

## Pneumonectomy With Extracorporeal Circulation to Treat Pulmonary Metastasis

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**Surgical resection of pulmonary metastasis is appropriate provided the general principals of oncological surgery are followed. Complete excision of the metastatic tumor is associated with long-term survival and low perioperative mortality.**

We present 2 cases of single pulmonary metastasis from osteosarcoma with cardiac involvement. In both cases, complete excision required left pneumonectomy by sternotomy with extracorporeal circulation. The outcomes were favorable, no perioperative complications were reported, and the patients remained free of disease at 14 and 17 months after surgery.

In conclusion, we believe that the cases presented confirm that extended pneumonectomy with extracorporeal circulation if necessary is a valid approach for complete resection of pulmonary metastasis.

**Pneumonectomía por metástasis pulmonar con utilización de circulación extracorpórea**

La resección quirúrgica de las metástasis pulmonares es un tratamiento aceptado si se mantienen los principios generales de la cirugía oncológica, y la exéresis completa de las metástasis se asocia a una supervivencia a largo plazo y una mortalidad perioperatoria baja.

Presentamos 2 casos de metástasis pulmonar única de osteosarcoma con infiltración cardíaca, que requirió para su exéresis completa neumonectomía izquierda por esternotomía, con utilización de circulación extracorpórea. El resultado fue favorable, sin que hubiera complicaciones perioperatorias y los pacientes permanecen indemnes a los 14 y 17 meses de la intervención quirúrgica.

En conclusión, consideramos que en casos seleccionados la neumonectomía ampliada, con utilización de circulación extracorpórea si se precisa, para poder realizar la exéresis completa de metástasis pulmonares es un procedimiento válido.

**Key words:** Pulmonary metastasis. Chondrosarcoma. Pneumonectomy. Cardiopulmonary bypass.

**Palabras clave:** Metástasis pulmonar. Osteosarcoma. Neumonectomía. Derivación cardiopulmonar.

### Introduction

The indication for surgical resection of lung metastases has become progressively broader as clinical experience has increased. Resection is currently accepted when patients meet general selection criteria,<sup>1</sup> which include the following points. First, the primary tumor should be under control and if local relapse occurs, this relapse should be treated first. Metastasectomy should only be considered once the primary tumor has been completely resected. Second, complete resection of the metastasis should be possible and extrathoracic metastases should not be present, although subsequent resection of the lung metastasis is acceptable in the case of a single resectable extrathoracic

metastasis. Finally, the patient should have sufficient functional reserve to tolerate whatever lung resection is to be done.

In 1991, the International Registry of Lung Metastases was created to facilitate the sharing of information, given that the series published prior to the registry were very heterogeneous. This registry made use of a common database to ensure consistent data entry. In the publication of the outcomes and prognostic analysis of 5206 cases, 4 different prognosis groups were defined using 3 variables of prognostic significance, namely, resectability, disease-free period, and number of metastases (Table).<sup>2</sup>

However, in clinical practice, certain cases bring into question the current indication for surgery. In particular, doubts are generally related to balancing the extent of the resection required to remove all cancerous tissue according to the pathology examination while ensuring an acceptable surgical risk and a good postoperative quality of life.

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**Prognostic Groups According to  
the International Registry of Lung Metastasis**

Group 1	Patients with resectable tumors and no definite risk factors (disease-free period $\geq 36$ months, single metastasis)	Mean survival of 61 months
Group 2	Patients with resectable tumors and one risk factor (disease-free period $< 36$ months or multiple metastases)	Mean survival of 34 months
Group 3	Patients with resectable tumors and 2 risk factors (disease-free period $< 36$ months and multiple metastases)	Mean survival of 24 months
Group 4	Patients with unresectable metastasis	Mean survival of 14 months

We report 2 cases of a single lung metastasis from a primary osteosarcoma. These metastases extended directly into the left atrium and pericardium. In both cases, control of the primary tumor had been achieved and no extrathoracic metastases were present. Left pneumonectomy with cardiopulmonary bypass was needed for partial resection of the left atrium and the pericardium. No postoperative morbidity was reported and both patients survived the procedure. The patients were alive and well after 14 months and 17 months, respectively.

