, with a small number of abdominal surgery.

In LC, pain is either due to visceral pain (caused by the trauma of gall bladder resection) or cutaneous, muscular pain (caused by the skin and muscle incision at trocar sites).[21] The severity of visceral pain dominates over incisional pain (especially periumbilical), which dominates over shoulder pain.[22] Visceral pain originates from irritation of insufflated CO gas that forms carbonic acid, diaphragmatic muscle fiber stretching, and residual pockets of gas in the abdominal cavity.[23] Anesthesiologists usually focus on reducing the postoperative visceral pain in those patients.

In a meta-analysis including five randomized clinical trials with a total of 250 patients, Daghmouri et al.[24] showed that bilateral ESP block significantly reduced opioid consumption 24 h and time to first rescue analgesic after LC compared to the control group without side effects.

In another study, Cesur et al.[25] divided 90 patients undergoing elective LC into two equal groups for unilateral and bilateral ESP. Morphine consumption was significantly lower in bilateral group at 12 and 24 hours ($p = 0.044$ and $p = 0.022$, respectively). Twelve patients in unilateral group and 3 patients in bilateral group had shoulder pain with a significant difference. The authors concluded that bilateral ESP block provided more effective analgesia than unilateral ESP block in patients undergoing elective LC.

Tulgar et al.[6] divided 30 patients undergoing LC (ASA I-II) in two equal groups (bilateral ESP block and control group). Pain intensity between groups were compared using Numeric Rating Scores (NRS). NRS was lower in block group during the first 3h after recovery. Tramadol consumption was lower in block group during the first 12 h. Furthermore, less rescue analgesia was required in block group.

In another study of ESPB in laparoscopic cholecystectomy, unilateral ESPB using lower concentrations of local anesthesia led to statistically significantly less morphine consumption in the first 24 hours (7.5±5.8 mg vs 13.2 ±5.6 mg) when compared to a control group.[26]

Aygun et al.[27] performed bilateral erector spinae plane and bilateral quadratus lumborum block and used a local anesthetic mixture consisting of 30-mL 0.5% bupivacaine, 10-mL 2% lidocaine, and 20-mL normal saline, with half of the mixture administered to each side. There was no difference between NRS scores and opioid consumption at any hour between the groups.

Daghmouri et al.[24] showed that bilateral ultrasound-guided ESPB could be an effective treatment to reduce opioid consumption and the time to the first use of rescue analgesia.

CONCLUSIONS

1. Unilateral and bilateral erector spinae plane block seem to have no serious impact hemodynamic indices .
2. Bilateral ESPB is associated with lower pain score than unilateral block, especially at 12thhr postoperative.
3. Bilateral ESPB is associated with lower need for postoperative analgesia than unilateral block.

RECOMMENDATIONS

1. Bilateral ESP block provided more adequate analgesia than unilateral ESP block in patients undergoing elective LC and could be routinely used to reduce pain and the need for postoperative analgesia.
2. further studies with larger sample size and longer postoperative follw up are required.

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