Infective endocarditis following patch closure of ventricular septal defect: a cross-sectional Doppler echocardiographic study

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Cross-sectional and Doppler echocardiographic characteristics of infective endocarditis are described in six cases following patch closure of a ventricular septal defect. The patients presented to us with fever one to five months after surgery. Five of them also had congestive cardiac failure. Cross-sectional echocardiography showed large masses over the patch in all cases. Dehiscence of the lower end of the patch was identified in three of them, and, in two cases, the right sinus of Valsalva had ruptured into the right ventricle. Doppler detected turbulent flow in the right ventricle in five cases, and a continuous signal indicating an aorto-right ventricular communication in two cases. A signal indicative of aortic regurgitation was also found in the latter two cases. Staphylococcus aureus was cultured from the blood in three cases and Aspergillus was identified at autopsy in one. The echocardiographic findings were confirmed in three cases (one during surgery and two at autopsy). Dehiscence of the patch and large masses were associated with a poor prognosis.

Key words: Patch endocarditis; Doppler echocardiography

Introduction

Infective endocarditis is rare following closure of a ventricular septal defect with a patch but, because of the known high mortality [1–3], early recognition is important. Before the advent of echocardiography, blood cultures were the only method of achieving this diagnosis. Cross-sectional echocardiography has been shown to be very sensitive for recognition of Dacron patches because of the brighter echoes from this structure [4]. With the additional use of Doppler, any dehiscence of the patch can be readily identified. We report the echocardiographic and Doppler features of six cases of infective endocarditis following closure of a ventricular septal defect with a Dacron patch.

Materials and Methods

In our Echocardiographic Laboratory during last two years, we encountered six patients with endocarditis of a patch inserted to close a ventric-
ular septal defect. The preoperative diagnoses were tetralogy of Fallot in 3 cases and 1 case each of an isolated ventricular septal defect, a defect complicated by aortic regurgitation and one co-existing with an atrial septal defect. The age of the patients ranged from 3.5 to 23 years, with 5 males and 1 female. The septal defect had been closed with a Dacron patch in all cases. Five of the six cases had undergone surgery at our institution.

Fever was the presenting symptom in all. It occurred within two months of the operation in three cases, and after two months in the other three. Congestive cardiac failure was present in five cases. A systolic murmur was heard at the lower left sternal border in four cases, and an additional continuous murmur along the lower left sternal border was audible in two cases. Blood cultures grew *Staphylococcus aureus* in three patients. In the other three cases, blood cultures were negative (one of these patients also had culture of the Dacron patch following reoperation which also proved sterile). The latter three patients were treated with antibiotics before being referred to us. *Aspergillus* species was identified at autopsy in 1 case. Five of the patients died of intractable congestive cardiac failure (two of these had undergone reoperation). Only one patient was discharged and was doing well after six months follow-up.

Cross-sectional echocardiographic examination was performed on the ATL Ultramark 8 Equipment. Standard parasternal, apical and sub-

