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ORIGINAL ARTICLE

Medicine Science 2022;11(3):1105-9

Medicine Science International Medical Journal

Pre-emptive analgesic effect of ultrasonography-guided transversus abdominis plane block performed by adding dexamethasone to bupivacaine

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Received 01 February 2022; Accepted 09 June 2022
Available online 21.07.2022 with doi: 10.5455/medscience.2022.01.016

Abstract

The objective of this study was to evaluate the preemptive analgesic effect of ultrasound-guided transversus abdominis plane block performed with bupivacaine or adding dexamethasone on bupivacaine in laparoscopic cholecystectomy. This retrospective study was conducted on a total of 84 patients who underwent ultrasound-guided TAP block in laparoscopic cholecystectomy. Patients were divided into two groups: Group Bupivacaine (Group B) and Group Bupivacaine+Dexamethasone (Group B+D). Intraoperative hemodynamic changes, intraoperative remifentanil consumption, postoperative visual analog scale scores, tramadol consumption in 24 hours postoperatively, and postoperative first analgesic time were obtained from the records and compared between the groups. There were no statistically significant differences between both groups in terms of intraoperative heart rate, mean arterial pressure, oxygen saturation, and end-tidal CO_2 values. Postoperative visual analog scale scores, doses of remifentanil and total tramadol, and time of receiving the first analgesic were similar. Dexamethasone can be added to the bupivacaine for the TAP block without major side effects. Adding dexamethasone to bupivacaine in transverse abdominis plane block performed in laparoscopic cholecystectomy procedures did not create a significant difference in VAS score. We think that the use of dexamethasone does not have an additional analgesic effect. However, our results should be supported by further studies.

Keywords: Bupivacaine, dexamethasone, pre-emptive analgesia, transversus abdominis plane block

Introduction

Today, laparoscopic cholecystectomy (LC) is a minimally invasive treatment method that is widely used as a gold standard in symptomatic and benign gallbladder diseases and early-stage malignancies [1,2]. Studies have reported that a successful LC procedure is associated with earlier recovery, shorter length of stay in the hospital, and better cosmesis [3].

On the other hand, mild-to-moderate postoperative pain seen after LC remains an important issue leading to readmissions [4]. The complex nature of acute pain after LC suggests that an effective analgesic treatment should be multimodal. However, there is no consensus on a modality for use in the treatment of postop pain after LC.

Preemptive analgesia is one of the widely used techniques in the management of postop pain. Preemptive analgesia, which is known as an antinociceptive treatment, hampers the establishment of changed central processing of afferent input from injuries [5].

Various preemptive analgesia models have been proposed for reducing postop pain after LC. TAP (Transversus Abdominis Plane) block is one of these modalities. The injection of a local anesthetic agent into the neurovascular plane between the transverse and internal oblique muscles in the lumbar Petit triangle is known as the TAP block [6]. Bupivacaine, ropivacaine, and levobupivacaine can be preferred as local anesthetics for TAP block. There are several studies examining the addition of agents such as dexamethasone, dexmedetomidine, and fentanyl to TAP block to potentiate the effect of local anesthetics [7-11].

We investigated the effects of bupivacaine and dexamethasone added to bupivacaine on postoperative pain in a TAP block used under ultrasonography in laparoscopic cholecystectomy.

Materials and Methods

Our study was a single-center, retrospective observational study.

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Patients who received TAP block using ultrasonography in an LC under general anesthesia in our hospital between January 2019 and December 2019 were included. They ranged in age from 18 to 65 years old and had an ASA physical status of 1-2. Patients' data were obtained from the general patient files and perioperative analgesia evaluation forms. This study did not include any patients who had incomplete records. This study excluded 28 patients out of a total of 123. The remaining 91 patients were classified based on the drugs used to block TAP, and 84 were studied retrospectively (Figure 1).

Patients were divided into two groups: those given only bupivacaine (Group B) and those given both bupivacaine and dexamethasone (Group B+D).

Anesthetic Management

Patients were routinely monitored with ECG, pulse oximeter, and noninvasive blood pressure.

