



Analysis of Anesthesia-controlled Operating Room Time After Propofol-based Total Intravenous Anesthesia Compared with Desflurane Anesthesia in Gynecologic Laparoscopic Surgery: A Retrospective Study

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Background: Anesthesia technique may contribute to the improvement of operation room (OR) efficiency by reducing anesthesia-controlled time (ACT). We compared the difference between propofol-based total intravenous anesthesia (TIVA) and desflurane (DES) anesthesia for gynecologic laparoscopic surgery undergoing general anesthesia. **Materials and Methods:** We performed a retrospective study using data collected in our hospital to compare the ACT of gynecologic laparoscopic surgery using either TIVA via target-controlled infusion (TCI) with propofol/fentanyl or DES/fentanyl-based anesthesia between January 2010 and December 2011. The various time intervals (waiting for anesthesia, operation time, anesthesia time, emergence time, exit from OR after extubation, total OR time and postanesthesia care unit stay time) and the incidence of prolonged extubation (≥ 15 min) were compared between the two anesthetic techniques. **Results:** We included data from 926 patients, with 377 patients receiving TIVA and 549 patients receiving DES. The only significant difference is emergence time, TIVA was faster than the DES group (7.3 ± 3.3 min vs. 8.3 ± 3.1 min; $P < 0.001$). The factors of prolonged extubation are DES anesthesia, body mass index, surgical time, and anesthesia time. **Conclusion:** In our hospital, propofol-based TIVA by TCI provide faster emergence compared with DES anesthesia in gynecologic laparoscopic surgery.

Key words: Total intravenous anesthesia, propofol, desflurane, emergence, gynecologic laparoscopic surgery

INTRODUCTION

Healthcare systems in current days are facing significant problems of increasing expenditures. As a result of the need to increase efficiency with cost containment, the stress on optimizing operation room (OR) efficiency increased. OR efficiency is regulated by several factors, three factors are anesthesia-controlled time (ACT), surgery-controlled time and between-case time.¹ ACT is the sum of the anesthesia induction time and wake-up time.² The wake-up time required between the end of surgery until extubation is of special interests to anesthesiologists because it is affected by anesthetics administered.³⁻⁵ Therefore, it is essential for anesthesiologists

to choose appropriate agents to avoid prolonged extubation in order to improve the efficiency of OR. Total intravenous anesthesia (TIVA) via a target-controlled infusion (TCI) system with combined administration of propofol and fentanyl has been shown to provide more rapid emergence compared with other anesthetic techniques in several kinds of surgeries.⁶⁻¹⁰

However, these studies did not compare the ACT and prolonged extubation time. Therefore, we performed this retrospective study to compare TIVA with desflurane (DES) anesthesia in gynecologic laparoscopic surgery.

MATERIALS AND METHODS

Patients

This study was approved by the Ethics Committee (TSGHIRB No.: 100-05-168) of Tri-Service General Hospital, Taipei, Taiwan (Chairperson, Professor Pauling Chu) on August 29, 2011.

This retrospective study retrieved information from the electronic database and the medical records of Tri-Service General Hospital (TSGH; Taipei, Taiwan, Republic of China). We enrolled 926 patients (ASA class I-III) who received

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Faster emergence and lower incidence of prolonged extubation in gynecologic laparoscopic surgery

elective gynecologic laparoscopic surgery under TIVA or DES from January 2010 to December 2011. Exclusion criteria were patient age younger than 18 years, emergent surgeries, combined inhalation anesthesia with TIVA, other inhalation anesthesia besides DES, failure to extubate, patient not sent to the postanesthesia care unit (PACU), or incomplete data.

Patient groups

No medication was administered prior to induction of anesthesia; however, regular monitoring, such as electrocardiography (lead II) and measurement of pulse oximetry, noninvasive blood pressure, respiratory rate, and end-tidal carbon dioxide pressure (EtCO₂), was performed. In all patients, anesthesia was induced with propofol and fentanyl. The patients were then intubated and maintained with DES or propofol and the analgesic fentanyl.

TIVA was induced using intravenous (i.v.) fentanyl (2 µg/kg) and 2% lidocaine (1.5 mg/kg). Subsequently, continuous infusion of propofol (Fresfol 1%) was delivered using Schneider's kinetic model of TCI (Fresenius Orchestra Primea; Fresenius Kabi AG, Bad Homburg, Germany) with the effect-site concentration (Ce) of 4.0 µg/mL. For DES anesthesia, the patients were induced with i.v. fentanyl (2 µg/kg), 2% lidocaine (1.5 mg/kg), and propofol (1.5-2 mg/kg). When patients lost consciousness, 0.6 mg/kg of rocuronium was administered, followed by endotracheal intubation and administration of i.v. dexamethasone (5 mg) to prevent postoperative nausea and vomiting (in all patients). For TIVA, anesthesia was maintained using TCI with a propofol Ce of 3-4 µg/mL under an oxygen flow of 300 mL/min. In patients anesthetized with DES, anesthesia was maintained using 8-12% DES (inhaled concentration) in an oxygen flow of 300 mL/min under a closed system without nitrous oxide. Ce for TCI propofol was adjusted at the range of 0.2 µg/mL and DES 0.5% according to the hemodynamics. If two increments or decrements were unsuccessful, the range of Ce for TCI propofol and DES was increased to 0.5 µg/mL or 2%, respectively. Ventilation rate and maximum airway pressure were adjusted to maintain the EtCO₂ pressure at 35-45 mmHg. Cisatracurium (2 mg) or rocuronium (10 mg) was administered as required to antagonize the return of neuromuscular function.^{7,8,11}

