Pulmonary Resection in Metastatic Carcinoma*

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Resection of pulmonary metastases in osteogenic sarcoma has been reported by us to result in a five-year survival rate of 27 percent. A later report of surgical management of pulmonary metastases from all types of sarcomas showed a five-year survival rate of 26 percent. This report reviews the experience with 188 patients treated surgically for pulmonary metastasis from a variety of carcinomas, demonstrating that a similar rate of survival is obtainable by surgical excision of these metastases. A total of 188 patients underwent 242 thoracotomies for metastatic pulmonary carcinomas. The most frequent sites of origin were the colon, melanoma, breast, and testicular carcinoma. Surgical treatment of these metastases is justified when the following criteria are adhered to: (1) primary site controlled or controllable; (2) no extrapolmonary metastatic sites demonstrable; (3) good surgical risk; and (4) no effective treatment available by nonsurgical means.

Pulmonary metastases from primary sites of carcinoma elsewhere in the body are usually regarded by patient and physician alike for foreboding. The present study reviews our experience over a ten-year period with resection of solitary and multiple, unilateral and bilateral, simultaneous and subsequent pulmonary metastases from various primary origins of carcinoma.

The propensity of carcinoma to metastasize to more than one distant site, usually the liver, required a preoperative program of screening to select those patients whose lungs contained the only metastases discernible. When the primary site was controlled and no effective nonsurgical means was available, excision of pulmonary metastases was undertaken.1–3

**MATERIALS AND METHODS**

The charts of all patients on the thoracic service who underwent surgery for pulmonary metastases from primary carcinomas were reviewed. The study embraces 188 patients from 1966 through 1975. Complete clinical and follow-up data were available on these patients.

Forty-one percent (77/188) were female patients, and 59 percent (111/188) were male patients. Pulmonary lesions varied in size from 1 mm to 11.5 cm, averaging 2 to 4 cm in diameter. Eighty-seven percent of the patients were asymptomatic at the time of diagnosis. The remainder had symptoms of cough, hemoptysis, and pain in the chest. The youngest patient was 1½ years of age, and the oldest was 83 years. All pulmonary metastases were detected by chest x-ray films or tomograms. All diagnoses were confirmed histologically.

A complete work-up on the extent of disease was performed on these patients, encompassing a hemogram, studies of hepatic chemistry, skeletal survey, brain scan, and liver scan. A bone scan was done on 10 percent (19 patients) of those who had a normal skeletal survey but did have skeletal complaints. The criteria required for pulmonary resection were as follows: (1) primary site controlled or controllable; (2) no extrapolmonary metastatic sites demonstrable; (3) good surgical risk, and (4) no effective treatment available by nonsurgical means.

**RESULTS**

The sites of origin of the 188 primary tumors and the numbers of patients are given in the following listing: colon and rectum, 40; melanoma, 29; breast, 28; testis, 25; head and neck, 23; kidney, 16; bladder, eight; cervix, six; uterus, four; lung, three; ependymoma, one; mediastinum (embryonal carcinoma), two; esophagus, one; sweat gland, one; and ovary, one. The seven most frequent sites comprise 90 percent of the total, and these will be presented in detail.

The interval from treatment of the primary tumor to diagnosis of the pulmonary metastases varied from zero (when the lesions were diagnosed simultaneously) to 28 years in a patient with primary melanoma. The average and median, disease-free interval and the range for the specific primary sites are listed in Table 1. Testicular tumors had the shortest median disease-free intervals. This reflects the fact that 20 percent (five) of these 25 patients

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initially had simultaneous diagnosis of pulmonary metastases and the primary tumor.

Two patients initially had a single metastasis in each lung (Table 2), 24 patients had multiple bilateral metastases, 58 patients had multiple lesions in one lung, and 104 patients (55 percent) had a solitary lesion in a single lung.

The extent of pulmonary resection was related to the number of lesions and the position of the tumor. Conservation of pulmonary tissue remained a guide in treating pulmonary metastases. Sixty percent had wedge resection or segmentectomy, 29 percent had lobectomy to eradicate all visible disease, and 4 percent underwent pneumonectomy for metastatic lesion when the position of the tumor precluded a lesser resection.

