the intercostal artery. A percentage (the percentage of "safe space") was then obtained using the rib-to-rib distance as the denominator and the rib-to-intercostal artery distance as the numerator. Percentages were used inasmuch as the measurements were made from roentgenograms which had varying degrees of magnification, and thus, "absolute" distances might be open to question. Use of percentages also avoids potential confusion resulting from the absolute "safe space" being smaller in small persons who have smaller intercostal spaces.

RESULTS
Analysis of the data demonstrated a definite trend toward increasing intercostal artery tortuosity with advancing age (Fig 2). As a consequence, the "percentage of safe space" available for thoracocentesis tended to decrease with advancing age (Fig 3). No correlation was noted between intercostal artery tortuosity and systemic blood pressure levels, or aortic tortuosity as demonstrated by chest radiography.

DISCUSSION
The results clearly demonstrate that the intercostal arteries become increasingly tortuous with age. The increase appears to be greatest between the ages of 40 and 60. As tortuosity increases, the amount of space available for safe insertion of a thoracocentesis needle decreases (ie, the "safe space" is decreased). Thus, it is mandatory that careful attention be paid to the proper technique for performing thoracocentesis in elderly patients, and in particular, that the needle be inserted just over the superior border of the rib rather than higher in the rib interspace.

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Severe Right Ventricular Outflow Tract Obstruction Caused by an Intracavitary Cardiac Neurilemoma*
Successful Surgical Removal and Postoperative Diagnosis

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A 32-year-old woman with a one-year history of progressive shortness of breath and chest pain was found to have a grade 4/6 systolic murmur at the base of the heart and left sternal border. Right ventricular enlargement was found by physical examination, ECG, and chest roentgenogram. Cardiac catheterization showed elevated right ventricular pressure, an intracavitary pressure gradient, and inability to enter the pulmonary artery. Angiography revealed a mass in the right ventricular outflow tract. Successful surgical removal of a large, well-encapsulated tumor mass was accomplished, and the tumor was interpreted as a benign neurilemoma. Postoperatively, the patient improved remarkably.

Primary cardiac neurilemoma is very rare, and this case appears to be the first arising from the right ventricle and presenting as an intracavitary tumor producing outflow obstruction. The incidence of cardiac tumors is very low and their diagnosis is often made at necropsy. The ante-mortem demonstration has improved with the use of echocardiography and other radiographic procedures and has led to the successful removal of increasing numbers of different cardiac tumors. The

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522 BETANCOURT ET AL

CHEST, 75: 4, APRIL, 1979
majority of cardiac tumors are histologically benign; however, most of them are potentially fatal depending upon the hemodynamic effects they exert on the heart. Sudden death is one important consequence of cardiac tumors and it can occur by obstruction of blood flow, production of severe arrhythmias, and by thromboembolic phenomena. 

Intracavitary right ventricular outflow tract obstruction has been caused by different types of primary tumors and pseudotumors, most common of which are myxomas and sarcomas. To our knowledge, this is the first case of obstruction of the right ventricular outflow tract caused by a neurilemoma.

CASE REPORT

A 32-year-old woman was asymptomatic until one year prior to the first admission on Jan 20, 1975, when she noted exertional dyspnea. This progressed rapidly and was accompanied by chest pain and dyspnea even at rest. There was no history of fainting or palpitations. She had four uneventful pregnancies, but she was told she had a heart murmur during her third pregnancy eight years prior to this admission. There was no history of rheumatic fever, cyanosis, anorexia, weight loss, or peripheral edema. She appeared healthy. The pulse rate was 80 beats per minute; blood pressure, 170/110 mm Hg, and there was moderate distension of neck veins at 45 degrees. The lungs were clear with a very active precordium and easily palpable right ventricle. A systolic thrill was felt over the pulmonic area and left sternal border. The second heart sound was widely split but with normal variation during respiration. A grade 4/6 systolic murmur was heard all over the precordium. There was no variation in the intensity of the heart sounds or in the murmur in different body positions or during respiration. There were no diastolic murmurs or rumbles.

