Echocardiographic Findings after Tricuspid Valvectomy*

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Resection of the tricuspid valve without prosthetic replacement has successfully been performed in patients with tricuspid valvular endocarditis. Using M-mode, two-dimensional, and Doppler echocardiograms, we studied four patients who underwent tricuspid valvectomy. All patients had previous history of intravenous drug abuse and staphylococcal endocarditis with tricuspid valvular involvement. In all patients, M-mode and two-dimensional echocardiograms showed that the tricuspid valve was absent. The right ventricle was dilated, and the interventricular septum had paradoxical motion in each patient. In each patient the right atrium was dilated, and with each ventricular systole, it expanded and its short axis increased by 20 to 33 percent. This caused shift of the interatrial septum toward the left atrium, with compression of its cavity. Doppler echocardiographic studies showed retrograde flow during systole in the right atrium, inferior vena cava, and hepatic vein. Echocardiographic findings in patients with tricuspid valvectomy correlate with the pathophysiologic findings of this condition.

Over ten years ago, tricuspid valvectomy without prosthetic replacement was successfully performed in patients with tricuspid valvular endocarditis.1 Subsequently, others have reported similar procedures and evaluated the resulting hemodynamics.2,4 The echocardiographic findings in four patients who underwent surgical removal of the tricuspid valve without prosthetic replacement are reported.

CASE REPORTS

Four patients (ages 22 to 37 years, three men and one woman) who were intravenous drug abusers had previously developed acute staphylococcal endocarditis with tricuspid valvular involvement and septic pulmonary embolization. Optimal medical therapy did not control the infection, and tricuspid valvectomy was therefore performed at from 1 to 48 months prior to this echocardiographic study. At the time of the study, the patients were afebrile, free of any valvular infection, and had no signs of congestive left-sided failure.

All four patients had jugular pulsations with prominent v waves. Hepatomegaly with systolic pulsation was noted in two patients, and two patients had edema of the ankles. Two patients had a systolic ejection murmur loudest at the second left intercostal space. No holosystolic murmur or diastolic murmur was audible. Chest x-ray films showed right ventricular enlargement and right atrial enlargement in all patients. Three were in sinus rhythm, and the fourth was in atrial fibrillation.

RESULTS

The right ventricular internal dimensions were measured from the M-mode echocardiogram at the end of diastole. Right atrial size in this study was measured at the end of diastole as well as the end of systole. Measurement was performed on the four-chamber view of the two-dimensional echocardiogram. The long dimension of the atrium was calculated as the maximal distance between the tricuspid ring and the posterior wall of the right atrium. The short dimension is perpendicular to the long-dimensional measurement and shows the maximal interval between the interatrial septum and the free wall of the right atrium.

In each of the patients, the tricuspid valve was absent. Other echocardiographic data are summarized.

Table 1—Echocardiographic Findings after Tricuspid Valvectomy

<table>
<thead>
<tr>
<th>Patient, Sex, Age (yr)</th>
<th>Time after Valvectomy, mo</th>
<th>Right Atrial Size at End of Diastole, cm</th>
<th>Right Atrial Size at End of Systole, cm</th>
<th>End-Diastolic Right Ventricular AP Dimension (M-mode), cm</th>
<th>Pulmonic Valve (M-mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, F, 37</td>
<td>48</td>
<td>5.5</td>
<td>5.6</td>
<td>4.7</td>
<td>Midsystolic closure</td>
</tr>
<tr>
<td>2, M, 24</td>
<td>15</td>
<td>5.0</td>
<td>5.0</td>
<td>3.8</td>
<td>Not visualized</td>
</tr>
<tr>
<td>3, M, 34</td>
<td>9</td>
<td>4.4</td>
<td>4.8</td>
<td>4.1</td>
<td>Prominent &quot;a,&quot;</td>
</tr>
<tr>
<td>4, M, 22</td>
<td>2</td>
<td>4.7</td>
<td>4.9</td>
<td>4.0</td>
<td>Premature closure</td>
</tr>
</tbody>
</table>

*AP, anteroposterior.

