Complete Atrioventricular Block due to Cardiac Metastasis of Bronchogenic Carcinoma

By Gerald D. Buckberg, B.S., and Noble O. Fowler, M.D.

ALTHOUGH cardiac arrhythmias are a common clinical manifestation of metastatic cardiac tumor, complete heart block is still a rather infrequent finding. The first reported example of complete atrioventricular block associated with metastatic carcinoma was made by Rosles in 1924. The diagnosis was suspected clinically and confirmed at necropsy. In 1931, Yater made the following statement concerning heart block, particularly when complete, "Any case of arrhythmia in which no satisfactory explanation of arrhythmia is obtainable may be one of tumor breaking through or originating in the main portion of the conducting system." Complete heart block has been reported with lymphangio-endothelioma, hemangio-endothelioma, myeloblastoma, reticulum-cell sarcoma, and leukemic infiltration of the interventricular septum. Despite the frequent occurrence of myocardial involvement in leukemia, Dresdale and co-workers could find only one other instance of complete atrioventricular block due to leukemic involvement when he reported his case in 1949.

Shelburne and Aronson reported a case of complete atrioventricular block and pericardial effusion in a patient with a myeloblastoma of the cranium. When irradiation therapy was employed the effusion cleared and a normal cardiac rhythm returned.

It is the purpose of this paper to report a case of bronchogenic carcinoma, metastatic to the heart, with complete atrioventricular block as the only clinical manifestation of metastatic cardiac disease.

**Case Report**

A 42-year-old white man was admitted to Cincinnati Veterans Administration Hospital on November 22, 1959. Six months prior to admission he developed retrosternal aching which did not radiate. A chest x-ray revealed a lesion in the right upper lobe. A physician noted that he had a slow heart rate (45 beats per minute) and an apical systolic murmur. There was no known history of heart disease. The patient observed palpitation during the month prior to admission but no edema, orthopnea, or paroxysmal nocturnal dyspnea. Mild shortness of breath and an intermittent cough with blood streaking were noted. He had smoked one pack of cigarettes per day for many years. There was no history of syncope. On admission his blood pressure was 130/70, and the ventricular rate was 45 beats per minute and regular. He was of normal weight and muscular development but appeared apprehensive. There was no cervical venous distention. In the right posterior area the chest was dull to percussion, the breath sounds were diminished, and no wheezes were audible. The point of maximum cardiac impulse was in the fifth left intercostal space in the midclavicular line. The apical first sound varied in intensity, and atrial sounds were heard in diastole. A grade II (of VI) systolic murmur was heard best over the left sternal border in the third intercostal space and it radiated to the cardiac apex. Abdominal examination was not remarkable. A firm movable subcutaneous nodule of 21/2-cm. diameter was palpated at the left iliac crest. Another subcutaneous mass of 4-cm. diameter was palpated adjacent to the first and second lumbar vertebrae. There was moderate clubbing of the fingers and toes.

The hematocrit value was 42 per cent, and the white cell count was 8,300 per mm. The serum glutamic oxaloacetic transaminase was 24 units. A posteroanterior roentgenogram of the chest showed an infiltrative lesion in the right upper lobe (fig. 1), interpreted as probable bronchogenic carcinoma. There was no cardiomegaly. X-rays of the lumbar spine demonstrated no abnormalities. An electrocardiogram showed complete atrioventricular block (fig. 2).

The patient was treated with sublingual isoproterenol (Isuprel), 10 mg. four times daily, and his ventricular rate varied between 32 to 56 beats per minute. A biopsy of the mass on the left iliac crest revealed poorly differentiated metastatic carcinoma.
Mass lesion within the right midlung field demonstrating a sharp undersurface. The cardiac silhouette is normal.

The clinical diagnosis was bronchogenic carcinoma with metastases; cardiac infiltration by the tumor was thought to be probable. A course of nitrogen mustard and radiation therapy to the mediastinum was initiated. During the last week of hospitalization the patient developed substernal pain radiating down the left arm that required merperidine (Demerol) for relief. The electrocardiogram remained unchanged. On January 5, 1960, the patient developed mild generalized convulsions that became more severe, and he died 3 days later after one of these episodes. The cardiac rhythm did not change during this terminal episode.

The left lung weighed 600 Gm., and the right lung weighed 800 Gm. The right upper lobe bronchus was occluded by tumor at its origin. The bronchial lumen admitted only a 2-mm. probe. The tumor extended into the lung parenchyma, and several regional lymph nodes contained metastases. The tumor measured 4 by 5 cm. and contained extensive areas of necrosis and hemorrhage. The lung was congested beyond the tumor. The pulmonary vessels were not remarkable. The mediastinum contained several enlarged tumor-filled lymph nodes, most marked at the bifurcation of the trachea.

The heart weighed 450 Gm. and was thought not to be dilated. The pericardial cavity contained 30 ml. of clear serous fluid. The pericardium and epicardium were normal; the valves were normal but on the right side of the heart the interventricular septum appeared to be obliterated by a large tumor mass. The mass did not seem to bulge into the right cardiac chamber. The metastatic tumor measured 5 by 6 cm. (fig. 3). An additional 1½-cm. metastatic tumor nodule was found in the anterior wall of the left ventricle. The coronary arteries showed virtually no atheroma. No scarring or fibrosis of the myocardium was noted.

Additional metastases were found in both adrenal glands, the right kidney, the pancreas, and the left iliac spine. The brain was not examined.

Microscopic sections of the heart showed well-differentiated adenocarcinoma as did sections of the tumor of the lung (figs. 4 and 5).

