Short Communication

Influence of desflurane on postoperative oral intake compared with propofol

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Postoperative oral intake is an important predictor of early postoperative recovery, and anesthesia is known to influence this intake. We compared the influences of desflurane anesthesia and propofol anesthesia on early postoperative oral intake retrospectively. The subjects included a consecutive series of patients who received general anesthesia with propofol or desflurane between June and December 2013. The total amount of calories and proteins taken orally and the incidence of postoperative nausea and vomiting (PONV) on postoperative days (POD) 0, 1, and 2 were collected. A total of 147 patients were analyzed. The desflurane (Des) and the propofol (Pro) groups included 52 and 95 patients, respectively. The incidence of PONV on POD 0, 1, and 2 did not show significant intergroup differences. Total calorie intake on POD 1 and 2 was not significantly different between the 2 groups (1117±508 vs. 1036±549 kcal/day, p=0.39 and 1504±368 vs. 1437±433 kcal/day, p=0.35, respectively). Total amount of protein via oral intake on POD 1 and 2 were not significantly different between the two groups (45.9±21.1 vs. 43.8±22.8 g/day, p=0.60 and 61.3±15.0 vs. 58.9±18.0 g/day, p=0.42, respectively). These findings suggest that desflurane and propofol affect postoperative oral intake in a similar fashion. These results should be confirmed in a future prospective study.

Key Words: postoperative oral intake, postoperative nausea and vomiting, desflurane, propofol, early recovery

INTRODUCTION

Evidence-based perioperative management protocols, such as the Enhanced Recovery after Surgery (ERAS™) protocol, can promote quick recovery from major surgery and reduced healthcare costs via reduced length of hospital stay.[1] The ERAS™ protocol has been used in perioperative management in many hospitals. Postoperative early oral intake is a very important factor in the ERAS™ protocol.[1] A previous meta-analysis study showed that early postoperative feeding is associated with significant reductions in total complications compared with traditional postoperative feeding strategies.[2] Prevention of postoperative nausea and vomiting (PONV) have also been reported to promote early oral intake.[3] Anesthetic procedures affect PONV, and anesthesiologists play an important role in preventing PONV and facilitating early oral intake. For this reason, previous studies have shown that an intravenous anesthetic agent, namely propofol, is preferred over inhalational anesthetic agents.[4,5]

Desflurane is a newly marketed inhalational anesthetic agent that has been used in our country since April 2011. This agent provides shorter emergence times when compared with inhalational anesthetic agents such as sevoflurane and early recovery of cognitive function.[6] In addition, a previous study in patients undergoing ambulatory surgical procedures has reported that while the incidence of PONV was significantly higher with desflurane compared with propofol, the relative risk for post-discharge nausea and vomiting did not differ between the two agents.[7] Until now, few studies have addressed the influence of desflurane on postoperative oral intake. We hypothesized that desflurane did not affect postoperative oral intake compared with propofol because this inhalational anesthetic agent provided early recovery from anesthesia state. We, therefore, compared the influences of desflurane anesthesia and propofol anesthesia on early postoperative oral intake retrospectively.

METHODS

This study was approved by the ethics committee of Kochi Medical School Hospital. The need to obtain informed consent was waived because this study was a retrospective study. The subjects included a consecutive series of patients who received general anesthesia with propofol (Diprivan; AstraZeneca K.K., Osaka, Japan) or desflurane (Suprane; Baxter Ltd., Tokyo, Japan) in our hospital between June 2013 and December 2013. Of these patients, those aged <20 years, those who were admitted to the intensive care unit (ICU) after operation, those who received abdominal surgery, and those who were dis-

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charged earlier than 2 days after operation were excluded from the study.

