

## Is recall of dreaming during anesthesia a sign of occurrence of postoperative nausea and vomiting?

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**Abstract** We examined the relationships between recall of dreaming during anesthesia and postoperative nausea and vomiting (PONV). We found a relationship between PONV within 24 h and age <50 years, use of postoperative epidural analgesia with morphine, and female gender. We also found a relationship between PONV lasting more than 24 h and dream recall. As serotonin plays an important role for both inducing PONV and dream recall, results of the present study may suggest a possible relationship between dream recall and PONV.

**Keywords** Dreaming · PONV · Serotonin

Numerous mechanisms are involved in recall of dreaming during general anesthesia; however, they still remain in debate [1, 2]. Rapid eye movement (REM) sleep is greatly involved in dreaming, and some anesthetics have an impact on REM sleep [3–5]. Among various neurotransmitters,

5-hydroxytryptamine (5HT) significantly influences the frequency of dream recall and subjective dream intensity during REM sleep by affecting the tegmentum of the pons and serotonergic raphe nucleus [6–8]. It also plays a major role in inducing postoperative nausea and vomiting (PONV) via a chemoreceptor trigger zone in the area postrema [9], suggesting that an increased 5HT level in the brain during anesthesia might be responsible for an increase of the incidence of PONV as well as for the frequency of dream recall. To examine this hypothesis, we analyzed the relationship between the incidences of PONV and recall of dreaming during anesthesia in a retrospective manner.

We obtained oral informed consent regarding the postoperative interview and possible use of the data for a clinical study from all patients before anesthesia. The content of the postoperative interview includes wound pain level intensity (using the visual analogue scale score), presence or absence of symptoms such as pruritus, PONV, new occurrence of neurological deficit, intraoperative awareness, and recall of dreaming during anesthesia. All nursing staff (including ward and operating room) recorded the issue of PONV based on its definition as an episode in which the patient suffers from nausea that lasts more than 15 min or vomiting. The staff anesthesiologists read the ward records to check the occurrence of PONV as well as other issues before visiting patients to interview. The staff anesthesiologists asked every patient about PONV and recall of dreaming during anesthesia; e.g., “Have you recalled dreaming during anesthesia postoperatively?” and “Have you been afflicted with nausea which had lasted more than 15 min or vomiting after surgery?” Whenever the patient recalled a dream during anesthesia but not its content, the staff anesthesiologists had a rule to record recall of dream (+) on the postoperative interview sheet.

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Whenever the occurrence of PONV on the ward record coincides with that of the interview, the staff anesthesiologists had a rule to record PONV (+) on the postoperative interview sheet when either the ward record or the postoperative interview could confirm it.

After approval from the institutional review board, we retrospectively analyzed the medical records of patients who underwent elective surgery under general anesthesia from January to December 2007. We excluded patients younger than 18 years and those with decreased consciousness levels and dementia. Predictors included gender, age, body mass index (BMI), the duration between the end of surgery and the time of patient's eye opening (DEO), types of anesthesia (maintenance), postoperative epidural infusion, recall of dreaming during general anesthesia, and PONV. Outcomes included recall of dreaming during general anesthesia and PONV. Each clinical variable was retrieved from the database of anesthetic charts and medical records. Age was categorized to patient age more than 50 years or not over 50 years. BMI was categorized to patient BMI more than 25 or not over 25. In our institute, inhalation anesthesia was performed with nitrous oxide combined with isoflurane or sevoflurane, and intravenous anesthesia was performed with the target-controlled infusion of propofol (propofol TCI) with remifentanyl or epidural anesthesia. All patients equipped with epidural tubing received postoperative epidural infusion with 0.2 % ropivacaine 100 ml containing morphine 6 mg (2 ml/h). The occurrence of PONV was divided into two types that lasted more than 24 h postoperatively [PONV (>24 h)] or not [PONV ( $\leq$ 24 h)]. Stepwise multivariate logistic regression was performed to assess the influence of these predictors on recall of dreaming and PONV. Significance was considered as  $p < 0.05$ . The statistical analyses were aided by SPSS version 14 (SPSS, Chicago, IL, USA).

Among a total of 2,704 patients, 88 (3.3 %) complained of recall of dream during anesthesia, 807 (29.9 %) had PONV  $\leq$ 24 h, and 52 (1.9 %) had PONV >24 h (Table 1).

Table 2 shows the relationships between the predictors and outcomes. PONV (>24 h) (odds ratio, 2.8; CI, 1.08–7.32;  $p = 0.03$ ), propofol TCI (odds ratio, 1.9; CI, 1.23–2.90;  $p < 0.01$ ), and age <50 years (odds ratio, 1.8; CI, 1.14–2.70;  $p = 0.01$ ) showed a statistically significant relationship with recall of dreaming during general anesthesia. Female gender (odds ratio, 12.9; CI, 2.46–3.50;  $p < 0.01$ ) and combination with postoperative epidural morphine (odds ratio, 1.2; CI, 1.03–1.45;  $p = -0.02$ ), but not recall of dreaming during general anesthesia, showed a statistically significant relationship with PONV ( $\leq$ 24 h). Female gender (odds ratio, 3.5; CI, 1.79–6.86;  $p < 0.01$ ), postoperative epidural morphine (odds ratio, 2.2; CI, 1.23–3.86;  $p < 0.01$ ), and recall of dreaming during general anesthesia (odds ratio, 2.8; CI, 1.08–7.36;  $p = 0.03$ )