### Case Description

#### Case 1

A 40-year-old man was diagnosed with osteosarcoma in the right femur. He had undergone surgery and chemotherapy in 1998. Four years after surgery to remove the primary tumor, he sought medical attention for an unproductive cough that had started 8 months previously. After a computed tomography scan of the thorax, he was diagnosed with a tumor in the left hemithorax that had well defined edges and contained macroscopic calcifications measuring 136 mm  $\times$  90 mm  $\times$  154 mm. The tumor occupied the space from the vertex to the middle lobe, occluding the left main bronchus and spreading via the pulmonary veins to the atrium (Figure 1). The finding of atrial involvement prompted a transthoracic echocardiographic examination, which showed an enlarged left atrium (diameter, 43 mm) and a pedunculated mass (53 mm  $\times$  40 mm) spreading from the pulmonary vein to occupy 80% of the atrium. The patient had posterior pericardial thickening and mild tricuspid regurgitation without pulmonary hypertension; the remaining flows were normal.

The final examination was fiberoptic bronchoscopy, which revealed a tumor mass emerging from the smooth surface of the left main bronchus, at more than 2 cm from the carina. From the biopsies taken, the histological diagnosis was metastasis of sarcoma. Bone scintigraphy revealed no signs of distant bone metastasis.

Given that multiple metastases were not present, the primary tumor was under control, and the patient had been free of disease

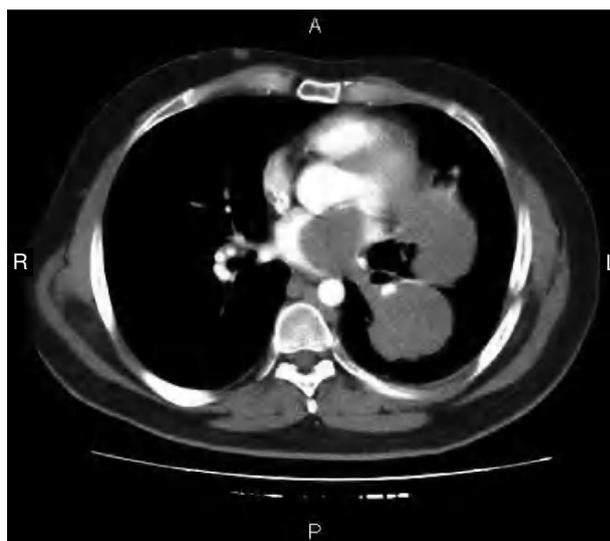


Figure 1. Computed tomography slice showing an atrial tumor that had extended from the left pulmonary veins.

for 4 years, surgical resection was indicated. Medial sternotomy was performed and a cardiopulmonary bypass was set up. The aorta was cannulated and a venous catheter was introduced into the right atrium after a circular cut was made in the left atrium around the left pulmonary veins. After extraction of the pedunculated mass from the atrial chamber, the pericardial flap was removed and the lung tissue resected. The pericardium was then reconstructed with a bovine pericardial patch. The cardiopulmonary bypass lasted 100 minutes and ischemia lasted 30 minutes.

The pathology report indicated high-grade undifferentiated sarcoma metastasis, measuring 150 mm  $\times$  120 mm  $\times$  110 mm, with large necrotic areas. The resection margins were free of disease and no lymph node involvement was reported.

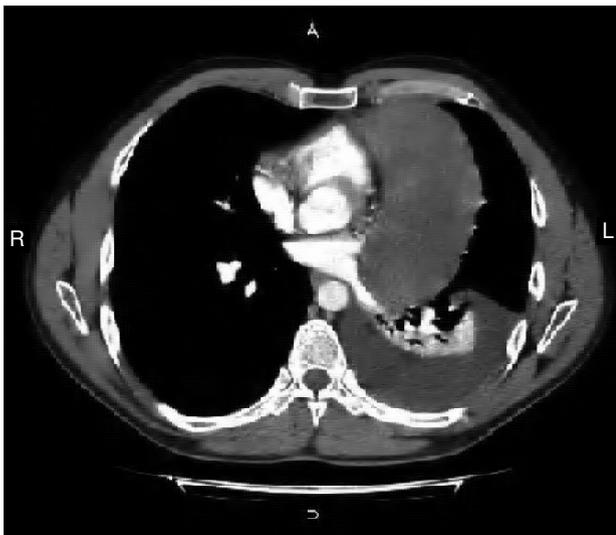
The patient progressed favorably after the operation, and remained in hospital for a further 7 days. Treatment was completed with adjuvant chemotherapy, and the patient was alive and well 17 months after surgery.

