
Value of Two-dimensional Echocardiography in Detecting Tricuspid Stenosis

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with the technical assistance of M. Butler

SUMMARY We reviewed the M-mode and two-dimensional echocardiograms of 100 consecutive patients with rheumatic heart disease. All were subsequently studied by cardiac catheterization and angiography. In four patients, cardiac catheterization showed tricuspid stenosis (average mean diastolic gradient 6.2 mm Hg), which was confirmed during cardiac surgery. M-mode echocardiography showed a diminished EF slope in 12 patients (mean 26 mm/sec), including the four patients with tricuspid stenosis. Seven of the eight patients without tricuspid stenosis had significant pulmonary hypertension; the reasons for the diminished EF slope in the other patient could not be identified. Tricuspid stenosis was diagnosed in four patients from two-dimensional echocardiograms on the basis of diastolic doming and restricted leaflet motion of the tricuspid valve. These four patients were the same patients in whom tricuspid stenosis was diagnosed by cardiac catheterization. We conclude that two-dimensional echocardiography is useful in the diagnosis of tricuspid stenosis.

TRICUSPID STENOSIS may be a difficult diagnosis and can be easily missed on clinical examination1—3 and on cardiac catheterization. It is most often caused by rheumatic heart disease4, 5, 6 though it has been described in systemic lupus erythematosus,7 carcinoid syndrome,8 Loeffler’s endocarditis,9 metastatic melanoma10 and as a congenital anomaly.11 The incidence of significant tricuspid stenosis in rheumatic heart disease has been estimated to be about 3–5% on the basis of data from autopsy and cardiac catheterization studies.11, 12 The diagnosis of tricuspid stenosis is important because undetected and uncorrected tricuspid stenosis increases operative morbidity and mortality of cardiac surgery for left-sided cardiac valvular disease and worsens the prognosis for those who survive.5, 13, 14

Echocardiography, both M-mode and two-dimensional, is a simple noninvasive technique for visualizing the tricuspid valve. In this report, we review the value of echocardiography in detecting tricuspid stenosis in 100 patients with rheumatic heart disease.

Materials and Methods

We reviewed the records of 100 consecutive patients with rheumatic heart disease studied by cardiac catheterization and by echocardiography. All 100 patients underwent right- and left-sided cardiac catheterization and cardiac angiography. In all 100 patients, M-mode and two-dimensional echocardiography were performed before cardiac catheterization. Angiography was performed in the usual manner.13 Simultaneous pressure across the tricuspid valve was obtained through a double-lumen catheter. Pullback pressure tracings were also obtained across the tricuspid valve. The mean pressure gradient across the tricuspid valve was calculated by planimetry.

M-mode echocardiography was performed using an Ekoline 20-A recorder. A 2.25-MHz transducer was
used and tracings were recorded on an Ekoline 21 recorder at a paper speed of 50–100 mm/sec. The transducer was placed in the third to fifth intercostal space with the patient’s right shoulder elevated 20–45° (left lateral position). High coarse gain, low reject and high damping settings were used.  

Two-dimensional echocardiograms were obtained using a 3-MHz transducer (ATL Instruments) mechanically driven through an 80° sector. The images were recorded on videotape and were available for analysis in real time, slow motion or as single frames. Individual frames were converted into hard copies using a Polaroid photographic system. The transducer was variously positioned to obtain a parasternal long-axis view of the right ventricle, a parasternal short-axis view at the level of the aortic root, an apical four-chamber view and a subcostal four-chamber view. The two-dimensional echocardiograms were reviewed by two experienced observers before the catheterization data were known.

**Results**

Of the 100 patients, 12 had M-mode or two-dimensional echocardiographic abnormalities of the tricuspid valve. The cardiac index and pulmonary pressures of these patients are shown in table 1. Twelve patients had diminished EF slope (less than 35 mm/sec). The EF slope in these 12 patients was 19–33 mm/sec (mean 26 mm/sec). We detected anterior motion of the posterior leaflet of the tricuspid valve in patients 6, 7, 8 and

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**Table 1. Catheterization, Echocardiographic, Surgical Results**

<table>
<thead>
<tr>
<th>Pt</th>
<th>Age (years)</th>
<th>Sex</th>
<th>CO (l/min)</th>
<th>CI (l/min/m²)</th>
<th>TVG (mm)</th>
<th>PAP (mm Hg)</th>
<th>2-D EF slope</th>
<th>Paradoxical motion of PLTV</th>
<th>Surgery</th>
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<td>1</td>
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Abbreviations: CO = cardiac output; CI = cardiac index; TVG = tricuspid valve gradient; PAP = pulmonary artery pressure; 2-D + = appearance of doming and restricted motion of leaflets on two-dimensional echocardiography; PLTV = posterior leaflets of tricuspid valve; NS = not seen; Surgery + = evidence of tricuspid stenosis at surgery.

