



Case Report

Surgical Treatment of Pulmonary Lesions in a Single Lung

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ABSTRACT

We performed surgery on 4 patients who had previously undergone left pneumonectomy and presented a second pulmonary lesion (3 lung cancers; 1 metastasis from colon cancer). Patients were aged between 52 and 79 years; 3 were men. Wedge resection was performed in 3 patients and segmentectomy in the other. Preoperative forced expiratory volumes in the first second were 1940 mL (72%), 576 mL (29%), 1390 mL (63%), and 2370 mL (63%). There was no perioperative mortality; 1 patient presented an air leak for 7 days. Two patients were alive and disease-free at 12 and 15 months, and 2 died from causes unrelated to the tumor at 52 and 183 months. There was no deterioration in the quality of life. In selected cases, patients with a second tumor in a single lung can be treated surgically with little or no mortality and with a prolonged survival.

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Tratamiento quirúrgico de lesiones pulmonares en pulmón único

RESUMEN

Hemos intervenido a 4 pacientes con neumonectomía izquierda previa y una segunda lesión pulmonar tumoral (3 carcinomas de pulmón y una metástasis de carcinoma de colon). Las edades estaban comprendidas entre 52 y 79 años, y 3 de ellos eran varones. Se realizó resección en cuña en 3 casos y segmentectomía en el restante. El volumen espiratorio forzado en el primer segundo antes de la intervención quirúrgica era de 1.940 ml (72%), 576 ml (29%), 1.390 (63%) ml y 2.370 ml (63%), respectivamente. No hubo mortalidad perioperatoria; una paciente presentó fuga aérea durante 7 días. Dos pacientes estaban vivos y sin enfermedad a los 12 y 15 meses, y 2 fallecieron por causas no tumorales a los 52 y 183 meses. No hubo disminución de la calidad de vida. En casos seleccionados se puede intervenir a pacientes con un segundo tumor en un pulmón único, con escasa o nula mortalidad, y obtener supervivencias prolongadas.

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Palabras clave:

Cirugía en pulmón único

Cirugía en cáncer de pulmón

Cirugía en metástasis pulmonares

Introduction

Lung resection in patients who have previously undergone pneumonectomy is rarely reported in the medical literature, and patients with a single lung and a potentially resectable condition in

the remaining parenchyma do not usually survive to surgery. However, in the few series that have been published, reported outcomes for patients have been better than expected, although only in the case of minor resections. Refusing to offer a patient with malignant tumor disease the option of resection means denying them the only curative treatment available. We describe 4 patients with a single lung who underwent pulmonary resection and analyze the resulting morbidity, mortality, and survival. We also provide the results of a manual and MEDLINE literature review performed to compare our results with those published to date.

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Table 1 Clinical, Follow-up, and Postoperative Characteristics in Our Series

Patient	Time Since Pneumonectomy, mo	Histology and Stage of First Tumor	Age, y	FEV ₁ , mL FVC, mL	Comorbidity	PO Stay, d	Follow-up, mo	Karnofsky Performance Status After Resection, %	Current Status
1	80	Squamous cell carcinoma T2N0M0	67	1940 (72%) 2730 (89%)	Chronic atrial fibrillation	8	183	70	Dead (cause, pneumonia)
2	55	Large-cell carcinoma	59	576 (29%)	Severe COPD	10	52	40	Dead (cause, respiratory failure)
3	10	T4N1M0 Colon adenocarcinoma metastasis	79	1300 (55%) 1390 (63%) 1510 (51%)	Home oxygen therapy Obesity Hypertension Intrathoracic goiter Chronic atrial fibrillation	5	15	70	Alive, disease free
4	12	Bronchoalveolar adenocarcinoma T2N0	52	2370 (63%) 2910 (62%)	No	7	12	80	Alive, disease free

Abbreviations: COPD, chronic obstructive pulmonary disease; PO, postoperative.

