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ORIGINAL ARTICLE

Erector spinae plane block as a rescue therapy in following cholecystectomy: a historical cohort study

Bloqueo del plano erector espinal como terapia de rescate tras colecistectomía: un estudio de cohorte histórica

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Abstract

Objective: *The aim of this study is to evaluate the effect of erector spinae plane block (ESPB) as a rescue therapy in the recovery room.* **Materials and methods:** *This single-center historical cohort study included patients who received either ESPB or intravenous meperidine for pain management in the recovery room. Patients' numeric rating scale (NRS) scores and opoid consumptions were evaluated.* **Results:** *One hundred and eight patients were included in the statistical analysis. Sixty-two (57%) patients received ESPB postoperatively (pESPB) and 46 (43%) patients were managed with IV meperidine boluses only (IV). The cumulative meperidine doses administered were 0 (0-40) and 30 (10-80) mg for the pESPB and IV groups, respectively ($p < 0.001$). NRS scores of group pESPB were significantly lower than those of Group IV on T30 and T60.* **Conclusion:** *ESPB reduces the frequency of opioid administration and the amount of opioids administered in the early post-operative period. When post-operative rescue therapy is required, it should be considered before opioids.*

Keywords: *Laparoscopic cholecystectomy. Acute post-operative pain. Regional anesthesia.*

Resumen

Objetivo: *Evaluar el efecto del bloqueo del plano erector espinal (ESPB) como terapia de rescate en la sala de recuperación.* **Método:** *Este estudio de cohortes histórico de un solo centro incluyó a pacientes que recibieron ESPB o meperidina intravenosa para el tratamiento del dolor en la sala de recuperación. Se evaluaron las puntuaciones de la escala de calificación numérica (NRS) de los pacientes y los consumos de opiáceos.* **Resultados:** *En el análisis estadístico se incluyeron 108 pacientes. Recibieron ESPB 62 (57%) pacientes y los otros 46 (43%) fueron manejados solo con bolos de meperidina intravenosa. Las dosis acumuladas de meperidina administradas fueron 0 (0-40) y 30 (10-80) mg para los grupos de ESPB y de meperidina sola, respectivamente ($p < 0.001$). Las puntuaciones de dolor del grupo ESPB fueron significativamente más bajas que las del grupo de meperidina sola en T30 y T60.* **Conclusiones:** *El ESPB reduce la frecuencia de administración de opiáceos y la cantidad de estos administrada en el posoperatorio temprano. Cuando se requiera terapia de rescate posoperatoria, se debe considerar antes que los opiáceos.*

***Palabras clave*:** *Colecistectomía laparoscópica. Dolor posoperatorio agudo. Anestesia regional.*

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Introduction

Laparoscopic cholecystectomy, one of the most commonly performed abdominal surgeries, is a gold standard therapy for the surgical treatment of benign biliary diseases. It has many advantages over open surgery including less surgical trauma and bleeding, better cosmetic results, early discharge from hospital, and reduced post-operative pain. Nonetheless, some patients may be suffered from moderate or even severe post-operative pain, and it may cause negative consequences such as prolonged hospital stay, so this requires well-planned analgesia management. The pain in this patient group consists of the following components: somatic pain on surgical port entries, visceral pain on the gallbladder resection area, and shoulder tip pain caused by peritoneal carbon dioxide exposure and peritoneal distension[1]. Multimodal analgesia is a mainstay strategy as it provides a synergistic analgesic effect using different analgesics together. Therefore, this strategy reduces the total doses of opioid and non-opioid analgesic agents used and protects patients from their side effects[2,3]. There is even a suggestion that opioids should not be routinely included in analgesia protocols after laparoscopic cholecystectomy and should be used only for rescue therapy[4]. As clinical experience in the use of truncal blocks increases, the frequency of their use in post-operative analgesia management also increases as a new part of multimodal analgesia with the potential to reduce post-operative pain and opioid consumption.

Erector spinae plane block (ESPB) was first presented in 2016 as the treatment of neuropathic pain in a case series, and gained popularity very quickly due to its safety applicability, and effect on both the visceral and parietal component of pain by providing paravertebral, transforaminal, and epidural spread[5,6]. Pre-operative application of ESPB has taken its place as a part of multimodal analgesia in laparoscopic cholecystectomy cases over time and has been shown to reduce post-operative pain scores and opioid consumption and to improve quality of recovery scores[7-10]. However, there is no data regarding the use of ESPB in the post-operative period as a rescue therapy.

