# Pulmonary Metastasectomy

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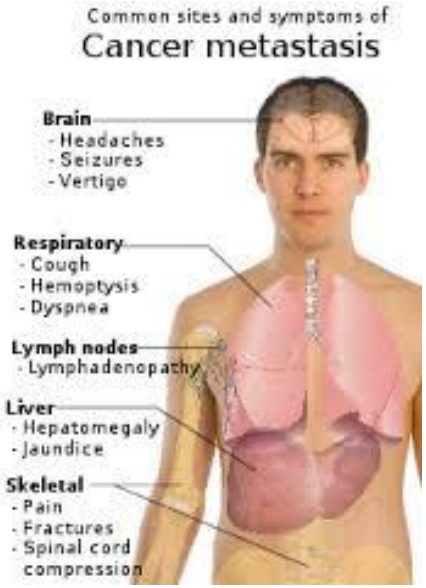
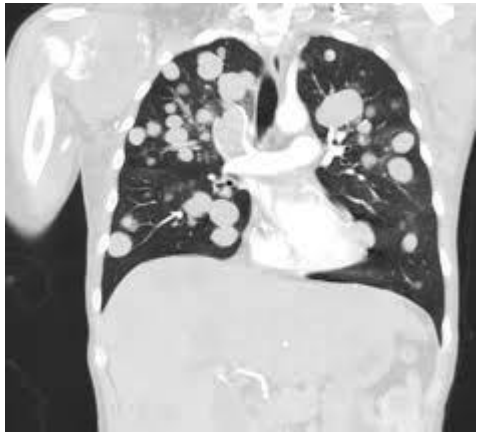

Common sites and symptoms of
Cancer metastasis
Brain
- Headaches
- Seizures
- Vertigo
Respiratory
- Cough
- Hemoptysis
- Dyspnea
Lymph nodes
- Lymphadenopathy
Liver
- Hepatomegaly
- Jaundice
Skeletal
- Pain
- Fractures
- Spinal cord compression



Metastatic disease : Principle reason for cancer death

Lung metastases : 25~30% of all patients with cancer at autopsy

1882, German surgeon

# Pulmonary metastases

**BOX 23-1 Primaries Most Commonly Metastatic to the Lung***

- Breast
- Colon
- Kidney
- Uterus
- Prostate
- Oropharyngeal carcinoma

*Most common because of greater prevalence.

**BOX 23-2 Tumors with the Highest Predilection for Pulmonary Metastasis**

- Choriocarcinoma
- Osteosarcoma
- Testicular tumors
- Melanoma
- Ewing sarcoma
- Kaposi sarcoma

# New pulmonary nodule

Primary lung cancer vs. metastasis

Original type of malignancy

| | Metastasis | Primary lung cancer |
|---|---|---|
| Sarcoma | 10 | 1 |
| Melanoma | 10 | 1 |
| Genitourinary cancer | 1 | 1 |
| Colorectal cancer | 1 | 1 |
| Head and neck cancer | 0.5 | 1 |

**Chest 1995; 107: 322S-332S**

First case: 1882, Weinlechner

## Criteria for metastasectomy

Primary tumor that has been definitely controlled.

Metastases limited to the lung that can be completely resected.

Ability of the patient to tolerate the planned operation.

Lack of a better alternative treatment.

The number of lung metastases.

The disease-free interval since treatment of the primary tumor.

The tumor doubling time, the presence of lymph node metastases.

The histology of the primary tumor.

Elevated serum markers such as carcinoembryonic antigen.

**J Thoracic Oncol 2010; 5: S130-1**

# GENERAL THORACIC SURGERY

## LONG-TERM RESULTS OF LUNG METASTASECTOMY: PROGNOSTIC ANALYSES BASED ON 5206 CASES

The International Registry of Lung Metastases*
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*Objectives:* **The International Registry of Lung Metastases was established in 1991 to assess the long-term results of pulmonary metastasectomy.** *Methods:* **The Registry has accrued 5206 cases of lung metastasectomy, from 18 departments of thoracic surgery in Europe ($n = 13$), the United States ($n = 4$) and Canada ($n = 1$). Of these patients, 4572 (88%) underwent complete surgical resection. The primary tumor was epithelial in 2260 cases, sarcoma in 2173, germ cell in 363, and melanoma in 328. The disease-free interval was 0 to 11 months in 2199 cases, 12 to 35 months in 1857, and more than 36 months in 1620. Single metastases accounted for 2383 cases and multiple lesions for 2726. Mean follow-up was 46 months. Analysis was performed by Kaplan-Meier estimates of survival, relative risks of death, and multivariate Cox model.** *Results:* **The actuarial survival after complete metastasectomy was 36%**

| | 5yr survival | 10yr survival |
|---|---|---|
| Complete metastasectomy | 36% | 26% |
| Imcomplere metastasectomy | 13% | 7% |