The ECG showed a normal sinus rhythm with normal atrioventricular conduction, right axis deviation, right ventricular and right atrial enlargement, right bundle branch block, and ST-T wave abnormalities considered secondary to block or ventricular enlargement. Chest x-ray films showed marked cardiomegaly with apparent biventricular components. Values for blood count, urinalysis, blood urea nitrogen, and fasting blood sugar were normal.

Cardiac catheterization revealed (all pressures in millimeters of mercury) a mean right atrial pressure of 7, right ventricular inflow 120/0, end diastolic pressure 7; right ventricular outflow tract 50/0 with a end diastolic pressure 4; pressure curves of different configurations were recorded in the right ventricle; pressure gradient at the right ventricular outflow tract was 90. The ascending aortic pressure was 162/90, mean 125; in the left ventricle it was 162/0, with an end diastolic pressure of 6.

Angiography revealed an enlarged right atrium and right ventricle, narrowing of flow at the level of the right ventricular outflow tract due to a large radiolucent mass in the right ventricle (Fig 1), and increased thickness at the left ventricular wall. The aortogram was normal.

On May 6, 1975, under cardiopulmonary bypass, a 8.75 × 6.25-cm intracavitary tumor weighing 96 gm was removed (Fig 2). It was attached to the parietal band of the crista by a broad base which extended to the area of the tricuspid valve. After excision of the mass, the base was deeply shaved down to include portions of the underlying myocardium. The tumor surface was smooth, and its cut surface was yellow.

FIGURE 1. Right atrial angiogram showing severe obstruction of right ventricular outflow tract by a huge radiolucent mass.

Microscopic sections showed the typical Antoni type A-tissue, with palisading of nuclei and fibers. In some areas, the fiber and cellular arrangement simulated Meissner corpuscles (Fig 3).

DISCUSSION

A variety of histologic types of primary intracavitary right ventricular cardiac tumors and pseudotumors has been reported, the most frequent of which have been in

FIGURE 2. Gross specimen (two pieces together) showing a shiny capsule.
order of frequency: myxoma, sarcoma, fibroma, rhabdomyoma and hamartoma. Less frequently encountered tumors include hematic cyst, teratoma, hematendothelioma, lipoma, mesenchymoma, and lymphangioma. Their clinical diagnosis has been based on the following various observations: (a) right ventricular inflow and outflow tract obstruction; (b) right ventricular failure; (c) pericardial effusion; (d) syncope; (e) pulmonary embolization; (f) fever; and (g) other less frequently occurring manifestations.

With the exception of the case reported by Factor et al, all the reported primary neurogenic cardiac tumors have been described on the external surface of the heart, and therefore, their origin has been questioned — primary cardiac vs extension from neurogenic tumors originating in adjacent structures. After review of the literature, we believe this is the first reported example of primary benign intracavitary neurogenic tumor, neurilemoma, without evidence of neurofibromatosis which manifested itself clinically by obstruction of the right ventricular outflow tract. We believe it originated from the sheaths of myelinated nerve fibers described in the ventricular septum and papillary muscles by Hirsh.

The cause of hypertension in this patient is not clear, but the return of her blood pressure to almost normal value postoperatively suggests a causal relationship between the tumor and hypertension. Incidentally, the patient reported by Factor et al, also had hypertension.

Unfortunately, studies for endocrine function abnormalities were not performed. However, postoperatively, the patient improved remarkably, and no evidence of tumor recurrence has been noted 36 months after surgery.

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**Mucor Mediastinitis**

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A 69-year-old man with lymphocytic leukemia presented with fever, a pericardial friction rub, widening of the mediastinum, and left pleural effusion. Atrial fibrillation, refractory hypotension and acute paraplegia punctuated his hospital course. Invasion of the mediastinum, myocardium, mediastinal, coronary and spinal arteries with mucormycosis was present at post-mortem examination.

Mediastinitis usually occurs secondary to infection involving structures passing through the mediastinum. From the Department of Internal Medicine, University of Texas Health Science Center at Dallas, and Medical Service, Veterans Administration Hospital, Dallas.

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524 CONNOR, ANDERSON, SMITH

CHEST, 75: 4, APRIL, 1979