**Table 1** Demographics, type of surgeries, anesthetic methods, and incidences of PONV and recall of dreaming

Demographics	
Female gender	1,426 (52.7 %)
Age (years)	58 $\pm$ 17
Height (cm)	157 $\pm$ 21
Weight (kg)	57 $\pm$ 18
BMI (kg/m <sup>2</sup> )	22 $\pm$ 7
Duration of surgery (min)	100 (56–182)
Duration of anesthesia (min)	136 (90–223)
DEO (min)	9 (5–14)
Type of surgery (%)	
Abdominal	577 (21.3)
Obstetrics and gynecology	509 (18.8)
Urology	357 (13.2)
Orthopedics	341 (12.6)
Otolaryngology	338 (12.5)
Chest surgery	190 (7.0)
Cardiovascular	114 (4.2)
Others	278 (10.4)
Anesthetic method (maintenance) (%)	
Inhalational anesthesia	1,233 (45.6)
Inhalational and epidural	407 (15.1)
Total intravenous anesthesia (propofol TCI)	239 (8.8)
Intravenous (propofol TCI) and epidural	825 (30.5)
Incidences of PONV and recall of dreaming (%)	
PONV ( $\leq$ 24 h)	807 (29)
PONV (>24 h)	52 (1.9)
Recall of dreaming during general anesthesia	88 (3.3)

Data were expressed as absolute number (%) or median (quartiles)

*BMI* body mass index, *DEO* time of patient's eye opening, *propofol TCI* target-controlled infusion of propofol, *PONV* postoperative nausea and vomiting

showed a statistically significant relationship with PONV (>24 h).

From our results, possible causative factors for PONV  $\leq$ 24 h (early PONV) are age <50 years old, postoperative epidural morphine, and female gender, and those for PONV >24 h (long-lasting PONV) are recall of dreaming during anesthesia as well as these three factors. Because previous reports indicate that risk factors for PONV include younger adult age, postoperative use of opioid, and female gender [10, 11], our statistical results are very likely reliable. Because 5HT has been reported to cause intractable PONV that lasts more than 24 h [12], it seems likely that a strong relationship exists between recall of dreaming during general anesthesia and long-lasting PONV.

Several issues have to be taken into consideration regarding our results. The frequency of recall of dreaming during anesthesia was low (3.3 %) in this study. Recall of dreaming during general anesthesia has been reported to

**Table 2** Relationships between each predictor and recall of dreaming during general anesthesia, between each predictor and PONV (<24 h), and between each predictor and PONV (>24 h)

	Predictor	Odds ratio	95 % CI	p value
Relationship between each predictor and recall of dreaming	PONV ≤24 h	–	–	0.29
	PONV >24 h	2.8	1.08–7.38	0.03
	Female	–	–	0.52
	Age <50 years old	1.8	1.14–2.70	0.01
	BMI >25	–	–	0.46
	DEO <5 min	–	–	0.31
	Propofol TCI	1.9	1.23–2.90	<0.01
Relationship between each predictor and PONV (≤24 h)	Epidural morphine	–	–	0.13
	Dreaming during anesthesia	–	–	0.24
	Female	2.9	2.46–3.50	<0.01
	Age <50 years	–	–	0.35
	BMI >25	–	–	0.55
	DEO <5 min	–	–	0.10
	Propofol TCI	–	–	0.46
Relationship between each predictor and PONV (>24 h)	Epidural morphine	1.2	1.03–1.45	0.02
	Dreaming during anesthesia	2.8	1.08–7.36	0.03
	Female	3.5	1.79–6.86	<0.01
	Age <50 years	–	–	0.79
	BMI >25	–	–	0.23
	DEO <5 min	–	–	0.11
	Propofol TCI	–	–	0.38
	Epidural morphine	2.2	1.23–3.86	<0.01

BMI body mass index, DEO time of patient’s eye opening, propofol TCI target-controlled infusion of propofol, PONV postoperative nausea and vomiting

have a wide-ranging frequency, from 3.3 % to 50 % [2, 11, 13, 14], and it has been also reported that the incidence is higher in patients who are interviewed immediately after anesthesia (approximately 22 %) than in those who are interviewed later (approximately 6 %) [2].

Furthermore, our postoperative interview did not include the content of dream, the patient’s home dream recall frequency, and the drugs that potentially influence dreaming or REM sleep. The content of dreams has been reported to be pleasant [2, 14], related with clinical variables such as gender [12, 13], and the rare near-miss awareness [12], but it remains controversial if home dream recall frequency associates with dreaming during general anesthesia [12, 15]. Scopolamine, an anticholinergic agent, prevents dreaming during general anesthesia [16]. Remifentanyl inhibits REM sleep [17]. Fentanyl and morphine but not remifentanyl inhibit acetylcholine release in the pontine regions that modulate arousal [3]. In addition, we performed retrospective cohort analysis by means of stepwise logistic regression, which might be less useful for testing hypotheses about statistical relationships, but this method was useful in finding relationships that had not been previously tested, i.e., possible relationship between recall of dreaming during anesthesia and PONV. Its findings, however, invite us to seek why an unusual relationship makes sense. Therefore, our findings might be worth performing a

future study of which the protocol includes enough considerations about timing of interview, content of dreams, patient’s home dream recall, and effects of any drugs that potentially influence dreaming or REM sleep. If future studies confirm our hypothesis, checking the presence or absence of recall of dreaming after emergence will help us to consider whether additional antiemetic treatment is needed or not.

In conclusion, our retrospective cohort study suggests that a relationship between recall of dreaming during general anesthesia and PONV may exist.

**Conflict of interest** None.

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