**simple system of classification valid for different tumor types. (J Thorac Cardiovasc Surg 1997;113:37-49)**

# European Society of Thoracic Surgeons (ESTS)

Lung metastasectomy project


1. Optimal preoperative imaging
2. The role of mediastinal lymph node dissection
3. Surgical approach
4. The extent of surgical resection

# Pathophysiology of Pulmonary Metastases

Initiated after cell detachment from the primary tumor mass

↓

Movement from the extracellular space into a vascular compartment (*intravasation*)

↓

Tumor cells bind to pulmonary vasculature

↓

Movement of tumor cells from the circulatory system into the interstitium (*extravasation*)

↓

Tumor cells proliferation and local invasion

# Symptoms and Presentation

Approximately 75% to 90% of patients are asymptomatic

(predominantly due to the usual peripheral location of pulmonary metastases)

↓

Discovered incidentally on follow-up radiologic examinations

↓

Symptoms typically occur with endobronchial or pleural involvement, large bulky disease, or central venous obstruction (cough, hemoptysis, dyspnea, wheezing etc.)

# Radiologic Image

# Imaging Requirements in the Practice of Pulmonary Metastasectomy

*Frank C. Detterbeck, MD,* Tomasz Grodzki, MD,† Fergus Gleeson, MD,‡ and John H. Robert, MD§*

**Abstract:** The primary imaging modality for the detection of pulmonary metastases is computed tomography (CT). Ideally, a helical CT scan with 3- to 5-mm reconstruction thickness or a volumetric thin section scanning should be performed within 4 weeks of pulmonary metastasectomy. A period of observation to see whether further metastases develop does not seem to allow better patient selection. If positron emission tomography is available, it may identify the extrathoracic metastatic sites in 10 to 15% of patients. Despite helical CT scan, palpation identifies the metastases not detected by imaging in 20 to 25% of patients and remains the standard. No data define the optimal interval for follow-up surveillance imaging.

**Key Words:** Imaging, Pulmonary metastasectomy, Lung metastases, Pulmonary nodule.

(*J Thorac Oncol.* 2010;5: S134–S139)

- What type and protocol of chest computed tomography scan (CT) should be performed in patients suspected to have pulmonary metastases?
- How should the images be reviewed?
- Are all nodules detected significant?
- How recently should a CT scan be done before metastasectomy?
- Is an observation period with serial CT scanning before metastasectomy beneficial?
- Should a positron emission tomography (PET) scan be performed before metastasectomy to diagnose extrathoracic or intrathoracic metastases?
- Is helical CT imaging adequate to avoid palpation of the lung?
- What interval of follow-up CT scans is necessary?

Nonspecific radiographic appearance

Critical importance

Chest CT : standard imaging modality

3 ~ 5mm slice thickness

Within 4 weeks of pulmonary metastasectomy

PET (role out occult distant metastases)

Follow-up

- 4~6 weeks after surgery
- every 6 months for 2 years
- every 1 years for at least 5 years

# Tissue Diagnosis

Sputum cytology, which has been

replaced by bronchoscopy, is often nondiagnostic because of the peripheral location of most pulmonary metastases

Percutaneous fine-needle aspiration (FNA) is another option (low sensitivity, difficulty to obtain ample tissue)

VATS with excisional biopsy
(sensitivity and specificity approaching 100%,
therapeutic as well as diagnostic)

# Indication for Surgery

*Q. Does the pulmonary nodule represent one site of multiorgan spread, thereby contraindicating resection?*

↓

Most pulmonary nodules (75% to 85%) are a manifestation of widespread disease

↓

Only 15% to 25% of patients have lesions confined to the lung and are appropriate candidates for curative resection

↓

Thorough preoperative evaluation should exclude extrathoracic disease

*Q. Is a nonsurgical therapeutic option available?*

Nonsurgical management may be more appropriate for certain cancers

Chemotherapy for nonseminomatous germ cell tumors, with cure rates approaching 90%

*Q. Will the patient tolerate the procedure?*

Thorough medical assessment with particular attention to their pulmonary and cardiac status

↓

Stress testing, echocardiograms, arterial blood gases, pulmonary function testing, and ventilation-perfusion scans etc.

