Metastatic Cardiac Tumor Demonstrated by $^{201}$Thallium Scan

David L. Lubell, M.D.,** and C. Richard Goldfarb, M.D.

A patient with bronchogenic carcinoma had an electrocardiogram that was initially thought to be consistent with myocardial infarction and possible left ventricular aneurysm. A heart scan with radioactive $^{201}$thallium showed an area of sharply diminished uptake ("cold spot"); however, subsequent thoracotomy showed that this was caused by local pericardial and myocardial infiltration by tumor. This suggests a role for radioactive $^{201}$thallium in the detection of cardiac metastatic tumors.

The myocardial scintillation scan using radioactive $^{201}$thallium has achieved rapid acceptance as an aid in the noninvasive evaluation of coronary arterial disease. Imaging with this nuclide, when properly performed, is probably the most accurate method for the identification of ischemic heart disease short of coronary angiographic studies.¹ The high specificity of the method for identification of coronary arterial disease is reflected in the surprisingly few reported cases of "false-positive" images. These include focal cardiomyopathy,² asymmetric hypertrophy,² and sarcoidosis.³ We encountered an unreported cause of a focal defect in a patient with mediastinal carcinoma.

**CASE REPORT**

The patient, a 52-year-old white man, had vague mild neurologic symptoms and a coin lesion in the right lower pulmonary field. An electrocardiogram taken one month before at another hospital was noted to be abnormal. Acute myocardial infarction was excluded on the basis of serial cardiac enzyme determinations and the absence of electrocardiographic changes and cardiac symptoms. Bronchoscopic examination and lung biopsy were performed and demonstrated squamous cell carcinoma of the right lower lobe. A normal computerized axial tomographic scan and bone scan ruled out the likelihood of metastases, and the patient was considered a candidate for thoracotomy and resection.

The 12-lead ECG (Fig 1) showed sinus rhythm at 88 beats per minute, a loss of R voltage from lead V₁ to lead V₆, and marked ST-segment elevation and small Q waves in leads V₁ to V₆. This tracing was identical to one taken one month earlier, thus suggesting the presence of an old antero-lateral myocardial infarction with possible left ventricular aneurysm. Another consideration was metastatic infiltration of the pericardium and perhaps of the myocardium. A $^{201}$thallium scan was obtained, primarily to exclude previous infarction. This showed (Fig 2 and 3) a sharply demarcated defect in the anterolateral and posterior walls of the heart.

Thereafter, the clinical condition of the patient deteriorated. Atrial fibrillation developed, and the cardiac size increased rapidly. An M-mode echocardiogram showed prominent anterior and posterior clear spaces, which were interpreted as pericardial effusion; however, despite multiple attempts, pericardiocentesis was unsuccessful. Surgical pericardial exploration showed that fluid was not present and that the pericardial space was replaced by tumor, up to 2 cm thick, with extensive myocardial infiltration. Microscopic examination showed metastatic squamous cell carcinoma, with areas of necrosis. Several days later, the patient died, and permission for postmortem examination was denied.

**DISCUSSION**

Following intravenous injection, the initial distribution of radioactive $^{201}$thallous chloride, a potassium analogue, depends on the flow of blood, with the heart receiving less than 5 percent of the dose. In addition, normal myocardial cells actively extract thallium via exchange with intracellular potassium. An abnormal myocardial region is visualized as a photon-deficient focus. The "cold spot" usually represents either an infarcted segment or a transiently ischemic zone if noted in association with exercise imaging. While decreased regional blood flow is most often responsible, disrupted cellular membrane transport mechanisms or decreased intracellular potassium have been suggested as factors causing reduced uptake of radioactive thallium in abnormal regions.⁴

*From the Division of Cardiology, Department of Medicine, and the Division of Nuclear Medicine, Department of Radiology, Nassau County Medical Center, East Meadow, NY.
**Presently Chief, Division of Cardiology, Mt. Sinai Hospital Medical Center, Chicago.
†Presently Chief, Division of Nuclear Medicine, Beth Israel Hospital, New York City.
Reprint requests: Dr. Lubell, Mt. Sinai Hospital Medical Center, Chicago 60608

![Figure 1. Routine ECG taken upon admission is identical to tracing recorded 29 days earlier.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21153/)
The relatively small list of false-positive results attests to the specificity of the technique. In our patient the focally reduced activity seemed to be caused by metastatic myocardial infiltration and replacement. In a previous case report, radioactive ¹³¹cesium, another potassium analogue, was used to demonstrate a benign cardiac tumor.

Is it possible that the carcinoma had produced infarction by direct invasion and obstruction of the coronary circulation, as described in a case reported by Franciosa and Lawrinson,⁷ or that the patient coincidentally had an ordinary ischemic infarction? We think that this is unlikely because (1) there was no prior history of angina or pain in the chest suggestive of myocardial infarction, (2) there was no enzymatic evidence of cardiac necrosis, and (3) there was no evolutionary pattern of infarction in the ECGs recorded over a seven-week period.

In retrospect, it is most likely that the electrographic abnormalities were primarily peri-epicardial in origin and possibly due to myocardial replacement or infiltration (or both).

The clear spaces demonstrated by M-mode echocardiographic studies are not explained by the usual cause, namely, pericardial effusion. Rather, the infiltrating tumor apparently created an interface of reduced echocardiographic density in the pericardial space, simulating fluid. A case of pericardial angiosarcoma, also producing a false-positive finding of effusion on the M-mode echocardiogram, has been recently reported by Lin et al.⁸

Twenty percent of the patients with metastatic tumors have cardiac involvement.⁹ Particularly prevalent is spread from acute leukemia and malignant melanoma, with reported incidences of over 60 percent. Other common causes of cardiac involvement are primary neoplasms of the lung and breast.¹⁰ Malignant pericardial effusion, which can cause tamponade, is virtually always associated with concomitant myocardial involvement.¹¹ Thus, Quaife et al.¹² (and others) have been able to observe an uptake of radioactive ⁹⁹technetium stannous pyrophosphate in the (damaged) myocardium of two patients with malignant pericardial effusions. Both of the patients of Quaife et al.¹² showed diffuse uptake, one intense and the other faint. In our patient the sharply demarcated defect on the thallium scan was striking, possibly because of the different mechanisms of uptake of ²⁰¹thallium and ⁹⁹technetium stannous pyrophosphate.

Thus, our experience suggests an additional role for ²⁰¹thallium as a noninvasive agent in the evaluation of myocardial disease. Further studies will be required to determine if ²⁰¹thallium scans are superior to scans using ⁹⁹technetium stannous pyrophosphate in the demonstration of cardiac metastases.

References