Clinical and Pathologic Features of Metastatic Neoplasms of the Pericardium*

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Of 60 cases with pericardial metastatic disease, 26 had significant effects on the cardiovascular system. Pericardial metastases were suspected in 18 of these cases before death. The most common features reported were dyspnea on exertion and pleural effusion. While these were nonspecific for circulatory disturbance, ECG features of ST-T changes and low voltage QRS complexes were helpful in suspecting pericardial metastases. Thoracic roentgenograms were not helpful unless there was a large pericardial effusion. Echocardiography reported in one case promises a higher incidence of suspicion in the future.

Metastatic pericardial disease is a common and significant way by which extracardiac malignant tumors affect the cardiovascular system. With recent advances in the therapy for some malignant tumors, the importance of pericardial metastatic disease has shifted from mere academic interest to one with significant therapeutic potential.1,2 With this in mind, we reviewed the clinical, ECG, thoracic roentgenographic, and pathologic features of cases with primary extracardiac malignant tumors in which pericardial metastases were identified at autopsy during the period 1958 to 1978. Sixty-five such cases were available for study.

From a review of the autopsy and clinical findings, patients were separated into those with and those without significant effects upon the cardiovascular system by the pericardial neoplastic process. The criteria for identifying those patients with significant effects on the cardiovascular system were the presence of one or several of the following: (1) dyspnea which had no pulmonary or systemic cause, (2) pedal swelling, (3) jugular venous distension, (4) hepatomegaly not caused by tumor, (5) ascites, (6) pleural effusion when associated with other signs of congestive heart failure, and (7) other signs of pericardial constriction or tamponade.

Materials and Methods

Of 65 patients who qualified for the study, 29 were male and 36 female (age range, 4 to 81 years; mean, 58 years). Only eight of the 65 patients were under the age of 40 years. The youngest was 4 years old, and the next youngest was 21 years of age.

Carcinoma of the breast and lung accounted for 55 percent of the cases, whereas leukemia and lymphoma accounted for only 17 percent of cases (Table 1).

Thirty-one of the 65 patients (48 percent) had antemortem features suggestive of circulatory disturbance. In five of 31, the dominant effects were caused by disease other than that of the pericardium (in four cases, superior vena cava obstruction, and in one, obstruction of pulmonary veins and a mass in the left atrium). We eliminated those five cases, leaving 26 cases with pericardial metastases in which evident circulatory effects were present and considered to have been caused by the pericardial disease.

The mechanisms of circulatory embarrassment in these 26 patients varied. These were (1) tumor encasement of the

<table>
<thead>
<tr>
<th>Primary Tumor Site</th>
<th>Clinically Significant No. (%)</th>
<th>Clinically Not Significant* No. (%)</th>
<th>Total No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinoma of breast</td>
<td>8 (12)</td>
<td>9 (14)</td>
<td>17 (26)</td>
</tr>
<tr>
<td>Carcinoma of lung</td>
<td>10 (15)</td>
<td>9 (14)</td>
<td>19 (29)</td>
</tr>
<tr>
<td>Leukemia</td>
<td></td>
<td>6 (9)</td>
<td>6 (9)</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>1 (2)</td>
<td>4 (6)</td>
<td>5 (8)</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>1 (2)</td>
<td>3 (4.5)</td>
<td>4 (6.5)</td>
</tr>
<tr>
<td>Hypernephroma</td>
<td></td>
<td>3 (4.5)</td>
<td>3 (4.5)</td>
</tr>
<tr>
<td>Carcinoma of larynx</td>
<td>2 (3)</td>
<td>1 (2)</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Others†</td>
<td>4 (6)</td>
<td>4 (6)</td>
<td>8 (12)</td>
</tr>
<tr>
<td>Total</td>
<td>26 (40)</td>
<td>39 (60)</td>
<td>65 (100)</td>
</tr>
</tbody>
</table>

*Includes four cases with dominant features of superior vena cava obstruction and one case with left atrial space occupation and pulmonary venous invasion.
†Carcinoma of the colon (two cases) with one case causing significant effect. Carcinoma of the floor of the mouth, ovary, and stomach (one case each) without significant effects. Carcinoma of the thyroid, malignant melanoma, and carcinoma of the renal pelvis (one case each) with significant effects on cardiovascular function in each.

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heart and pericardial effusion (nine cases), (2) pericardial effusion alone (six cases), (3) pericardial effusion with myocardial invasion (seven cases), and (4) tumor encasement of the heart (four cases).

### Results

#### Signs and Symptoms

Of the 26 cases with significant effects of the pericardial tumor on the cardiovascular system, in only 18 cases was there an antemortem suspicion of pericardial metastatic disease, although congestive cardiac failure was suspected in each of the remaining eight cases.

Apart from the symptoms of the primary tumor, Figure 1 shows the relative frequency of the cardiovascular manifestations. In the affected patients one or more of the manifestations sought was encountered. The two most common features were dyspnea on exertion (20 times) and pleural effusion (13 times). Among the less common manifestations, in order of decreasing frequency, were hepatomegaly, tachycardia, and pedal edema. Distant cardiac sounds and paradoxic pulse were noted in three patients, each with pericardial effusion alone. A pericardial friction rub was uncommon and noted in only three cases.

#### Electrocardiographic Manifestations

Electrocardiographic records were available in 16 of the 26 cases with cardiovascular effects. Figure 2 shows that the most common abnormalities were nonspecific ST-T wave abnormalities and low voltage of the QRS complex, and, less commonly, atrial flutter or fibrillation, ventricular extrasystoles, and electric alternans. Sinus tachycardia was reported in two cases, and in only one of the cases was there a normal ECG.

