Sixty-five patients with malignant melanoma metastatic to the thorax were evaluated retrospectively. Chest x-ray films showed abnormalities in 63 patients and provided the first evidence of dissemination in 42 of the 62 with widespread metastasis. Frequent radiographic follow-up evaluations of patients with primary melanoma is necessary to detect metastasis at an early stage. Pulmonary metastasis was seen radiographically in almost 90 percent of the patients. Snowstorm metastasis denotes a poorer prognosis than other patterns of pulmonary involvement. Enlargement of mediastinal lymph nodes, bronchial obstruction with atelectasis, pleural effusion, bone metastasis with an extrapleural mass, and cardiomegaly were also seen. Follow-up chest x-ray films are of limited value in evaluating patients once they are found to have thoracic metastasis. The rate of growth of metastatic lesions or the regression of the metastasis does not correlate with survival.

**Materials and Methods**

The medical records and chest x-ray films of 65 consecutive patients having thoracic metastasis from melanoma were reviewed. All of the patients were seen at the University of California, San Francisco, from June 1968 through September 1974. There were 44 male and 21 female patients, all of whom were white. At the time of diagnosis of their primary tumor, the ages of patients ranged from 16 to 76 years, as follows: 16 to 19 years, four patients (6 percent); 20 to 29 years, seven patients (11 percent); 30 to 39 years, 12 patients (19 percent); 40 to 49 years, 19 patients (29 percent); 50 to 59 years, 13 patients (20 percent); 60 to 69 years, six patients (9 percent); and 70 to 79 years, four patients (6 percent).

The primary tumors were most commonly of the chest, back, or abdomen, but sites were widely distributed, as shown by the following listing: head and neck, 12 patients (18 percent); upper extremity, 17 patients (26 percent); trunk, 24 patients (37 percent); lower extremity, nine patients (14 percent); and unknown, three patients (5 percent). All were diagnosed histologically as malignant melanoma. Nineteen tumors had been classified using Clark's criteria. Twelve were of the nodular type, and seven were superficial spreading. All but one of the 19 had invaded levels 4 or 5 (subcutaneous fat) of the dermis. Thoracic metastasis was proved by examination of a tissue specimen, primarily at autopsy, in 31 patients; for the other 34, pathologic data were not available, and the diagnosis of thoracic involvement was based on abnormal findings on the chest x-ray film and pathologic, radiographic, or clinical evidence of extrathoracic metastasis.

Fifty-six of the 65 patients received systemic chemotherapy, immunotherapy, or both. Eleven patients had local radiation to the lung and mediastinum, and seven underwent partial or complete lobectomies.

Forty-nine patients died. Thirteen have been observed from one month to almost three years (mean, 9 months) since detection of thoracic metastasis. Three patients did not return for follow-up examinations.

**Results**

Sixty-three of the 65 patients demonstrated abnormalities on chest x-ray films; as shown by the following tabulation listing numbers of patients with various findings on plain chest x-ray films:
Normal chest x-ray film 2
Pulmonary metastasis 57
Solitary nodules 14
Multiple nodules 41
Miliary (snowstorm) nodules 8
Lymphangitic spread 5
Enlargement of lymph nodes 28
Pleural effusion 10
Atelectasis and bronchial obstruction 8
Lytic bone metastasis 6
Cardiomegaly 4

The two patients with no radiographic abnormalities were found at autopsy to have small pulmonary nodules. Sixty-two patients exhibited both intrathoracic and extrathoracic metastases; in 42 the chest x-ray films provided the first objective evidence of dissemination beyond regional lymph nodes. In two instances, pulmonary metastasis was identified radiographically before detection of the primary tumor.

The period of time from diagnosis of the primary tumor to radiographic recognition of thoracic metastasis averaged 32 months, but the range was broad, and in two instances, pulmonary metastasis appeared 12 and 15 years after the initial diagnosis of melanoma. The length of this period did not correlate with the length of subsequent survival. Survival after radiographic recognition of thoracic metastasis averaged 7 months and was not greater in patients with primary tumors that were slow to metastasize.

