

Visualization of Atrial Myocardium with Thallium-201: Case Report

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An adult patient evaluated for cyanotic congenital heart disease was found to have pulmonary atresia with intact ventricular septum, hypoplastic right ventricle, and right atrial enlargement. Thallium-201 myocardial imaging before surgical correction showed thallium activity in the right atrium. Following the establishment of a conduit from the right atrium to pulmonary artery, the right-atrial thallium uptake was even more prominent.

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Myocardial perfusion imaging with thallium-201 is finding increasing use in clinical cardiology. Its major application has been the evaluation of ischemic heart disease (1-3), but characteristic myocardial images have also been reported in idiopathic hypertrophic subaortic stenosis and congestive cardiomyopathy (4,5). Recently thallium-201 has been used to identify the presence of right-ventricular hypertrophy in patients with pulmonary hypertension (6). Visualization of atrial myocardium with thallium-201, however, has not been achieved previously in either health or disease. This report presents an unusual congenital cardiac malformation in an adult in which the right atrium is clearly identified by thallium-201 myocardial imaging.

CASE REPORT

A 23-year-old woman was referred for evaluation of cyanotic congenital heart disease. She had cyanosis at birth but was asymptomatic. Cardiac catheterization was performed at 1 yr of age and a diagnosis of tricuspid atresia was suggested. She remained asymptomatic until age 7, when increasing cyanosis and moderate exercise intolerance developed. A Blalock-Taussig anastomosis was performed with a good functional result. At age 22 she noted increasing cyanosis and developed mild exercise intolerance, which progressed over the next 1.5 yr. An electrocardiogram showed right axis deviation and prominent P waves, suggesting right atrial enlargement and hypertrophy. Cardiac catheterization revealed pulmonary atresia with an intact interventricular septum and stenosis of the Blalock-Taussig anas-

tomosis. The right ventricle was hypoplastic with moderate hypokinesis, and moderate tricuspid regurgitation was present. The right atrium was enlarged with a mean right atrial pressure of 4 mm Hg.

Scintigraphic studies were performed on a mobile scintillation camera equipped with a high-resolution collimator. Before operation, myocardial imaging was performed with 1.5 mCi of thallium-201, using a 20% window centered over the characteristic mercury x-rays (69-83 keV), and collecting 400,000 counts per view. An essentially normal left ventricular pattern of thallium-201 distribution was demonstrated (Figure 1, right), but a thin rim of thallium uptake was identified medially and parallel to the ventricular septum (arrows). This corresponded to the right cardiac border on a radionuclide angiogram that was subsequently performed using 15 mCi of Tc-99m pyrophosphate (Figure 1, left). This was characteristic of a large right-to-left shunt. Due to the hypoplastic right ventricle, surgical correction was performed using a modification of the Fontan procedure for tricuspid atresia (7). The tricuspid valve orifice was closed with a pericardial patch, the Blalock-Taussig shunt and the atrial septal defect were both closed, and a valved external conduit was connected from the right atrial appendage to the main pulmonary artery. The postoperative course was uncomplicated and the patient became acyanotic.

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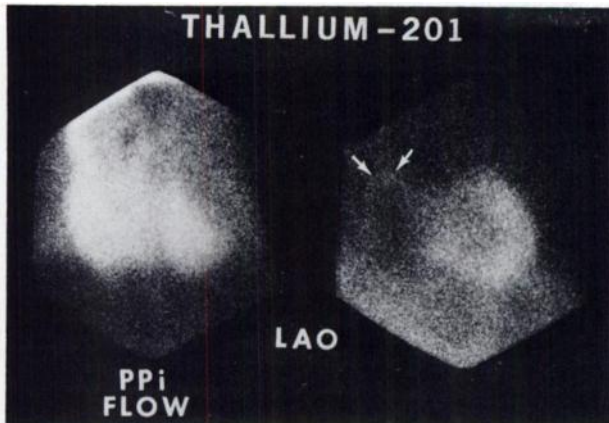


FIG. 1. Pyrophosphate composite flow image (left), obtained after thallium study, shows anatomical position of right atrium, with no apparent pulmonary outflow tract. Left ventricle was noted to have early activity consistent with right-to-left shunt at atrial level. Thallium-201 static image (right) shows essentially normal left ventricular distribution, and activity is seen in the area of right atrium (arrows).