*Q. Are the lesions resectable?*

Preoperatively, imaging modalities can only provide an estimate of resectability

↓

Resectability is best determined at operation

↓

Direct metastases to the pleura or pericardium in a discontinuous manner and malignant pleural or pericardial effusions are generally contraindications for resection

*Q. Is the primary tumor controlled?*

Efficacy of pulmonary metastasectomy depends on the ability to control the primary site of disease

The primary neoplasm should generally be addressed before resection of the pulmonary metastases

## BOX 23-3 Selection Criteria* for Metastasectomy

- Local control of the primary tumor or ability to completely resect the primary with synchronous presentations[20]
- Radiologic findings consistent with metastatic disease
- Absence of extrathoracic metastases (i.e., metastasis is confined to the lung)
- Ability to perform a complete resection of the metastases
- No significant comorbidity that would preclude surgery
- No alternative therapy that is superior to surgery

*Approximately one third of patients with metastatic disease meet these criteria.

# Surgical Approach

1. Need for palpation

2. Thoracotomy vs VATS

Excellent visualization of the pleural surface
vs
Bimanually palpate the entire lung

3. Bilateral exploration vs unilateral exploration

4. Simultaneous vs staged approach
(in patients with bilateral metastases)

Table 1
Results of the ESTS survey regarding the surgical approach for pulmonary metastasectomy

| | No. of Patients | (%) |
|---|---|---|
| Which is your preferred approach for unilateral metastases | | |
| Anterolateral thoracotomy | 53 | (36.3) |
| Video-assisted thoracic surgery (VATS) | 42 | (28.8) |
| Posterior muscle sparing thoracotomy | 38 | (26) |
| Posterolateral thoracotomy | 33 | (22.6) |
| Horizontal axillary thoracotomy | 15 | (10.3) |
| Vertical axillary thoracotomy | 10 | (6.9) |
| Sternotomy | 2 | (1.4) |
| Other | 7 | (4.8) |
| Which is your preferred approach for bilateral metastases | | |
| Bilateral staged thoracotomy | 96 | (66.2) |
| Sternotomy (1-stage) | 39 | (26.9) |
| Bilateral sequential thoracotomy (1-stage) | 28 | (19.3) |
| Bilateral staged video-assisted thoracic surgery (VATS) | 18 | (12.4) |
| Bilateral video-assisted thoracic surgery (VATS) (1-stage) | 11 | (7.6) |
| Clamshell (1-stage) | 11 | (7.6) |
| Other | 3 | (2.1) |

**Thorac Surg Clin 22 (2012) 91-99**

# Comparison of pulmonary nodule detection rates between preoperative CT imaging and intraoperative lung palpation

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**KEYWORDS:**
Pulmonary metastasectomy;
Thoracoscopy;
CT imaging

**Abstract**

**BACKGROUND:** Recent advances in computed tomographic (CT) imaging have improved the detection rate of pulmonary metastasis. The aim of this study was to test the hypothesis that the pulmonary nodule detection rate for preoperative CT imaging and intraoperative palpation are now equivalent.

**METHODS:** A retrospective review of 108 pulmonary metastasectomies in 84 patients was performed. The number of nodules detected on preoperative CT imaging by radiologist report was compared with the number of malignant nodules identified on pathology. Secondary outcome measures were operative approach and primary malignancy.

**RESULTS:** Sarcoma metastases were the most common indication for resection (n = 54 [50%]). Thirty-three percent of metastasectomies were performed using a thoracoscopic approach. When thoracotomy was used, significantly more nodules were palpated and resected than were identified on preoperative CT imaging (3.24 vs 2.12, $P < .001$). Significantly more of these nodules were confirmed malignant on final pathology (2.40 vs 1.60, $P = .01$). This difference was not seen for thoracoscopic resections.

**CONCLUSIONS:** Although the sensitivity of CT imaging has improved, a significant number of malignant pulmonary nodules are detected intraoperatively that are not identified on preoperative imaging. Patients undergoing pulmonary metastasectomy require careful intraoperative palpation of lung parenchyma, and therefore open thoracotomy remains the standard of care.



