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Anesthetic management of laparoscopic adjustable gastric banding in Japanese patients with morbid obesity

Shinichiro Kira, Hironori Koga, Shunsuke Yamamoto, Naozumi Takeshima, Akira Hasegawa, Hiroshi Miyakawa, and Takayuki Noguchi

Department of Anesthesiology, Oita University Faculty of Medicine, 1-1 Idaigaoka, Hasama-machi, Yufu, Oita 879-5593, Japan

Abstract
Laparoscopic adjustable gastric banding (LAGB) is a common type of bariatric surgery worldwide, though not so in Japan. Here we report the anesthetic management of LAGB in ten Japanese patients with morbid obesity. General anesthesia was induced with propofol, fentanyl, and vecuronium bromide and maintained with sevoflurane in oxygen and air (or nitrous oxide in some cases). In a limited number of patients, perioperative epidural analgesia was performed, with fentanyl injected intravenously for analgesia in the remaining patients. Although some special considerations were needed, in perioperative management, including thromboprophylaxis, there were no severe complications in any of the patients.

Key words Morbid obesity · Bariatric surgery · Laparoscopic adjustable gastric banding

Introduction

Over the past 30 years, as the Japanese have been changing from a traditional to a more western-style diet, while also becoming an increasingly motorized society, resulting in an increasing lack of exercise, obesity has become a major health problem in Japan [1]. According to recent data analyzed from a nationwide survey conducted in 2000, the incidence of metabolic syndrome, which is strongly correlated with obesity, is 7.8% in the Japanese population [2]. In addition, it was reported that the number of obese high school students whose body mass index (BMI; weight [kg]·height^{-2} [m^{-2}]) is 25 or greater has been increasing [3]. A BMI higher than 28 is associated with increased morbidity due to stroke, ischemic heart disease, and diabetes mellitus (DM) that is three to four times the risk in the general population. However, a weight loss of only 5 to 20 kg is considered to be sufficient for decreasing systemic blood pressure and plasma lipid concentrations and enhancing the control of DM [4]. Therefore, weight loss is crucial for obese patients to avoid obesity-related morbidity. For weight loss, increased physical activity and/or decreased caloric intake should first be recommended to obese patients. However, the number of patients with morbid obesity (BMI > 35 kg·m^{-2}) who are also resistant to medical treatment has been increasing gradually [5]. In response to this problem, our institution has been employing laparoscopic adjustable gastric banding (LAGB), one of the bariatric surgical methods, for morbidly obese patients, for clinical evaluation, in an effort to spread the use of this procedure in Japan. In this article we report on the anesthetic management of this procedure. To our knowledge, this is the first report of anesthesia in LAGB in Japanese patients.

Patients and the LAGB method

Ten Japanese patients underwent LAGB between August 2005 and October 2006. After this procedure was approved by the ethics committee of the Oita University Faculty of Medicine, written informed consent was obtained from each patient. Patients with the following characteristics were selected: BMI equal to or greater than 35 kg·m^{-2} in those who had failed nonsurgical treatment and had medical comorbidities such as DM, hypertension (HT), hyperlipidemia (HL), and/or sleep apnea syndrome (SAS), although patients 1 and 9, did not meet these criteria. Table 1 shows preoperative characteristics of all the patients. The primary goal of this procedure is weight loss and the improvement of obesity-related comorbidities.

There are two broad types of procedures in bariatric surgery [6]. One type consists of malabsorptive proce-

Address correspondence to: S. Kira
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Table 1. Patients' preoperative characteristics

No.	Age (years)/sex	Height (cm)	Weight (kg)	BMI ($kg \cdot m^{-2}$)	Complications
1	45/F	158	79.4	31.8	Hypertension
2	40/M	163	106.5	40.1	Hypertension
3	44/F	157	88.0	35.7	Hyperlipidemia
4	52/F	158	97.0	38.9	Hypertension
5	31/M	182	134.5	40.6	DM, FL, SAS
6	40/F	155	95.8	39.9	Hypertension Hyperlipidemia
7	40/F	163	120	45.2	RA
8	19/M	156	158	64.9	Hyperuricemia
9	27/M	173	100	33.4	SAS
10	48/M	182	130	39.2	Hypertension
Mean	39	165	111	41.0	
SD	10	10	24.3	9.2	

BMI, body mass index; DM, diabetes mellitus; FL, fatty liver; SAS, sleep apnea syndrome; RA, rheumatoid arthritis

