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SEGMENTECTOMY FOR LUNG NODULES: OUR EXPERIENCE AT AN ONCOLOGY CENTER IN SOUTH INDIA

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Abstract

Background: Lung segmentectomy is a sublobar resection technique increasingly considered for select lung nodules, including primary lung cancer. However, data on segmentectomy in the Indian population remain sparse. This study presents our experience with segmentectomy at a cancer center in South India.

Methods: We conducted a retrospective analysis of patients who underwent segmentectomy for lung nodules between January 2021 and August 2024. Patients undergoing multi-organ resection or with poor pulmonary reserves were excluded. Data on surgical approach (open vs. VATS), intraoperative parameters, postoperative outcomes, histopathology, and oncological follow-up were analyzed.

Results: A total of 24 segmentectomies were performed, with a median patient age of 52 years and a median nodule size of 2 cm. VATS was used in 9 cases, with 3 conversions to open surgery. The median surgical duration was 140 minutes, with a mean blood loss of 100 mL. The median intercostal drainage duration was 3 days. Postoperative complications included hemoptysis (11 cases, managed conservatively) and air leaks (3 cases, managed with suction devices). No Clavien-Dindo grade 3 or 4 complications were observed. Histological evaluation revealed a range of pathologies, including adenocarcinoma, neuroendocrine tumors, and metastatic lesions. On follow-up, three patients with malignant disease developed distant metastases.

Conclusion: Segmentectomy is a safe and effective option for lung nodules of varied etiology, with minimal morbidity and acceptable short-term oncological outcomes. This study highlights the feasibility of segmentectomy in the Indian population and underscores the need for further research into segmental lung anatomy and surgical training.

Keywords: Lung segmentectomy, sublobar resection, lung nodules, thoracic surgery, VATS, oncology, India, postoperative outcome

Introduction

Lung segmentectomy is a form of sublobar resection performed for lung nodules. Following the publication of JCOG0802(1) and CALGB 140503(2), the indications for segmentectomy have expanded even for primary lung cancer in clinically fit patients. Compared to lobectomy, segmentectomy is a more complex procedure as it requires a detailed understanding of the segmental anatomy of the arteries, veins, and bronchi. In contrast, the lobar anatomy of the lung is relatively simpler.(3)

There is a limited number of studies on segmentectomy for lung nodules in the Indian population. This study presents our experience with segmentectomy for lung nodules at a cancer center in South India.

Materials and Methods

We included all patients who underwent segmentectomy for lung nodules between January 2021 and August 2024 at a cancer center in South India. Patients who underwent segmentectomy as part of a multi-organ resection, those with poor pulmonary reserves, and those who underwent wedge resections were excluded.

Data were collected from a prospectively maintained database of lung resections at the cancer center, managed by thoracic surgical oncologists. After multidisciplinary discussions, patients were evaluated based on nutritional status, functional capacity (effort tolerance), pulmonary function, and cardiac assessment. A thorough examination, including pulmonary function tests and a six-minute walk test, was performed. Patients underwent extensive prehabilitation, including chest physiotherapy, nutritional support, and smoking cessation.

Thoracic surgical oncologists reviewed CT scans to map the lung nodules and segmental anatomy, determining the type of segmentectomy, surgical margins, and approach—either open thoracotomy or video-assisted thoracoscopic surgery (VATS)—based on patient preference and logistical considerations.

Patients were intubated with a double-lumen tube or bronchial blocker, as preferred by the anesthesiologist. For open procedures, a lateral position was used, and a posterolateral muscle-sparing thoracotomy was performed. For VATS, a two-port technique was employed: a camera port in the 7th intercostal space and an access incision in the 4th intercostal space for upper lobe segmentectomy or the 5th intercostal space for lower lobe segmentectomy.

The lesion was localized by inspection, and segmental vessels and bronchi were identified and either ligated or stapled. Segmental anatomy was confirmed using inflation of the remaining lung or a modified inflation-deflation technique. Parenchymal division was performed using staplers.

Postoperatively, patients were extubated based on anesthesiologist preference and observed in the intensive care unit (ICU) for one day before being transferred to the ward. Intercostal drainage (ICD) tubes were removed based on output and lung expansion. Patients were discharged after ICD tube removal.

Histopathological analysis was performed to assess tumor histology and margin status. Patients were followed up every three months with necessary imaging. All data were recorded in an SPSS data sheet and analyzed using appropriate statistical tests.

