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Peritrocal and Intraperitoneal Ropivacaine for Laparoscopic Cholecystectomy: A Prospective, Randomized, Double-Blind Controlled Trial[1]

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Background. **The goal of this study was to evaluate the effect of peritrocal, intraperitoneal, or combined peritrocal-intraperitoneal ropivacaine on the parietal, visceral, and shoulder tip pain after laparoscopic cholecystectomy.**

Methods. **Eighty patients were randomly assigned to four groups. Group A received peritrocal and intraperitoneal saline. Group B received peritrocal saline and intraperitoneal ropivacaine. Group C received peritrocal ropivacaine and intraperitoneal saline. Group D received peritrocal and intraperitoneal ropivacaine. The parietal, visceral, and shoulder tip pain were assessed at 2, 4, 8, 12, 24, and 48 h postoperatively using a visual analog scale (VAS). The frequency of the patient pushing the button of the PCA and fentanyl use were also recorded.**

Results. **In visceral pain, significantly lower VAS scores were observed in Group B from 2 to 4 h and in Group D from 2 to 8 h. In parietal pain, significantly lower VAS scores were observed in Group C from 4 to 24 h and in Group D from 2 to 12 h. In shoulder tip pain, significantly lower VAS scores were observed in Group B from 4 to 48 h and in Group D from 2 to 12 h. The fentanyl use and the frequency to push the button of the PCA were the highest in Group A and the lowest in Group D at every time point.**

Conclusions. **We conclude that peritrocal infiltration of ropivacaine significantly decreases parietal pain and intraperitoneal instillation of ropivacaine significantly decreases the visceral and shoulder tip pain. Their effects are additive with respect to the total pain.**

Key Words: **intraperitoneal instillation; laparoscopic cholecystectomy; peritrocal infiltration; postoperative pain; ropivacaine.**

INTRODUCTION

Despite the markedly reduced postoperative pain after laparoscopic cholecystectomy (LC) than that after open traditional cholecystectomy [1], the early pain after LC is still considered a significant issue [2]. The pain after LC is thought to have a multifactorial origin [3–6]: incisional trauma at the port site [7, 8], the pneumoperitoneum in association with both the local changes (peritoneal and diaphragmatic stretching, ischemia, acidosis), and the systemic changes (hypercarbia causing sympathetic nervous system excitation that results in amplification of the local tissue inflammatory response), and the postcholecystectomy wound within the liver [9]. Pain after LC has three major main components; parietal pain caused by incisional trauma at the port site [7, 8], visceral pain related to pneumoperitoneum-induced local and systemic changes and the postcholecystectomy wound within the liver [9–11], and shoulder tip pain that occurs due to diaphragmatic stretching with phrenic nerve neuropraxia [4, 12]. These components have different intensities and their own time course [5].

Various studies have been performed for reducing the pain after LC by blocking these sites using local

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anesthetics: peritrocal infiltration of local anesthetics [7, 8], diffuse instillation of local anesthetics into the entire peritoneal space [13], intraperitoneal spraying above the gall bladder [11], instillation into the subdiaphragmatic area [5, 11], or a combination of peritrocal and peritoneal blocks [14, 15]. However, there is controversy about the characteristics and intensity among these components that cause the pain after LC [3, 5, 15–17] and also about the pain-reducing effects of intraperitoneal or peritrocal local anesthetics [5, 15–17].

The aim of our prospective, randomized, double-blind study was to evaluate the intensity of the parietal, visceral and shoulder tip pain and to determine the efficacy of peritrocal injection and intraperitoneal instillation of ropivacaine on each of these pain components.

MATERIALS AND METHODS

This study was approved by the Institutional Review Board of the College of Medicine of Chung-Ang University (c2009014 (201)) and was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12610000910000). This study was carried out according to the principles of the Declaration of Helsinki, 2000.

We performed a prospective, randomized, double-blind, controlled study, and informed written consent was obtained from each patient before inclusion in the study.

Patients and Groups

All the patients undergoing LC from May 2008 to May 2009, who were between the ages of 18 and 65 y, and who had an American Society of Anaesthesiologists (ASA) physical status score of 1 or 2 were candidates for inclusion in this study. The patients who weighed less than 45 kg or more than 100 kg, those who had severe underlying cardiovascular, renal, or hepatic disease, a history of previous abdominal surgery, chronic pain other than gallbladder disease, or an allergy to local anaesthetics were excluded.