Case Descriptions

Between June 1992 and January 2007, we excised malignant tumors in 4 patients (3 men and 1 woman) aged between 52 and 79 years with a history of pneumonectomy. The pneumonectomy had been performed for primary lung carcinomas in 3 patients and metastasis of colon adenocarcinoma in 1 patient. The left lung had been removed in all 4 cases, and the time between the pneumonectomy and the lung resection ranged from 10 to 84 months. All patients underwent a preoperative assessment consisting of chest and abdominal computed tomography (CT), fiberoptic bronchoscopy, lung function tests, electrocardiography, plain posteroanterior and lateral chest radiography, complete blood count, erythrocyte biochemistry, and coagulation tests. A cranial CT scan, bone scintigraphy, and abdominal ultrasound were also performed in the oldest case (patient 1); the other 3 patients underwent positron-emission tomography-CT. Fine-needle aspiration was ruled out because of the risk of pneumothorax in a single lung. The suspected diagnosis was confirmed by the imaging tests. The decision to offer lung resection was made in a multidisciplinary clinical session held by the medical oncology and radiotherapeutic, pulmonology, radiology, and thoracic surgery departments, in which other therapeutic options were also considered. All patients were informed of the diagnostic options, surgical risks, and therapeutic alternatives, and all understood and consciously and voluntarily consented. All malignancies were peripheral tumors smaller than 3 cm, and the preoperative studies (CT scan, positron-emission tomography-CT scan) showed a single tumor site, with no mediastinal or extrathoracic lymph node involvement. The tumors were resected by VI segmentectomy in 1 patient and by wedge resection (with a stapler) in the other 3, with macroscopically tumor-free margins of 1 to 1.5 cm. Hilar and mediastinal lymphadenectomy was not performed, and no lymph node samples were taken. Pathology of the resected tissue showed a cell type similar to that of the previously resected tumor in all 4 cases. An epidural catheter was used for pain management before the thoracotomy, and the insertion site was chosen according to the tumor site, which was posterolateral (in 2 patients), axillary, and anterior. The anesthesiologist maintained periods of apnea during pulmonary suturing and extubated the patients in the operating theater, once the operation was completed. All patients spent the immediate postoperative period in the cardiothoracic recovery unit, and then remained on the ward until hospital discharge. Outpatient follow-up was handled by the oncology and thoracic surgery departments over a period of 12 to 183 months and consisted of questioning by the physician, measurement of tumor markers, lateral and posteroanterior chest radiographs, and chest and abdominal CT scans. The patients who died completed all scheduled checkups until the time of death.

There were no operative or postoperative deaths, and the patients' stay in the cardiothoracic recovery unit ranged from 3 to 5 days. One patient presented an air leak for 7 days and required a chest tube for 9 days. There was no other associated morbidity, and patients were discharged after 5 to 10 days (mean stay, 7.5 days). At the time of writing, 2 patients were alive and disease free 12 and 15 months after the surgery, respectively. One patient remained disease free for 52 months, although with considerable functional limitation. She had previously had severe chronic obstructive pulmonary disease and was receiving home oxygen therapy. She died from further deterioration of respiratory function. The first patient who underwent surgery died of pneumonia after 183 months of disease-free survival. Table 1 contains a summary of the data.

Discussion

Pulmonary resection in a patient who has undergone pneumonectomy is rare and, therefore, experience is very limited.

Table 2
Mortality and Survival After Single-Lung Tumor Resection. Review of the Medical Literature Since 1961

Authors	Year	No. of Patients	30-Day Postoperative Mortality, No. of Patients	Survival Time Excluding Postoperative Mortality, mo
Hughes and Blades ¹²	1961	1	0	7
Shields et al ¹¹	1964	1	0	29
Neptune et al ¹⁵	1966	1	0	27
Struve-Christensen ¹⁴	1971	2	1	61
Martini and Melamed ⁷	1975	3	2	61
Salerno et al ⁵	1979	3	0	8-67
Kittle et al ⁸	1985	15	1	2-73
Barker et al ¹⁶	1990	1	0	23
Levasseur et al ^{9,a}	1992	7*	2	6-29
Wex ¹³	1992	2	0	30-38
Westermann et al ¹⁰	1993	8	1	3-40
Massard et al ⁶	1995	4	0	5-67
Spaggiari et al ³	1996	13	0	4-36
Grunenwald et al ^{18,b}	1997	5**	1	12-36
Doddoli et al ¹⁷	2001	2	0	Not reported
Spaggiari et al ⁴	2003	6	0	Estimated probability of 53% at 3 years
Donintong et al ²	2002	24	2	6-140
Terzi et al ¹	2004	14	0	7-142
Our series	2008	4	0	12-183
Total		112	10	2-183

*Series of 9 patients, 2 of whom had not undergone prior pneumectomy.