Discussion

At one time the prevailing opinion was that both primary and secondary tumors of the heart and pericardium were a rare occurrence. Cohen and associates, however, analyzed 315 autopsies of malignant tumor cases; the incidence of cardiac involvement was 20.6 per cent. In a similar study by DeLoach and Haynes cardiac metastasis was observed in 13.8 per cent of 980 necropsies of patients who died with malignant disease. Scott and Garvin discovered secondary cardiac involvement in 10.9 per cent of 1,082 cases of malignant disease that they reviewed. Hanfling, in a similar survey, recently reported an incidence of 18.5 per cent in 694 cases.

Metastatic tumor of the heart has been said to be 20 to 40 times as common as primary tumor. Four types of primary tumor are especially prone to cardiac metastases. These are carcinoma of the lung, carcinoma of the breast, malignant melanoma, and the group of hematopoietic malignancies (leukemia, lymphoma, myeloma). In one series (Scott et al.) cardiac involvement was seen in 35.6 per cent of patients dying of bronchogenic or breast carcinomas. Bisel et al. encountered cardiac infiltration in 52 of 119 patients with leukemia (44 per cent). Hanfling found 46 per cent of 74 patients with leukemia had myocardial involvement.

The pathogenesis of cardiac metastasis involves one of three postulated mechanisms: 1. Direct extension from primary or secondary...
tumor of the lung or neighboring mediastinal structures. By this method the tumor may infiltrate the pericardium and subsequently invade the myocardium. 2. Tumor emboli may reach the heart via the coronary arteries as a result of intrathoracic neoplastic invasion of the pulmonary veins with subsequent spread to the left atrium, left ventricle, and aorta. This may give rise to miliary myocardial infarction due to tumor emboli. Multiple or single nodules may result from hematogenous dissemination. Blood stream spread from distal tumor sites other than thoracic structures is another postulated mechanism of cardiac metastasis. 3. Retrograde lymphatic extension from nearby intrathoracic structures may give rise to neoplastic lymphangitis.

The clinical aspects of metastatic tumor to the heart are varied. The triad of congestive heart failure, arrhythmias, and pericardial effusion leading to cardiac compression or tamponade are considered by Cohen et al.\textsuperscript{8} suggestive of cardiac involvement of a previously normal heart in a patient with a malignant neoplasm. In Scott's study of 1,082 patients with malignant disease,\textsuperscript{10} clinical evidence of heart disease was uncommon. When congestive heart failure was present the patient invariably had tumor invasion of the

Figure 2

\textit{Electrocardiogram showing complete atrioventricular block with idioventricular rhythm. The atrial rate is 82 per minute; the ventricular rate is 37 per minute.}

Figure 3

\textit{Neoplastic nodule protruding into the right ventricle from the interventricular septum. The mass extends from the tricuspid chordae tendineae almost to the cardiac apex.}
Figure 4

Nests of anaplastic tumor cells are seen invading the myocardium. Hematoxylin and eosin stain.

Figure 5

Anaplastic tumor cells of bronchogenic carcinoma with dense stromal reaction are seen adjacent to cartilage in the bronchus of origin. Hematoxylin and eosin stain.

heart. In 100 patients, selected so as to exclude those with metastatic cardiac disease, 7 had pericardial effusion and 2 had arrhythmias. Scott concluded that congestive heart failure is the most valuable sign, while arrhythmias and pericardial effusion are but suggestive signs of metastatic cardiac disease.

The most common arrhythmias associated with cardiac metastasis were atrial fibrillation, atrial flutter, and paroxysmal atrial tachycardia in separate studies by Auerbach et al. and Cohen et al. In most of these instances involvement of the right atrium was found.

Bisel et al. found the electrocardiogram to be suggestive of cardiac involvement in 28.8 per cent of his cases. He found T-wave abnormalities to be the most consistent abnormality (14 per cent). He also reported S-T deviation and Q waves in some cases. In one interesting report by Fishberg pain suggestive of myocardial infarction was the chief complaint of a patient with a cardiac tumor; at autopsy the tumor surrounded the left circumflex coronary artery.

Sudden death has been reported in patients with cardiac neoplasms, most frequently, however, in patients with primary cardiac tumor. Culpepper and Von Haam reported a case of a patient with carcinoma of the liver who died suddenly and was found to have tumor thrombosis of the inferior vena cava protruding into the right atrium. They postulated sudden death resulting from ball-valve action of the tumor. Extensions of tumor masses to the heart via the great veins have been seen in hypernephroma, testicular neoplasm, lymphosarcoma, thyroid carcinoma, and bronchogenic carcinoma.11, 16, 18, 19

There have been case reports of cardiac rupture secondary to metastatic cardiac tumor, as well as neoplastic involvement of the pericardium producing constrictive pericarditis.21, 22

Summary

A partial review of the literature indicates that the heart is not infrequently involved in patients who have malignant disease. The most common tumors metastasizing to the heart are bronchogenic carcinoma, breast carcinoma, malignant melanoma, and the group of hematopoietic malignant tumors. The clinical triad of myocardial insufficiency, cardiac arrhythmia, and pericardial effusion involving a previously normal heart should alert one to this possibility, especially in a patient with known malignant tumor.

Complete atrioventricular block is a rather uncommon manifestation of metastatic cardiac tumor. A case is reported in which complete heart block appeared as the sole clinical manifestation of metastatic involvement of the heart by bronchogenic carcinoma. Necropsy revealed cardiac involvement by tumor.
to be virtually limited to the interventricular septum.

References
Complete Atrioventricular Block due to Cardiac Metastasis of Bronchogenic Carcinoma
GERALD D. BUCKBERG and NOBLE O. FOWLER

Circulation. 1961;24:657-661
doi: 10.1161/01.CIR.24.3.657
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1961 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/24/3/657

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/