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ORIGINAL ARTICLE

A comparison of propofol target controlled infusion-based and sevoflurane-based anesthesia in adults undergoing elective anterior cervical discectomy and fusion

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Abstract The target controlled infusion (TCI) of propofol with fentanyl facilitates easy titration of the depth of anesthesia, and thereby may improve the quality of anesthesia. The aim of this study is to investigate if propofol TCI-based anesthesia is practical for anterior cervical discectomy and fusion (ACDF), one of the most common surgical interventions in spine procedures, when compared with sevoflurane-based anesthesia with respect to the quality of anesthesia. Patients were classified into two groups according to the anesthesia regimen of maintenance of anesthesia with fentanyl and either propofol TCI (group FP) or inhalational sevoflurane (group FS), respectively. The primary endpoint was to evaluate quality of anesthesia and extubation time. Secondary endpoints were hemodynamic stability during the operation, operative fentanyl consumption, and postoperative complications. The study results revealed there were comparable results on time to extubation, changes in intraoperative hemodynamic parameters, and the occurrence of postoperative complications between the groups. No differences in average length of intensive care unit (ICU) stay and hospital stay were noticed. However, opioid consumption and blood loss during the operation for patients in group FP were significantly higher than those of patients in group FS (551.28 ± 193.98 vs. 446.86 ± 177.15 μg, $p = 0.005$; 52.06 ± 58.25 vs. 28.33 ± 40.74 mL, $p = 0.019$, respectively). In these adult

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patients undergoing ACDF, propofol TCI-based anesthesia appears to be as efficacious as sevoflurane-based anesthesia but consumed more fentanyl and experienced higher blood loss.

Introduction

Anterior discectomy with or without fusion is the most common surgical intervention performed by spine surgeons for degenerative cervical spondylosis. When surgery is indicated, the choice of operative approaches including anterior, posterior, and combined procedures becomes a significant part in the optimal management of the disease [1]. Anterior cervical discectomy and fusion (ACDF) procedures then become one of the most common procedures performed in spinal surgery [2].

Including three components such as muscle relaxation, unconsciousness, and analgesia, general anesthesia introduces lack of response and recall to noxious stimuli [3]. As well as obtaining a rapid and safe level of depth of anesthesia during the induction phase, the anesthesiologist is also concerned with providing a comfortable and precise return to consciousness after surgery [4]. The type of surgery and patient variability are key factors for an anesthesiologist to consider when choosing anesthetic agents and/or changing drug dosage during the maintenance of anesthesia [5].

Because of its low blood-gas partition coefficient, sevoflurane is able to facilitate rapid emergence from anesthesia and is thus used in a wide range of clinical practices [6,7]. However, emergence agitation and excitatory behavior are frequently seen when sevoflurane is offered to pediatric patients [7—9]. Whether this might entail risks of unexpected events for the adult patients receiving cervical spine surgery and further disturb subsequent postoperative neurological examinations remains unknown. Besides, several studies suggest that postoperative agitation and restlessness are mainly caused by pain, i.e., inadequate pain relief during the emergence period, and that the concomitant use of an opioid provides smoother anesthetic management [6,10,11].

The target controlled infusion (TCI) system was recently introduced in clinical practices in Taiwan. Total intravenous anesthesia (TIVA) with fentanyl combined with TCI of propofol facilitates easy titration of depth of anesthesia and has therefore become an attractive alternative anesthesia regimen, which might improve the quality of emergence from anesthesia in Western patients [6,12]. Interindividual variability in pain perception is believed to exist because of genetic polymorphism [13]. Whether TIVA with TCI is well adopted in the southern Taiwanese population is of interest.

The present study was designed to investigate if propofol TCI-based anesthesia was practical for ACDF when compared with sevoflurane-based anesthesia with respect to the quality of anesthesia in a medical center in southern Taiwan.

Methods

All adult patients aged 23—75 years who underwent ACDF in the Neuroscience Center at Kaohsiung Medical University Hospital from January 2009 to December 2011 were enrolled in the study and data were collected and then reviewed retrospectively. The Institutional Review Board approved the study (KMUH-IRB-990271). Patients were excluded based on C1—2 involvement, trauma, neoplasia, or previous cervical fusion and then further classified into two groups according to the anesthesia regimen they received: (i) maintenance of anesthesia with fentanyl (Glaxosmithkline Manufacturing S.P.A., Verrona, Italy) and propofol (B.Braun Melsungen AG, Melsungen, Germany) TCI (group FP); and (ii) maintenance of anesthesia with fentanyl and inhalational sevoflurane (group FS). A dedicated anesthesia team for neurosurgery decided on the procedure for maintenance of anesthesia on the operation day.

Information regarding age, sex, medical comorbidities, history of preoperative medicine, history of smoking, body mass index (BMI), and surgical details were collected, and routine blood workup, including blood cell count, prothrombin and partial thromboplastin times, and international normalized ratio, were routinely obtained. International Classification of Diseases-9 (ICD-9) diagnosis codes were used to generate a Charlson comorbidity index (graded 0 or $\geq$ 1; categorical variables) for each patient. For patients assigned to group FP, patients were induced with propofol 5 μg/mL (effect site of concentration, Ce value) using a TCI pump (EP-1809-1; Fresenius Kabi, Bad Homburg, Germany) and fentanyl 2 μg/kg. The Ce value was continuously monitored during induction, intubation, and operation for adequate maintenance of anesthesia depth. To facilitate intubation, rocuronium 0.6 mg/kg was offered. After successful intubation, propofol TCI was titrated to 1.5—5.0 μg/mL according to the level of unconsciousness, and fentanyl 1—3 μg/kg infusion was maintained with intermittent fentanyl 50 μg boluses offered according to changes in heart rate or blood pressure over 20% from baseline by surgical stimuli. In addition, rocuronium 0.3 mg/kg/h were continuously offered. Patients assigned to group FS were induced with fentanyl 2 μg/kg and thiamylal 5 mg/kg, and rocuronium 0.6 mg/kg was also offered to facilitate intubation. Following successful intubation, fentanyl 1—3 μg/kg infusion was maintained with intermittent fentanyl 50 μg boluses offered according to changes in heart rate or blood pressure over 20% from baseline by surgical stimuli. In addition, rocuronium 0.3 mg/kg/h were continuously offered. Anesthesia was maintained with inhaled sevoflurane (Ultane; Abbott Laboratories, Chicago, IL, USA) at 1.5—2.0 minimum alveolar concentration (MAC) end-tidal.

Standard cardiovascular and respiratory monitoring included continuous electrocardiography (ECG), pulse