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ORIGINAL ARTICLE

Propofol target-controlled infusion for sedated gastrointestinal endoscopy: A comparison of propofol alone versus propofol–fentanyl–midazolam

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Abstract Gastrointestinal (GI) endoscopy is the major technique for diagnosis of GI disease and treatment. Various sedation and analgesia regimens such as midazolam, fentanyl, and propofol can be used during GI endoscopy. The purpose of the study was to compare propofol alone and propofol combination with midazolam and fentanyl in moderate sedation for GI endoscopy. One hundred patients undergoing GI endoscopy were enrolled in this study. All patients received a propofol target-controlled infusion (TCI) to maintain sedation during the procedure. Patients were randomly allocated into either Group P (propofol TCI alone) or Group C (combination of propofol TCI plus midazolam and fentanyl). Dermographic data, anesthetic parameters (sedation regimen, blood pressure, heart rate, and oxygen saturation), procedure parameters (procedure time, colonoscopy, or panendoscopy), propofol consumption, and adverse events (hypoxia, hypotension, and bradycardia) were all recorded. Postprocedural records included recovery time, postoperative adverse events (nausea, vomiting, dizziness, recall, and pain) and satisfaction. The average propofol consumption was 251 ± 83 mg in Group P and 159 ± 73 mg in Group C ($p < 0.001$). The incidence of transient hypotension was higher in Group P ($p = 0.009$). The recovery time and discharge time were both shorter in Group C

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($p < 0.001$ and $p = 0.006$ respectively). Overall, postprocedural adverse events were similar in both groups. The postanesthetic satisfaction was comparable in both groups. TCI of propofol combined with midazolam and fentanyl achieved sedation with fewer hypotension episodes and shorter recovery and discharge time than propofol TCI alone in patients undergoing GI endoscopy.

Introduction

Gastrointestinal (GI) endoscopy is considered the major technique for diagnosis of GI disease and treatment. Various sedation and analgesia regimens primarily intend to diminish anxiety, discomfort, and achieve better tolerability and satisfaction. In many developed countries, most patients undergo GI endoscopy under sedation and analgesia [1–3]. Sedation for the GI endoscopic examination has also become more popular in Taiwan.

Various sedation and analgesia techniques have been proposed for sedated GI endoscopy. The currently used regimens include propofol, benzodiazepines (such as midazolam and diazepam), opioids (such as fentanyl and remifentanil), ketamine, and de-dexmedetomidine [3–6]. Among them propofol has become popular in developed countries, because it provides rapid onset and safe and effective sedation, and is associated with rapid recovery profile [5,7]. However, propofol sedation is associated with dose-related side effects including airway obstruction and respiratory and cardiovascular suppression [8–10].

Target-controlled infusion (TCI) achieves the desired concentration of drugs in plasma or the effect site by an automatic administration system based on a pharmacokinetic model-based computer calculation [11,12]. The TCI system requires several demographic parameters such as age, sex, body weight, and height to determine the rate of infusion. Theoretically, TCI provides a more precise control of propofol concentration than the intermittent bolus methods, which result in many peaks and troughs of propofol level. Only limited reports have investigated propofol TCI in sedated GI endoscopy [13–15]; instead, propofol was administrated by intermittent bolus methods in most non-anesthesiologist practices [16,17].

Sedation and analgesia may be accompanied by cardiovascular and respiratory suppression; hence, the primary goals of sedation for GI endoscopy are patient safety and comfort. We hypothesized that a combined regimen might reduce propofol dosage resulting in less hypotension episodes and faster recovery. The aim of this observational study was to compare the safety (adverse events) and efficacy (satisfaction and recovery) of the synergistic effect of propofol TCI combined with midazolam and fentanyl versus propofol TCI alone titrated to sedation during diagnostic GI endoscopy in a Taiwanese population.

Methods

The study was approved by the Institutional Review Board (Kaohsiung Medical University Hospital, Kaohsiung City, Taiwan) and informed consent was obtained from each patient. One hundred patients with GI problems who were undergoing a diagnostic colonoscopy and/or upper GI endoscopy were enrolled in this study. Exclusion criteria were: patient refusal to participate or inability to provide informed consent; age under 18 years; pregnant and lactating women; American Society of Anesthesiologists (ASA) class IV; allergy to propofol, fentanyl, or benzodiazepine; and anticipated difficult airway.

Physical monitoring included electrocardiography (lead II), heart rate, peripheral oxygen saturation, capnography, and noninvasive blood pressure (every 5 minutes). Abdominal wall and chest excursions were also monitored using inspection and palpation. Baseline vital signs were recorded for all patients before sedation. All patients received oxygen 2 L/min via nasal cannula throughout the procedure. Before the systemic administration of intravenous (IV) anesthetics, IV scopolamine 20 mg was given to decrease bowel movement. All patients received a propofol TCI by the Base Primea system (Fresenius, Brezins, France) as the mainstay of sedation regimen.

The nurse anesthetists administered the IV anesthetics under the supervision of anesthesiologists and were certified in advanced cardiac life support. Patients were allocated into propofol alone (Group P) or combination regimen (Group C) according to anesthetics use. For Group P primarily receiving propofol TCI alone, low dose of fentanyl bolus (25–50 μg) could be added as a rescue during endoscopy. Group C received IV midazolam (1–2 mg) and fentanyl (25–50 μg) routinely before propofol TCI. According to our previous report [13], the initial effect site concentration (Ce) of propofol TCI system was set at 4.0–5.0 mg/mL for upper GI endoscopy, while the initial Ce of propofol TCI system was 2.0–3.0 mg/mL for colonoscopy. Ce of propofol TCI was further titrated using 0.5 μg/mL step-size patient response. Patient response was evaluated by the modified observer's assessment of alertness/sedation (MOAA/S) [2,13].The procedure began when the patient did not respond to eyelid stimulation (MOAA/S scores of 2). If patient movement occurred and might interfere with endoscopic examination, a bolus of fentanyl

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