At the end of the operation, DES or propofol was discontinued, and the lungs were ventilated with 100% oxygen at a fresh gas flow of 6 L/min. When the patient regained consciousness with spontaneous and smooth respiration, the endotracheal tube was removed after i.v. administration of neostigmine 2 mg and atropine 1 mg.^{7,8} An emergence time equal or longer than 15 min is considered as prolonged extubation.

Static analysis

Data are presented as the mean and standard deviation, the number of patients, or percentage. Demographic and perioperative data were compared using Student's *t*-test. Categorical data were compared using Chi-square test. *P* < 0.05 was considered as statistically significant. Multiple linear regression analysis was performed to assess the association between variables influencing extubation time

RESULTS

Ninety-five patients were excluded from the analysis. Of those excluded, 10 patients received combined inhalation anesthesia with propofol, 62 patients received sevoflurane anesthesia, and 26 patients had incomplete data [Figure 1].

Our study included 926 patients, of which 377 were received DES and 549 were received TIVA anesthesia. There were no significant differences in patient demographics. The emergence time was faster for TIVA group (7.3 ± 3.3 min vs. 8.3 ± 3.1 min; *P* < 0.001). The percentage of prolonged extubation was higher in DES group (3.4% vs. 2%; *P* = 0.251) despite no statistically significant difference. The waiting for anesthesia, operation, anesthesia, exit from OR after extubation, total OR and PACU time showed no differences between groups [Table 1].

The result of multiple linear regressions comparing emergence time between several variants is shown in Table 2. Group, body mass index (BMI), surgical time and anesthesia time are factors that contribute to emergence time. The results showed that patients with DES, higher BMI, longer anesthesia time, and shorter surgical time have a slower emergence. Age of the patients had no significant influence.

DISCUSSION

The major findings in this retrospective study show that propofol-based TIVA by TCI reduced the emergence time relative to DES anesthesia and the factors of prolonged

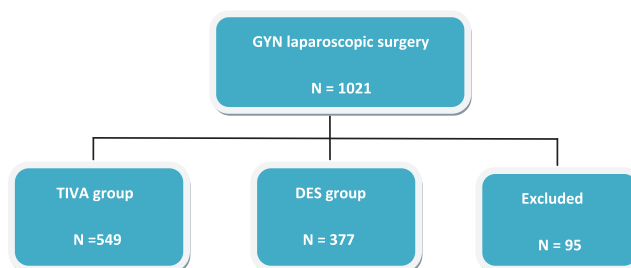


Figure 1. Flow diagram
GYN = Gynecologic; TIVA = Total intravenous anesthesia; DES = Desflurane anesthesia

Table 1: Patient's characteristics and OR time measurement between DES and TIVA group

	Group DES (n = 377)	Group TIVA (n = 549)	P
ASA I/II/III	255/122/15	363/161/25	0.57
Age (years/old)	44.3±9.0	45.3±9.9	0.11
Height (cm)	160.0±6.4	160.3±6.6	0.65
Weight (kg)	59.3±8.9	59.8±8.6	0.44
BMI	23.1±3.2	23.3±3.0	0.59
Waiting for anesthesia time (min)	7.9±3.4	7.7±3.3	0.26
Surgical time (min)	87.9±28.7	87.3±31.1	0.76
Anesthesia time (min)	115.7±29.8	114.2±33.0	0.47
Emergence time (min)	8.3±3.1	7.3±3.3	<0.001
Exit from OR after extubation (min)	6.5±2.0	6.4±2.3	0.61
Total OR time (min)	130.1±30.2	128.2±32.9	0.38
PACU stay time (min)	49.8±14.0	49.6±13.0	0.84
Prolonged extubation	13 (3.4)	11 (2.0)	0.251

Prolonged extubation was defined as extubation time ≥ 15 min; Data shown as mean $\pm$ SD. OR = Operation room; PACU = Postanesthesia care unit; SD = Standard deviation; BMI = Body mass index; ASA = American society of anesthesiologists; DES = Desflurane; TIVA = Total intravenous anesthesia

Table 2: Comparisons of extubation time between variants by multiple linear regression

	β	SE	P
Group	-0.829	0.168	<0.001
Age	0.00764	0.00866	0.378
BMI	0.0178	0.00811	0.028
Surgical time	-0.0375	0.0137	0.006
Anesthesia time	0.0968	0.0130	<0.001

β : Difference between each variant using emergence time as dependent variable. Group: DES = 0, TIVA = 1; $P < 0.05$ were considered significant; DES = Desflurane; TIVA = Total intravenous anesthesia; BMI = Body mass index; SE = Standard error

extubation are group, BMI, surgical time and anesthesia time in patients undergoing gynecologic laparoscopic surgery.