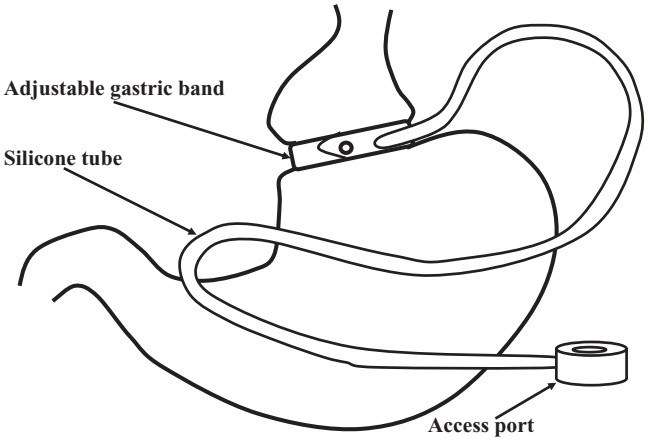

Fig. 1. Adjustable gastric band. The band forms a circular ring and transitions to a silicone tube, which joins the access port for percutaneous adjustment of the ring diameter

dures, in which the anatomy and function of the gastrointestinal tract is altered to limit the digestion and absorption of food, and the other procedure comprises restrictive operations that are designed to severely reduce gastric capacity. LAGB is one of the latter type of procedures, and the band system consists of a circular silicone adjustable ring and transition to a 50-cm silicone tube (Fig. 1). The ring is placed around the angle of the cardia under laparoscopy. The end of the tube joins the access port, which is for the percutaneous adjustment of the ring.

Preoperative evaluation and preparation

In addition to a standard preoperative evaluation, special evaluations and preparations were needed, as follows: (1) confirmation of airway status as a precaution in case of a difficult airway, and preparation of airway access devices such as a laryngeal mask, McCoy laryngoscope, stylet scope, bronchofiberscope, and percutaneous tracheostomy kit; (2) evaluation of peripheral venous access and arterial cannulation sites; (3) confirmation of the adequacy of the operating table size for accommodating the patient; (4) planning of perioperative analgesia and thromboembolism prophylaxis; and (5) crystalloid fluid replacement for the maintenance of adequate blood volume.

Anesthesia

Anesthetic management was performed with reference to the recent review by Ogunnaike et al. [7], with some modifications. In the operation room, standard monitors were applied for each patient. Next, an epidural catheter was secured at the Th 9–10 or Th 10–11 interspace for perioperative analgesia, in four patients, as they had recognizable interspinous space and their platelet counts and coagulation activity were normal. Before the induction of general anesthesia, as demonstrated in Fig. 2, all patients were well strapped so as not to slip off the operating table, and were placed in an approximately 30° head-up position to improve lung and chest wall compliance, and preoxygenation with 100% oxygen was conducted. Then, general anesthesia was induced with propofol 1.5–2.0 $mg \cdot kg^{-1}$ and fentanyl 100–200 μg; mask ventilation was confirmed, and vecuronium bromide 1 $mg \cdot kg^{-1}$ was administered for muscle relaxation. The administration of these drugs was based on an estimation of ideal body weight (height^2[m^2] × 22). When the doses of these drugs were not sufficient, additional doses were administered up to the total dose according to body weight. Because blood pressure measurements can be falsely increased if the noninvasive blood pressure cuff is too small for the patient's arm, invasive arterial monitoring was used to