**Am J Surg 2011; 201: 619-22**

# Role of Video-Assisted Thoracic Surgery in the Treatment of Pulmonary Metastases: Results of a Prospective Trial

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*Background.* A retrospective review revealed a 42% error rate between computed tomographic scan reports and thoracotomy findings; therefore, a prospective study was designed to compare the value of computed tomographic scans, video-assisted thoracoscopic exploration, and open thoracotomy in the management of pulmonary metastases.

*Methods.* Eligibility included any patient with only one or two ipsilateral pulmonary metastases identified on computed tomographic scan who was being considered for surgical resection. Initially video-assisted thoracic surgery was performed and all lesions identified were resected. A thoracotomy adequate for complete lung palpation was then carried out and any additional lesions found were removed.

*Results.* Eighteen patients of a planned 50 were treated before closure of the study. Four patients (22%) had no additional lesions found at thoracotomy. The primary sites of tumor were colon (10), breast (3), and one patient each skin (squamous), cervix, kidney, melanoma, and sarcoma. Four patients (22%) did have additional lesions at thoracotomy, which were benign. In the remaining 10 patients (56%) additional malignant lesions were found at thoracotomy after video-assisted thoracoscopic exploration. After 18 patients were entered, analysis of the early results disclosed a 56% failure rate of a computed tomographic scan and video-assisted thoracic surgery to detect all lesions. Being within the 95% confidence interval (32% to 78%), the study was abandoned.

*Conclusions.* We conclude that video-assisted thoracic surgery should be used only as a diagnostic tool in managing lung metastasis. A thoracotomy is required to achieve complete resection, which is the major survival prognosticator for satisfactory long-term results.

*(Ann Thorac Surg 1996;62:213–7)*

# What Are the Considerations in the Surgical Approach in Pulmonary Metastasectomy?

*Tamas F. Molnar,* Cengiz Gebitekin,† and Akif Turna‡*

1. Thoracotomy seems to be the preferred approach
   even with bilateral metastatic disease.

2. Sequential thoracotomy with an interval 3~6 weeks, interval CT.
   (Bilateral metastatic disease)

3. With regard to VATS, the evidence for its superiority is a matter of debate.

4. VATS seems appropriate for diagnostic procedures,
   but it is not the standard for therapeutic pulmonary metastasectomy.

5. No alternative to palpation currently exists.

**J Thorac Oncol 2010; 5: S140-4.**

# Lymph Node Status

TABLE 1. Incidence of Thoracic Lymph Nodes in Patients with Lung Metastases

| Publication | Era | Primary | Patients | Nodal Spread | Percent |
|---|---|---|---|---|---|
| Loehe et al.[2] | 1996–1998 | Mixed | 63 | 9 | 14 |
| Saito et al.[3] | 1990–2000 | Colorectal | 138 | 20 | 14 |
| Ercan et al.[4] | 1985–1999 | Mixed | 70 | 20 | 29 |
| Pfannschmidt[5] | 1996–2001 | Mixed | 245 | 80 | 33 |
| Welter et al.[6] | 1993–2003 | Colorectal | 169 | 28 | 17 |
| Menon et al.[9] | 2002–2005 | Mixed | 57 | 6 | 11 |
| Weighted average | | | | | 22 |

J Thorac Oncol 2010; 5: S166

# Prognostic Significance of Lymph Node Metastasis Found During Pulmonary Metastasectomy for Extrapulmonary Carcinoma

Sina Ercan, MD, Francis C. Nichols III, MD, Victor F. Trastek, MD, Claude Deschamps, MD, Mark S. Allen, MD, Daniel L. Miller, MD, Cathy D. Schleck, BS, and Peter C. Pairolero, MD

Divisions of General Thoracic Surgery and Biostatistics, Mayo Clinic and Mayo Foundation, Rochester, Minnesota, and Division of General Thoracic Surgery, Mayo Clinic, Scottsdale, Arizona

*Background.* The prognostic significance of lymph node metastasis in cancer patients is well documented. Pulmonary metastasectomy in selected patients is associated with improved survival. Little is known about the prognostic significance of lymph node metastases found during pulmonary metastasectomy for extrapulmonary carcinoma metastatic to the lung.

*Methods.* The records of all patients who underwent pulmonary metastasectomy and complete mediastinal lymph node dissection for extrapulmonary carcinomas at our institution from November 1985 through July 1999 were reviewed.