Electrocardiographic records were available in
only eight of the 34 cases with pericardial metastases without evident cardiovascular effects. In the three with abnormalities, there were ST-T changes in two cases, one of which also displayed low voltage of the QRS complex. Isolated left bundle branch was observed in one case.

**Thoracic Roentgenograms**

Reports of thoracic roentgenograms were available in 15 of the 26 cases with significant cardiovascular effects. Of the 13 with abnormalities, ten showed cardiomegaly and pulmonary venous congestion. In the remaining three the abnormality was a globular-shaped heart, consistent with pericardial effusion, and autopsy in those three showed pericardial fluid greater than 600 ml.

**Echocardiography**

This was utilized in only one case for confirming a suspicion of pericardial effusion.

**Serous Cavities**

In only four of the 26 cases was pericardiocentesis performed. The procedure was done mainly for the relief of acute cardiac distress, and the cytology was recorded in only one case, which was positive for malignant cells.

The average quantity of the pericardial fluid found at autopsy in those with pericardial effusion alone was 580 ml; in those with pericardial effusion and cardiac encasement by tumor, 200 ml; and in those with pericardial effusion and myocardial involvement, 100 ml. In the 22 cases with pericardial fluid noted at autopsy, the fluid was straw-colored in ten cases, serosanguineous in eight cases, and bloody in four cases.

At autopsy, pleural effusion was found in 22 of the 26 cases with significant effects upon the cardiovascular system of the pericardial tumor. It was bilateral in 12 cases and unilateral in four cases. The average amount of fluid per space was 600 ml (range, 50 to 1,500 ml).

Ascitic fluid was present in only five cases, the average quantity being 350 ml (range 50 to 2,000 ml). One of the patients with a large volume of peritoneal fluid had peritoneal carcinomatosis.

**Liver and Spleen**

Congestion of the liver was reported in 16 of the 26 cases with cardiovascular manifestations (weight of liver: range 1,100 to 3,300 g; average, 2,300 g). In five of these 16 cases, hepatic metastases were also present.

Splenic congestion was found in 19 of the 26 cases. The average splenic weight was 186 g (range, 80 to 550 g).

**COMMENT**

The pericardium is the most frequent site of metastatic disease involving the heart. Several reports indicated that the pericardium is involved either alone or along with the myocardium in about 75 percent of cases showing metastatic disease to the heart.

Consistent with most reports, in our studies the primary sites of tumor were the breast and lung, accounting for more than one half of the cases. The lower incidence of cardiac metastases from leukemia and/or lymphoma in this study compared with others may be attributed at least in part to the fact that this hospital's patients are principally adults. Colorectal carcinoma accounted for only 3 percent of our cases studied and is generally recognized as having a low tendency to metastasize to the heart.

In 18 of our 26 cases with significant disease there was some clinical suspicion of pericardial or myocardial metastases based on the clinical, ECG, and/or roentgenographic examinations, although in only three cases were features of cardiac effusion with tamponade established. The incidence of clinical suspicion in our series is higher than that generally reported. In those cases with significant pericardial disease but in which the fundamental process was not suspected clinically, the usual clinical diagnosis was congestive cardiac failure. In such cases, administration of digitalis and diuretics was common but without significant response. The most common symptom reported in our cases was dyspnea on exertion, but could, in part, have been caused by other conditions, such as pleural effusion of neoplastic origin or nonspecific effects of terminal disease.

In our series other symptoms, such as anterior thoracic pain, cough, orthopnea, and pedal swelling, also were nonspecific. Of the clinical signs, pleural effusion was the most common. While this may result from systemic venous congestion, local effects of the tumor in the lungs and pleura were probably significant in the cases studied where in more than one half of the cases, the primary sites were breast and lung. In the cases with pericardial effusion and tamponade, significant signs, such as jugular venous distention, paradoxic pulse, and distant heart sounds were consistently reported.

In a given patient with a background of a malignant tumor and in the absence of signs of pericardial effusion, other significant signs suggesting metastatic disease of the pericardium include tachycardia,
pedal edema, ascites, and pulmonary rales.

Pericardial friction rub was reported in only three of our cases. A low incidence has also been the observation of Thurber et al.9

As judged from our cases, the ECG is useful in suspecting malignant pericardial involvement, the most common changes observed being ST-T change and low voltage of the QRS complex. Arrhythmias were also relatively common and took the forms of atrial flutter, atrial fibrillation, and ventricular extrasystoles. Electrical alternans was reported in only two of our six cases with pericardial effusion. In each of these two there were clear clinical signs of cardiac tamponade. Biran et al.11 and Surawicz and Lasseter12 stressed the importance of ECG changes in the diagnosis of cardiac metastases even before significant hemodynamic effect occurred.

Radiologic studies are not very sensitive in diagnosing pericardial metastases.13 However, they are very sensitive in large effusions when the pericardial fluid content is greater than 600 ml.

In our series, only one patient had an echocardiographic examination. This is in part related to the relatively recent introduction of this method of study in clinical cardiology and in part to the tendency to treat terminally ill patients palliatively without costly investigations.

In recent years echocardiography has been shown to be a very sensitive method of detecting pericardial effusion.14 Because pericardial effusion, although not universal, is common in metastatic disease, echocardiography is expected to have an important place in diagnosis in future cases.

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