The details of the anesthetic procedure were decided by individual anesthesiologists. However, in propofol group (Pro group), propofol, rocuronium and fentanyl or remifentanil were used to induce anesthesia, and anesthesia was maintained with propofol, remifentanil and/or fentayl, rocuronium. Administration of propofol was performed using target control infusion and bispectral index in all patients. In desflurane group (Des group), propofol, rocuronium and fentanyl or remifentanil were used to induce anesthesia, and anesthesia was maintained with desflurane, remifentanil and/or fentayl, rocuronium. No patients received nitrous oxide. The following data were obtained from electronic patient records: total amount of calories and proteins taken orally on postoperative day (POD) 1 and 2; and PONV on POD 0, 1, and 2. In our hospital, electronic patient records system calculated total amount of calories and proteins automatically based on nursing record about oral intake. Definition of PONV was below; Nurses asked patients about nausea and vomiting and they recorded it. The following data were obtained from anesthetic records: total volume of infusion, bleeding, and urine volume; total amount of remifentanil and fentanyl during anesthesia; and type of postoperative analgesia.

Data are expressed as the mean±standard deviation. A non-paired *t*-test and a chi-square test were performed using JMP 9.0 (SAS Institute Japan, Tokyo, Japan). $p< 0.05$ was considered statistically significant.

RESULTS

A total of 374 patients received general anesthesia. Of these patients, 147 were analyzed; twelve patients younger than 20 years of age, 156 patients who had received abdominal surgery, 39 patients who were admitted to the ICU after operation, and 20 patients who were discharged earlier than two days after operation were excluded from the study. Finally, the Des group and the Pro group included 52 and 95 patients, respectively.

Age, height, weight, time of anesthesia, total volume of infusion, the percentage of gynecological surgery and consumption of fentanyl and remifentanil were not significantly different between the 2 groups (Table 1). The body mass index in the Des group was significantly higher than that in the Pro group (p=0.0009). Postoperative epidural analgesia in the Des group was significantly less frequent than in the Pro group (p=0.01). The incidence of PONV on POD 0, 1, and 2 was not significantly different between the two groups. The total amount of calorie via oral intake on 1 and 2 POD was not significantly different between the two groups (p=0.39 and 0.35, respectively). The total amount of calorie per body weight on 1 and 2 POD was not also significantly different between the two groups (p=0.90 and 0.78, respectively). Total amount of protein via oral intake on POD 1 and 2 was not significantly different between the two groups (p=0.60 and 0.42, respectively).

Individual data for female and male patients are shown in Tables 2 and 3. The incidence of PONV on POD 0, 1, and 2 was not significantly different between the Des and Pro groups in either gender. In addition, there was no significant difference between the Des and Pro groups in either gender, in terms of the total calorie intake per body weight on POD 1 and 2.

DISCUSSION

The influence of desflurane on postoperative oral intake is still unclear. However, the results of this study indicated that the use of desflurane might not affect the total amount of calories and proteins via oral intake on POD 1

Table 1. Patient data

	Des group (n=52)	Pro group (n=95)	*p* value
Age (y)	65±16	60±19	0.11
Gender (F:M) (%)	46:54	59:41	0.14
Height (cm)	157±9	159±10	0.21
Weight (kg)	60±14	56±12	0.07
Body mass index (kg/m^2)	24±5*	22±3	0.0009
ASA physical status	1.8±0.5	1.8±0.4	0.78
Gynecological surgery (%)	8*	11	0.03
Time of anesthesia (min)	211±95	237±111	0.16
Total amount of infusion (mL)	1518±693	1752±814	0.08
Total amount of bleeding (mL)	115±159	114±205	0.99
Total amount of urine volume (mL)	270±236*	486±461	0.002
Consumption of fentanyl (mL)	3.6±2.5	3.5±3.0	0.83
Consumption of remifentanil (mg)	1.7±1.3	2.2±1.8	0.12
Epidural analgesia (%)	10*	26	0.01
PONV on 0 POD (%)	21	19	0.75
PONV on 1 POD (%)	12	17	0.39
PONV on 2 POD (%)	2	3	0.67
Calorie intake on 1 POD (kcal/day)	1117±508	1036±549	0.39
(kcal/kg·day)	18.7±8.3	18.9±10.8	0.90
Protein intake on 1 POD (g/day)	45.9±21.1	43.8±22.8	0.60
Calorie intake on 2 POD (kcal/day)	1504±368	1437±433	0.35
(kcal/kg·day)	25.8±7.6	26.2±9.0	0.78
Protein intake on 2 POD (g/day)	61.3±15.0	58.9±18.0	0.42

We assessed each of these parameters with a non-paired t-test and a chi-square test.
Data shown as mean±SD. * indicates $p<0.05$ between groups.
ASA: American society of anesthesiologists; PONV: postoperative nausea and vomiting; POD: postoperative day.