*Results.* Eight hundred eighty-three patients underwent pulmonary metastasectomy. Of these, 70 patients (7.9%) (44 men, 26 women) had concomitant complete lymphadenectomy. Median age was 64 years (range, 33 to 83 years). Median time interval between primary tumor resection and metastasectomy was 34 months (range, 0 to 188 months). Wedge excision was performed in 46 patients, lobectomy in 16, both in 7, and pneumonectomy in 1. Lymph node metastases were found in 20 patients (28.6%) and were classified as intrapulmonary or hilar (N1) in 9, mediastinal (N2) in 8, and both in 3. There were no operative deaths. Median follow-up was 6.6 years (range, 1.1 to 14.6 years). Three-year survival for patients with negative lymph nodes was 69% as compared with only 38% for those with positive lymph nodes ($p < 0.001$).

*Conclusions.* The presence of lymph node metastases at the time of pulmonary metastasectomy for extrapulmonary carcinoma has an adverse effect on prognosis. Complete mediastinal lymph node dissection should be considered at the time of pulmonary metastasectomy for carcinoma to improve staging and guide treatment.

(Ann Thorac Surg 2004;77:1786–91)


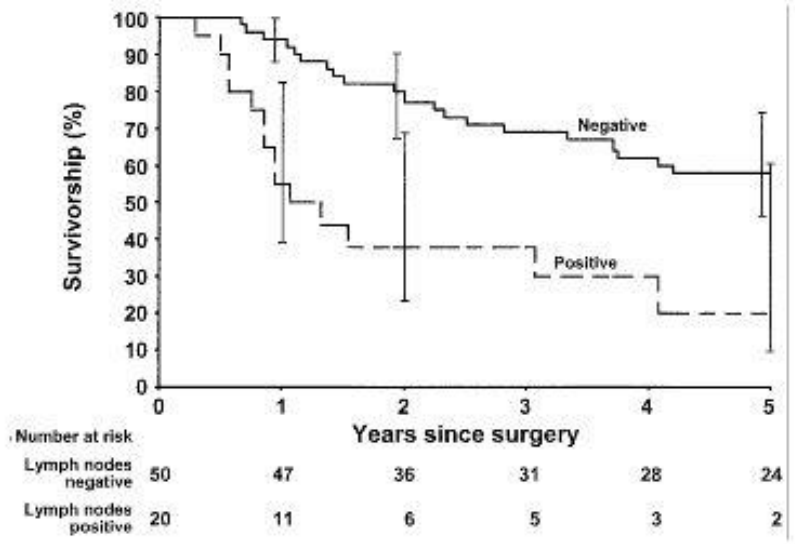


*Fig 2. Estimated survival of 70 patients undergoing pulmonary metastasectomy and complete mediastinal lymphadenectomy without metastatic nodal involvement (negative) and with nodal involvement (positive).* Zero time on the abscissa *is date of first pulmonary metastasectomy and lymph node dissection.* ($p < 0.001$).

**3-year survival**
Negative : 69%
Positive : 38%

# Nodal Involvement at the Time of Pulmonary Metastasectomy: Experiences in 245 Patients

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*Background.* Although routine systematic mediastinal and hilar lymph node dissection contemporary with pulmonary metastasectomy has not been uniformly performed in many thoracic surgical centers, the value of this procedure needs to be investigated.

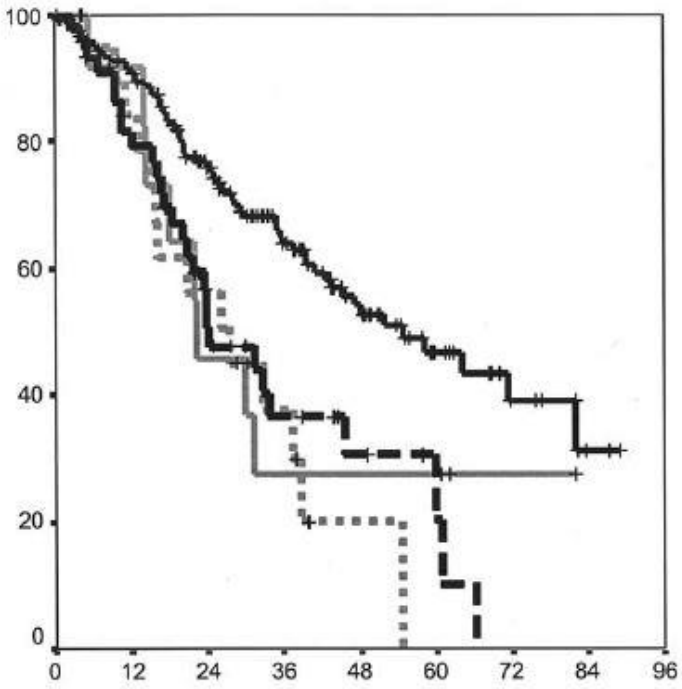
*Methods.* Between 1996 and 2001, 245 patients (157 men, 88 women) underwent pulmonary resection of metastatic colorectal carcinoma, sarcoma, and renal cell carcinoma. Generally, systematic mediastinal and hilar lymph node dissection was performed concurrently with pulmonary metastasectomy. Patients were assessed for patterns of lymph node metastases. The frequency of lymph node involvement was determined. Patients and tumor characteristics were assessed to ascertain whether certain factors were likely to predict lymph node spread.