**Series of 5 patients who underwent single-lung resection due to metastasis.

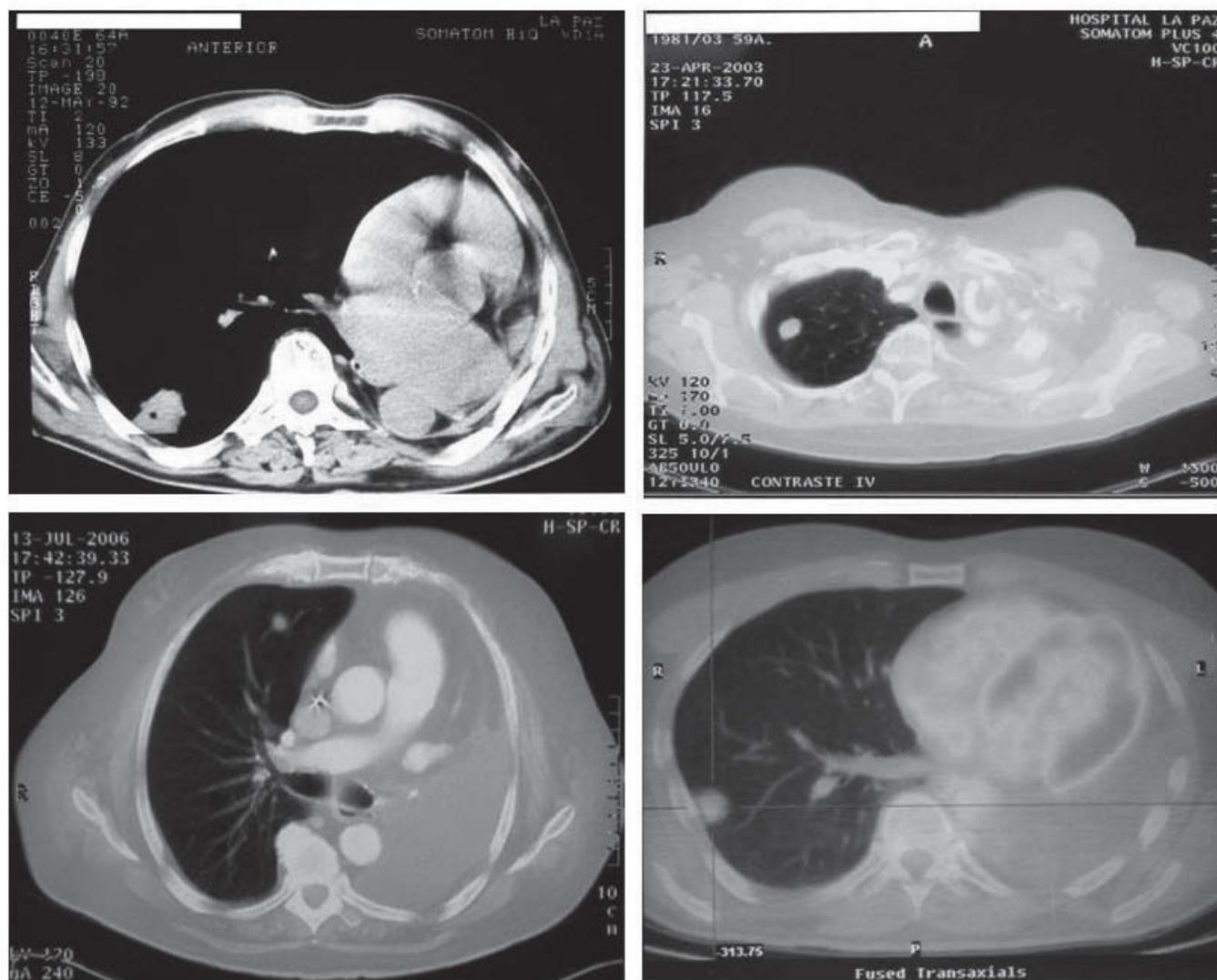


Figure 1. Patients 1 (May 12, 1992), 2 (April 23, 2003), 3 (July 13, 2006), and 4 (December 22, 2006) with peripheral lesions in a single lung.



