The Variable Echocardiographic Features in Aortic Valve Endocarditis

By TAYLOR M. WRAY, M.D.

SUMMARY
The echocardiographic abnormalities in five cases of aortic valve endocarditis are described and are correlated with the anatomical appearance of the valve at the time of aortic valve replacement. These echocardiographic findings are compared with those which have been reported previously in this condition. Thickening of the aortic leaflets in systole or multiple linear or coalescent aortic valve echoes in diastole are highly suggestive of valvular vegetations. Ruptured aortic leaflets may produce chaotic, high-frequency echo patterns which differ from those produced by vegetations. The specificity of these echocardiographic patterns is discussed.

IT IS EVIDENT from several recent reports that the aortic valve echograms in patients with aortic valve endocarditis do not have a uniform appearance, and there is considerable variation depending on the anatomy of the valve leaflets.1 This report reviews the previously reported cases and presents five cases we have studied which define a spectrum of echocardiographic abnormalities of the aortic valve in endocarditis. The echocardiographic studies are correlated with the anatomical findings described at surgery.

Patient Material and Methods
In a nine month period between April 1974 and January 1975 five patients were admitted to the Vanderbilt University Hospital or the Nashville Veterans Administration Hospital with bacterial endocarditis and aortic regurgitation. The patients were all young, had a relatively brief illness and were acutely ill with congestive heart failure. After a period of antibiotic therapy all patients subsequently underwent aortic valve replacement because of persistent heart failure. Although one patient required a second operation because of perivalvular leak, the other patients had an uneventful postoperative course. The pertinent clinical data are summarized in table 1.

At least one preoperative echocardiogram was obtained in each patient. The echocardiographic findings and the appearance of the aortic valve at the time of surgery are summarized in table 2. Echocardiography was performed with a commercially available echograph using a 2.25 MHz, 13 mm diameter transducer focused at 7.5 cm. Strip chart recordings were made using a Honeywell model 1858 fiberoptic system (patients 1, 4 and 5) or a Cambridge multichannel photographic recorder (patients 2 and 3).

Discussion
The echocardiographic abnormalities in previously reported cases of aortic valve endocarditis are summarized in table 3. In an early echocardiographic description of aortic valvular vegetations by Dillon et al., emphasis was placed on the importance of the angle of the transducer and the complete scanning of the aortic valve area.1 Their report demonstrated clearly that the systolic and diastolic appearance of the aortic leaflets in endocarditis may vary greatly depending on the angle of the transducer.1 Nevertheless, it appears that certain general observations can be made regarding the various echocardiographic abnormalities of the aortic valve area in endocarditis. These generalizations are based on the previously reported cases and our own group of five patients.

Systolic Echocardiographic Patterns in the Aortic Root
Irregular or "shaggy" thickening of the anterior or posterior aortic leaflets is highly suggestive of aortic vegetations, especially in the clinical setting of aortic regurgitation of recent onset or suspected endocarditis.1, 2, 4, 5 The absence of clearly defined aortic leaflets in systole in endocarditis may suggest at least partial destruction of one or more of the leaflets. Although this finding was noted in all patients in the present series, satisfactory aortic cusp echoes may be difficult to record in patients without aortic valve disease. The disappearance of a cusp in sequential echocardiograms (fig. 1A and B) is particularly helpful in the diagnosis of leaflet destruction. Fine high frequency systolic fluttering of the aortic leaflets may be seen in echograms from normal subjects.7

Diastolic Echocardiographic Patterns in the Aortic Root
Multiple linear or coalescent diastolic echoes are

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Table 1

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age and sex</th>
<th>Infesting organism</th>
<th>Duration of symptoms preop</th>
<th>Duration of antibiotic therapy preop</th>
<th>Cardiac cath data (mm Hg)</th>
<th>Operative result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>41 M</td>
<td><em>Staphylococcus aureus</em></td>
<td>7 wk</td>
<td>6 wk</td>
<td>AO - 96/50</td>
<td>Uneventful recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LV - 100/28</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PAW - 24</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>25 F</td>
<td>alpha hemolytic streptococcus</td>
<td>2 wk</td>
<td>6 wk</td>
<td>Not performed</td>
<td>Uneventful recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>27 F</td>
<td><em>Streptococcus fecalis</em></td>
<td>2 wk</td>
<td>2 wk</td>
<td>Not performed</td>
<td>Uneventful recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>28 M</td>
<td><em>Streptococcus fecalis</em></td>
<td>8 wk</td>
<td>2 wk</td>
<td>AO - 90/50</td>
<td>Second operation for perivalvular leak</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LV - 100/50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PAW - 24</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>42 M</td>
<td><em>Diplococcus pneumoniae</em></td>
<td>5 wk</td>
<td>5 wk</td>
<td>AO - 90/40</td>
<td>Uneventful recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LV - 93/29</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PAW - 21</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AO = aorta; LV = left ventricle; PAW = pulmonary wedge.