Table 2. Patient data, female patients

	Des group (n=24)	Pro group (n=56)	*p* value
Age (y)	63±18	59±17	0.34
Height (cm)	152±5	154±7	0.16
Weight (kg)	55±14	51±9	0.13
Body mass index (kg/m^2)	24±5*	22±3	0.02
ASA physical status	1.9±0.4	1.8±0.4	0.48
Time of anesthesia (min)	212±91	239±122	0.34
Total amount of infusion (mL)	1471±707	1697±791	0.23
Total amount of bleeding (mL)	142±189	111±204	0.52
Total amount of urine volume (mL)	327±242	454±416	0.17
Consumption of fentanyl (mL)	3.6±2.4	3.5±3.4	0.95
Consumption of remifentanil (mg)	1.8±1.1	2.2±1.8	0.24
Epidural analgesia (%)	8	21	0.06
PONV on 0 POD (%)	21	25	0.69
PONV on 1 POD (%)	17	23	0.51
PONV on 2 POD (%)	0	4	0.35
Calorie intake on 1 POD (kcal/day)	1010±551	989±558	0.88
(kcal/kg·day)	18.5±10.1	19.9±12.5	0.61
Protein intake on 1 POD (g/day)	41.4±21.9	40.6±22.9	0.87
Calorieintakeon 2 POD (kcal/day)	1410±407	1344±450	0.54
(kcal/kg·day)	26.3±8.6	26.9±10.4	0.78
Proteinintakeon 2 POD (g/day)	58.9±17.8	54.4±18.7	0.33

We assessed each of these parameters with a non-paired t-test and a chi-square test.
Data shown as mean±SD. * indicates $p<0.05$ between groups.
ASA: American society of anesthesiologists; PONV: postoperative nausea and vomiting; POD: postoperative day.

Table 3. Patient data, male patients

	Des group (n=28)	Pro group (n=39)	*p* value
Age (y)	66±15	61±20	0.27
Height (cm)	162±9*	167±8	0.02
Weight (kg)	65±13	64±12	0.69
Body mass index (kg/m^2)	25±4	23±3	0.05
ASA physical status	1.8±0.5	1.8±0.5	0.84
Time of anesthesia (min)	211±101	235±95	0.31
Total amount of infusion (mL)	1559±692	1833±850	0.17
Total amount of bleeding (mL)	91±127	119±210	0.53
Total amount of urine volume (mL)	221±220*	532±522	0.004
Consumption of fentanyl (mL)	3.6±2.6	3.4±2.0	0.76
Consumption of remifentanil (mg)	1.7±1.4	2.1±1.8	0.35
Epidural analgesia (%)	11	38	0.08
PONV on 0 POD (%)	21	10	0.21
PONV on 1 POD (%)	7	8	0.93
PONV on 2 POD (%)	4	3	0.81
Calorie intake on 1 POD (kcal/day)	1208±459	1104±536	0.41
(kcal/kg·day)	18.8±6.7	17.3±7.5	0.41
Protein intake on 1 POD (g/day)	49.6±20.0	48.5±21.9	0.83
Calorie intake on 2 POD (kcal/day)	1585±316	1571±373	0.87
(kcal/kg·day)	25.4±6.9	25.2±6.2	0.90
Protein intake on 2 POD (g/day)	63.3±12.1	65.2±14.9	0.57

We assessed each of these parameters with a non-paired t-test and a chi-square test.
Data shown as mean±SD. * indicates $p<0.05$ between groups.
ASA: American society of anesthesiologists; PONV: postoperative nausea and vomiting; POD: postoperative day.

and 2 more than propofol does. Furthermore, the incidence of PONV was similar in desflurane- and propofol-treated patients. In other words, desflurane might be a good alternative to propofol in the enhancement of postoperative recovery.