The metastases could not be resected at thoracotomy in 10 percent (19/188) of the patients, either because of involvement of vital structures or because of the restricted pulmonary reserve that precluded the resection of substantial pulmonary tissue. In this latter group of patients, interstitial irradiation was utilized by implantation of seeds of radioactive 125Iodine into the lesion without resection.

Simultaneous diagnosis of the primary tumor and the pulmonary metastases occurred in 19 patients. Of these, nine had a single pulmonary lesion; two of these single metastatic lesions were from a primary tumor of the colon, and one each was from the breast, testis, head and neck, kidney, ependymoma, lung, and bladder. Six of these 19 patients initially had multiple pulmonary metastases; the primary sites were the colon in two patients, kidney in two patients, esophagus in one patient, and head and neck in one patient. In addition, five patients with testicular carcinoma out of these 19 patients received chemotherapy initially for control of their metastases. Pulmonary resection was performed later because of persistent lesions after adequate chemotherapy or for lesions growing progressively during medical treatment.

A summary of treatment and survival in patients requiring multiple thoracotomies is shown in Figure 1. Thirteen patients had bilateral pulmonary metastases initially, necessitating two thoracotomies during the same hospitalization. Two patients had a single metastasis in each lung, and 11 had multiple bilateral disease.

<table>
<thead>
<tr>
<th>Primary Site</th>
<th>Average Interval, mo</th>
<th>Median Interval, mo</th>
<th>Range of Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colon and rectum</td>
<td>36</td>
<td>33</td>
<td>0-26 yr</td>
</tr>
<tr>
<td>Melanoma</td>
<td>49</td>
<td>29</td>
<td>4 mo-28 yr</td>
</tr>
<tr>
<td>Breast</td>
<td>70</td>
<td>51</td>
<td>0-25 yr</td>
</tr>
<tr>
<td>Testis</td>
<td>7</td>
<td>2</td>
<td>0-2.2 yr</td>
</tr>
<tr>
<td>Head and neck</td>
<td>41</td>
<td>36</td>
<td>0-11 yr</td>
</tr>
<tr>
<td>Kidney</td>
<td>8</td>
<td>8</td>
<td>0-3.5 yr</td>
</tr>
<tr>
<td>Bladder</td>
<td>9</td>
<td>8</td>
<td>0-3.7 yr</td>
</tr>
<tr>
<td>Other</td>
<td>29</td>
<td>12</td>
<td>0-10 yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pulmonary Metastases</th>
<th>One in Each Lung</th>
<th>One in Each Lung</th>
<th>Multiple in One Lung</th>
<th>Multiple in Each Lung</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colon and rectum</td>
<td>23</td>
<td>1</td>
<td>10</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>Melanoma</td>
<td>23</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>Breast</td>
<td>24</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Testis</td>
<td>8</td>
<td>0</td>
<td>14</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Head and neck</td>
<td>10</td>
<td>0</td>
<td>12</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Kidney</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Bladder</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>104</td>
<td>2</td>
<td>58</td>
<td>24</td>
<td>188</td>
</tr>
</tbody>
</table>
Nineteen patients underwent a second thoracotomy three months to ten years later, with a median interval between thoracotomies of 12 months. Seven patients required more than two thoracotomies to control continued pulmonary metastases. The disease-free interval between thoracotomies in this group of patients ranged from 1 to 61 months, with a survival from the first thoracotomy ranging from four to nine years.

**Survival**

Curves for five-year survival after the diagnosis and treatment of pulmonary metastases were determined by the actuarial method and are shown in Figure 2. Overall survival in resected solitary metastases was 21 percent. Overall survival in resected multiple metastases was 15 percent. Although the overall rate of survival for all groups was 21 percent, the breakdown was significant.

In carcinoma of the head and neck, the rate for five-year survival from surgical treatment of the pulmonary metastases was 44 percent (10/23), and the median survival was 51 months. In melanoma the rate of five-year survival was 21 percent (6/29), with a median survival of 22 months. In the 25 patients with testicular carcinoma, survival ranged from 7 to 108 months, with a median of 24 months and a five-year survival rate of 30 percent. The median survival in carcinoma of breast and of colon combined was 20 months.