*Results.* Of the 245 patients (328 primary thoracic procedures), 165 had no lymph node involvement, 45 had pulmonary and hilar metastases, 22 had pulmonary, hilar, and mediastinal metastases, and 13 had only mediastinal involvement without pulmonary and hilar spread. Patients with more than one pulmonary metastasis or metachronous disease were more likely to have thoracic lymph node metastases. The risk for mediastinal lymph node involvement was even more likely for patients who had already pulmonary or hilar lymph node spread; the odds ratios (with 95% confidence intervals) were 1.30 (0.71 to 2.36), 1.32 (0.59 to 2.99), and 5.87 (2.73 to 12.6), respectively. Median survival for the group of patients after complete resection was 54.8 months (95% CI: 40.9 to 68.7); and for the patients with no lymph node involvement, it was 63.9 months (95% CI: 45.3 to 82.6); with N1 disease, 32.7 months (95% CI: 9.2 to 56.2); and with N1 + N2 disease, 20.6 months (95% CI: 5.1 to 36.1). The log-rank test revealed significance between N0 and N1 ($p = 0.018$) and N0 versus N1, 2 ($p = 0.001$).

*Conclusions.* We conclude that systematic mediastinal and hilar lymph node dissection contemporary with pulmonary metastasectomy offers a further understanding of metastatic disease and provides important information for complete surgical staging.

(Ann Thorac Surg 2006;81:448–54)






| Number at risk | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N0 | 165 | 136 | 93 | 61 | 39 | 17 | 8 | 2 | 0 |
| N1 | 45 | 33 | 17 | 10 | 5 | 2 | 0 | 0 | 0 |
| N2 | 13 | 10 | 5 | 3 | 3 | 3 | 1 | 0 | 0 |
| N1+N2 | 22 | 15 | 10 | 5 | 1 | 0 | 0 | 0 | 0 |

Mediastinal evaluation

EBUS, EUS, Mediastinoscopy

# Thoracic Lymphatic Involvement in Patients Having Pulmonary Metastasectomy

## *Incidence and the Effect on Prognosis*

*Mariano García-Yuste, MD, PhD,* Stephen Cassivi, MD, PhD,† and Cristian Paleru, MD‡*

**Abstract:** Mediastinal and hilar lymph node involvement are rarely reported in the literature concerning pulmonary metastasectomy. The first problem is to determine with accuracy the incidence and location of thoracic lymph node involvement in patients with lung metastases. Determination of the impact on survival of this type of lymphatic spread may contribute to assessing whether metastatic nodal disease identified preoperatively is an absolute contraindication to metastasectomy. Systematic mediastinal lymph node dissection has revealed a statistically significant difference in survival between patients with lymph node involvement and those without lymph node metastases. Videomediastinoscopy to identify involved mediastinal lymph nodes can be safely performed and may have a role in a more accurate staging of the metastatic disease. The authors conclude that attention should be paid to ensuring that we do not operate on patients in whom we will leave behind diseases that we cannot reach. The discovery of mediastinal lymph node involvement may also influence decisions with respect to postresection adjuvant therapy.

**Key Words:** Pulmonary metastasectomy, Lymphadenopathy, Lymphatic spread.

(*J Thorac Oncol.* 2010;5: S166–S169)

and gauge opinion in this respect, it is necessary to conduct the appropriate examination of clinical reports in which, apart from any other prognostic factors, the presence and significance of nodal involvement have been analyzed.