Figure 1

A) Echogram of the aortic valve in patient 1 taken one month preoperatively. The anterior (right coronary) and posterior (noncoronary) leaflets appear to be intact in systole, although the posterior leaflet is thickened (small arrow). There are multiple non-uniform linear echoes in diastole (large arrow). LA = left atrium. (Sweep speed = 25 mm/sec.)  B) Echogram of the aortic valve in patient 1 taken one day preoperatively. The anterior leaflet appears intact (small arrow) but the posterior leaflet is no longer visible in systole. Irregular high-frequency diastolic echoes are now seen (large arrow) which are arising from flail segments of the noncoronary leaflet. (Sweep speed = 25 mm/sec.)
### Table 2

**Echocardiographic and Operative Findings in Aortic Valve Endocarditis (Present Series)**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Systolic echo appearance of AV</th>
<th>Diastolic echo appearance of AV</th>
<th>Abnormal diastolic echoes in LVOT</th>
<th>Appearance of AV at operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (a) 1 month preop</td>
<td>Thickened posterior leaflet</td>
<td>Multiple linear echoes</td>
<td>No</td>
<td>Destruction of noncoronary leaflet; essentially normal right and left coronary leaflets; septal abscess</td>
</tr>
<tr>
<td>(b) 1 day preop</td>
<td>Normal anterior leaflet; absence of posterior leaflet</td>
<td>Normal anterior leaflet; high frequency flutter of posterior leaflet</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2. Clear</td>
<td>Multiple linear echoes</td>
<td></td>
<td>No</td>
<td>Bicuspid aortic valve; right leaflet thickened; left leaflet fragmented</td>
</tr>
<tr>
<td>3. Clear</td>
<td>Multiple irregular echoes</td>
<td></td>
<td>No</td>
<td>Severe partial destruction of all aortic leaflets; vegetations present; septal abscess</td>
</tr>
<tr>
<td>4. Clear</td>
<td>Coarse, irregular group of echoes</td>
<td></td>
<td>Yes</td>
<td>All leaflets almost totally destroyed; no major vegetations</td>
</tr>
<tr>
<td>5. Thin segments of anterior and posterior leaflets</td>
<td>Thin irregular echoes posteriorly</td>
<td></td>
<td>No</td>
<td>Almost complete destruction of left and noncoronary leaflets; essentially normal right leaflet; no major vegetations</td>
</tr>
</tbody>
</table>

Abbreviations: AV = aortic valve; LVOT = left ventricular outflow tract.

### Table 3

**Echocardiographic Findings in Previously Reported Cases of Aortic Valve Endocarditis**

<table>
<thead>
<tr>
<th>Author</th>
<th>Number of cases</th>
<th>Systolic echo appearance of AV</th>
<th>Diastolic echo appearance of AV</th>
<th>Abnormal diastolic echoes in LVOT</th>
<th>Appearance of AV at operation or autopsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dillon et al.¹</td>
<td>5</td>
<td>Shaggy, non-uniform thickening of leaflets</td>
<td>Shaggy, non-uniform thickening of leaflets</td>
<td>No</td>
<td>Vegetations</td>
</tr>
<tr>
<td>Martinez et al.²</td>
<td>3</td>
<td>Shaggy thickening of leaflets</td>
<td>Essentially normal</td>
<td>No</td>
<td>Destroyed right coronary leaflet; partially destroyed left leaflet; vegetations</td>
</tr>
<tr>
<td>DeMaria et al.³</td>
<td>3</td>
<td>Shaggy thickening of both leaflets</td>
<td>Double line of echoes in mid-aorta</td>
<td>No</td>
<td>Perforated right coronary leaflet; vegetations on other cusps</td>
</tr>
<tr>
<td>Gottlieb et al.⁴</td>
<td>2</td>
<td>Essentially clear</td>
<td>Shaggy echoes posteriorly</td>
<td>No</td>
<td>Destroyed right coronary leaflet; vegetations on other cusps</td>
</tr>
<tr>
<td>Hirschfeld et al.⁵</td>
<td>6</td>
<td>Irregular thickening of both leaflets</td>
<td>Thickened, irregular echoes</td>
<td>No</td>
<td>Vegetation of right coronary leaflet</td>
</tr>
<tr>
<td>Lee et al.⁶</td>
<td>4</td>
<td>Fine linear echoes</td>
<td>Dense anterior echoes</td>
<td>No</td>
<td>Ruptured aortic leaflets</td>
</tr>
</tbody>
</table>