The aim of this study is to evaluate the effect of ESP block as a rescue therapy retrospectively in terms of opioid consumption and numeric rating scale (NRS) scores in patients underwent laparoscopic cholecystectomy and needed additional analgesics in the recovery room.

Methodology

Study design and patient selection

This study was designed as a single-center historical cohort study of consecutive patients who needed intervention for pain management in the post-operative anesthesia care unit (PACU) following elective laparoscopic cholecystectomy between February 2022 and May 2022. Ethical approval was obtained from the Clinical Research Ethics Committee of Istanbul Basaksehir Cam and Sakura City Hospital, Turkey (2021.11.254) on November 24, 2021. The study was registered in clinical trials with the number NCT05706233. Written informed consent was waived due to the retrospective design of the study. Patients with the following conditions were excluded: ASA score > 2, age > 65, surgery following biliary pancreatitis, use of any regional technique preoperatively or intraoperatively, violation of the standard analgesia protocol for any reason, duration of surgery > 90 min or < 45 min.

Anesthesia management

A standardized perioperative care management protocol is applied for all laparoscopic cholecystectomy procedures in our department. Briefly, all patients are informed about ESPB and offered its application pre-operatively. Patients who refuse pre-operative ESPB are also informed regarding the post-operative analgesic alternatives which are ESPB or meperidine, if needed. Following the premedication with 2 mg midazolam intravenously, patients are transferred to the operating room. Anesthesia is induced with 2 mcg/kg fentanyl, 2 mg/kg propofol, and 0.6 mg/kg rocuronium following the standard monetization. Anesthesia is maintained with sevoflurane (1-2%, 1 minimum alveolar concentration), remifentanil (0.05-0.2 mcg/kg/min) infusion and oxygen/air mixture (50%/50%), and remifentanil (0.05-0.3 mcg/kg/min) infusion to keep the heart rate and blood pressure within 20% of baseline. Isotonic saline solution (4 mL/kg/h) with 50 mg/kg magnesium sulfate is infused during the perioperative period. Patients receive 20 mg tenoxicam, 0.1 mg/kg dexamethasone, 1 g paracetamol, and 1.5 mg/kg tramadol intraoperatively for analgesia. After the surgery, 2 mg/kg sugammadex is used for the reversal of neuromuscular blockade and tracheal extubation occurs when adequate muscle strength is established. All patients are followed up for 60 min in the PACU.

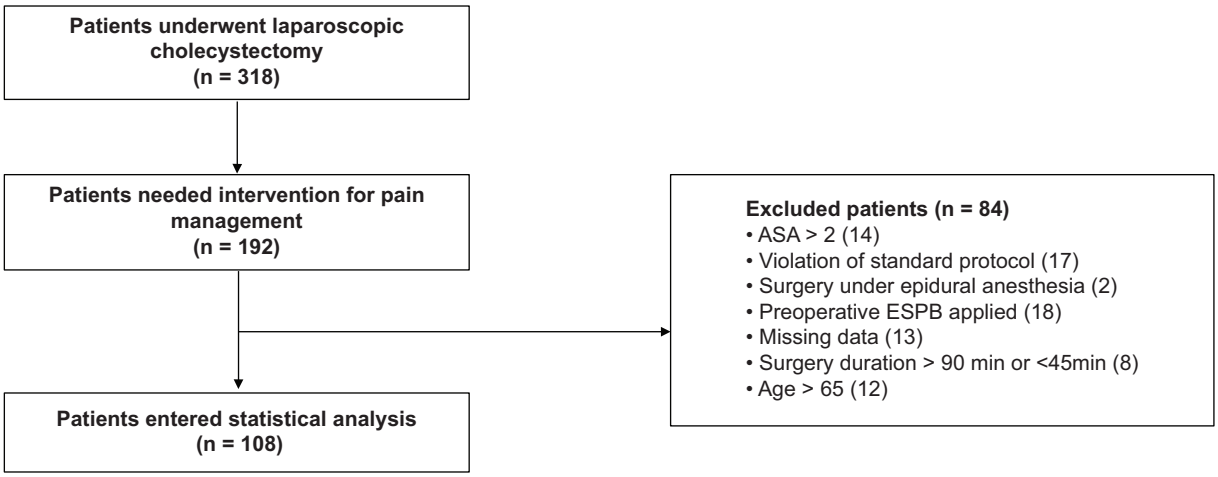

Figure 1. *Flow chart. Eighty-four patients were excluded in line with the exclusion criteria and 108 patients were included in the statistical analysis.*

