

Management of Sarcoma Metastases to the Lung



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KEYWORDS

- Sarcoma • Pulmonary metastasectomy • Thoracic surgery • Prognostic factors
- VATS • SBRT

KEY POINTS

- Sarcoma is a rare, heterogeneous disease with a common propensity to metastasize to the lungs.
- With careful patient selection, pulmonary metastasectomy improves survival when compared with historical controls.
- Many favorable prognostic factors have been identified, including long disease-free interval and complete (R0) resection.
- Video-assisted thoracoscopic surgery is increasingly used in highly select patients with favorable prognostic characteristics.
- Extensive resection for large or recurrent metastatic sarcomas can be safely performed in some patients.

INTRODUCTION

Sarcoma comprises a heterogeneous group of histologic subtypes with a propensity to metastasize to the lungs. Isolated pulmonary metastases occur in as many as 20% of patients diagnosed with soft tissue sarcoma and as many as 40% in those with a primary bone sarcoma.^{1,2} Although historically pulmonary metastasis represented advanced disease and the need for palliation, surgical resection for control of disease burden has become a mainstay of therapy and a potentially curative option for those with resectable pulmonary metastasis. The role for surgery continues to evolve with the introduction of adjunctive therapies, including radiofrequency ablation; advanced

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radiation therapy, such as stereotactic body radiation therapy (SBRT); and complex salvage operations. These advances have driven the need for complex multidisciplinary care, particularly with the inclusion of a thoracic surgeon.³ Resection of metastatic pulmonary sarcoma has been reported since the late 1800s; however, the first isolated resection of metastatic foci occurred in 1926 by Divis.⁴ Despite this, there have been no published randomized controlled trials comparing surgery with systemic therapy or radiation for metastatic sarcoma, though significant research, particularly with the formation of the International Registry of Lung Metastases (IRLM), indicates that pulmonary metastasectomy (PM), when it can be performed, is associated with improved outcomes.^{4,5}

Many of the original reports of PM for sarcoma were small case series pointing toward improved overall survival with resection in eligible patients when compared with historical controls. For example, one center noted a high incidence of patients with osteosarcoma developing lung metastases follow extremity amputation. A system for iterative complete surgical resection of pulmonary metastases in these patients was developed, with some patients requiring up to 9 thoracotomies. Five-year survival in this center's cohort significantly increased from 0% to 32%.^{4,6}

The IRLM was formed in the 1990s as a consortium of high-volume centers performing PM for a variety of malignancies, including sarcoma. In a long-term follow-up study from the IRLM, 5206 patients underwent metastasectomy with 42% having sarcoma as the primary tumor. Most patients underwent open thoracotomy or sternotomy and had an overall survival of 31% at 5 years and 26% at 10 years. Patients with sarcoma, however, were more likely to recur (64%) as opposed to those with epithelial (46%) or germ cell (26%) metastases. Favorable outcomes were reported in those with a longer disease-free interval (DFI), small number of nodules, and complete resection.⁵

Guidelines for physicians and surgeons in the treatment of metastatic pulmonary sarcoma have been proposed dating back to Ehrenhaft and colleagues⁷ in 1958; however, the lack of randomized controlled trials has limited their overall utility. Rusch and colleagues⁸ concluded that patients should meet the following criteria: control of the primary tumor; ability to resect metastatic disease completely; ability of patients to tolerate pulmonary resection; absence of extrathoracic metastases; and absence of better alternative systemic therapies. The indications for resection of metastatic sarcoma to the lung continue to evolve as more studies examine the use of minimally invasive surgery, the utility of aggressive resections, and alternate therapies, such as SBRT.

In this article, the authors review the prognostic factors associated with improved survival following pulmonary metastasectomy for sarcoma, preoperative evaluation, surgical techniques and management, long-term follow-up, and the complex management of large tumors and recurrent disease.

PROGNOSTIC FACTORS

Although the primary source of sarcoma may be highly variable and includes both indolent and aggressive subtypes, several characteristics have been identified to inform patients' prognosis and treatment plan. It is again important to note that these characteristics have largely been identified based on single-center, retrospective reviews that, although generally consistent, may be subject to bias from the pathologic heterogeneity of sarcomas, multiple adjuvant therapies involved, and careful case selection by surgeons.⁹ In addition, although the characteristics may be useful in guiding the surgeon as well as the rest of the multidisciplinary team, they do not preclude patients from undergoing PM, especially in those with limited disease. With this

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