episodes of respiratory distress.\textsuperscript{7}

The involvement of the respiratory muscles by the extrapyramidal disorders as the cause of reduced inspiratory and expiratory flows and flow oscillations is unlikely. The diaphragm seems to be spared in extrapyramidal disorders,\textsuperscript{14,17} and we have been unable to show any changes in pleural pressure associated with rhythmic contractions of expiratory muscles.\textsuperscript{7}

Absence of a significant bronchodilator effect and the good response of this patient's respiratory symptoms and flow rates to levodopa suggest that good control of parkinsonism may be all that is required to improve respiratory function in these patients.

Parkinsonian involvement of the upper airway can produce a dysfunctional upper airway obstruction of varying degree but severe enough to produce serious airflow limitation and dyspnea in these patients.

\textbf{REFERENCES}

1 Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. Neurology (Minneapolis) 1967; 17:427-42
13 Quinn NF. Anti-parkinsonian drugs today. Drugs 1984; 28:236-44
17 Petit JM, Delhez L. Activite electrique du diaphragme dans la maladie de Parkinson. Arch Int Physiol 1961; 69:413-17

\textbf{Echocardiographic Detection of an Infected Superior Vena Caval Thrombus Presenting as a Right Atrial Mass*}

Andrew E. Dick, M.D.,† Charles M. Gross, M.D.,‡ and Joseph W Rubin, M.D., F.C.C.P.

A patient was found to have a large mobile right atrial mass by two-dimensional echocardiography after developing sep sis due to prolonged central hyperalimentation. Contrast echocardiography was helpful in localizing the origin of the mass. A large infected thrombus emanating from the superior vena cava was removed at operation. The discussion includes a review of the literature on the echocardiography of right atrial masses.

(Chest 1989; 96:219-14)

The ability of two-dimensional echocardiography to non-invasively examine the right atrium makes the differential diagnosis of right atrial masses an issue of considerable practical importance. There is an abundance of literature on right atrial thromboembolism,\textsuperscript{14} but the differential diagnostic spectrum includes other entities, from normal structures to primary or metastatic tumors.\textsuperscript{14} This report demonstrates the utility of echocardiography in characterizing a particular type of right atrial mass that developed due to prolonged central venous catheterization. To our knowledge, this entity has been unreported previously in the literature.

\textbf{CASE REPORT}

A 45-year-old man was transferred to our institution for further evaluation of persistent fever. He had presented to another hospital with several days of epigastric pain, nausea, abdominal distention, anorexia, and early satiety. He denied consumption of alcohol, although there was a history of alcohol abuse and recurrent pancreatitis, for which he had last been hospitalized three months earlier. At that time, a large pancreatic pseudocyst was demonstrated on computerized tomographic scan, and the patient's condition improved with conservative management. Initial laboratory studies at the other hospital revealed blood cultures negative at 48 hours, with normal serum levels of amylase and lipase. There was improvement with nasogastric suction, intravenous fluids, and cepheporazone intravenously. Past medical history was significant for an exploratory laparotomy four years previously, a right inguinal hernia repair five years earlier, and glucose intolerance.

On physical examination, the patient was a thin man in no apparent distress. His blood pressure was 110/70 mm Hg, the pulse rate was 120 beats per minute, the respiratory rate was 20/minute, and the oral temperature was 38.2°C (100.6°F). The abdomen was distended, and normoactive bowel sounds were present throughout. On palpation of the left upper quadrant, mild tenderness was elicited, and a cystic mass was palpable. The ECG showed sinus tachycardia at a rate of 100 beats per minute, early transition in

*From the Sections of Cardiology and Thoracic and Cardiac Surgery, Medical College of Georgia and Veterans Administration Medical Center, Augusta.
†Instructor in Medicine.
‡Associate Professor of Medicine and Director, Echocardiography Laboratories.
§Professor of Surgery and Chief, Section of Thoracic and Cardiac Surgery.

Echo Detection of Infected SVC Thrombus (Dick, Gross, Rubin)
lead V₆, and left atrial abnormality. The chest radiograph was remarkable only for a small area of atelectasis in the left base. Kidney, ureter, and bladder and upright films of the abdomen revealed a nonspecific bowel gas pattern. Significant laboratory data on admission included a hemoglobin level of 8.7 g/dL, and a total white blood cell count of 16,000/cu mm with a leftward shift. Serum levels of amylase and lipase were normal, but a two-hour urinary amylase concentration was elevated. Results of hepatic function tests were normal. Computerized tomography of the abdomen showed evidence of chronic pancreatitis, multiple areas of early pseudocyst formation, and a large phlegmon in the lesser sac. The patient was given nothing by mouth, nasogastric suction was continued, and hyperalimentation was begun using a central venous catheter inserted into the superior vena cava via the right subclavian vein. Triple antibiotic therapy with tobramycin, clindamycin, and ampicillin was given for a total of seven days and resulted in defervescence. Cultures of blood, urine, and sputum were negative.

Over the next two weeks, conservative management resulted in improvement in the pancreatic inflammatory process, as demonstrated by a follow-up computerized tomographic scan; however, one month after admission, the patient's temperature rose abruptly to 39.5°C (103.5°F) orally. No erythema, exudate, or swelling were noted at the site of insertion of the central venous catheter. The catheter, which had been in place for three weeks, was removed and the tip cultured. The white blood cell count was 39,400/cu mm with a leftward shift, and cultures of blood were positive for coagulase-negative Staphylococcus.