Post-operative pain management

As part of the standardized perioperative care in our clinic, the pain management is routinely carried out as follows: Patients with a NRS score of > 3 receives either an IV meperidine bolus dose or ESPB in line with their selections. Following the initial intervention, patients are evaluated every 5 min in terms of their NRS scores until sufficient pain relief is secured (defined as NRS score of < 4). If the NRS score is not reduced by at least 20% when compared to the prior one, additional meperidine bolus is applied. All meperidine boluses are dosed in line with the pain intensity as follows: 10 mg if NRS score > 3, 20 mg if NRS score > 5, and 30 mg if NRS score > 8. NRS scores and meperidine boluses applied are recorded on the PACU follow-up form.

Ultrasound (USG)-guided ESPB

All blocks were performed by an anesthesiologist, who is in charge of post-operative pain control in the recovery room and is experienced in the application of truncal blocks. The patients are placed in the left lateral recumbent position following the intravenous administration of 10 mcg of remifentanil. Blocks are applied using a high-frequency (12-15 MHz) linear USG transducer (Hitachi Arietta 65 USG device) and a 22G, 80-mm, peripheral nerve block needle. After skin disinfection is ensured, the level of the lower end of the scapula is determined and accepted as T7 level and the probe is placed longitudinally 2.5-3 cm lateral to the T8 level. Transverse process and erector spinae muscle are visualized. The needle is advanced up to the transverse process at the T8 level with an out-of-plane approach. After negative aspiration and confirming the location with physiological saline, 5 cc 2% lidocaine and 20 cc 0.5% bupivacaine are injected and its spread is visualized under USG. The indicated doses are within the safe dose range for all patients to be used according to their weight. Blocks are applied unilaterally (right). The patients are evaluated every 5 min in terms of their NRS scores until NRS < 4 is achieved. Additional meperidine doses are applied when the target NRS is not achieved.

Data collection

Data regarding patients' sex, age, ASA score, body mass index, duration of surgery, and pre-operative/intraoperative use of regional techniques were obtained from intraoperative follow-up forms. Data regarding post-operative pain management (patients' NRS scores, number of meperidine boluses and cumulative meperidine doses applied, application of ESPB) and whether the patients had nausea and vomiting were obtained from PACU follow-up forms. Five time points were determined for data recording: admission to PACU (T0), and 5^{th}, 15^{th}, 30^{th}, and 60^{th} min in the PACU (T5, T15, T30, and T60, respectively).

Statistical analysis

Our primary outcome was to evaluate the effect of ESPB applied postoperatively on meperidine

Table 1. Characteristic of patients

Variables	ESP (62)	IV (46)	p-value
Age	43 ± 12	44 ± 11	0,37
Sex			0.96
Male	24 (39%)	18 (38%)	
Female	38 (61%)	30 (62%)	
ASA Score			0.66
1	20 (32%)	17 (35%)	
2	42 (68%)	31 (65%)	
BMI (kg/m^2)	26.4 ± 3.9	26.3 ± 4.2	0.85
Duration of Surgery (min)	68 ± 14	65 ± 14	0.64

Values are expressed as mean ± SD, or frequency (percentage). Chi-square and Student's t-tests were used for the comparison of categorical and continuous variables, respectively. BMI: body mass index

Table 2. NRS scores in rest at the post-operative time points

Groups	T0	T5	T15	T30	T60	p intragroup
ESP	8 (7-9)	6 (5-8)	4 (3-5)	3 (2-3)	2 (1-3)	$p_i < 0.001$
IV	8 (6-9)	6 (5-7)	4 (3-6)	3 (2-4)	2 (2-3)	$p_i < 0.001$
p intergroup	p: 0.4	p: 0.5	p: 0.12	p: 0.03	p < 0.007	

