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Original Contribution

Postoperative analgesic efficacy of single-shot and continuous transversus abdominis plane block after laparoscopic cholecystectomy: A randomized controlled clinical trial

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ABSTRACT

Study objective: To compare the analgesic efficacy of ultrasound-guided single-shot and continuous transversus abdominis plane (TAP) block to that of IV-PCA in patients undergoing laparoscopic cholecystectomy.
Design: Prospective randomized controlled trial.
Setting: Post-anesthesia care unit and General ward.
Patients: 108 American Society of Anesthesiologist (ASA) physical status I-II patients undergoing laparoscopic cholecystectomy.
Interventions: Group A received IV-PCA; group B received both ultrasound-guided single-shot TAP block with 0.2% ropivacaine (20 mL) and IV-PCA; and group C received continuous TAP block using an ultrasound-guidance-inserted indwelling catheter. In group C, infusion of 0.2% ropivacaine at a basal rate of 3 mL/h, bolus dose of 4 mL, and a lockout interval of 30 min was maintained for 48 h postoperatively. The primary outcome was evaluated analgesic efficacy using the numeric rating scale (NRS) for 48 h postoperatively. Other outcomes included the number of patients requiring additional analgesics, patient satisfaction with postoperative pain control, and incidence of postoperative adverse events.
Main results: Compared to other groups, group C had higher deep abdominal NRS at 1 h postoperatively ($P < 0.05$), and lower incidence of postoperative urinary retention ($P < 0.05$). There were no significant intergroup differences in the number of patients requiring additional analgesics, and patient satisfaction with postoperative pain control.
Conclusions: Compared to IV-PCA with or without single-shot TAP block, ultrasound-guided continuous TAP block provided similar analgesia in somatic pain and less analgesia in visceral pain. Moreover, the latter resulted in a lower incidence of postoperative urinary retention.

1. Introduction

The major goal of postoperative pain management is to minimize the dose of medications, in order to reduce the side effects, while still providing adequate analgesia [1]. Despite its minimally invasive nature, laparoscopic cholecystectomy frequently results in moderate-to-severe pain during the postoperative period [2]. Intravenous patient-controlled analgesia (IV-PCA) with opioids and non-steroidal anti-inflammatory drugs (NSAIDs) is the most commonly utilized method for acute postoperative pain management. However, the administration of opioids has several adverse effects such as postoperative nausea and vomiting (PONV), dizziness, pruritus, and respiratory depression [3].

As an alternative to opioid-based IV-PCA, ultrasound-guided transversus abdominis plane (TAP) block has been widely used for pain management after abdominal surgeries. Most studies involving TAP block have used a single-shot technique [4–7]. Pain relief can be obtained by a single injection of a local anesthetic into the transversus abdominis fascial plane, where the nerves from ventral ramus of T6 to L1 are located at the surgical incision sites, and this could lower the pain scores until 24 h postoperatively [8]. However, the typical duration of sensory blockade after a single-shot TAP block is 6 to 12 h, with a mean analgesic effect of 9.5 (interquartile range [IQR] 8.5 to 11.9) hours [9], and hence, early analgesic intervention is needed in the postoperative period. Very limited literature is available regarding the utility of continuously infused local anesthetics through indwelling catheters

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in the TAP [10–11]. Therefore, the use of a continuous TAP block may be an attractive method to provide longer postoperative analgesia after laparoscopic cholecystectomy.

This study was designed to compare the analgesic efficacy of ultrasound-guided single-shot and continuous transversus abdominis plane (TAP) block to that of IV-PCA in patients undergoing laparoscopic cholecystectomy.

2. Methods

2.1. Enrollment

After obtaining approval from the Institutional Review Board of Pusan National University Yangsan Hospital (approval number: 05-2015-073), this study was also registered at the Clinical Research Information Service (registration number: KCT0001911). All participants provided written informed consent. The study included 108 consecutive patients with American Society of Anesthesiologists (ASA) physical status 1 to 2, aged 19 to 70 years, and undergoing laparoscopic cholecystectomy. The exclusion criteria included allergy to any of the drugs used in the study, chronic opioid medication prior to surgery, intellectual impairments or psychiatric conditions precluding adequate communication, ipsilateral neurological deficits, hepatorenal dysfunctions, and pregnancy. Participants and post-anesthetic care unit (PACU) nurses performing pain assessments were blinded to the group allocation. Participants were managed by a variety of surgeons and anesthetists.

2.2. Randomization

A list of random numbers generated using Microsoft Excel (Microsoft Co., Redmond, WA, USA) was used to randomize patients into 3 groups before the start of surgery. The patients in group A (n = 36) received IV-PCA as a control group. The patients in group B (n = 36) received both ultrasound-guided single-shot TAP block with 0.2% ropivacaine (20 mL) and IV-PCA. The patients in group C (n = 36) received continuous TAP block.