The patients in Group A received intraperitoneal and peritrocal saline; the patients in Group B received intraperitoneal ropivacaine and peritrocal saline; the patients in Group C received intraperitoneal saline and peritrocal ropivacaine; and the patients in Group D received intraperitoneal and peritrocal ropivacaine (Table 1). The patients were prospectively randomized into four groups by Excel random-number generation. The details of the series were unknown to the investigators and the group assignments were kept in a set of sealed envelopes, each bearing only the case number on the outside.

Several hours before surgery, the appropriate numbered envelope was opened by the pharmacist and the card inside determined which group the patient would be in. Ropivacaine or normal saline was then prepared by the pharmacist in the form of syringes labelled 'peritrocal injection' or a bottle labeled 'intraperitoneal instillation' with the case number. All the parties involved, including the patients, the surgeons, the anesthesiologists, and the data collecting investigator were unaware of the study drugs or the patients' group assignment.

After the operation, the patients started an oral intake as soon as they could tolerate it and when their bowel function became adequate. The patients were discharged as soon as they were eating an adequate oral diet and they were mobile.

Surgical Technique

All the surgical procedures were performed by the same surgical team. After induction of anesthesia, all the patients were placed in the reverse Trendelenburg position (30°), with the table tilted downward to the patient's left. The 'blind method' was used to introduce the Veress needle (Tyco Healthcare, Dublin, Ireland) on the supraumbilical site followed by inserting an 11 mm trocar. The abdomen was insufflated with CO_2 gas until the abdominal pressure reached the level of 15 mmHg. The other three ports were inserted under direct laparoscopic visual confirmation. The epigastric port was created at the right side border of the falciform ligament by an 11 mm trocar, and two other 5 mm trocars were placed in the right upper abdomen two finger breadths below the right coastal margin in the midclavicular and the midaxillary line, respectively. Clipping and transection were delayed until Calot's triangle was exposed with electrocauterization and blunt dissection. The gallbladder was dissected from the liver bed using a hook, Bovie (Covidien, Dublin, Ireland), and the gallbladder was extracted through the umbilical port site. The CO_2 was carefully evacuated at the end of surgery by manual compression of the abdomen with open trocars.

General Anesthesia

Anesthesia was induced using thiopental (5 mg/kg) and rocuronium (0.6 mg/kg) with sevoflurane (4%–5%) and 100% O_2. After intubation, ventilation was controlled at a tidal volume of 10 mL/kg and at a respiratory rate of 10 breaths/min. The anesthesia was maintained using sevoflurane (2%–3%) and a N_2O/O_2 mixture (50% O_2). The noninvasive arterial blood pressure, electrocardiography, and pulse oximetry were continuously monitored. During the surgery, the patients received an intravenous infusion of lactated Ringer's solution at a rate of 3–6 mL/kg/h. No additional intravenous opioids were injected.

Intraperitoneal and Peritrocal Anesthesia

For Groups C and D, 20 mL of a solution containing ropivacaine (2 mg/mL) was infiltrated at the port site before insertion of the trocar (6 mL for the umbilical port, 6 mL for the epigastric port, and 4 mL for each working port). The patients in Groups A and B received the same amount of normal saline. Peritrocal solution was applied to the skin, subcutis, fascia, muscle, and parietal peritoneum.

For Groups B and D, 100 mL of ropivacaine solution (2 mg/kg) was infused intraperitoneally, and the patients in Groups A and C received the same amount of normal saline.

The intraperitoneal solutions were administered as follows: immediately after the creation of the pneumoperitoneum, the surgeon sprayed 30 mL of solution on the upper surface of the liver and on the right subdiaphragmatic space, and then 30 mL of solution on

TABLE 1

Presentation of the Different Treatment Protocols

Treatment	Group A ($n = 20$)	Group B ($n = 20$)	Group C ($n = 20$)	Group D ($n = 20$)
Peritrocal injection	Saline	Saline	Ropivacaine	Ropivacaine
Intraperitoneal instillation	Saline	Ropivacaine	Saline	Ropivacaine

n = number of patient.