The ERAS^{TM} protocol recommended that postoperatively patients should be encouraged to take normal food as soon as possible after surgery.[1] Some previous studies described that postoperative early oral intake provided reduction of hospital stay, postoperative complication and infective complications.[8,9] In addition, postoperative early oral intake was associated with high postoperative satisfaction.[9] Therefore, anesthesiologists should not select anesthetic agents which was closely related to PONV and affected rapid recovery. In this view point, desflurane is the ideal inhaled anesthetic agent because this inhalation drug is association with not only early recovery but more rapid complete recovery.[10] In ERAS^{TM} protocol, patients eat normal hospital food and consume 1200-1500 kcal/day.[1] In this study, oral intake in the two groups reached this target value. Therefore, we thought that desflurane as same as propofol might provide adequately

early oral intake for postoperative patients.

The incidence of PONV on POD 0, 1, and 2 was not significantly different between the two groups in this study. Although propofol reduces PONV by blocking the 5-hydroxytryptamine 3 receptor of the serotonergic system,[5] its antiemetic effect usually lasts less than 6 hours.[4,5] In another study, in patients undergoing ambulatory surgical procedures, although the incidence of PONV was significantly higher with desflurane compared with propofol, the relative risk for post-discharge nausea and vomiting did not differ between the two agents.[7] These points may support our results. Although our data did not specify when PONV occurred on POD 0, the possibility of a difference between the two groups during the early phase on POD 0 cannot be overlooked.

This study has several limitations. First, the percentage of female patients in the Pro group tended to be higher than that in the Des group because of the retrospective design of the study. It is possible that anesthesiologists chose propofol because female gender is known to be a major predictor of PONV.[1] When we analyzed the data from female and male patients individually to ensure that our results were not affected by this preference, we determined that the incidence of PONV and the total calorie intake per body weight were not significantly different between the two groups in either gender. Therefore, we do not think that this preference affected our results. Secondly, the sample size is relatively small and our results might have underestimated the incidence of PONV because we collected the data retrospectively. Finally, we did not include total calorie intake on POD 0 because most patients in our hospital resumed oral intake from POD 1. A prospective randomized trial is necessary to more comprehensively elucidate the effect of desflurane on postoperative oral intake.

In conclusion, the results of this study suggested that the use of desflurane might not affect total calorie and protein oral intake on POD 1 and 2 more than propofol does. These results should be confirmed in a future prospective study.

AUTHOR DISCLOSURES

All authors have no conflicts of interest or financial or other contractual agreements that might cause conflicts of interest.

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地氟醚和异丙酚对术后口腔摄入功能的影响比较

术后口腔摄入功能是术后早期恢复的一个指征，众所周知麻醉影响术后口腔摄入功能。我们回顾性分析比较了地氟醚麻醉和异丙酚麻醉对早期术后口腔摄入功能的影响。受试者为 2013 年 6 月到 12 月间接受过地氟醚或异丙酚的全麻患者。我们收集分析了 147 位患者口腔摄入的卡路里和蛋白质总量以及术后（POD）第 0、1、2 天的恶心呕吐（PONY）的发生情况。地氟醚组（Des）有 52 名患者，异丙酚（Pro）组有 95 名患者。在组内 PONY 在 POD 第 0、1 和 2 天无显著差异。两组间口腔摄入卡路里在 POD 第 0、1 和 2 天的差异不显著（分别是 1117±508 vs. 1036±549 kcal/day, p=0.39 和 1504±368 vs. 1437±433 kcal/day, p=0.35）。两组间口腔蛋白质摄入量在 POD 第 0、1 和 2 天也无显著差异（分别是 45.9±21.1 vs. 43.8±22.8 g/day, p=0.60 和 61.3±15.0 vs. 58.9±18.0 g/day, p=0.42）。本研究表明地氟醚和异丙酚对术后口腔摄入功能的影响相似。此结果还需下一步的前瞻性研究来证实。

关键词：术后口服摄入量、术后恶心呕吐、地氟醚、异丙酚、早期恢复