2.3. Analgesic technique

Premedication was performed by injecting glycopyrrolate (0.003 mg/kg) and midazolam (0.05 mg/kg). Noninvasive blood pressure, electrocardiography, pulse oximetry, and bispectral (BIS) index (XP version 4.1; Aspect Medical Systems, Newton, MA, USA) were monitored continuously. Induction of general anesthesia was performed by injecting thiopental sodium (5 mg/kg) and remifentanil (1 μg/kg/min), which was diluted to 100 μg/mL using normal saline. After the patients lost consciousness, rocuronium (0.8 mg/kg) was injected and endotracheal intubation was performed after 90 s of mask ventilation.

Desflurane (6 vol%) was used as an inhalational anesthetic, and intravenous remifentanil was infused and titrated (0.5–1 μg/kg/min) for anesthesia maintenance. In addition, the BIS index was maintained within the range of 40 to 60, and the end-tidal carbon dioxide partial pressure was maintained within the range of 35 to 40 mmHg.

For postoperative pain management, group A (n = 36) received an IV-PCA pump (Ambix anaplus®; *E*-Wha Fresenius Kabi Inc., Gunpo,

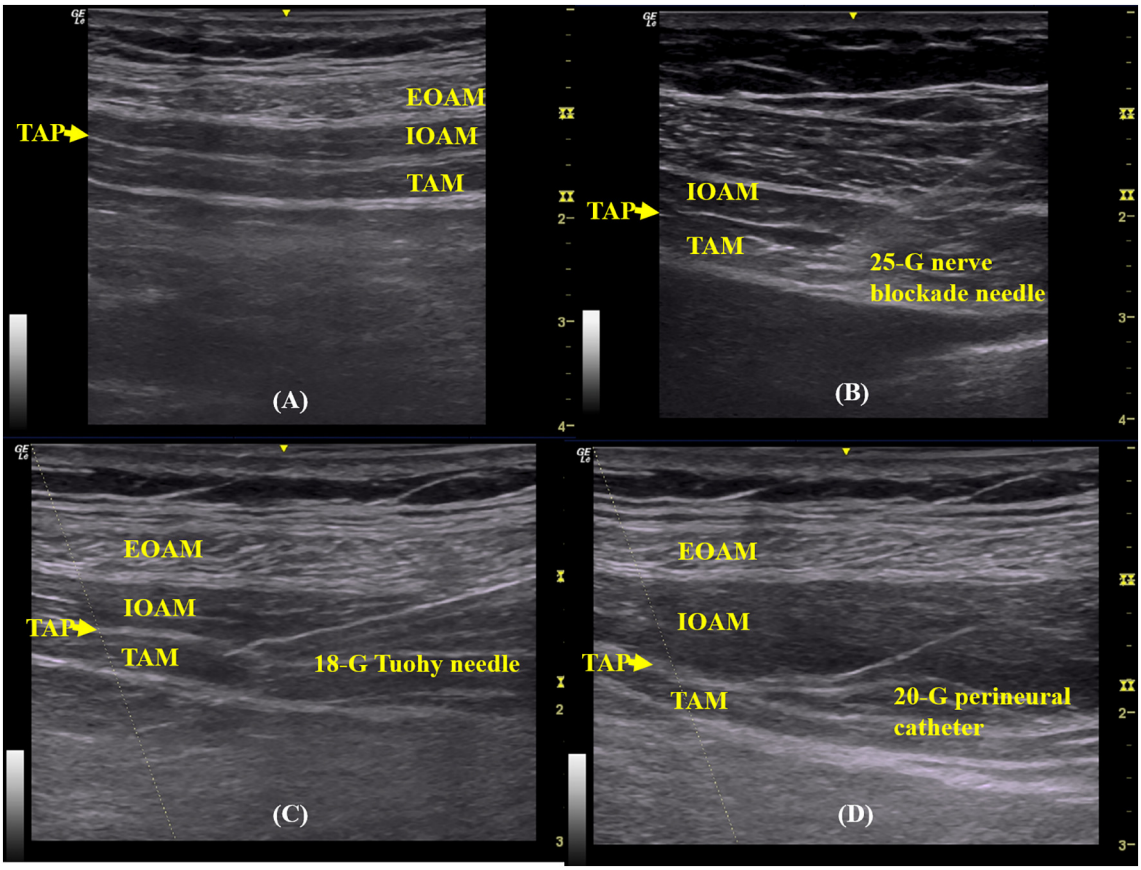

Fig. 1. (A) Transverse ultrasonographic view of the external oblique abdominis muscle (EOAM), internal oblique abdominis muscle (IOAM), and transversus abdominis muscle (TAM) during the injection of the local anesthetic between the two inner muscles. (B) Single-shot transversus abdominis plane (TAP) block during the injection of the local anesthetic between the two inner muscles. (C) Continuous TAP block during the insertion of the 18-gauge Tuohy needle. (D) Continuous TAP block during the insertion of the 20-gauge three-orifice perineural catheter.