All patients included in the study were given 0.02mg/Kg intravenous (iv) midazolam as premedication. Anesthesia was induced using iv 2mg kg propofol and 1mcg/Kg iv remifentanil bolus (within 30-60 seconds); 0.6mg kg rocuronium was administered before endotracheal intubation. Following endotracheal intubation, 40% air with 4-6% desflurane and iv 0.025-0.75 mcg/Kg/min remifentanil infusion were administered for anesthesia maintenance. As required, rocuronium was used for muscle relaxation. To provide analgesia, 1g of paracetamol was infused intravenously 30 minutes before the end of the operation.

Patients were asked to verbally assess their level of postoperative nausea during the 0-24 h postoperative period, using the numeric rating scale (NRS); (for a 0–100 point; <30 no, ≥30 yes). Ondansetron (8mg, iv) was used as a rescue antiemetic when NRS was greater than or equal to 30 or more than one episodes of vomiting. Postoperative pain was assessed with the visual analog scale (VAS). When the VAS was greater than 4, diclofenac 75mg was administered intramuscularly as a rescue analgesic.

TAP Block Procedure

TAP block was performed in the supine position following intubation by an experienced anesthesiologist. The ultrasonography (USG) (Esaote, MyLab30 Gold Cardiovascular, Florence, Italy) probe was placed obliquely along the subcostal edge near the midline in the upper abdominal wall, and the probe was fixed after visualization of the M. Obliquus externus, M. Obliquus internus, M. Transversus abdominis, and peritoneum.

After the needle tip was seen between the M. Obliquus internus and M. Transversus abdominis, 0.3ml/kg 0.25% bupivacaine (max. 20ml) plus 2ml normal saline was injected on each side between the two muscles in Group B; and 0.3ml/kg 0.25% bupivacaine (max. 20mL) plus 4mg dexamethasone in 2mL in each side in Grup B+D using 10 cm Braun (22 G 100mm, Melsungen, Germany) block needles. Distribution of the agents was observed. All patients received patient-controlled intravenous analgesia (PCA) for 24 hours with tramadol 500mg (10ml) and saline (90mL). It was adjusted to a bolus dose of 5ml and no continuous infusion. As a rescue analgesic, 75mg diclofenac was administered intramuscularly. No complications occurred during the procedures.

Data Evaluation

Patients' demographic data, operation time, and ASA classes were recorded. In addition, vital signs including heart rate (HR), mean arterial pressure (MAP), oxygen saturation (SPO_2), and end-tidal carbon dioxide ($ETCO_2$) were measured at the intraoperative minutes 0,5,15,30,45,60 and 75. Time of the first analgesia, requirement of rescue analgesics, total tramadol doses, and intraoperative remifentanil doses were obtained from the records and included in the analysis. The Visual Analogue Scale (VAS) was used to assess postoperative pain. (VAS) is widely used in the literature to determine the severity of pain. VAS is applied on a 100 mm length ruler and patients are asked to indicate their level of pain on this ruler, with a score of 0 indicating no pain and a score of 10 indicating intolerable severe pain. In our study, VAS scores were measured at the postoperative hours 1,2,6,12,18 and 24, while the rates of using the first analgesic were measured at the postoperative hours 1,2,6,12 and 24.

Ethic Consideration

The study protocol was approved by the Recep Tayyib Erdogan University, Non-interventional Clinical Research Ethics Committee with the 09/07/2020 dated and 2020/161 numbered decision. Since the study was designed of retrospective nature, patients' informed consent forms were waived. The study was conducted by the ethical principles of the Declaration of Helsinki and the Code of Ethics of the World Medical Association.

Statistical Analysis

The data obtained in this study were statistically analyzed using NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) software. When evaluating study data, descriptive statistical methods (Mean, Standard Deviation, Median, Frequency, Ratio, Minimum, Maximum). The Shapiro-Wilk test was used to determine the normality of the data. Two-group comparisons of non-normally variables were made with Mann-Whitey U test. A comparison of qualitative variables was carried out with the Chi-square test. Friedman test was used to determine the differences in quantitative data among three or more-time measurement times. The statistical significance level was set at p0.05.