The first finding was consistent with several previous studies showing that general anesthesia using TCI system with propofol could achieve faster extubation than using DES in different surgeries.⁶⁻¹⁰ In our previous large case number retrospective study, we show that propofol-based TIVA by TCI reduced the mean time to extubation (14%) relative to DES in patients undergoing ophthalmic surgery.⁸ Because the awakening time can be predicted by TCI system.¹² However, there are many studies compared inhalation anesthesia with propofol-based TIVA and failed to show any significant clinical difference in terms of extubation.¹³⁻¹⁵ The three studies showed that there was no significance in extubation

time between propofol group and DES group in laparoscopic cholecystectomy,¹³ otological surgery¹⁴ and ear, nose and throat surgery,¹⁵ respectively. These were different from our retrospective study and other previous studies.⁷⁻¹⁰ The reason might be due to the DES maintenance flow rate of oxygen was different: 1-4 L/min versus 300 mL/min in our study. Using close circuit anesthesia in the DES group would also prolong the neuromuscular blockade and delay the extubation time.¹⁶ In another study, Dolk *et al.*¹⁷ had reported that there were shorter emergence time for DES anesthesia compared with propofol delivered by TCI in knee surgery. The differences may have been caused by using nitrous oxide as an adjuvant to anesthetics, which reduce the requirement of inhalation anesthetics during the maintenance period and facilitate early emergence.

Prolonged extubation is an incident that would decrease OR efficiency. Prolonged extubation time would cause slowing of workflow, having OR members staying idly waiting for extubation, and the surgeon have to wait longer for next operation.^{18,19} Epstein *et al.*²⁰ concluded that prolonged extubation time should be treated as resulting in proportionally increased variable costs. Therefore, monitoring the incidence of prolonged extubation was recommended as an economic measure.²¹ In this study, we showed the incidence of prolonged extubation was no significant difference between TIVA and DES groups, this might be due to the same gender, similar BMI, surgical time, and anesthesia time. Since many gynecologic laparoscopic surgical cases are of brief durations and are performed supine, likely there were not many cases with prolonged extubations.

Previous studies showed that the risk factors of prolonged extubation including prone position, prolonged surgical time, significant blood loss, larger volume of crystalloid and colloid infusion, procedure, or surgeon.²¹⁻²³ We showed shorter surgical time contributes to delay awaken, it result might be due to the prolonged duration of neuromuscular relaxants resulting from the close circuit anesthesia,¹⁶ the surgical time less than initial estimation by the surgeon in many cases. Sanford *et al.*²⁴ had reported that emergence time was longer in high BMI patients. However, Anastasian *et al.*²³ showed that BMI was not the factor contribute to emergence time. In their report, patients' BMI was 28.2 and the total incidence of prolonged extubation was 44% (126/289). In our study, patients' BMI was 23.2 and the total incidence of prolonged extubation was 2.6% (24/926). It also seemed to reveal that emergence time was longer in higher BMI patients against the report of Anastasian *et al.*²³ The result might be due to the longer surgical and anesthesia time of multilevel spinal decompressions and fusions (≥ 8 h) in the prone position compared with our brief gynecologic laparoscopic surgery in the supine position. The

Faster emergence and lower incidence of prolonged extubation in gynecologic laparoscopic surgery

reduction in direct cost will be largest for facilities at which all ORs consistently are used for more than 8 h daily. Among those ORs, each 1-min reduction in OR time results in an overall 1.1-1.2 min reduction in regularly scheduled labor costs. Consequently, small reductions in OR time achieved by reducing the extubation time, as reported in this study, would reasonably be treated as having economic benefit, since our OR workday is longer than 8 h.^{25,26} Therefore, in our study, TIVA group reduced total OR time is 1.9 min relative to DES group will have an economic impact on increasing OR productivity and reducing labor costs because our ORs are consistently used for more than 8 h daily despite no statistic difference.

A retrospective study may lead to bias considering standardization and comparability of study groups. However, retrospective analysis of data offered the anesthetic management was performed by attending anesthesiologist according to clinical demands and was not by a study protocol. It reflects more precisely the clinical relevant benefit that may be expected with the use of new drugs or devices.

CONCLUSION

Our results showed that propofol-based TIVA by TCI significantly reduce the emergence time in gynecologic laparoscopic surgery with clinical economic benefit.

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