### WHAT IS THE TRUE INCIDENCE OF THORACIC LYMPH NODE INVOLVEMENT?

The first problem is to determine the incidence of positive thoracic lymph nodes in patients with lung metastases. In the International Registry of Lung Metastases between 1991 and 1995 of 5206 patients, 4572 (88%) underwent a complete surgical resection of the metastases.[1] Data are available from this source on the incidence of lymph node involvement in a large number of patients. The primary tumor was epithelial in 2660 cases, sarcoma in 2173, germ cell in 363, and melanoma in 328. Metastases to hilar or mediastinal nodes were found in 5% of patients overall (239 cases), corresponding to 11% in germ-cell tumors, 8% of melanomas, 6% of epithelial metastases, and only 2% of sarcomas. This is the largest data set available nevertheless, there are some difficulties in interpreting these results:

1. The incidence of lymphatic spread from the pulmonary metastases to the usual lymphatic drainage of the lung is common.

2. LN involvement = worse survival

3. LN involvement → postresection adjuvant therapy ?

# Extent of Surgical Resection

Resection with free margins

Preservation as much normal lung parenchyma as possible.

**ESTS survey**

**Wedge resection** >>> Precision excision >> Segmentectomy > Lobectomy

Pneumonectomy (64%-relative contraindication, 23%-absolute contraindication )

**ESTS survey**

**Surgical staplers** >> Electrocautery > Direct suture

Other instrument ( Harmonic scapel, Ligasure ) – rarely used.

**J Thorac Oncol 2008; 3: 1257-66**

# Pneumonectomy for Lung Metastases: Indications, Risks, and Outcome

Lorenzo Spaggiari, MD, PhD, Dominique H. Grunenwald, MD, Philippe Girard, MD, Piergiorgio Solli MD, and Thierry Le Chevalier, MD

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*Background.* Resection of pulmonary metastases (PM) by pneumonectomy is infrequently performed and benefits are uncertain.

*Methods.* From 1985 to 1995, 42 patients underwent pneumonectomy for PM. Twenty-nine patients had PM from sarcomas, 12 patients from carcinomas, and 1 patient from melanoma. The indications for pneumonectomy were pulmonary recurrences in 12 patients, PM centrally located in 26 patients, and high number of PM in 4 patients. There were 11 intrapericardial and 6 extended pneumonectomies. The average number of PM resected was 3. Twenty-two patients (52%) had lymph nodes involvement.

*Results.* There were 2 postoperative deaths (4.8%) related to pneumonectomy and one death within 30 days for rapidly evolving disease; 4 patients (9.5%) had major postoperative complications that were medically treated. Five patients (12%) were operated on for recurrences on the residual lung. At the completion of the study, 12 patients were still alive, 8 without recurrences. The median survival was 6.5 months (range, 1 to 144 months); the 5-year survival was 16.8%.

*Conclusions.* Pneumonectomy should not be considered an absolute contraindication in patients with PM, but the poor outcome of our series suggests strict criteria of selection.

(Ann Thorac Surg 1998;66:1930–3)



## INVITED COMMENTARY

Pulmonary resection for metastatic lung disease has been controversial since the first successful resection of pulmonary metastases by Barney and Churchill in 1938 [1]. Nonetheless, since that time many patients have benefited from this procedure and pulmonary wedge excision eventually has emerged as the procedure of choice. For this procedure to be effective, however, metastatic disease must be limited, the amount of lung removed minimal, mortality near zero, and morbidity low. Using these principles, recent 5-year survival for most cancer sites has consistently averaged 25% to 30%.

If pulmonary wedge excision is the preferred treatment, what then is the indication for pneumonectomy? In my opinion, the only indication is a solitary central lesion in a patient with a previous soft tissue or bone tumor, who has a long tumor-free interval, and who had no previous pulmonary resection for metastatic disease. And then only rarely should pneumonectomy be performed. Although Spaggiari and associates did not report isolated results for their 26 patients with central lesions, their operative mortality of 7.1%, complication rate of 9.5%, median survival of 6.5 months, and 5-year survival of 16.8% suggest that pneumonectomy for any more advanced metastatic lung disease should never be done.

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### Reference

1. Barney JD, Churchill ED. Adenocarcinoma of the kidney with metastases to the lung: cured by nephrectomy and lobectomy. Trans Am Assoc Genitourin Surg 1938;31:71.