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ECHOES IN AV ENDOCARDITIS

Highly suggestive of aortic vegetations, especially in the clinical setting of aortic regurgitation of recent onset or suspected endocarditis. Calcification of the aortic valve usually produces more dense echoes which persist throughout the cardiac cycle. Congenital non-calcific aortic stenosis may also produce multiple linear diastolic echoes. Patient 2 in the present series had a bicuspid aortic valve and multiple linear diastolic echoes were present in the aortic root (fig. 2). Dense echoes which fill the aortic root in diastole have been reported in two cases of fungal endocarditis in which very bulky valvular vegetations were present. Patient 3 in the present series (fig. 3A and B) illustrates that transducer angle is critical in determining whether the aortic root is “filled” with echoes in diastole. Transducer position and gain setting are other variables which may influence the density of these diastolic echo patterns.

Coarse or thin diastolic echoes in the aortic root which move very erratically or “vibrate” are highly suggestive, if not diagnostic, of at least partial destruction of one or more of the aortic leaflets in which the fragments are flail (figs. 1B, 4B and 5). Fine high-

Figure 2
Echogram of the aortic valve in patient 2. Systole is clear but multiple non-uniform linear echoes are seen in the aortic root in diastole (arrows). LA = left atrium. (Sweep speed = 50 mm/sec.)

Figure 3
A) Echogram of the aortic valve in patient 3. Systole is clear but an irregular mass of echoes fills most of the aortic root in diastole (large arrow). In figure 3B the transducer is at a slightly different angle and two fairly distinct echoes are seen anteriorly and posteriorly (small arrows) in diastole. (Sweep speed = 25 mm/sec.)
frequency diastolic echoes in the aortic root

echograms associated with ruptured aortic valve
leaflets have also been described by Lee et al.6

Diastolic Echoes in the Subaortic Left Ventricular Outflow Tract

Only three cases of endocarditis have been reported
in which diastolic echoes were demonstrated in the
subaortic left ventricular outflow tract.3,9 In one of
these (fig. 4A) the echoes almost certainly were caused
by a portion of a flail aortic valve leaflet prolapsing
into the outflow tract.9 Bulky aortic valve vegetations
created the abnormal diastolic echoes in the outflow
tract in the other two cases.9

Echocardiography provides useful information in
the diagnosis of suspected cases of endocarditis as well
as useful preoperative information in patients with
documented endocarditis who may require valve
replacement. In addition to the echocardiographic

Figure 4

A) Echogram of the left ventricular outflow tract in patient 4. As the
transducer is directed from the anterior mitral leaflet (AMV) toward
the mitral annulus (MA) and aortic root, disorganized diastolic
 echoes (arrows) are noted between the anterior mitral leaflet and
the interventricular septum (IVS). (Sweep speed = 50 mm/sec.) B) Echogram of the aortic valve in patient 4. Systole is relatively clear
(small arrow) but a coarse irregular group of echoes is seen in
diastole (large arrow). (Sweep speed = 50 mm/sec.)

Figure 5

Echogram of the aortic valve in patient 5. Thin segments of the
anterior and posterior leaflets in systole are demonstrated by the
horizontal arrows. Thin irregular diastolic echoes are noted
posteriorly (vertical arrows). LA = left atrium. (Sweep speed = 25
mm/sec.)
demonstration of aortic valvular vegetations or aortic valve destruction, premature closure of the mitral valve has been demonstrated echocardiographically. This latter finding is seen only in acute severe aortic regurgitation and is usually considered an indication for early valve replacement.

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References

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