The surgical mortality in all patients explored was 1 percent (2/188). One patient died of pulmonary sepsis, and the other died of a massive pulmonary embolus.

Of the 19 patients who had implantation of radioactive seeds in their pulmonary metastases, three are alive and free of disease at 15, 41, and 55 months, and one patient with a primary tumor of the head and neck is also alive and well at 5½ years. One patient is alive with disease at 14 months. Fourteen patients have died after 5 to 65 months (median survival, 19 months).

**Discussion**

Pulmonary metastases from a primary carcinoma elsewhere in the body need not be regarded as a hopeless development in a patient with cancer. In those tumors for which effective chemotherapy or immunotherapy has not yet been developed, surgical extirpation in a patient who is a good surgical risk carries a low mortality and morbidity, and offers good hope for improving the quality of survival for most patients and of eradicating the tumor completely in many.

Timing of the surgical intervention remains controversial. Some authors believe that a waiting period should be given, in order to allow other metastases to appear. We believe that the ultimate prognosis is relative to the site of origin and the specific tumor's behavior and not so much to the tumor's doubling time; and, therefore, we advocate strongly the belief that an early complete eradication of all known tumor offers the best chance for long survival. A complete work-up for the extent of disease is essential before surgical intervention is planned, in order to ascertain that the lungs contain the only metastases.

The extent of resection is determined by the location of the lesions, the amount of disease, the origin of the primary tumor, and the physiologic pulmonary function. The ability of the patient to return to full functional capacity after pulmonary resection is a foremost consideration before resection. We prefer wedge excision of pulmonary metastases when they are multiple, in order to conserve pulmonary tissue and retain the option of further thoracotomies as needed in the course of follow-up. In patients with solitary lesions, if the pulmonary reserve is adequate, lobectomy is the preferred mode of treatment, since in many of these patients, it is not possible to differentiate primary from metastatic lesions unless the entire lobe is available for histologic evaluation.

We do not advocate pneumonectomy for metastases, although it appears from this study that in very select instances, such a procedure may be justified. In patients where resection is not possible, consideration must be given for interstitial implantation of radioactive seeds in the tumor, particularly in patients where nonsurgical means of management have failed.
Most patients received chemotherapy following resection, since according to our present knowledge, this method offers the best results with minimal tumor present. In testicular carcinoma, chemotherapy is now the primary form of treatment. Surgical treatment in this group of patients is confined to those with no response or continued progression of their disease in the face of active chemotherapy.

The disease-free interval between treatment of the primary tumor and diagnosis of pulmonary metastases did not correlate with the five-year survival nor did the extent of the disease at the time of diagnosis. The origin of the primary tumor is most significant in predicting survival.

The lowest rates of survival (15 percent [4/28], 15 percent [6/40], and 21 percent [6/29]) were in carcinoma of the breast, colon, and melanoma, respectively, but these tumors had the largest percentage of solitary metastases, i.e., 86 percent (24/28), 58 percent (23/40), and 79 percent (23/29), respectively.

The best rate of survival was in the primary tumors of the head and neck, where only 43 percent (10/23) were single metastases, but 43 percent (10/23) survived for five years. The testicular tumors were a unique group, and while 32 percent (8/25) of the patients initially had solitary metastases, 32 percent (8/25) survived for five years.17

Chest surgeons have believed since 193818 that a solitary pulmonary metastasis should be resected, provided the primary tumor was controlled.18-21 In general, this principle yielded five-year survival rates of 20 to 30 percent. Previous reports from Memorial Hospital for Cancer and Allied Diseases, New York, of experience with resection of pulmonary metastases of osteogenic sarcoma led to application of this principle to all types of sarcomas metastatic to lung.22-24 Encouraged by these results, we now have used this approach in carefully selected patients with carcinomas metastatic to lung. This report evaluated the survival of patients with multiple pulmonary metastases from a variety of carcinomas treated primarily by surgery alone, since adjuvant therapy, if any, had failed. An aggressive surgical approach in these patients yielded a five-year survival rate of 15 percent in resected multiple metastases and of 21 percent in resected solitary metastases.

References

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