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ORIGINAL ARTICLE

Desflurane reinforces the efficacy of propofol target-controlled infusion in patients undergoing laparoscopic cholecystectomy

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Abstract Whether low-concentration desflurane reinforces propofol-based intravenous anesthesia on maintenance of anesthesia for patients undergoing laparoscopic cholecystectomy is to be determined. The aim of this study was to investigate whether propofol-based anesthesia adding low-concentration desflurane is feasible for laparoscopic cholecystectomy. Fifty-two patients undergoing laparoscopic cholecystectomy were enrolled in the prospective, randomized, clinical trial. Induction of anesthesia was achieved in all patients with fentanyl 2 μg/kg, lidocaine 1 mg/kg, propofol 2 mg/kg, and rocuronium 0.8 mg/kg to facilitate tracheal intubation and to initiate propofol target-controlled infusion (TCI) to effect site concentration (Ce: 4 μg/mL with infusion rate 400 mL/h). The patients were then allocated into either propofol TCI based (group P) or propofol TCI adding low-concentration desflurane (group PD) for maintenance of anesthesia. The peri-anesthesia hemodynamic responses to stimuli were measured. The perioperative psychomotor test included p-deletion test, minus calculation, orientation, and alert/sedation scales. Group PD showed stable hemodynamic responses at CO_2 inflation, initial 15 minutes of operation, and recovery from general anesthesia as compared with group P. There is no significant difference between the groups in operation time and anesthesia time, perioperative psychomotor functional tests, postoperative vomiting, and pain score. Based on our findings, the anesthetic technique combination propofol

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and desflurane for the maintenance of general anesthesia for laparoscopic cholecystectomy provided more stable hemodynamic responses than propofol alone. The combined regimen is recommended for patients undergoing laparoscopic cholecystectomy.

Introduction

Laparoscopic cholecystectomy (LC) provides patients less postoperative pain, more rapid mobilization, faster return to normal activities, and earlier hospital discharge as compared to traditional open cholecystectomy [1—3], and general anesthesia is the standardized anesthetic technique of choice for this procedure [4]. Desflurane has a lower blood:gas solubility coefficient (0.47) than other volatile anesthetics, and provides rapid induction and recovery from anesthesia [5,6]; however, desflurane easily leaks out to the air and blunts the protective responses in anesthetists and medical personnel who are exposed in the environment. Hence, LC surgery under total intravenous anesthesia (TIVA) was chosen as an alternate option. Propofol is a short-acting general anesthetic agent used widely for TIVA because of the beneficial effects on antiemetic properties and rapid recovery time [7,8]. For general anesthesia, opioids given for the alleviation of surgical-injury-induced pain also decrease the propofol dose or decrease the inhaled anesthetics concentration, but inevitably the decreased general anesthetics cannot ensure loss of consciousness and lack of awareness [9,10]. Propofol and desflurane are therefore suitable because of their recommended pharmacological properties [11,12]. However, propofol provides less potency, and the patient consumes more opioids to relieve pain as compared to desflurane [13]. Whether propofol target-controlled-infusion (TCI) combination of low-concentration desflurane provides a proper regimen for patients undergoing LC surgery is not yet determined. We hypothesize that the regimen of propofol TCI adding low-concentration (3%) desflurane might reinforce the anesthetic effect and provide better hemodynamic stability for LC. The study was designed to assess the feasibility of two propofol-based anesthetic regimens (desflurane with propofol vs. propofol alone) with fixed fentanyl continuous infusion to maintenance profile in patients undergoing LC.

Methods

The study was approved by the local Institutional Review Board (KMUK-IRB-990201). Fifty-two American Society of Anesthesiologists physical status I and II patients, aged 21—63 years, scheduled for elective LC, were enrolled in this prospective, randomized, clinical study after their written informed consents were obtained. The patients were randomly assigned to one of the following two anesthesia groups for maintenance during operation: propofol TCI and low-concentration desflurane (group PD), or propofol TCI alone (group P). The exclusion criteria were severe systemic disease, morbid obesity, and patient refusal.

According to the study protocol, standard monitoring was installed upon arrival in the anesthetic room. Oxygen was offered via an anesthetic breathing circuit and face-mask. After 3-minute preoxygenation, the induction of anesthesia was achieved in all patients with fentanyl 2 μg/kg, lidocaine 1 mg/kg, propofol 2 mg/kg, and rocuronium 0.8 mg/kg to facilitate tracheal intubation and to initiate propofol TCI (Ce: 4 μg/mL, infusion rate 400 mL/h) using a TCI pump (EP-1809-1; Fresenius Kabi, Bad Homburg, Germany) to blunt intubation-induced hemodynamic responses and to maintain general anesthesia. For the maintenance of anesthesia, patients in group PD received propofol TCI with fentanyl (1 μg/kg/h) and desflurane at an end-tidal concentration of 3%. Patients in group P received propofol TCI (Ce: 4 μg/mL) with fentanyl (1 μg/kg/h). As compared with the baseline mean arterial pressure (MAP) value, if hemodynamic responses deviate up each 10% MAP values, increased propofol Ce level 0.5 and fentanyl 0.5 μg bolus; if hemodynamic responses deviate down 10% MAP values, decreased propofol Ce level 0.5 and administered ephedrine 8 mg intravenously as over 20% MAP dropped.

The primary outcome was measured by the hemodynamic stability. The parameters of hemodynamic response included heart rate and MAP; the response was measured by heart rate and MAP difference from baseline value. During anesthesia, hemodynamic responses to stimuli were measured at each time point of pre-intubation as baseline (PI), post-intubation (PoI), pre-CO_2 insufflation (PC), post-CO_2 insufflation (PoC), operation time every 5 minutes to 35 minutes (Op5 to Op35), remove trocar (Rt), set Ce level back to 2 (Ce2), stop propofol infusion (stop-P), spontaneous breathing (SB), and remove endotracheal tube (Rendo). Perioperative psychomotor tests that included a p-deletion test (a set time test in which patients identify the p's in lines of random letters), observer's assessment of alertness/sedation (OAA/S) scale (0—5), attention and calculation (0—5), and orientation (0—10) were performed at preoperation and 60 minutes after the end of surgery.

Following the end of surgery, postoperative pain, nausea and vomiting, and complication were also assessed by the unaware nurse assistant. All patients rated their postoperative pain using a 10-point numeric rating scale (from 0 = no pain to 10 = worst pain). All postoperative observations were completed by the same nurse anesthetist who was unaware to the study-grouping patients. Intravenous ketorolac 30 mg was the first-line rescue analgesia, and pethidine 50 mg was considered as the second rescue analgesics if needed. Postoperative nausea and vomiting (PONV) was treated with metoclopramide as needed. Resource utilization included anesthesia time, operation time, and consumption of anesthetic agents.