Thirty-eight patients had more than one radiographic examination. Of these 38 patients, 29 demonstrated progression of metastatic disease, five showed no change during a follow-up period of one to two months, and four patients had a decrease in the size and number of visible nodules. Of the 29 patients with progression of metastasis, 20 were receiving chemotherapy or immunotherapy. The four patients showing regression of nodules were also being treated.

Among the patients with progressive metastatic disease, the time period over which nodules doubled in volume ranged from less than one week to five months, with a mean of approximately two months. The rate of growth of the metastatic lesions or the presence of regression had little effect on survival of patients. Metastatic lesions that showed regression, were unchanged in size, or doubled in a period of more than two months were associated with a slightly longer survival period (seven months) than those more rapidly growing tumors (six months), but differences were statistically insignificant.

Twenty-three patients had respiratory symptoms, most commonly cough, chest pain, and shortness of breath. Symptoms were most frequently found in patients exhibiting enlargement of hilar or mediastinal lymph nodes or bronchial obstruction with atelectasis. The average survival of symptomatic patients was five months, not significantly less than that of patients without symptoms.

**Pulmonary Metastasis**

Fifty-seven patients (88 percent) had pulmonary metastasis detected radiographically. Metastases were visible on plain chest x-ray films in 55. In five patients with radiographically normal lungs, multiple small pulmonary nodules were found at autopsy. Twelve tomographic examinations were performed on 11 patients, and ten of these examinations were helpful in determining the extent of thoracic involvement (Table 1). Tomograms were particularly useful in detecting small nodules in the lung, and in two patients with normal radiographic findings, tomograms disclosed pulmonary nodules for the first time. Despite the frequent finding of central necrosis and hemorrhage in pulmonary nodules at autopsy, no instance of cavitation was documented radiographically or pathologically.

Solitary nodules were identified radiographically in 14 patients (Fig 1); multiple discrete nodules

<table>
<thead>
<tr>
<th>Plain Film</th>
<th>Tomogram</th>
<th>Examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Lung nodules</td>
<td>2</td>
</tr>
<tr>
<td>Lung nodule (?)</td>
<td>Normal</td>
<td>1</td>
</tr>
<tr>
<td>Lung nodules</td>
<td>Additional nodules seen</td>
<td>5</td>
</tr>
<tr>
<td>Lung nodules</td>
<td>No additional nodules</td>
<td>2</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>Bronchial narrowing</td>
<td>2</td>
</tr>
</tbody>
</table>

**Table 1—Comparison of Results of Plain Films and Tomograms in 11 Patients**
FIGURE 2. Multiple large nodules located predominantly at bases of lungs. These were detected four years after removal of primary tumor.

were seen in 41 patients (Fig 2). Lengths of survival after detection of pulmonary metastasis averaged nine and seven months, respectively, for these two groups and were not significantly different from each other. Innumerable miliary (or snowstorm) nodules were recognized in eight patients (Fig 3). Survival of patients with this pattern of metastasis averaged only five weeks from the time of detection, significantly less than that of patients with either solitary or discrete multinodular lesions. Five patients demonstrated ill-defined, linear interstitial densities, suggesting lymphangitic spread (Fig 4). Survival of this group averaged only four weeks, but three of these patients had superimposed miliary pulmonary metastases.

FIGURE 3. Innumerable, small pulmonary nodules (snowstorm metastasis). This man had been observed for 18 months because of slowly enlarging solitary nodule but died six weeks after appearance of this pattern.

FIGURE 4. Snowstorm metastasis with linear interstitial densities and Kerley's B lines. Lymphatic obstruction and interstitial pulmonary edema were found at autopsy.

Lymph Node Metastasis

Radiographically identifiable enlargement of intrathoracic lymph nodes was present in 28 of the 65 patients. Nodal involvement was associated with
FIGURE 6. Large subcarinal and left hilar mass with marked narrowing (arrows) of left main-stem bronchus and volume loss in left lower lobe.

radiographic evidence of pulmonary parenchymal metastasis in 25 instances (Fig 5). The average survival period of patients with radiographic intrathoracic adenopathy and associated pulmonary metastasis was not different from that of patients showing a similar pulmonary parenchymal pattern without mediastinal or hilar involvement. The average survival period of the three patients having only lymph node metastasis was three months.

Thirteen patients with no radiographically visible enlargement of intrathoracic lymph nodes were examined at autopsy. Lymph nodes were involved by melanoma in seven of these patients.