The patient was started on antibiotic therapy, but persistent fever after five days of appropriate antibiotic therapy directed attention to the heart as a potential locus of infection, and an echocardiographic examination was performed (Fig 1). This revealed a large, highly mobile pedunculated mass extending from the superior vena cava into the body of the right atrium. The origin of the mass in the superior vena cava was confirmed by the injection of agitated physiologic saline solution via an antecubital vein. Since the mass appeared to have considerable embolic potential, surgery was carried out promptly. At operation, a 7-cm mobile thrombus (Fig 2), abundantly streaked with purulent material, extended into the body of the right atrium from a point of attachment in the superior vena cava. Upon removal, the distal portion of the thrombus approximated a cast of the venous system. Culture of the thrombus grew out coagulase-negative Staphylococcus with the same antibiotic sensitivities as the organism isolated from the cultures of the blood. The postoperative course was uneventful; however, after two weeks of a planned four-week course of intravenous vancomycin, the patient left the hospital against medical advice.

**DISCUSSION**

Right atrial masses of many types have been described, but this appears to be the first report of an infected thrombus originating from the superior vena cava presenting as a right atrial mass. It seems clear that this complication was related to prolonged central venous catheterization.

The differential diagnosis of right atrial masses detected echocardiographically is presented in the following tabulation:

<table>
<thead>
<tr>
<th>Structural variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiari network</td>
</tr>
<tr>
<td>Eustachian valve</td>
</tr>
<tr>
<td>Thebesian valve</td>
</tr>
<tr>
<td>Thrombus</td>
</tr>
<tr>
<td>Free-floating</td>
</tr>
<tr>
<td>Adherent</td>
</tr>
<tr>
<td><strong>Tricuspid valve endocarditis</strong></td>
</tr>
<tr>
<td>Infective vegetations</td>
</tr>
<tr>
<td>Marantic vegetations</td>
</tr>
</tbody>
</table>

**Figure 1A (top).** Subcostal five-chamber view in diastole, demonstrating 4 x 2-cm right atrial mass protruding through tricuspid valve (TV) into right ventricle (RV). Depth scale markers are 1 cm apart. LB (bottom). Subcostal view of right side of heart in diastole following injection of agitated physiologic saline solution via antecubital vein. Note stream of contrast material from superior vena cava (SVC) entering right atrium (RA) adjacent to and surrounding mass and passing through tricuspid valve (TV) into right ventricle (RV). Depth scale markers are 1 cm apart. AV, Aortic valve; LA, left atrium; LV, left ventricle; and IVC, inferior vena cava.

Flail tricuspid valve leaflets
Tumors
Metastatic
Primary
Tricuspid valve or annular calcification
Iatrogenic
Central venous catheters
Swan-Ganz catheter
Pacemaker electrodes
Prosthetic tricuspid valve
Intraatrial baffles
Ventricular septal defect patches
Sinus of Valsalva aneurysm or rupture
Artifacts

Normal right atrial structures are frequently detectable echocardiographically and should not be confused with true right atrial mass lesions. These structures include Chiari
network and prominent eustachian or thebesian valves. Right atrial thrombi may represent emboli from deep veins in the thigh and pelvis, or they may develop in situ due to predisposing conditions such as those listed in the following tabulation:

<table>
<thead>
<tr>
<th>Catheters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central venous</td>
</tr>
<tr>
<td>Swan-Ganz</td>
</tr>
<tr>
<td>Ablation of atrioventricular node</td>
</tr>
<tr>
<td>Extracorporeal membrane oxygenation</td>
</tr>
<tr>
<td>Ventriculoatrial shunt for hydrocephalus</td>
</tr>
<tr>
<td>Peritoneovenous shunt for ascites</td>
</tr>
<tr>
<td>Pacemaker electrodes</td>
</tr>
<tr>
<td>Low cardiac output</td>
</tr>
<tr>
<td>Cardiomyopathies</td>
</tr>
<tr>
<td>Right ventricular infarction</td>
</tr>
<tr>
<td>Right atrial enlargement</td>
</tr>
<tr>
<td>Right atrial surgery</td>
</tr>
<tr>
<td>Tricuspid valve endocarditis</td>
</tr>
<tr>
<td>Endomyocardial fibrosis</td>
</tr>
</tbody>
</table>

In general, tricuspid valve vegetations tend to be larger than those seen with mitral valve endocarditis. This difference in size is probably related to the fact that the circumference of the tricuspid anulus is larger and right ventricular systolic pressure lower than the corresponding values for the left side of the heart, however, echocardiographic features bearing upon prognosis have not been identified by two dimensional or M-mode echocardiography. Myxomas, the most common intra-atrial tumors, most frequently originate from the atrial septum and are usually pedunculated. Metastatic tumors rarely present as intra-atrial masses but, when present, are most often due to tumor invading the inferior vena cava and extending into the right atrium. There are reports of right atrial thrombi occurring secondary to central venous catheters and these may be associated with pulmonary thromboembolism. Contrast echocardiography may be helpful in confirming the superior vena cava as the point of origin of the thrombus, as in our patient. Sinus of Valsalva aneurysm can, on two-dimensional echocardiography, mimic a right atrial mass. Artifacts are of particular importance because of their possible confusion with a mass lesion. Reverberations, beam-width artifacts due to insufficient lateral resolution, and truncation of adjacent structures due to slight changes in transducer angulation or position can mimic right atrial masses. Artifactual echoes can usually be minimized by proper adjustment of gain settings and should be suspected when they cannot be consistently reproduced in multiple transducer planes.

**References**

1. Felner JM, Churchwell AL, Murphy DA. Right atrial thromboemboli: clinical, echocardiographic, and pathophysiologic manifestations. J Am Coll Cardiol 1984; 4:1041-51