G*Power version 3.1.9.2 was used to estimate the sample size (Franz Faul, University of Kiel, Kiel, Germany). The sample size was calculated to be 76 using a power of 80%, a statistical level of significance of 0.05, and an effect size of 0.5.

Results

This study included 91 patients who had undergone laparoscopic cholecystectomy, with 84 of them statistically analyzed. (Figure 1). In terms of demographic data, no statistically significant differences were discovered between the groups (Table 1).

When the MAP values were compared, the values measured at the 45th minute in Group B+D were noticeably higher than in Group B (p=0.001). In terms of the other MAP values, there was no noticeable difference between the groups (Figure 2). No statistically remarkable difference was found in the HR value measured at all measurement times (for all p>0.05).

In addition, SPO_2 and $ETCO_2$ values were compared between both groups only at the 5th minute, SPO_2 value was remarkably higher in Group B+D compared to Group B (p=0.15). No remarkably difference was encountered between the groups regarding the other SPO_2 values (p>0.05). The mean $ETCO_2$ value was statistically remarkable higher in Group B+D compared to Group B at the 75th minute (p=0.042). No remarkable difference was encountered between the groups regarding the other $ETCO_2$ values (p>0.05).

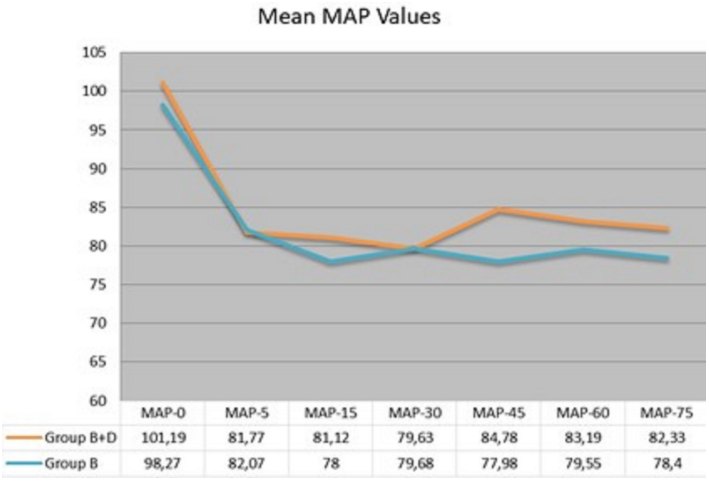

Figure 1. Flow chart of this study

Table 1. Demographic characteristics of the patients

	Group B (n:41)	Group B+D (n:43)	P*
Age (year), Mean±SD	44.95±13.21	47.53±12.42	0.359
Gender(Female,%)	68.2	69.7	0.535
BMI (kg/m²), Mean±SD	27.85±4.74	29.26±5.68	0.121
ASA (ASA 1,%)	36.5	30.2	0.350
Operation time (minute), Mean±SD	48±11.24	44.65±13.16	0.461

SD: Standard deviation; **BMI:** Body mass index; **ASA:** American Society of Anesthesiology; *Mann-Whitney U Test and Chi-Square test

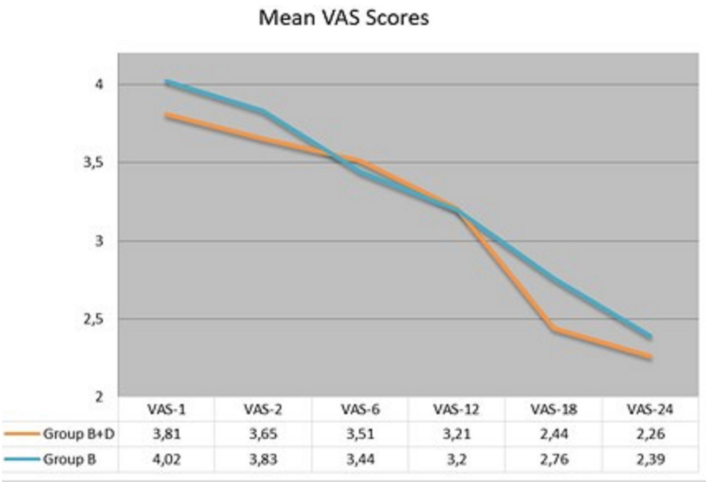

Figure 2. Comparison of the mean arterial pressure (MAP, mmHg) values between the intraoperative measurement times (minutes). Group B: Bupivacaine; Group B+D: Bupivacaine+ Dexamethasone