measure blood pressure and to analyze blood gas after the induction of general anesthesia, in all patients. Although a difficult airway was anticipated due to the effect of the obesity, tracheal intubation was easier than expected (Cormack and Lehane grade I, 8 patients; grade II, 2 patients). General anesthesia was maintained with sevoflurane in oxygen and air (or nitrous oxide in some cases). In patients with epidural tube insertion, mepivacaine or ropivacaine was injected intermittently for epidural anesthesia during the operation. In the remaining six patients, fentanyl was injected intravenously as chief analgesic agent. In regard to the ventilator setting, we used tidal volumes of 10–12 ml·kg^{-1} (ideal body weight) so as not to provoke barotraumas, while maintaining normocapnia during the laparoscopic surgery with carbon dioxide abdominal inflation. A positive end-expiratory pressure (PEEP) of 2–5 cmH_2O was used to improve oxygenation when necessary. In order to facilitate ventilation and to maintain an adequate space for the visualization and safe manipulation of the laparoscopic instruments, complete muscle relaxation was mandatory in this operation. For this purpose, we used a mean dose of 4.4 mg·h^{-1} of vecuronium bromide, as shown in Table 2. We also found the intraoperative fluid requirements to be much larger than expected in order to maintain systemic blood pressure and urine volume. The total fluid volume extended to 3–3.5 l of crystalloid for an operation of about 2 h. In regard to thromboprophylaxis, Fujii et al. [8] have emphasized that factors causing venous stasis in the leg should be avoided during laparoscopic surgery. As well, professional organizations such as the European Association for Endoscopic Surgery [5] and the American College of Chest Physicians [9] recommend the use of pneumatic compression devices. Therefore, pneumatic compression devices were placed on the feet for thromboprophylaxis during the procedure. Moreover, these devices were also used naturally until the patient could ambulate after the operation, to decrease the potential risk of pulmonary embolism. The surgery was concluded uneventfully in all patients. All patients awoke rapidly and were extubated soon, except for patient 10. A chest X-ray of patient 10 revealed right lower-lobe atelectasis, and therefore 100% oxygen was inflated to reexpand the lobe. After reexpansion, the patient was soon extubated, and peripheral oxygen saturation, using a face mask and nasal airway with 100% oxygen, was 99%.

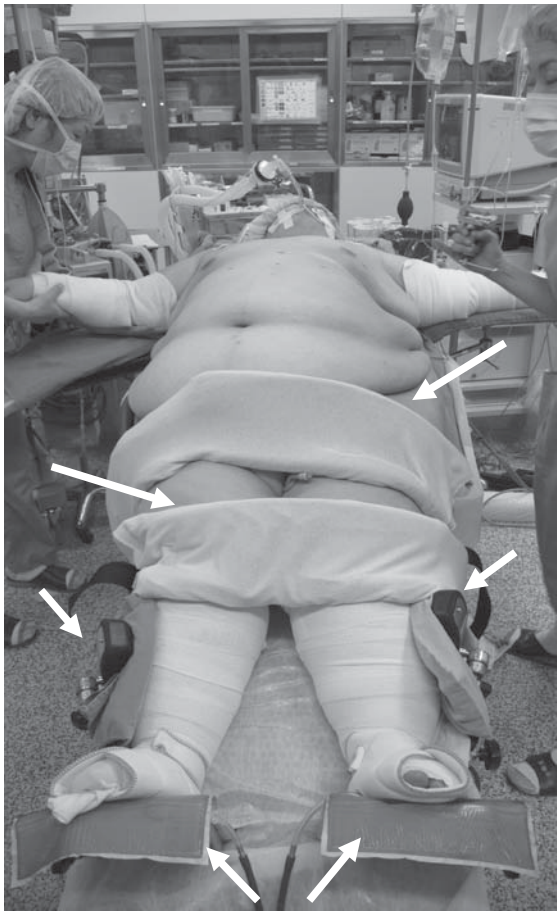

Fig. 2. Patient positioning and preparation for surgery. The patient was well strapped so as not to slip off the operating table, and was placed in an approximately 30° head-up position. *Arrows* indicate strap equipment to prevent the patient from slipping off the operating table

Table 2. Intraoperative profiles

Duration of anesthesia (min)	256.0 ± 56.6
Duration of operation (min)	132.0 ± 44.5
Intravenous fluid volume (ml)	3072 ± 980
Intraoperative urine volume (ml)	554 ± 380
Intraoperative blood loss (ml)	Not determined, amount too small
Intraoperative propofol (mg)	187 ± 63.4
Intraoperative vecuronium (mg)	18.2 ± 4.2 (4.4 ± 1.0 mg·h^{-1})
Intraoperative fentanyl (μg)	365 ± 138 (83.7 ± 19.4 μg·h^{-1})
No. of patients with epidural anesthesia	n = 4/10 (<100 kg, n = 3/4)
Cormack and Lehane grade	Grade I, n = 8/10; grade II, n = 2/10
Perioperative complications	n = 1/10 (patient 10, Atelectasis)