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**Figure 1.** Simultaneous right ventricular (RV) and right atrial (RA) pressure recordings showing a large diastolic pressure gradient across the tricuspid valve in the patient referred to in figures 2 and 3.

**Figure 2.** Two-dimensional echocardiogram showing a systolic frame in the parasternal short-axis view illustrating a thickened tricuspid valve (TV) in patient 9, who had proved tricuspid stenosis. Ao = aorta; RA = right atrium; LA = left atrium, QRS = QRS complex; P = P wave.
FIGURE 3. A diastolic frame from patient 9 showing doming and restricted motion of the tricuspid leaflets. TV = tricuspid valve; Ao = aorta; RA = right atrium; LA = left atrium; T = T wave.

10. Catheterization showed evidence of tricuspid stenosis (diastolic gradient across the tricuspid valve) in four patients (fig. 1). The presence of tricuspid stenosis was confirmed at open heart surgery. These four patients were also shown to have mitral stenosis.

In these four patients, two-dimensional echocardiography showed thickening, doming of the tricuspid valve and restricted motion of the valve leaflets (figs. 2, 3 and 4). Doming of the tricuspid valve was seen during diastole as a hemispheric shape of the leaflets, which instead of opening relatively parallel and straight to each other, were concave toward the right atrium with their tips separating to a lesser extent than their midportion. All four echocardiographic views used were useful for the diagnosis, though the short-axis views at level of the aortic root were the most impressive. None of the patients without evidence of a tricuspid gradient had doming of the tricuspid valve or restriction of leaflet excursion.

Discussion

The criteria used to diagnose tricuspid stenosis on M-mode echocardiography include a diminished EF slope, anterior displacement of the posterior leaflet of the tricuspid valve and thickening of the valve. However, there are problems with each of these criteria. In rheumatic heart disease there is often concomitant pulmonary hypertension and right ventricular hypertrophy, which diminish the EF slope. The anterior displacement of the posterior leaflet of the tricuspid valve cannot always be detected and therefore, when absent, tricuspid stenosis cannot be excluded. M-mode echocardiography in patient 6 showed definite anterior motion of the posterior leaflet of the tricuspid valve, but catheterization showed no gradient. Two-dimensional echocardiography showed thickening, but no evidence of doming. During surgery, thickening of the tricuspid valve and some adhesions between leaflets were noted. Tricuspid regurgitation was also observed. The abnormal anterior motion of the posterior leaflet of the tricuspid valve (fig. 5) detected by M-mode echocardiography was probably caused by the adhesions seen at surgery. Thickening of the valve indicates disease, but not stenosis. In our series, 12 patients had diminished EF slopes and only four had stenosis proved by catheterization studies and surgery.

FIGURE 5. M-mode echocardiogram of the tricuspid valve showing diminished EF slope of the anterior leaflet (AL) and paradoxical motion of the posterior leaflet (PL) in patient 6.
Seven of the other eight patients had pulmonary hypertension, which could account for the diminished EF slope. Patient 5 however, had normal pulmonary arterial pressures and cardiac output.

Two-dimensional echocardiography displays the tricuspid valve in several projections, enabling a better visualization of the valve. Diastolic doming of the cardiac valve is characteristic of valve stenosis. In our series, all four patients with tricuspid stenosis had doming of the tricuspid valve on two-dimensional echocardiography, together with restricted motion of the valve leaflets. In none of the patients without tricuspid stenosis were these abnormalities seen on the echocardiogram. A further study of a larger group of patients with tricuspid stenosis is required to ascertain the sensitivity and specificity of two-dimensional echocardiography in its diagnosis. However, such a study may be difficult to obtain because of the low incidence of tricuspid stenosis in rheumatic heart disease. For example, four of our 100 patients with rheumatic heart disease had evidence of tricuspid stenosis, an incidence similar to that previously reported.11,12

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References

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