VAS scores measured at the postoperative hours 1,2,6,12,18, and 24 were compared between the two groups. No statistically remarkably difference was found between Group VAS values measured at all time points (p>0.05) (Figure 3). There were no significant differences between the two groups in terms of the time between initial analgesia doses of intraoperative remifentanil, postop total tramadol, and the need for rescue analgesia (p>0.05) (Table 2).

Table 2. Intraoperative and postoperative analgesic requirement

	Group B (n:41)	Group B+D	P*
Total remifentanil consumption intraoperative period (µcg), Me-dian (min.–max.)	240(80-480)	200(60-600)	0.539
Total tramadol consumption during 24h (mg), Median (min.–max.)	150(50-400)	150 (50-450)	0.539
Time of first analgesia (minute), Median (min.–max.)	27(5-180)	35(8-150)	0.072
Requirement of rescue analge-sics, %	19.7	14.6	0.327

in.: Minimum; max.: Maximum; *: Mann-Whitney U test.

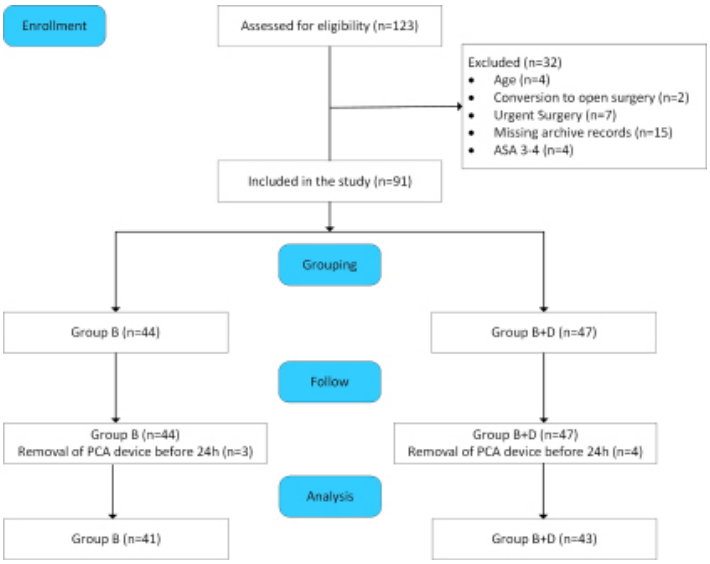

Figure 3. Comparison of the VAS scores between the postoperative measurement times (hours). Group B: Bupivacaine; Group B+D: Bupivacaine+ Dexamethasone

And finally, both groups were compared in terms of postoperative nausea and vomiting. The statistical results of the two groups are similar (p>0.05) (Table 3).

Table 3. Comparison of the postoperative nausea and vomiting between the groups

Complication	Group B (n:41)	Group B+D (n:43)	P*
Nausea,%	19.5	18.6	0.916
Vomiting,%	7.3	11.6	0.501

*Chi-Square test

Discussion

The purpose of this study was to determine the postoperative pain associated with the addition of dexamethasone to bupivacaine for

TAP block application under ultrasonographic guidance in LC. The primary outcome of this study is that there is no remarkable difference between the measured VAS values of the groups. No significant difference in tramadol consumption or the need for rescue analgesia was observed between the groups in the postoperative 24 hours.