Results

During the study period, 172 lobectomies, 20 pneumonectomies, and 24 segmentectomies were performed. The median age of patients was 52 years (range: 16-72 years), with 14 females and 8 males. The median preoperative forced expiratory volume in 1 second (FEV1) was 66%. The median size of the lung nodules was 2 cm (range: 0.9-3.5 cm).

Among the 24 segmentectomies performed:

- 8 right upper lobe segmentectomies (S1-5: 5 cases, S2: 2 cases, S3: 1 case)
- 7 left upper lobe segmentectomies (S1+2+3: 3 cases, S1+2: 1 case, Lingular: 3 cases)
- 6 right lower lobe segmentectomies (S6: 2 cases, S6+9+10: 2 cases, Basilar: 2 cases)
- 3 left lower lobe segmentectomies (S6: 2 cases, Basilar: 2 cases, Subsuperior: 1 case)

VATS resection was performed in 9 cases, with conversion to open surgery in 3 cases. Twelve patients underwent open resections. The median duration of surgery was 140 minutes, with a mean blood loss of 100 mL. Seventeen patients were extubated on the day of surgery, and 7 were extubated the following morning.

Postoperatively, the median duration for ICD removal was 3 days (range: 2-7 days). Eleven patients experienced postoperative hemoptysis, managed conservatively with tranexamic acid nebulization.

No blood transfusions were required. Two patients experienced thoracic air space emptying, particularly after upper lobe apical segmentectomy. Three patients developed air leaks, managed with negative suction devices. No patients experienced Clavien-Dindo grade 3 or 4 complications.

Histopathological findings included:
- Adenocarcinoma (4 cases)
- Inflammatory myofibroblastic tumor (3 cases)
- Neuroendocrine tumor (2 cases)
- Gestational trophoblastic neoplasia (2 cases)
- Vaginal cancer metastasis (1 case)
- Inflammatory metastatic tumors (5 cases)
- Colorectal metastatic tumors (2 cases)
- Bone and soft tissue sarcoma metastases (2 cases)
- Fungal ball (1 case)
- Hydatid cyst (1 case)

For malignant tumors, all margins were negative except for one patient with a positive staple line. During follow-up, one patient with primary lung cancer developed bony metastases after two years. One patient with vaginal carcinoma metastasis (with a positive staple line) developed mediastinal nodal metastasis after three months. Another patient with bone sarcoma metastasis developed contralateral lung metastasis after six months.

Discussion

Segmentectomy offers a parenchyma-preserving approach compared to lobectomy for lung nodules, with encouraging postoperative outcomes.(4)

Lung segmentectomy remains underreported in India compared to Western and Eastern countries, largely due to the lack of lung cancer screening programs and limited surgical training opportunities.(5) The technical complexity of segmentectomy, requiring intricate anatomical knowledge, further adds to these challenges.

Our study highlights the early phase of thoracic surgical oncology development at our cancer center, where we currently operate on approximately 60-70 lung tumors annually, with a segmentectomy-to-lobectomy ratio of about 7:1. However, given the increasing number of medical colleges in India, the field of thoracic surgical oncology is expected to expand rapidly.(6)

Additionally, as thoracic imaging is a routine part of metastatic workups in oncology, incidental lung nodules requiring histological evaluation are frequently encountered. Segmentectomy provides a minimally invasive approach for both diagnostic and therapeutic purposes.

VATS conversion to open surgery occurred in three cases: one due to bleeding and two due to logistical issues with endostaplers. The high cost of endostaplers, requiring 6-10 cartridges per procedure, poses a financial challenge for economically disadvantaged patients. In cases where additional staplers were unaffordable, the procedure was converted to an open approach.

In our study, linear or endostaplers were used for parenchymal division, reducing air leaks compared to Eastern literature, where some centers use electrocautery for this step.(7) Airspace issues were observed in two patients. Following these complications, we routinely release the inferior pulmonary ligament to prevent similar occurrences in future cases.

Post operative pulmonary function outcomes have to studied on long term follow up which will be published in future

Conclusion

Segmentectomy is a safe and effective option for lung nodules of varied etiology. It can be performed using either a traditional open or VATS approach with minimal morbidity and acceptable short-term oncological outcomes. Further studies are needed to explore segmental lung anatomy in the Indian population.

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