Values are expressed as median (25th-75th percentile). Friedman test and Mann–Whitney U-test were used for intergroup and intragroup comparisons, respectively. Statistically significant *post hoc* analyses: p_i; statistical significance was observed between all-time points ($p < 0.05$).

consumption in PACU. We expected at least a 20 mg reduction in the cumulative meperidine dose applied. A sample size of 89 patients was calculated to reveal this reduction assuming α of 5% (two-tailed) and β of 10% using the power analysis program (G-Power, P.S. version 3.1.2).

Data distribution was evaluated by Shapiro–Wilk test. Normally distributed data were presented as mean ± standard deviation and compared with Student's t-test. Non-normally distributed data were presented as median (25th percentile-75th percentile) unless stated otherwise. Categorical data were presented as frequency (percentage) and compared with a Chi-square test. NRS scores and cumulative meperidine consumption were compared between and within the groups using the Mann–Whitney U-test and Friedman/Wilcoxon test, respectively.

Results

A total of 318 patients underwent laparoscopic cholecystectomy between February 2022 and May 2022, and 192 of them had a NRS score > 3 at admission to the PACU. Eighty-four patients were excluded in line with the exclusion criteria and 108 patients were included in the statistical analysis (Fig. 1). The patients were allocated into two groups: 62 (57%) patients received ESPB postoperatively (pESPB group) and 46 (43%) patients were managed with IV meperidine boluses only (IV group). Data regarding the patients' demographic characteristics, ASA scores, and surgery durations are given in Table 1.

There was no statistically significant difference in terms of NRS scores between the groups on T0, T5, and T15 while the NRS scores of the pESPB group were significantly lower than those of the IV group on T30 and T60 (Table 2). Trends of the groups' NRS scores

Table 3. Frequencies of analgesic doses at post-operative time points

Patients received a meperidine dose	T0	T15	T30	Total
ESP	n/a	12 (19%)	4 (6%)	12 (19%)
IV	46	28 (58%)	11 (23%)	46 (100%)
p intergroup	n/a	p < 0.001	p: 0.009	p < 0.001

Values are expressed as frequency (percentage) and compared with the Chi-square test

Table 4. Post-operative analgesic requirements

Use of meperidine	T0	T15	T30	p intragroup
Cumulative dose administered (mg)				
ESP	ESP	0 (0-40)	0 (0-40)	p: 0.06
IV	20 (10-30)	30 (10-60)	30 (10-80)	$p_1 < 0.001$
p intergroup	n/a	p < 0.001	p < 0.001	

Values are expressed as median (minimum - maximum). Mann–Whitney U-test was used for intergroup comparisons. In accordance with the number of paired groups compared, the Wilcoxon/Friedman test was used for intragroup comparisons. Statistically significant *post hoc* analyses: p_1; statistical significance was observed between all subgroup comparisons ($p < 0.05$)

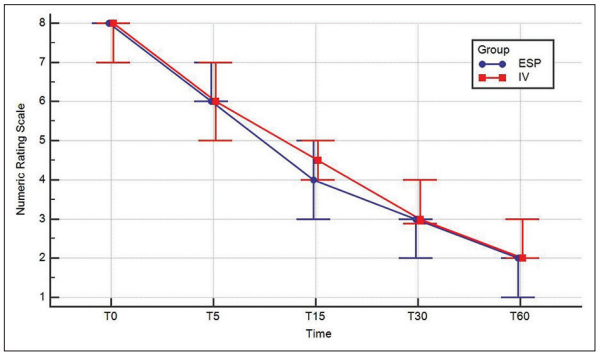

Figure 2. *NRS scores over time. Trends of the groups' NRS scores over time.*

over time were placed in figure 2. In the pESPB group, 12 (19%) patients needed at least one meperidine bolus while 50 (81%) patients recovered without the need for any additional meperidine application (Table 3). Cumulative doses of meperidine used between and within the groups are shown in Table 4. In the pESPB group, 58 (94%) patients had a NRS score < 4 on T30 while 35 (77%) patients in the IV group reached this outcome at the same time point (p = 0.009). There was no patient with a NRS score > 3 on T60.