Figure 2. Emergency department radiograph for patient 1 (September 12, 2007). Pneumonic infiltrate in the right upper lobe is observed. The patient died 1 month later.

Recently, Terzi et al¹ presented 14 cases and Donington et al² described 24 and found in their literature review fewer than 100 cases reported in the past 35 years. Mortality differs according to the various series published (Table 2). In a review of 60 patients, Spaggiari et al³ found a mortality of 0% in 3 series involving 20 cases,³⁻⁶ and an average of 7 deaths for every 40 patients (17.5%) for the other series.⁷⁻¹⁶ In our review¹⁻¹⁸ of 112 cases, 10 patients died in the 30-day postoperative period, corresponding to an overall mortality of 8.9%. An analysis according to type of resection showed that morbidity and mortality are closely related to the extent of resection. In the series published by Terzi et al,¹ no deaths occurred in the 11 patients who underwent 1 wedge resection. Donington et al² reported no deaths in patients who underwent solitary wedge excision and 2 deaths in those who underwent more extensive resections. The authors also reported a significant difference between these 2 subgroups in terms of complications (28.6% vs 70%, respectively). Spaggiari et al^{3,4} (no mortality) performed simple wedge resection or segmentectomy in 17 of 19 patients. In a series of 15 patients reported by Kittle et al,⁸ the only patient who died had undergone triple wedge resection.

Lesion size and location will determine whether the resection is technically possible, and wedge resection clearly provides the best risk-to-benefit ratio. We therefore believe that the tumor should be peripherally located and be smaller than 3 cm. Our 4 patients fulfilled these criteria (Figure 1) and we were able to resect the tumor as planned. We believe that the good morbidity and mortality results are directly related to tumor size and location. The criteria used to select candidates for this type of resection should be those applied in any other case. As we have already pointed out in a previous paper,¹⁹ the spirometry cut-off points for selection of patients who are to undergo pulmonary resection are constantly being revised. While various values and algorithms have been proposed in an attempt to predict the possibility of postoperative complications, after decades of research, the functional cut-off values for resection have still not been clearly established. A predicted postoperative value below 800 to 1000 mL forced expiratory volume in 1 second, or 35% to 40% of the theoretical value, has traditionally been considered the threshold to contraindicate resection, although resections have occasionally been carried out in patients with figures below the limit, with little or no morbidity or mortality.²⁰ In patient 3 of this series, respiratory function values would theoretically have precluded any surgical procedure, but the patient refused any other therapeutic action and

expressly and voluntarily stated that he assumed the high risk associated with the operation.

Regarding 3-year and 5-year survival, Terzi et al¹ reported 46% and 30%, whereas Donington et al² described 61% and 40%, respectively. Spaggiari et al³ estimated a 46% probability of survival at 3 years and undertook a review of the medical literature from 1961, in which they found 47 cases with a calculated median survival of 15.5 months for lung carcinoma (range, 0-73 months). In our review of the literature, which included a series of patients who underwent resection due to metastasis¹⁸ (a potential source of bias), we found 14 series that reported survival times of over 24 months (Table 2). Our patients remained disease free for a long period: survival was very good in 2 patients and the other 2 patients were still alive at the time of writing, 12 and 15 months after the operation. Patient 1 achieved the longest survival reported to date (Figure 2); this case was first described 12 years ago.²¹ However, the patient's recent death has led us to update our experience.

Another important aspect to consider is residual quality of life after resection. Three of our patients had a virtually normal life (with the usual restrictions regarding effort) and 1 patient experienced no significant worsening in her baseline situation, which was already deteriorated (Table 1).

The results of our small series are consistent with the conclusions obtained in the aforementioned studies. In sporadic cases involving wedge resection, excision of a second tumor in patients with a history of pneumonectomy can lead to little or no mortality and offer long-term survival benefits not otherwise possible. Hence, this therapeutic option should be offered more often to eligible patients.

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