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Original Article

# Efficacy of transverse abdominis plane block in reduction of postoperation pain in laparoscopic cholecystectomy

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ABSTRACT

*Objective:* Transversus abdominis plane (TAP) block is a recently introduced regional anesthesia technique that is used for postoperative pain reduction in some abdominal surgeries. The present study evaluated the efficacy of the TAP block on the post laparoscopic cholecystectomy pain intensity and analgesic consumption.

*Methods:* Fifty-four patients were enrolled in three groups: TAP block with normal saline (Group 1, $n = 18$); TAP block with bupivacaine (Group 2, $n = 18$); and TAP block with bupivacaine plus sufentanil (Group 3, $n = 18$). The time to the first fentanyl request, fentanyl consumption in the 24 hours following surgery, and postoperative pain intensity at 30 minutes, 1 hour, 6 hours, 12 hours, and 24 hours following discharge for recovery were measured and recorded.

*Results:* The total amount of 24-hour fentanyl consumption was higher in Group 1 (877.8 ± 338.8 μg) than either Group 2 (566.7 ± 367.8 μg) or Group 3 (555.5 ± 356.8 μg; $p = 0.03$). Postoperative pain score was higher in Group 1 than intervention groups ($p = 0.006$); however, there was no significant difference in intervention groups. The time to the first fentanyl request in Group 1 (79.44 ± 42.2) was significantly lower than Group 3 (206.38 ± 112.7; $p = 0.001$).

*Conclusion:* The present study demonstrated that bilateral TAP block with 0.5% bupivacaine reduces post laparoscopic cholecystectomy pain intensity and fentanyl request and prolongs time to the first analgesic request. Adding sufentanil to the block solution reduced neither pain intensity nor fentanyl further consumption.



## 1. Introduction

Postoperative pain management is a challenging issue in anesthesiology and one of the most important factors in postoperative rehabilitation and return to normal activities. Opioids as the most efficient used analgesic agents, but are accompanied with adverse effects such as nausea, vomiting, pruritus, respiratory depression, and urinary retention. The adverse effects of opioids are dose-dependent, so using a multimodal approach to pain control would enhance analgesia while decreasing opioid side effects.[1]

Transversus abdominis plane (TAP) block has been recently introduced as a postoperative pain control modality to reduce the usage of opioids and reduce the side effects and patient management costs.[2–4] Almost a decade has passed since the introduction of TAP block, and tremendous interest has evolved into its utility; it has been used for pain control in the radical prostatectomy, hysterectomy, cesarean delivery, and laparoscopic surgeries.[1]

The analgesia produced by neuraxial opioids alone, or opioids as adjuvants to local anesthetics, has been demonstrated for acute postoperative pain control.[5,6] Research in the past three decades has proven the effectiveness of opioid receptors for excitatory and inhibitory peptides in peripheral tissues including sensory afferent nerve terminals. Several studies have been conducted to evaluate the effect of opioids as adjuvants in peripheral nerve blocks[7,8]; however, there are many controversies about their efficacy. To our

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knowledge, the effect of sufentanil as an adjuvant in TAP block has not been evaluated yet.

In the present study, it was hypnotized that the TAP block can efficiently reduce postlaparoscopic cholecystectomy pain intensity and adding the sufentanil to local anesthetic solution can enhance this effect. The pain intensity and time to the first fentanyl request were evaluated as secondary outcomes.

## 2. Methods

After getting the approval of the Institutional Ethics Committee and patients' informed consent, 54 participants scheduled for elective laparoscopic cholecystectomy under general anesthesia were enrolled in this study.

Patients with a history of addiction (including opioids and benzodiazepines), chronic pain, sensitivity to prescribed drugs, psychological disorders, coagulopathy, any contraindication for TAP block, and those receiving any drugs within 48 hours of surgery (except for the study protocol) were not enrolled to this study. Any patients with surgical complication, and in cases where the operation was longer than 100 minutes, were also excluded from this study.

In a controlled, randomized double blind design and using a computer-generated randomization list, patients were allocated into three groups, to receive: 32 mL of 0.9% normal saline 16 mL in each side (Group 1, $n = 18$); 30 mL of bupivacaine 0.5% plus 2 mL normal saline, 16 mL in each side (Group 2, $n = 18$); or 30 mL of bupivacaine 0.5% plus 2 mL (10 μg) sufentanil, 16 mL in each side (Group 3, $n = 18$) at the end of surgical procedure.

At the time of the preoperative visit, a trained investigator explained the study plan and the scale [visual analog scale (VAS) for pain] used in the study to patients. Drug solutions were prepared and blocks were done by an anesthesiologist who was not involved in the data collection, and patients received their block when they were under anesthesia; thus both the investigators and the patients were blinded to the group assignment.

The severity of postoperative pain was measured and recorded using a 10-cm VAS scale, where 0 = no pain and 10 = the worst possible pain. Patients were asked to score the pain at different times after the operation including the time of discharge from recovery and 30 minutes, 1 hour, 6 hours, 12 hours, and 24 hours later.