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in Table 1, Figure 1. The right atrium and the right ventricle were dilated in each patient. In addition, the M-mode echocardiogram showed paradoxical septal motion. Table 1 also shows that the right atrium expanded during each ventricular systole. The expansion was more prominent in the four-chamber view, in which unusual motion of the interatrial septum was identified. This septum shifted to the left with each ventricular systole, causing a reduction in left atrial size. With every ventricular systole, the right atrium expanded, and the left atrium was compressed (Fig 2).

Subxiphoid echocardiographic studies also showed systolic expansion of the hepatic vein and the inferior vena cava. The pulmonic valve was visualized in three out of four patients. Midsystolic closure of the pulmonic valve was noted in two patients. Of the three

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FIGURE 1. Two-dimensional echocardiogram (four-chamber view; systolic frame). Note absent tricuspid valve. Right atrium (RA) is dilated, and interatrial septum (arrow) is shifted toward left. RV, right ventricle; LV, left ventricle; MV, mitral valve; and LA, left atrium.

FIGURE 2. Short-axis view. A (top), end-diastolic frame; and B (bottom), end-systolic frame. Note absence of tricuspid valve. In systole, interatrial septum (arrow) changes direction of its convexity and bulges toward left atrium (LA). RVO, right ventricular outflow tract; Ao, aorta; and RA, right atrium.
patients in sinus rhythm, a prominent atrial kick was present in two. Premature opening of the pulmonic valve was noted in one individual.

After injection of 5 ml of agitated saline solution into the brachial vein, microcavitation was noted in the right atrium and the right ventricle, moving retrogradely during systole. The microcavitation could easily be detected in the hepatic vein and inferior vena cava, with clear evidence of retrograde systolic flow. These findings have previously been identified with tricuspid regurgitation.

Doppler echocardiographic studies were performed in three patients and showed retrograde flow during systole in the right atrium, inferior vena cava, and hepatic vein.

**DISCUSSION**

Tricuspid valvectomy without prosthetic replacement is considered to be the treatment of choice in patients with bacterial valvular endocarditis in whom antibiotics fail to eradicate the infection. Most patients have tolerated surgery without hemodynamic compromise or severe heart failure. Previous reports described occasional M-mode findings in patients after this procedure. Such findings include paradoxic septal motion and premature opening of the pulmonic valve with deep a wave. Dilated right-sided chambers and paradoxic septal motion are frequently seen in patients with tricuspid regurgitation (without tricuspid valvectomy), atrial septal defect, pulmonic regurgitation, and partial anomalous pulmonary venous drainage. This finding is considered secondary to right ventricular volume overload.

Our study describes two-dimensional echocardiographic findings after tricuspid valvectomy. Two-dimensional echocardiograms are superior to M-mode echocardiograms in evaluating the size of the right atrial chamber and visualization of the interatrial septum. Ventricularization of the right atrium causes a dramatic increase in right atrial pressure during systole. Since the left atrial pressure is normal, the high pressure in the right atrium during systole is transmitted across the interatrial septum and shifts the interatrial septum toward the left atrium, and left atrial compression results. Previous reports described systolic left atrial expansion in patients with severe mitral regurgitation.

Systolic left atrial compression has not been identified in patients with rheumatic tricuspid regurgitation. This may be due to a lesser degree of tricuspid regurgitation and the coexistence of elevated left atrial pressures associated with mitral valvular disease. Despite the fact that these patients had severe regurgitation from the right ventricle to the right atrium, a murmur typical of tricuspid regurgitation could not be auscultated. This is likely due to the absence of turbulence of blood due to that usually associated with tricuspid regurgitation across a defective valve. An unusually large "a" kick was noted on the pulmonic valvular echocardiogram of two patients in normal sinus rhythm. It is related to the increased trans-tricuspid end-diastolic flow. Mid-systolic closure is associated with severe tricuspid regurgitation.

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**REFERENCES**