Three patients (4.8%) in the pESPB group and 9 (19.5%) patients in the IV group had nausea at T60 (p = 0.02). One patient in the pESPB group and one patient in the IV group suffered from vomiting during the follow-up (1.6% and 2.2%, respectively, p = 0.61).

No major complications occurred due to the block application.

Discussion

The current study shows that in patients undergoing laparoscopic cholecystectomy, USG-guided unilateral ESPB reduces both the number of patients requiring opioid administration and the total dose of opioids used when applied as rescue therapy in the PACU. NRS scores are statistically lower in patients who receive ESPB. Furthermore, ESPB is related to lower time duration for achieving a NRS score < 4. These results are in line with recent studies showing that ESPB application reduces opioid consumption in the post-operative period[7–11]. Several meta-analyses have shown that ESP block reduces the 24-h consumption of opioids in different surgical settings[12,13]. In a study conducted in laparoscopic cholecystectomy patients, Cesur et al.[14] reported a 26% reduction in 24-h morphine consumption due to the unilateral application of ESP block. However, in these studies, ESP block was performed preoperatively or after the completion of surgery but before the termination of general anesthesia. To the best of our knowledge, this is the first study in which ESP block was applied as a post-operative rescue therapy.

There is no gold standard for the application level of the ESP block, as well as for the concentration, volume, and type of local anesthetics used in patients undergoing laparoscopic cholecystectomy. ESPB has been applied successfully from the levels between T7-T9 in different studies for this patient group[7-9,11]. We applied ESP at the T8 level and visualized local anesthetic spread in the craniocaudal direction in each patient under USG guidance. There are studies indicating that the ESP block only shows ipsilateral efficacy because it does not spread to the paravertebral/epidural spaces.[15,16] Therefore, it has been performed bilaterally in many studies for laparoscopic cholecystectomy.[7,8,12,17] However, we performed the ESPB unilaterally to avoid double injection in awake patients, as it has been shown that ESPB can result in bilateral sensory blockage with local anesthetic spread when applied unilaterally[6,14,18]. We preferred 0.5% as the bupivacaine concentration since there are studies in the literature showing that the duration of sensory block is longer when the local anesthetic concentration is higher[19,20]. One of the reasons for the unilateral application of the block was the need to divide the maximum dose of local anesthetic administered when the block was applied bilaterally, which would lead to a decrease in concentration. In this study, ESPB was used as a rescue therapy in the post-operative period. Therefore, we needed to initiate the analgesic effect as quick as possible. In line with this aim, we chose to use lidocaine along with bupivacaine due to its shorter onset of action[21].

Opioids might be insufficient in somatic pain control and are associated with many post-operative complications, including nausea and vomiting[2,22]. Therefore, it is clear that we need strategies that will relieve patients of their opioid overload. Compared with the IV group, the number of patients who suffered from post-operative nausea was lower in the pESPB group (p: 0.02 at T60). This difference can be explained by the lower total opioid consumption in the pESPB group. There was no significant difference in terms of post-operative vomiting. These data are consistent with studies showing that ESP block reduces the incidence of PONV when applied in spinal surgery and breast surgery[23,24].

This study has some limitations. First, the study was conducted retrospectively with a relatively small sample size. In the future, multi-center, prospective randomized controlled studies with larger sample sizes are needed to evaluate any possible advantages and disadvantages of post-operative ESPB for patients undergoing laparoscopic cholecystectomy. Second, the pain follow-up of the patients was performed only in the recovery room, and long-term results were not evaluated due to the absence of NRS score documentation in the clinics. Third, ESPB was applied unilaterally from the T8 level using both lidocaine and bupivacaine. Different interventional approaches might result in different outcomes.

Conclusion

When ESPB is applied as a post-operative rescue analgesic technique, the frequency of opioid administration and the amount of opioids administered are both reduced in the early post-operative period. Therefore, in case ESPB is not performed preoperatively, it is rational to apply the block postoperatively. This approach should be considered before opioid administration in terms of avoiding systemic side effects and ensuring a faster and stronger analgesic efficacy.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained approval from the Ethics Committee for analysis and publication of routinely acquired clinical data and informed consent was not required for this retrospective observational study.

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