Pleural Effusion

Pleural effusion was identified radiographically in ten patients; in two patients, it was bilateral. Most effusions were small and did not affect treatment or survival. Enlargement of mediastinal or hilar lymph nodes was seen in eight of the patients, and in all eight, it was present only on the side of effusion. The association of pleural effusion with lymph node metastasis has also been noted in other types of malignant neoplasms.25

Atelectasis and Bronchial Obstruction

Bronchial obstruction in melanoma may be due to endobronchial metastasis or compression by enlarged lymph nodes. Eight patients demonstrated segmental or lobar atelectasis. Enlargement of ipsilateral hilar lymph nodes was present in five of the patients; two had visible bronchial narrowing (Fig 6).

At autopsy, two patients who demonstrated radiographic findings of atelectasis were found to have tracheal or bronchial metastasis. In one patient, a fungating intratracheal mass 1 cm in diameter, was found just proximal to the carina.

Bone Metastasis

Lytic bone metastasis was visible on the chest x-ray films of six patients. Rib metastasis was present in five patients; in three of the five, more than...
metastasis was most frequent, but solitary nodules, snowstorm nodules, and lymphangitic spread were also recognized as distinct patterns. Cavitation of nodules has been reported\textsuperscript{3} but did not occur among our patients and was not observed in 30 patients with pulmonary melanoma studied by Dodd and Boyle.\textsuperscript{9} The radiographic pattern of pulmonary metastasis has not been stressed in the literature as useful for determining prognosis in this disease; however, our patients with snowstorm pulmonary involvement had a shorter survival period than those with other patterns of disease. The many pulmonary nodules reflect the diffuse dissemination that is responsible for the patient's death.

Intrathoracic lymph node metastasis is frequently identified in both surgical and autopsy series of patients with melanoma.\textsuperscript{7,8} Almost half of our patients demonstrated radiographic enlargement of lymph nodes; nevertheless, more than 50 percent of our patients without radiographically enlarged lymph nodes had hilar or mediastinal metastasis at autopsy. Therefore, chest radiographic studies must be considered of limited value in detecting nodal metastasis in patients with melanoma.

Despite its value in detecting and delineating metastasis, chest x-ray films are of limited usefulness in the follow-up study of patients with known intrathoracic disease. It has been suggested that chest x-ray films be used to assess systemic therapy in patients with melanoma by allowing an easy determination of change in size of metastatic deposits.\textsuperscript{8} In our study, regression of pulmonary nodules was uncommon and had no discernible effect on survival. In addition, prognosis was not altered by the length of time between diagnosis of the primary tumor and detection of thoracic metastasis, the pattern of metastasis (other than snowstorm), or the rate of growth of metastatic lesions.

**References**

ANNOUNCEMENTS

Advances in Clinical Immunology and Asthma

Beth Israel Medical Center (New York) and the National Jewish Hospital and Research Center (Denver) will present the course, Advances in Clinical Immunology and Asthma April 27 at the Beth Israel Medical Center. For further information, contact the Postgraduate School Office, Beth Israel Medical Center, Ten Nathan D. Perlman Place, New York, New York 10003.

Clinical Cytopathology for Pathologists

The 18th Postgraduate Institute for Pathologists in Clinical Cytopathology will be held April 11-22 at The Johns Hopkins University School of Medicine and The Johns Hopkins Hospital, Baltimore. For information, write John K. Frost, M.D., 610 Pathology Building, The Johns Hopkins Hospital, Baltimore, Maryland 21205.

Current Problems in Intensive Care—Mechanical Ventilation

The Department of Anesthesia, in cooperation with extended programs in medical education, University of California School of Medicine, San Francisco, will sponsor the course, Current Problems in Intensive Care—Mechanical Ventilation, April 28-29 at the Stanford Court Hotel, San Francisco. For information, contact Extended Programs in Medical Education, Room 569-U, University of California, San Francisco 94143.

American Heart Association/Virginia Affiliate

The American Heart Association/Virginia Affiliate will present a scientific program at the 1776 Inn, Williamsburg, Virginia, April 22-23. For further details, write the American Heart Association, Virginia Affiliate, PO Box 12365, Richmond, Virginia 23241.