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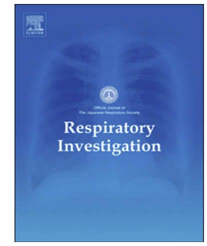

Review

Recent evidence, advances, and current practices in surgical treatment of lung cancer

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ABSTRACT

In the last 10–15 years, strategies and modalities of lung cancer treatment have changed dramatically. Meanwhile, the treatment objectives, the lung cancers themselves, have also changed, probably owing to early detection by computed tomography and aging of the population. In particular, the proportions of smaller lung cancers, lung adenocarcinomas with ground-glass opacity, and lung cancers in older patients are increasing. Along with these changes, surgeons have innovated and evaluated novel procedures for pulmonary resection. These include the application of minimally invasive surgical techniques, such as video-assisted thoracoscopic surgery (VATS) and robotic surgery, and sub-lobar resection, such as wedge resection and segmentectomy, for small peripheral lung cancers. Currently, VATS has gained wide acceptance and several institutions in Japan have started using robotic surgery for lung cancers. Two important clinical trials of sub-lobar resection for small peripheral lung cancers are now underway in Japan. In addition, surgery itself is of growing importance in lung cancer treatment. In particular, recent evidence supports the use of surgery in strictly selected patients with locally advanced disease, lung cancers with N2 lymph node metastases, small cell lung cancers, recurrent oligo-metastasis after pulmonary resection, or relapsed tumors after drug treatment. Surgical treatment also provides abundant tumor samples for molecular analysis, which can be used for drug selection in the adjuvant setting or after disease relapse. In the era of personalized treatment, surgery is still one of the most important treatment modalities to combat lung cancer.

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Contents

1. Introduction

The first surgery with a curative result for lung cancer was left pneumonectomy, performed by Graham in 1933 [1]. Thereafter, pneumonectomy was substituted with lobectomy with lymph node dissection as the standard surgical procedure for lung cancers, since Cahan reported equal treatment outcomes for these two procedures in 1960 [2]. To this day, surgery is the treatment most likely to “cure” patients with lung cancer. Therefore, the first decision about treatment strategy for lung cancer is whether the tumor is resectable.

Surgical applications for lung cancers depend upon tumor histology (small cell lung cancer versus non-small cell lung cancer (NSCLC)), clinical stage of disease, and patients' general health (age, performance status, pulmonary function, comorbidities, etc.). In addition, the presence of specific somatic mutations may affect surgical applications in marginal surgical candidates, owing to extremely high efficacies and low adverse events of molecularly targeted drugs for lung cancers that harbor such mutations. In this review, we summarize recent studies, advances, and current practices in surgical treatment for lung cancer in Japan.

2. Development of surgical instruments and perioperative management

Thanks to recent technological advances, such as preoperative examination, use of stapling and energy devices during surgery, and progress in perioperative management, surgery for lung cancers has become considerably safer and has resulted in satisfactory outcomes. Preoperative examination by imaging, such as high-resolution computed tomography with 3D-reconstruction and FDG-positron emission tomography (PET), provide surgeons with anatomical information about the patient and oncologic information about the tumor. The introduction of endobronchial ultrasound-guided transbronchial needle aspiration or endoscopic ultrasound-guided fine-needle aspiration, for patients with suspected N2 disease has resulted in 95% accuracy in mediastinal lymph node evaluation [3].

Differential pulmonary ventilation enables collapse of the affected side of the lung to create working space in the restricted intra-thoracic space under closed circuit anesthesia, while preserving ventilation of the opposite side. Stapling devices, which enable simultaneous cutting and suturing with metallic staplers, allow accurate, consistent, and reliable cutting and closure of large blood vessels, pulmonary parenchyma, and the bronchus. Furthermore, the recent development of surgical energy devices based on ultrasonic or radio-frequency technologies has made it easier to cut tissues and smaller vessels, which reduces blood loss, as well as operation time and surgeon fatigue. According to the Japanese Lung Cancer Registry Study of 11,663 surgical cases in 2004, the rate of severe postsurgical complications ($\geq$ grade 3, using the National Cancer Institute Common Toxicity Criteria) and the postoperative death rate (death within 30 days of surgery) were extremely low—4.5% and 0.4%, respectively [4]. En passant, the top five causes of death within 30 days of pulmonary resection for lung cancer were interstitial pneumonia, cardiovascular event, pneumonia, bronchopleural fistulas, and respiratory failure [5].

3. Surgery for clinical stage I–II NSCLCs

For patients with clinical stage I–II non-small cell lung cancer (NSCLC), surgical resection with or without adjuvant chemotherapy is the gold standard of treatment. Currently, pulmonary resection for lung cancer is often performed by so-called “minimally invasive techniques”—in particular, video-assisted thoracoscopic surgery (VATS). The annual report of the Japanese Association for Thoracic Surgery reports lung cancer surgeries in Japan are increasingly performed using VATS technology; VATS now accounts for more than 50% of lung cancer surgeries (59.6% in 2010) [5]. Note, however, that VATS is a collective designation of surgeries that use the thoracoscope. Many different types of VATS are being performed, e.g., complete VATS versus so-called hybrid VATS in which the operator directly views his or her work through a small thoracotomy, VATS with different numbers of thoraco-ports (usually 3–5), and VATS with differences in the length of the main incision. The National Clinical