Ten days after surgery, thallium-201 and radionuclide angiocardiography were repeated (Figure 2). The enlarged right atrium was clearly shown in the thallium images, and the Tc-99m pyrophosphate flow study was normal, with no evidence of left-to-right shunt. No atrial pyrophosphate accumulation was seen in delayed views.

DISCUSSION

Thallium-201 provides a useful noninvasive means of assessing regional myocardial blood flow and functioning myocardial muscle mass. The left ventricular free wall and the interventricular septum are the major areas of myocardial thallium-201 uptake and are well visualized with imaging at rest (8). Images can be used to assess homogeneity of thallium uptake and relative left ventricular size, thickness,

and wall motion (5,6). Areas of diminished thallium-201 myocardial activity have correlated well with regional perfusion abnormalities and abnormal left ventricular wall motion in patients with coronary-artery disease (5,9). Characteristic images have also been obtained in patients with idiopathic hypertrophic subaortic stenosis, in which the disproportionately thickened ventricular septum can be identified in the left anterior oblique view and compared with the thickness of the left-ventricular free wall (4).

Recently thallium-201 has been used to evaluate right ventricular function. In normal subjects imaged at rest, right-ventricular thallium-201 uptake is only occasionally visualized (8). In situations of increased myocardial blood flow, however, particularly in exercise scintigraphy, right ventricular thallium-201 activity is usually evident (9). In addition, increased right-ventricular muscle mass may also result in visualization of the right ventricle with the patient at rest. Cohen et al. (6) have reported consistent visualization as well as increased relative right ventricular wall thickness in patients with pulmonary hypertension.

Since situations of increased myocardial blood flow, or increased myocardial muscle mass, may be associated with visualization of thallium-201 activity in regions not usually identified, one might predict that under certain conditions atrial myocardium could also be imaged. Pulmonary atresia with intact ventricular septum is usually associated with hypoplasia of the right ventricle, and is functionally similar to tricuspid atresia when the right ventricle is small (10), as in this patient. The presence of right atrial hypertrophy and enlargement provides a setting in which atrial thallium-201 uptake might be visualized. A small area of thallium-201 activity was present in the region of the right atrium in our pre-operative study, consistent with increased right atrial

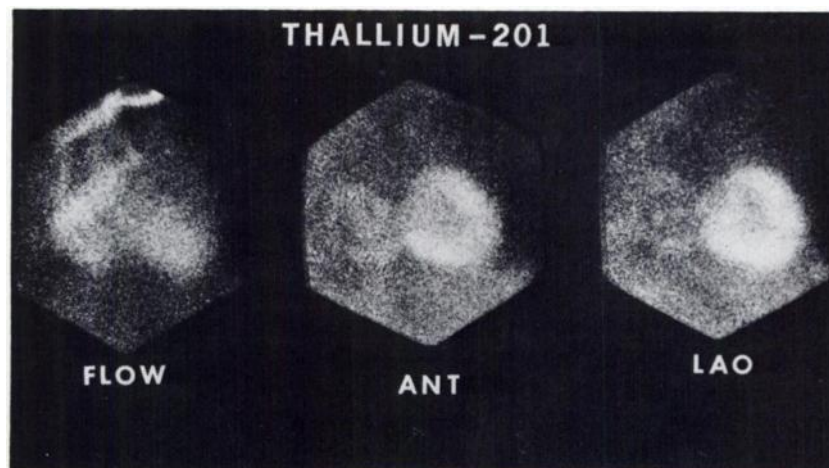


FIG. 2. Postoperative composite pyrophosphate flow image (left), obtained after thallium study, now shows right atrium and conduit to pulmonary artery. Thallium-201 images (center and right) now show even greater activity in right atrium.

mass. Surgical correction necessitated conversion of the right atrium into the sole venous pumping chamber with, presumably, an increased work load, and postoperatively the thallium-201 image showed more extensive visualization of the right atrium. These unusual images demonstrate that thallium-201 can identify atrial myocardium, and suggest that atrial visualization may also occur in other pathologic conditions involving atrial overload or enlargement.

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