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Original contribution

Insomnia may increase anesthetic requirement☆,☆☆

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Abstract

Study Objective: Gamma aminobutyric acid (GABA) is the primary inhibitory neurotransmitter in the central nervous system. It is a common target for general anesthetics, and it is strongly related to the etiology of chronic insomnia. In this study, we aimed to investigate whether insomnia has any effect on anesthetic requirement, and we also assessed pain to reveal a relationship with insomnia.

Design: This study designed as a prospective, observational study, registered ANZCTR (ACTRN12616000241437), with institutional review board approval and written informed consent.

Setting: Preoperative and postoperative areas of the training and research hospital.

Patients: Inpatients planning to undergo laparoscopic cholecystectomy as an elective surgery were enrolled in this study.

Interventions: Patients were divided into 2 groups based on the results of the 4-item Jenkins Sleep Questionnaire which assesses the degree of sleep disturbance: those with or without insomnia. Anesthesia was standardized, and delivered sevoflurane concentration was adjusted according to bispectral index (BIS) value in both groups.

Measurements: Parameters of the study were heart rate, noninvasive arterial blood pressure, arterial oxygen saturation, BIS, end-tidal carbon dioxide, and inspiratory and end-tidal concentrations of sevoflurane at 5-minute intervals during the operation. Pain was assessed for all participants; preoperatively using 2-sided blank body manikin (front and back) and postoperatively with numeric rating scale between 0 and 10.

Main Results: End-tidal concentration of sevoflurane found higher in insomnia group during the maintenance phase of anesthesia. Pain experience was higher in insomnia group. In addition, postoperative abdominal pain score was higher only at 18-hour interval in insomnia group. Although BIS values were similar in both groups during surgery, mean end-tidal sevoflurane concentrations were significantly higher in insomnia group (1.48 ± 0.20) than control group (1.23 ± 0.18) ($P < .0001$).

Conclusion: Insomnia may result in increased anesthetic requirement and pain experience. Further study is required to identify the relationship between insomnia and anesthetics.

☆ There is no conflict of interest for all authors.

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1. Introduction

Insomnia is a common sleep disorder that affects 10% to 30% of adult population [1–3]. Chronic insomnia is defined by insomnia symptoms persisting for more than 1 year [1]. Chronic insomnia has a comprehensive effect on health and quality of life [4]. Patients are usually influenced physically and emotionally by all aspects such as cognitive impairments, poor social functioning, and physical complaints including pain [5–9]. GABA, which is the primary inhibitory neurotransmitter in the central nervous system, is a common target for general anesthetics and strongly related with the etiology of chronic insomnia. Most of the studies showed that low GABA levels in some brain regions or whole brain are associated with chronic insomnia [10,11].

The GABA system is also suggested as a major substrate of anesthetic efficacy [12]. Therefore, anesthetic requirement may differ in patients with chronic insomnia depending on an abnormal GABA content. In literature, there is not any study about this subject. The aim of this study was to investigate whether insomnia has any effect on anesthetic requirement. In addition, we assessed pain to reveal a relationship with insomnia.

2. Materials and methods

After institutional review board approval and informed consents, 50 patients, having planned to undergo laparoscopic cholecystectomy as an elective surgery, who had a history of cholelithiasis were enrolled in this study. Patients having renal failure, thyroid dysfunction, morbid obesity, obstructive sleep apnea, neurologic dysfunction, alcoholism, urgency about cholecystitis, and using anticonvulsant or opioid therapy were excluded.

Heart rate, noninvasive arterial blood pressure, and arterial oxygen saturation were measured (CARESCAPE Monitor B650 GE Healthcare) and recorded during the surgery. All measurements were recorded at 5-minute intervals. The VISTA A bispectral index (BIS) monitor (Aspect Medical Systems, Norwood, MA) was used in the study. The BIS sensor was applied to patients' forehead and connected to digital signal converter before the induction of anesthesia. Inspiratory and end-tidal concentrations of sevoflurane and end-tidal CO_2 were measured with Avance CS2 CARESCAPE Monitor (GE, Finland).

The patients were divided into 2 groups by using the 4-item Jenkins Sleep Questionnaire (JSQ) according to degree of sleep disturbance [13]. Four items were asked to the patients: "how frequent they have trouble falling asleep, waking up several times per night, having trouble staying asleep, feeling tired and worn-out after the usual amount of sleep during the previous 4 weeks." There were 6 alternative responses: not at all (1), 1 to 3 days (2), 4 to 7 days (3), 8 to 14 days (4), 15 to 21 days (5), and 22 to 28 days (6). All participants assessed in insomnia group had sleep problems for at least 1 year. Patients reported sleep problems 4 to 7 days in the previous month at least for 1 item were classified as insomnia group. Patients reported any sleep problem 1 to 3 days in the previous month for 1 item or more were not included in insomnia group. Patients who responded "not at all" to all items were classified as control group.

None of the patients was premedicated. In all groups, anesthesia was standardized and assessed by different anesthesiologists. Anesthesia was induced with propofol 2 mg/kg, rocuronium 0.5 mg/kg was given to establish muscle relaxation. Fentanyl was given to all patients intravenously as bolus 1 μg/kg before induction of anesthesia. No further fentanyl was given during operations. Anesthesia was maintained with sevoflurane in a mixture of nitrous oxide 2 L/min and oxygen 2 L/min, and all patients were mechanically ventilated to maintain an end-tidal CO_2 concentration of 30 to 37 mm Hg. The BIS target range was maintained between 40 and 60 via adjustment of sevoflurane concentration. End-tidal concentration of sevoflurane was used as a parameter that showed anesthetic requirement in this study.

All participants were asked about their pain experience lasting for 1 day or more in the previous month and to describe it on a 2-sided blank body manikin (front and back) before the operation. Then the outcomes were categorized as widespread pain, some pain, or no pain. *Widespread pain* was defined as pain located on the both sides of the body, above and below the waist and in the axial skeleton. Such cases in which all criteria of widespread pain could not be satisfied were defined as some pain. Postoperative abdominal pain was assessed by the patients themselves using numeric rating scale (0 = no pain; 10 = worst possible pain), from 0 to 10 at 2, 4, 8, 12, and 18 hours postoperatively at rest. All patients in both groups were informed about how to use patient-controlled intravenous analgesia (CADD-Legacy patient Control Analgesia device Model 6300; Ambulatory Infusion Pump Smith Medical ASD) self-control pump which was administered as soon as possible after the surgery ended. Each of the patient-controlled intravenous analgesia pumps contained 300 mg tramadol dilution to 100 mL of 0.9% saline solution and adjusted as 10 mg/h background dose, bolus dose of 10 mg, and a locked out interval of 15 minutes.

Table 1 Baseline demographic and clinical characteristics

	Insomnia group	Control group	*P*
Age (y)	47.4 ± 7.5	48.04 ± 10.9	.82
Sex (M:F)	6:19	8:17	.75
ASA	1.28 ± 0.4	1.4 ± 0.5	.38
BMI (kg/m^2)	26.5 ± 4.4	27.5 ± 4.4	.44
Operation time (min)	57.6 ± 16.5	53.6 ± 13.5	.35
Tramadol consumption dose (mg)	271.7 ± 42.4	262.1 ± 41.3	.41
Duration of sleep problem (y)	4.0 (1-23)	–	–

ASA = American Society of Anesthesiologists; BMI = body mass index; F = female; M = male.
Data are presented as mean ± SD, median (minimum-maximum), and number.