Original Article

The Results of Surgery Under General Anesthesia in Patients with Lung Cancer

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Abstract

Purpose. There are few reports of surgical complications for underweight patients. This study evaluated the complications associated with lung cancer surgery and anesthesia in underweight patients in a comparison with obese ones.

Methods. A single-center retrospective evaluation of perioperative complications was conducted in 756 patients who underwent thoracic surgery under general anesthesia between 1996 and 2006. The body mass index showed that 39 were extremely underweight (<17.2 kg/m²), 45 were underweight (17.2–18.4 kg/m²), 513 were normal (18.5–24.9 kg/m²), and 159 were obese (>24.9 kg/m²).

Results. Extremely underweight patients had the most preoperative thoracic disease such as emphysema, whereas obese patients had the most preoperative cardiovascular disease such as hypertension. The postresection-predicted pulmonary function showed no difference among the four groups. Extremely underweight patients had an increased incidence of intraoperative hypotension and arrhythmia in comparison to underweight patients. On the other hand, obese patients had the majority of intraoperative thoracic complications such as hypoxia. Extremely underweight patients had more postoperative thoracic complications, especially pneumonia and pulmonary air leakage, than other patients.

Conclusions. Extremely underweight patients as well as obese patients had a high risk of perioperative complications, especially postoperative thoracic complications. Extremely underweight patients should therefore be carefully observed with regard to respiratory management.

Key words Lung cancer · General thoracic surgery · General anesthesia · Body mass index · Complication

Introduction

More Japanese people tend to be either normal weight or slender in comparison to Europeans and North Americans. There have been many reports on the relationship between obesity and perioperative complications for surgery under general anesthesia. However, there have been very few or no reports regarding complications with respect to underweight patients, especially extremely underweight patients. Obese patients often have preoperative complications such as hypertension, hyperlipidemia, and diabetes mellitus, which are not only risk factors for intra- and postoperative complications, but also for the onset of severe complications such as a cerebral infarction and myocardial infarction. However, there are no reports that address whether thoracic surgery under general anesthesia is associated with intra- and postoperative complications of underweight patients, other than for morbidly lean patients. One of the indicators of physique is the body mass index (BMI). The normal physique in Japan is defined as a body mass index of 18.5–24.9. The work reported in the present article investigated whether the underweight Japanese lung cancer patients with a BMI of less than 18.5 have different perioperative complications during general thoracic surgery and general anesthesia.

Patients and Methods

Patients

The data of 756 patients with lung cancer who underwent general thoracic surgery from January 1996 to December 2006 were retrospectively analyzed. Almost all of the...
patients had an electrocardiogram and a respiratory function test and, if necessary, an echocardiogram, cardiac scintigram, and pulmonary ventilation-blood flow scintigram. The recommended lower limit postresection value predicted forced expiratory volume in 1 s (FEV₁), corrected for area of body surface allowing a surgical resection, is 600mL/m². The preoperative data were collected from the medical records. Clinical staging was defined according to the 6th edition of the TNM criteria of the International System for Staging Lung Cancer. Histological typing was carried out according to the World Health Organization histological classifications. Preoperative data were collected from the medical records. Surgical data were reviewed using the anesthesia charts, including the age, sex, height, surgical methods, anesthetic methods, anesthetic drugs, operation time, length of stay in the operating room, extubation time, impossibility of extubation, and intraoperative complications. The length of stay in the operating room was defined as the time from when the patient was carried into the operating room to when he or she was carried out. Similarly, the extubation time was defined as time from closure of the incision to extubation. The BMI was calculated using the patients’ height and weight (BMI = weight (kg)/height (m)²) at the time of surgery. The patients were classified into four groups: extremely underweight (BMI < 17.2kg/m²), underweight (BMI 17.2–18.4kg/m²), normal (BMI 18.5–24.9kg/m²), and obese (BMI > 25.0kg/m²). The BMI cutoff of 17.2 was determined by the average BMI of 84 patients with BMI < 18.5. Postoperative complications and mortality were analyzed using data from the medical records. Morbidly underweight patients, such as those with more advanced disease, low albumin, or malnutrition, were excluded. Operative death was defined as death within 30 postoperative days.

All operations were performed under general anesthesia with or without epidural analgesia, or total intravenous anesthesia. Propofol was mainly used for anesthetic induction and its concentration was controlled using a target-controlled infusion system (Diprifusor; AstraZeneca, Wilmington, DE, USA); the concentration of propofol was determined according to the patient’s age and weight. Anesthesia was maintained in almost all patients with sevoflurane and nitrous oxide gas if necessary. No epidural analgesia was used in 0%–4.4% of patients in the four groups because of the use of anticoagulants such as antiplatelet or antithrombotic agents, difficulty in inserting epidural tubing, or minimally invasive operation by video-assisted thoracic surgery, such as a wedge resection.

**Statistical Analysis**

Continuous variables are presented as the mean ± standard deviation. The statistical analysis was performed using independent Student’s t-test for continuous variables and the chi-squared test for categorical variables. A Kruskal–Wallis test was performed to compare the medians across groups. A P value of less than 0.05 was considered to be significant in all statistical analyses.

**Results**

The patients’ characteristics are listed in Table 1. The mean BMIs of the four groups were extremely underweight, 16.4kg/m²; underweight, 18.0kg/m²; normal, 21.9kg/m²; obese, 27.2kg/m². The preoperative comorbidities, smoking history, and preoperative pulmonary functions are listed in Table 2. The preoperative total cardiac complications, especially hypertension, were significantly higher in the obese group, whereas preoperative thoracic complications, especially emphysema, were significantly more frequent with decreasing BMI. Preoperative FEV₁% showed a statistical difference, especially between the underweight and normal group, and the predicted FEV₁ showed no difference between four groups. There was no statistical difference in the smoking history between the four groups.

Surgical complications and anesthetic details are shown in Table 3. The incidence of intraoperative total cardiac complications, especially hypotension, was significantly highest in the extremely underweight group. There were statistical differences in the intraoperative total thoracic complications between the four groups; hypoxia was significantly more frequent in the obese group. The amount of propofol and sevoflurane required decreased with decreasing BMI. However, the propofol/BMI ratio was similar among the four groups; on the other hand, the sevoflurane/BMI ratio was high in extremely underweight and underweight groups. Operation time and length of stay in the operation room showed no statistical difference among the four groups; however, the extubation time was significantly longer in the obese group.

Postoperative complications and operative mortality are shown in Table 4. The total numbers of postoperative cardiac complications showed no statistical significance. The total numbers of postoperative thoracic complications did show statistical significance; in particular, the rates of pneumonia were significantly higher with decreasing BMI. In extremely underweight and underweight patients, the ratio of respiratory pulmonary air leakage was higher than in other patients. There were statistical differences regarding the hospital stay; however, no statistical differences were observed regarding operative death among the four groups.

**Discussion**

Japanese people continue to have a lower rate of obesity than Westerners; as a result, they tend to experience