# Results of Pulmonary Metastasectomy

TABLE 23-2 **Five-Year Survival Rates of Various Histologic Metastatic Resections**

| Histology | 5-Yr Survival Rate without Metastasectomy (%) | 5-Yr Survival Rate with Metastasectomy (%) |
|---|---|---|
| All histologies | — | 25-40[65,149] |
| Breast cancer | 11[103] | 35-50[105,150,151] |
| Colorectal cancer | <5[54] | 40-45[25,152] |
| Germ cell tumors | — | 68[65] |
| Head and neck squamous cell carcinoma | — | 29-60[65] |
| Melanoma | 3-4[128,129] | 21-36[77,128,129] |
| Osteosarcoma | 0-17[83,153] | 20-40[65,154,155] |
| Renal cell carcinoma | — | 13-54[22,156] |
| Soft tissue sarcoma | — | 20-40[65,79] |
| Urinary tract cancer | — | 25-43[156] |

Pulmonary metastasectomy in appropriately selected patients has been shown in retrospective studies to improve survival (the 5-year survival rate is 25% to 40%)

## TABLE 23-3 Prognostic Factors in Metastasectomy

| Absolute | Equivocal |
|---|---|
| Complete resectability | Tumor doubling time<br>Disease-free survival<br>Number of nodules<br>Histology<br>Nodal status |

## BOX 23-4 Factors Not Affecting Prognosis in Patients with Metastasectomy

- Age
- Sex
- Unilateral versus bilateral disease
- Wedge resection versus formal lobectomy

# Specific Secondary Lung Tumors

# Soft Tissue Sarcoma

Only 50% of patients with lung metastases from sarcoma are operative candidates (of those, 80% undergo complete resection)

Extremity soft tissue sarcomas tend to develop pulmonary metastases more frequently than those with sarcomas at other sites

Regardless of histology, primary and repeat metastasectomy has been associated with improved long-term survival

# Osteosarcoma

A strong predilection for metastasis to the lung

Tumor recurs in 50% of patients within 1 year and 85% of these patients relapse with recurrent pulmonary disease

Resection of these recurrences is indicated if feasible, as numerous studies have demonstrated improved survival

Only complete resection has consistently been associated with improved survival

# Colorectal Cancer

The lung and liver are the most common sites of metastatic disease in colorectal cancer

Pulmonary resection have demonstrated that the survival in selected patients at 5 years ranges from 27% to 61%

Prognostic factors associated with improved prognosis include primary tumor stage and completeness of the resection

# Breast Carcinoma

Pulmonary involvement in breast cancer is most commonly associated with widespread disease
(thorough search before considering metastasectomy)

A significant 5-year survival advantage for patients who underwent metastasectomy (36% versus11%)

Factors conferring a more favorable prognosis include estrogen and progesterone receptor (ER/PR) status and a complete resection

# Head and Neck Carcinoma

Head and neck carcinomas most commonly spread through local lymphatics

The lung is among the more common sites of distant spread

Five-year survival rates after metastasectomy for head and neck cancers range from 29% to 59%

# Renal Cell Carcinoma

The lung is a frequent site of renal cell metastases (as high as 72% to 76% in autopsy)

Patients with a solitary renal metastasis fare best, with a 5-year survival of up to 54%

Synchronous metastases, greater than 6 metastases, absence of regional and mediastinal nodes, and resectability have been identified as being important prognostic factors

# Germ Cell Tumors

Most germ cell tumors are highly responsive to chemotherapy
and even patients with metastatic disease have
an excellent prognosis

Surgical intervention for pulmonary metastases
from germ cell tumors is primarily reserved
for evaluation of a residual mass after chemotherapy

# Gynecologic Tumors

The lung represents the most common organ involved in uterine cancer spread

A 5-year survival rate of approximately 50% in well-selected patients

Completeness of resection, longer disease free interval, and three or fewer metastases

have been associated with an improved survival rate

# Melanoma

The lungs are the second most common site of metastases in patients with melanoma

If a complete resection cannot be performed, little or no benefit is provided in terms of prolonging patient survival

# Endocrine Tumors

Slow-growing endocrine tumors, including carcinoids, well-differentiated thyroid cancers, and parathyroid cancers, may benefit from resection of their metastases

# Alternative Treatment Options

Stereotactic body radiation therapy (SBRT)

Radiofrequency (RF) ablation

Cryoablation

# Summary

Optimal preoperative imaging ?

The role of mediastinal lymph node dissection?

Surgical approach?

The extent of surgical resection?