In patients undergoing LC, ultrasound-guided bilateral Subcostal TAP block provides effective postoperative analgesia while reducing opioid consumption [12]. A study by Vrsajkov et al., have randomized patients undergoing LC either subcostal TAP block or standard postoperative analgesia. Subcostal TAP block may provide superior postoperative analgesia and reduce the need for opioids following LC [13].

Dexamethasone has been used to improve the quality and duration of local anesthetics administered during various peripheral nerve block techniques. Many studies have been carried out to determine the analgesic effects of corticosteroids when combined with local anesthetic agents [14-16].

Animal studies in the literature have revealed the analgesic efficacy of dexamethasone. Droger et al. demonstrated in their study that combining dexamethasone with bupivacaine prolonged intercostal nerve blockade in sheep [17]. Similarly, in a study by Castillo et al., adding dexamethasone to bupivacaine was reported to prolong sciatic nerve blockade in rats [18].

Adding dexamethasone to local anesthetics to increase the analgesic effect in humans is still controversial due to its side effects. It has been reported that delayed recovery, postop inflammation, and ulcer in the gastric mucous membrane may occur with the use of steroids [19].

Additionally, dexamethasone added to local anesthetics in TAP block has been shown in human studies to reduce pain scores at the 4th, 6th, and 12th hours postoperatively and to prolong the first postoperative additional analgesic demand [20]. Ammar et al. conducted a study with 60 patients who underwent hysterectomy surgery, 8 mg dexamethasone added to 20mL bupivacaine 20% resulted in a remarkable decrease in VAS scores over 48 hours compared to the control groups (bupivacaine alone) [21]. In contrast, no statistically significant difference in postoperative VAS scores was observed between the groups in this study. However, the measurements in our study were made until the 24th hour, because patients usually are discharged 24 hours after the surgery. In addition, different operation types between the studies might affect these results.

Dexamethasone, which is a member of the glucocorticoid family, is commonly used to prevent postoperative nausea and vomiting (PONV) seen in 20-40% of the patients after surgery [22,23]. Dexamethasone was found to reduce the incidence of PONV when combined with local anesthetics in the TAP block in a meta-analysis [20]. However, in our study, there was no statistically remarkable difference between Group B and Group B+D in terms of PONV (both $p>0.05$).

Among the parameters investigated in our study, the mean intraoperative vital signs including HR, MAP, SPO_2, and $ETCO_2$ showed no statistically remarkably difference between Group B and Group B+D. In a study by Fouad et al. with 50 male patients who underwent inguinal herniorrhaphy operation, no remarkable difference was found between the group who were administered bupivacaine alone and the group who were given bupivacaine + dexamethasone in terms of vital signs (MAP, HR, SPO_2) [24].

According to Vetriselvan et al., administering dexamethasone via perineural or intravenous route improves the quality of analgesia in patients undergoing laparoscopic gynecological surgery. In our clinic, iv 8 mg dexamethasone can be administered to patients with risk factors for PONV. In our retrospective study, we did not question the use of dexamethasone. This may have contributed to the similarity in postoperative pain scores [25].

Study Limitations

This study has several limitations. The first of these is that the study was carried out retrospectively in a single center. Second, the use of iv dexamethasone for PONV was not questioned. However, unlike studies in the literature, measuring intraoperative remifentanil doses stands out as one of the strengths of our study.

Conclusion

As a result of this study, it was revealed that the addition of dexamethasone to bupivacaine in a TAP block performed in LC procedures to increase the preemptive analgesic effect did not make any difference in intraoperative HR, MAP, SO_2, and $ETCO_2$ values and postoperative VAS scores, remifentanil doses and time of first analgesic administration. Given the variability among studies on this issue in the literature, we believe that our results contrary to previous studies will bring a new perspective to the discussions in the literature. Therefore, we think that adding dexamethasone to local anesthetics to increase analgesic efficiency is unnecessary. However, because our findings are opposite to most previous studies, our findings should be confirmed with more comprehensive and prospective studies.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
The study protocol was approved by the Recep Tayyib Erdogan University, Non-interventional Clinical Research Ethics Committee with the 09/07/2020 dated and 2020/161 numbered decision.

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