Comparison of Analgesic Efficacy of Laparoscope-Assisted and Ultrasound-Guided Transversus Abdominis Plane Block after Laparoscopic Colorectal Operation: A Randomized, Single-Blind, Non-Inferiority Trial

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BACKGROUND: Transversus abdominis plane (TAP) block has been used as a component of multimodal analgesia after abdominal operation. We introduced a new laparoscope-assisted TAP (LTAP) block technique using intraperitoneal injection and compared its analgesic effect with that of an ultrasound-guided TAP (UTAP) block in terms of postoperative pain control.

STUDY DESIGN: A prospective, randomized, single-blinded non-inferiority clinical trial was conducted with patients undergoing elective laparoscopic colectomy for colon cancer. Eighty patients were randomly assigned (1:1 ratio) to the UTAP and LTAP groups. At the end of the operation, opioid consumption and numeric rating scores (NRS; 0 [no pain] to 10 [worst pain]) of pain were recorded at 2, 6, 24, and 48 hours postoperatively and were compared between the groups. The primary end point was pain NRS during rest at 24 hours after operation.

RESULTS: Thirty-eight patients in the LTAP group and 35 patients in the UTAP group completed the study protocol. We found no significant difference in mean ± SD pain NRS during rest at 24 hours between the LTAP group (3.90 ± 1.7) and the UTAP group (4.5 ± 1.9). The mean difference in pain NRS during rest at 24 hours was 0.57 (95% CI −0.26 to 1.41). Because the lower boundary of a 95% CI for the differences in pain NRS was > -1, non-inferiority was established. There was no significant difference between the groups in NRS pain during rest, NRS pain on movement, and postoperative morphine consumption during the 48 hours after operation.

CONCLUSIONS: These results show our new LTAP block technique was non-inferior to the ultrasound-guided technique in providing a TAP block after laparoscopic colorectal operation. (J Am Coll Surg 2017;225:403−410. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

The laparoscopic approach can reduce the incision and pain associated with colorectal operation.[1] However, pain is still a major concern for patients undergoing laparoscopic colorectal procedure and is the main hindrance to enhanced recovery after operation.[2] Transversus abdominis plane (TAP) block has been used as a component of multimodal analgesia after abdominal operation. The TAP block is performed by injecting a local anesthetic solution between the internal oblique and transversus abdominis muscles to block the sensory nerves between T8 and L1 that innervate the lower abdominal wall.[3]

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Abbreviations and Acronyms

LTAP = laparoscope-assisted transversus abdominis plane
NRS = numeric rating scale
PCA = patient-controlled analgesia
PONV = postoperative nausea and vomiting
TAP = transversus abdominis plane
UTAP = ultrasound-guided transversus abdominis plane

The TAP block was introduced by Rafi[4] and was originally performed blindly via the lumbar triangle of Petit. The block needle would occasionally penetrate intra-abdominal organs, with subsequent bowel and liver injuries.[5,6] Ultrasound-guided TAP (UTAP) block permits visualization of TAP, the needle, and the spread of the anesthetic solution. Using an ultrasound device could improve the accuracy and safety of TAP block; however, it requires an ultrasound device and a trained physician to reduce the risk of visceral injury.[7] To address these issues, TAP block with direct vision of the laparoscopic camera has been introduced,[8-10] but these techniques are done by extraperitoneal approach.

We have introduced a new TAP block technique that is done by a laparoscopic needle through the working port using laparoscope monitoring. Our new laparoscope-assisted technique eliminates the need for an ultrasound device and can reduce the risk of visceral injury. However, the efficacy of this method was not validated. It is necessary to validate the analgesic efficacy of laparoscope-assisted TAP (LTAP) block during the postoperative period with direct comparison with UTAP block. Therefore, we designed a randomized, controlled, non-inferiority trial to compare the efficacy of LTAP block with UTAP block in terms of postoperative pain control and morphine consumption.

METHODS

Trial design and participants

After appropriate trial registration (cris.nih.go.kr: KCT0001576) and hospital medical ethics review board approval (KNUMC_15-1018), all patients with colon cancer who were scheduled for laparoscopic colorectal procedures at Kyungpook National University Medical Center between May 2015 and April 2016 were considered for entry into the trial. A member of the research team recruited patients, explained the study protocol, and obtained written informed consent. We included patients aged 20 to 75 years categorized as American Society of Anesthesiologists physical status I (a normal healthy patient) and II (a patient with mild systemic disease). We excluded patients with history of allergy to local anesthetics or systemic opioids, impaired kidney function, coagulopathy, chronic pain syndrome, chronic opioid use, and those weighing <40 kg or >80 kg. Patients who were unable to independently provide consent to participate in the trial or who were unable to use a patient-controlled analgesia (PCA) device were also excluded.

Patients were randomly allocated to either the LTAP group or the UTAP group in a 1:1 allocation ratio, and block randomized in blocks of size 4. Eighty opaque sealed envelopes containing the group assignments were prepared by a research assistant. Sealed envelopes were stored in a research office away from the clinical care team and were delivered to the operating room after induction of anesthesia. A nurse who was not involved with patient care opened the envelope to allocate the patient into the group.

Standard monitoring devices were applied for all patients on arrival in the operation room. Propofol (1.5 mg/kg) and rocuronium (0.4 mg/kg) were administered for induction of anesthesia. Anesthesia was maintained using 4% to 8% desflurane in a mixture of 50% oxygen in air and remifentanil infusion. Remifentanil was infused within a target plasma concentration range of 2 to 4 ng/mL using a target controlled infusion pump during anesthesia. Additional doses of rocuronium were administered as needed to maintain muscle relaxation. All patients received IV Hartmann's solution at a rate of 6 to 12 mL/kg/h during the procedure. No additional analgesics were used during the procedure.

Ultrasound-guided transversus abdominis plane block

Ultrasound-guided TAP blocks were performed before incision by an anesthesiologist with considerable experience in ultrasound-guided nerve blocks. A high-frequency linear transducer (UST5411; Aloka) was placed at the midaxillary line between the lower costal margin and the iliac crest. On visualization of the transversus abdominis, the anesthesiologist placed a 21-gauge Tuohy needle in the space between the internal oblique and transversus abdominis muscles using an in-plane ultrasound-guided technique and injected 2 mL saline to verify the needle placement; subsequently, 30 mL 0.25% ropivacaine was injected and the contralateral block was performed by the same technique.

Laparoscope-assisted transversus abdominis plane block

Laparoscope-assisted TAP blocks were performed by the operating surgeon. The surgeon made a camera port incision below the umbilicus and created the pneumoperitoneum. The camera was positioned for visualization of the