#### Case 2

A 28-year-old man was diagnosed with high-grade sarcoma measuring 6.6 cm  $\times$  5.5 cm in the soft tissue of the anterior and posterior compartments of the elbow, and in the anterior brachialis muscle. The tumor extended to the supinator muscle. He underwent surgery followed by adjuvant radiotherapy and chemotherapy.

After 12 disease-free months, a computed tomography scan revealed a large pulmonary mass measuring 154.2 mm in diameter, with invasion of the mediastinal pleura. The mass was in extensive contact with the chest wall (from the third to the sixth anterior costal arch), and extended to the inferior pulmonary vein with extensive pericardial involvement and areas of contact with the myocardium. Myocardial involvement could not be ruled out (Figure 2). Doppler echocardiography to assess cardiac involvement revealed that the mass had invaded the pericardium and was in extensive contact with the myocardium. Fiberoptic bronchoscopy demonstrated extrinsic compression of the left main bronchus, with no evidence of endobronchial spread. Metastatic bone disease was ruled out with scintigraphy of the axial skeleton.

Surgical resection was indicated. Medial sternotomy was chosen because of the extensive mediastinal involvement. The



**Figure 2.** Computed tomography slice showing a tumor in contact with the anterior chest wall, extensive pericardial infiltration, and compression of the pulmonary veins where they enter the atrium.

midline pericardiotomy was carried out in front of the region of tumor infiltration.

With the patient on cardiopulmonary bypass support, the atrium was sutured with a tumor-free margin. The posterior pericardium was sectioned as far as the carina; finally the lung was removed. The cardiopulmonary bypass lasted 73 minutes.

The pathology report stated that the metastasis was of poorly differentiated sarcoma, with parietal pleural infiltration and disease-free resection margins.

No complications occurred during the immediate postoperative period and the patient remains free of disease 14 months after surgery.

## Discussion

Koong et al<sup>3</sup> extensively analyzed pneumonectomies included in the International Registry of Lung Metastases. They concluded that pneumonectomy for lung metastasis, although uncommon, is associated with an acceptably low mortality and an acceptable long-term survival in the case of selected patients in whom complete resection is possible.

Most of the patients diagnosed with lung metastasis with infiltration of extrapulmonary structures due to direct extension are not considered candidates for surgery. Surgical excision is possible in selected cases in which resectable structures are affected and these structures can be removed leaving a sufficient tumor-free margin, and provided no distant extrapulmonary metastases or lymph node involvement are detected. Surgery might be of

questionable value, however, given that we could find few case reports in the literature<sup>4,5</sup> and no findings from studies with homogeneous groups of patients.

A number of investigators such as Shirakusa and Kimura,<sup>6</sup> Klepetko et al,<sup>7</sup> and Ferguson and Reardon<sup>8</sup> resorted to extracorporeal circulation with full cardiopulmonary bypass to resect lung tumors that had invaded the atrium or the aorta. These authors reported that their patients remained free of disease in the long term, that the morbidity and mortality were acceptably low, and that extracorporeal circulation was not associated with a risk of systemic dissemination of the cancer. Therefore there is no evidence to suggest that extracorporeal circulation should not be used.

In the 2 cases we present here, pneumonectomy was carried out by sternotomy, without any evidence of greater postoperative hemorrhage than normal 24 hours after the procedure when the pleural drain was withdrawn. Complete tumor resection and systematic dissection of the mediastinal lymph nodes were achieved.<sup>9</sup> According to the pathology report, the margins were free of tumor and the lymph nodes were not involved. Surgical complications and postoperative morbidity were not reported, and the patients were free of disease 14 months and 17 months after resection.

We therefore consider that cardiopulmonary bypass during extended pneumonectomy for lung metastasis is a valid procedure in certain patients.

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