Values are means ± SD

Postoperative management

For obese patients who have just undergone upper abdominal surgery, because hypoxemia due to upper airway obstruction and atelectasis is anticipated, continuous positive airway pressure (CPAP) treatment or bilevel positive airway pressure (BiPAP) is recommended to overcome such problems [7]. Thus, if a patient could not be extubated because of respiratory problems or if ventilatory support such as CPAP or BiPAP was required after extubation, the patient would have been scheduled to be transferred to the intensive care unit (ICU) for airway management. Fortunately, in the present study, there were no hypoxemic patients who needed special equipment to alleviate hypoxemia or who needed to be transferred to the ICU. For thromboprophylaxis, 5000–10000 IU of heparin per day was infused continuously so the patient could ambulate. In patients with epidural analgesia, the epidural catheter was not removed until the day following the discontinuation of heparin infusion. There were no cases of thromboembolism or epidural hematoma in any of the patients. Patients not receiving analgesia via the epidural route received intramuscular administration of pentazocine 15 mg or buprenorphine 0.2 mg intermittently for postoperative analgesia. Buprenorphine 0.4 mg per day was administered to the patients receiving epidural analgesia, and two patients were totally free from any analgesic drugs. In two patients, serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels (>200 IU·l^{-1}) were elevated on postoperative days 1 and 2. Although no related symptoms were found in these patients, glycyrrhizin 80 mg per day was administered for 3 days to improve this liver injury. This treatment resulted in a reduction of serum AST and ALT levels.

Discussion

Bariatric surgery is a widely used method for achieving sustained weight loss in severely obese patients. However, this method is not very common in Japan, except in the fields of cosmetic, plastic, and reconstructive surgery. Although LAGB is becoming the most common type of bariatric surgery with minimal invasion, and notwithstanding the fact that there is considerable literature regarding the anesthetic considerations of this surgery [5–8], there have yet to be any case reports of Japanese LAGB patients. Our hospital has been employing this procedure since August 2005 and has become the leading institution for education in this procedure in Japan [10]. Thus, it is likely that we have had more patients indicated for LAGB than other Japanese institutions. Therefore, here we specially discuss the difference between our cases and the special considerations previously noted for bariatric surgery.

We attempted to insert an epidural catheter using a 17-gauge, 80-mm-long Tuohy needle (Hakko, Nagano, Japan) for perioperative analgesia in four patients weighing 79.4–106.5 kg, and fortunately the catheter was secured in all of these patients. Lai et al. [11] demonstrated that, in 977 patients (mean body weight, 60.5 kg) with thoracic epidural pain control achieved via the paramedian approach, the thoracic epidural depth was 5.11 ± 0.94 cm (mean ± SD), and this was positively correlated with the body weight and BMI. They also reported that each 10 kg increase in body weight resulted in a 0.39-cm increase in thoracic epidural depth. These findings suggest that there might be cases where an ordinary Japanese epidural needle does not reach the epidural space in patients with a body weight above 100 kg. Therefore, although thoracic epidural analgesia in bariatric surgery settings has advantages such as the prevention of deep venous thrombosis, improved analgesia, and earlier recovery of intestinal motility [7], it may be better to avoid epidural analgesia in such patients, unless there is adequate equipment and appropriate techniques are available. In patients with a difficult airway, such as morbidly obese patients, sevoflurane is considered to be an excellent induction drug that has a few definite advantages, such as the maintenance of spontaneous ventilation [12–14]. However, such patients are at high risk for aspiration pneumonia resulting from the aspiration of gastric contents, because 75% of obese patients have a gastric volume greater than 25 ml and a pH less than 2.5 [15]. In addition, there is a high incidence of gastroesophageal reflux and hiatus hernia in obese patients [15]. Propofol, on the other hand, has different advantages, such as rapid onset, rapid offset, and antiemetic properties [13], and therefore we chose it for rapid induction in all our patients. There were no induction complications. In view of these points, the rapid induction of propofol may be safer than the slow induction of sevoflurane in severely obese patients. In our study, two patients revealed elevated serum AST and ALT levels on postoperative days 1 and 2. However, as these two patients were the first two LAGB cases at our institution, we were not yet accustomed to the anesthesia or the surgery itself. The mechanism of this liver injury remains unclear, but because we observed transient intraoperative hypotension due to lack of fluid replacement therapy and transient intraabdominal mechanical compression of the liver, it seems these problems may have been related to the etiology of the elevated enzymes.

In summary, we investigated the anesthetic management of LAGB in morbidly obese Japanese patients. This treatment is minimally invasive surgery. However, because there is are relatively large numbers of anes-

thetic considerations, it is necessary to plan the detailed perioperative management for each patient.

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