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Clinical impact of lung age on postoperative complications in non–small cell lung cancer patients aged >70 y

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ABSTRACT

Background: Surgery for elderly patients with primary lung neoplasms has become relatively common as populations age; however, the high frequency of postoperative complications has prevented its broad application. Recently, the Japanese Respiratory Society proposed lung age (LA) as an index of lung function, but reports on the association between LA and the risk factors for postoperative complications with non–small cell lung cancer (NSCLC) surgery have been limited. In this study, we analyzed the clinical applicability of LA for elderly patients with NSCLC.

Materials and methods: We studied 320 patients aged >70 y underwent curative resections for NSCLC. LA was calculated based on the formula provided by the Japanese Respiratory Society, which depended on the patient's preoperative respiratory function and was divided into four age gap (AG) groups between the LA and the true age (TA). The categorical data were compared among the four groups.

Results: The numbers of patients in groups A, B, C, and D were 80, 77, 79, and 84, respectively. For the univariate analysis, the preoperative factors for postoperative complications were gender, AG, and smoking ($P < 0.05$). In a multivariate analysis, AG proved to be an independent factor. Although we found no significant differences, there was a tendency for the prognosis to worsen with an increase in the AG ($P = 0.06$).

Conclusions: The AG was significantly associated with and an independent predictive factor for postoperative complications. We conclude that LA and AG are useful factors for predicting the risk of postoperative complications.

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1. Introduction

As in many developed countries, lung cancer is now the leading cause of cancer mortality in Japan, with more than 65,000 deaths recorded annually [1]. Because the number of elderly patients with non–small cell lung cancer (NSCLC) has increased along with longer life expectancies, surgical treatment for such individuals has become a major challenge for thoracic surgeons. Although recent studies have demonstrated the efficacy and safety of surgery for elderly patients with early stage disease [3,4], aging results in physiological changes in the cardiovascular and respiratory systems and can increase the frequency of medical problems. Thus, the risk of various complications after surgery in elderly patients may be elevated. As described in the Society of Thoracic Surgeon General Thoracic Database [5], the predictive factors for major morbidity from lung cancer resection are age, body mass index, steroid exposure, chronic heart disease, coronary artery disease, recent smoking, and the surgical method used. More information regarding short- and long-term postoperative outcomes is necessary to help surgeons select subgroups of elderly patients who are suitable for pulmonary resection.

Morris and Temple [6] have developed an original formula that allows an individual's age to be calculated by rearranging the regression equation, which was constructed to predict the normal reference value of the forced respiratory volume at 1 s (FEV_1), to solve for the lung age (LA). The LA calculation was reported at the lung physiology special member meeting of the Japanese Respiratory Society (JRS) in 2001; the standard regression equation was used to calculate the FEV_1 of approximately 2000 Japanese nonsmokers (aged from 18 to 95 y) from the pulmonary function tests (PFT), and LA was calculated using the inverse operation expression [7]. The PFT for measuring individual FEV_1 values is routinely performed preoperatively on lung cancer patients to assess surgical risks and to predict and prevent postoperative complications. For this evaluation, the JRS recently proposed the concept of LA for describing patient respiratory function [6]. LA is easily understood by both clinicians and patients, and it was reported that assessing the difference between LA and the true age (TA) is useful and convenient for predicting respiratory complications [8]. However, few studies have reported on the suitability of using this new concept in lung cancer surgery.

Therefore, in the present study, we retrospectively analyzed the surgical results for patients aged >70 y who underwent curative resections for NSCLC, and we evaluated whether LA contributes to the clinical outcome. In this investigation, we set the age cutoff at 70 y because approximately one-half of all NSCLC patients undergoing surgical treatment in Japan are at or above this age [2].

2. Patients and methods

2.1. Patients

About 902 patients underwent curative pulmonary resections for NSCLCs, and 320 subjects were aged >70 y at Kitasato University Hospital from January 1998 to March 2012. The curative pulmonary resections included lobectomy, bilobectomy, and pneumonectomy. This study was approved by the Ethics Committee of Kitasato University School of Medicine. Documented informed consent was obtained from each patient before treatment.

Based on the criteria regarding the indications for surgical resection at our institute, the eligibility of all of the patients for surgery was determined based on their clinical stage, respiratory function, electrocardiogram results, and Zubrod or Eastern Cooperative Oncology Group performance status [9]. To determine the clinical stage [10], all of the patients underwent a chest X-ray, chest computed tomography (CT) scan, brain CT or magnetic resonance imaging, and bone scans or positron emission tomography. Regarding the PFT, the patients who were predicted to have postoperative FEV_1 of <700 mL/(body surface area [square meter]) were not indicated for surgical resection. All of the patients with preoperative comorbidities were treated appropriately.

The clinical and pathologic stages were defined according to the criteria of the seventh edition of the Tumor Node Metastasis International System for Staging Lung Cancer [11]. Histologic typing was conducted according to the World Health Organization histologic classification [12]. The viability status was determined based on the all-cause-related death, and the survival time was defined as the duration from the date of surgery to the date of death or the end of follow-up. A follow-up examination was usually performed every 2 or 3 mo for the first 2 y and every 4–6 mo thereafter. The follow-up included physical examinations, tumor marker assessments, and chest X-rays. Chest and brain CT scans, bone scintigraphy, and positron emission tomography were conducted once or twice a year after the operations.

2.2. Comorbidities and postoperative complications

The comorbidities and postoperative complications were diagnosed and recorded during the daily clinical routine *via* laboratory, radiologic, and physiological examinations. The comorbidities included cardiovascular diseases (e.g., ischemic heart disease, arrhythmia, or chronic heart failure), respiratory diseases (e.g., chronic obstructive pulmonary disease [COPD] or interstitial pneumonitis [apparent interstitial shadows detected on the chest CT scan]), metabolic disorders (e.g., diabetes mellitus [$HbA1_C \geq 6.0\%$], hyperlipidemia, or gout), and other malignancies or diseases.

Postoperative complications were defined when any of the following diagnoses were originally made after the surgical resection: wound infection (accompanying wound failure), postoperative hemorrhage (200 mL/h or more), prolonged air leakage (≥7 d), chylothorax (≥1000 mL/d), pulmonary embolism, empyema, pneumonia (presenting as abnormal shadows on chest radiography), respiratory failure (requiring mechanical ventilation for ≥3 d), myocardial infarction and cerebral infarction.