In the operating room, an infusion of 7 mL/kg lactated Ringer's solution was commenced. All patients were monitored with an electrocardiogram, noninvasive blood pressure, and pulse oximetry. All patients received standardized general anesthesia. The induction of anesthesia was done by administration of 2 mg/kg intravenous (IV) propofol and 3 μg/kg IV fentanyl, tracheal intubation was facilitated by 0.6 mg/kg IV atracurium and anesthesia was maintained with 80–100 μg/kg/min propofol and 1 μg/kg IV fentanyl and 0.3 mg/kg IV atracurium administrated every 30 minutes.

At the end of the surgical procedure and before wound dressing, the skin was prepared with 2% chlorhexidine solution. Blocks were performed by a senior trainee experienced in the technique, under the direct supervision of a study investigator. Images were obtained using a Sonosite M-Turbo ultrasound machine with an L38 from 10 MHz to 5 MHz 38-mm broadband linear array probe. Blocks were performed using a 150 mm Stimuplex needle (B-Braun Medical, Bethlehem, PA, USA). A high frequency linear ultrasound probe (6–13 MHz) is placed transverse to the abdominal wall between the costal margin and iliac crest on the mid axillary line. The satisfactory image was aimed to visualize the subcutaneous fat, external oblique muscle, internal oblique muscle, transversus abdominis muscle, peritoneum, and intraperitoneal cavity. The needle was introduced in plane of the ultrasound probe directly under the probe and advanced until it reaches the plane between the internal oblique and transversus abdominis muscles. Upon reaching the plane, 3 mL of prepared solution was injected. The transversus abdominis plane was visualized expanding with the injection and total blood anesthetic solution was injected.

Subsequently, anesthetic administration was stopped and neuromuscular blockade was antagonized by IV administration of 2.5 mg of neostigmine along with 1.0 mg atropine. Patients were considered awake when they opened their eyes on command or after gentle tactile stimulation; they were extubated soon thereafter.

Patients were scheduled to receive patient-controlled analgesia (PCA) following surgery. The loading dose of fentanyl was administrated at the first time of reported pain score >3. The patients were attached to a PCA device. The PCA device was programmed to achieve each patient's desired level of comfort and contained 50 mL of fentanyl. Bolus dose of 50 μg fentanyl with lockout at 8-minute intervals with no preset of maximum dose was set. The postoperative fentanyl consumption was considered as primary outcome.

For the partial $\eta^2$ of 0.1 for the primary endpoint, the sample size of 18 patients per arm was calculated to achieve 80% power with a two-sided significance level of 0.05.

Continuous variables were presented as mean (standard deviation). Normality of variables was tested with Kolmogorov–Smirnov test; they followed normal distribution. In order to investigate the difference between the three groups, one-way analysis of variance (ANOVA) was used. Associations between sex, American Society of Anesthesiologists class, and groups were tested using Chi-square test. Repeated measure ANOVA was used to test the equality of time trend of pain score between three groups, and *post hoc* Tukey HSD test was performed to detect differences between groups.

Data were analyzed using SPSS version 20 (SPSS Inc., Chicago, IL, USA). For all analyses, $p < 0.5$ was considered statistically significant.

## 3. Results

Fifty-four patients were included in the study, 18 patients in each group. There was no protocol violation, so all data were analyzed. The mean age of patients was 45.39 ± 10.7 years (range, 28–61 years). Characteristics of the patients are summarized in Table 1. Patients in the three groups did not differ significantly in terms of the mean age and sex ($p = 0.86$ and $p = 0.80$, respectively). However, the mean duration of operation, time to the first fentanyl request and amount of 24-hour postoperation fentanyl usage were significantly different in the three groups ($p = 0.019$, $p = 0.002$, and $p = 0.012$, respectively). *Post hoc* Tukey test showed that the mean time to first fentanyl request in Group 1 (79.44 ± 42.20 minutes) was significantly lower than other groups (ANOVA, $p = 0.001$), but there was no significant difference between Group 2 (144.44 ± 83.1 minutes) and Group 3 (206.30 ± 112.7 minutes; $p = 0.13$). The 24-hour postoperation fentanyl usage was significantly higher in Group 1 (877.8 ± 338.8 μg) than either Group 2 (566.7 ± 367.8 μg) or Group 3 (555.5 ± 356.8 μg; $p = 0.03$ and $p = 0.02$, respectively), although Groups 2 and 3 showed no significant difference (*post hoc* Tukey test, $p = 0.99$).

VAS at all five measured times, separated for three groups are presented in Figure 1. Based on multivariable repeated measures ANOVA, there was a difference in three groups ($p = 0.004$). *Post hoc* Tukey test demonstrated that the changes in the mean of pain score in Group 1 was significantly different from both Groups 2 and 3 ($p = 0.004$ and $p = 0.006$, respectively); however, the two experimental groups were not significantly different ($p = 0.98$).