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>TPSM</th>
<th>Clinical features</th>
<th>Blood culture</th>
<th>Echocardiography</th>
<th>Doppler</th>
<th>Clinical course</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>M</td>
<td>TOF</td>
<td>One</td>
<td>Fever, CHF, continous murmur</td>
<td>Sterile</td>
<td>Patch dehiscence, large mass ruptured right sinus of Valsalva to RV</td>
<td>Continuous signal in RV, AR (mild)</td>
<td>Died; autopsy – <em>Aspergillus</em> endocarditis, ruptured right sinus of Valsalva, <em>Aspergillus</em> mass over PA bifurcation</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>M</td>
<td>VSD, AR</td>
<td>Two</td>
<td>Fever</td>
<td><em>S. aureus</em></td>
<td>Patch dehiscence, large mass over patch, ruptured right sinus of Valsalva to RV</td>
<td>Continuous signal in RV, severe AR</td>
<td>Reoperated; died at surgery, vegetation over patch, ruptured right sinus of Valsalva</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>M</td>
<td>TOF</td>
<td>Four</td>
<td>Fever, CHF</td>
<td>Sterile</td>
<td>Large mass over patch, no dehiscence</td>
<td>VSD signal in RV (velocity 2.5 m/sec)</td>
<td>Died</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>M</td>
<td>VSD</td>
<td>One</td>
<td>Fever, CHF</td>
<td>Sterile</td>
<td>Large mass over patch, vegetation on TV, PV, patch dehiscence</td>
<td>VSD signal in RV (3 m/sec)</td>
<td>Reoperated, died; vegetation over patch extending to TV and PV; patch culture and microscopy negative</td>
</tr>
<tr>
<td>5</td>
<td>3.5</td>
<td>M</td>
<td>TOF</td>
<td>Three</td>
<td>Fever</td>
<td><em>S. aureus</em></td>
<td>Mass over VSD patch</td>
<td>No VSD signal</td>
<td>Responded to antibiotics, discharged</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>M</td>
<td>VSD, ASD</td>
<td>Five</td>
<td>Fever, CHF</td>
<td><em>S. aureus</em></td>
<td>Large mass over patch with dehiscence</td>
<td>VSD signal 3.0 m/sec in RV</td>
<td>Died</td>
</tr>
</tbody>
</table>

TOF = tetralogy of Fallot; CHF = congestive cardiac failure; RV = right ventricle; AR = aortic regurgitation; PA = pulmonary artery; VSD = ventricular septal defect; *S. = Staphylococcus*; TV = tricuspid valve; PV = pulmonary valve; ASD = atrial septal defect; TPSM = time of presentation after surgery in months.
costal views were used to examine the Dacron patch. The continuous wave Doppler probe was used to quantify the left to right ventricular systolic pressure gradients when present.

**Observations (Table 1)**

Echocardiographic examination revealed dehiscence of the patch with abnormal motion in four cases. In all these cases the dehiscence was noted at its lower attachment. Irregularity of the patch was present in all cases. Abnormal masses attached to the right ventricular aspect of the patch were observed in all cases (Figs. 1, 2). These varied in size from 3–5 mm to 10–20 mm. The masses were responsible for the loss of the normally smooth appearance of the Dacron patch and showed an abnormal motion. They were interpreted as representing vegetations. In one patient, the vegetations could be seen to extend and involve the tricuspid and pulmonary valves.

Rupture of the right sinus of Valsalva was seen in two cases. There was no aneurysmal dilatation of these sinuses and, in the short axis views, a direct communication could be seen between the right sinus and right ventricular outflow tract.

Doppler examination revealed abnormal systolic turbulence in the right ventricular cavity in these cases, indicative of a left-to-right shunt. The velocity of these turbulent signals varied between 2.5–3.0 meters per second, giving a left to right ventricular systolic pressure gradient of 25–36 mm Hg and indicating the presence of pulmonary arterial hypertension. A continuous signal was picked up in the right ventricular outflow tract in two cases, indicating rupture of the right sinus of Valsalva. A signal of aortic regurgitation was also found in these two cases.

The echocardiographic findings were corroborated in three cases (one at surgery and two cases at autopsy). The dehiscence of the patch was found as seen on echocardiography, namely at its

![Fig. 1. Case 3. Four chamber view showing large irregular mass 20 mm by 10 mm attached to the lower end of the prosthetic patch (arrow). RV = right ventricle; LV = left ventricle; RA = right atrium; LA = left atrium.](image)
lower margin of attachment. Rupture of the right sinus of Valsalva was confirmed in the two cases with an echocardiographically identified aorto-right ventricular communication. The masses seen at echocardiography were vegetations attached to the Dacron patch. \textit{Aspergillus} could be grown from culture of the patch in one case. In this same case, a large mass of \textit{Aspergillus} was detected at surgery at the bifurcation of the pulmonary trunk. The large mass which extended to involve the tricuspid and pulmonary valves was also confirmed at the operation.

**Discussion**

From July 1986 to July 1988, we encountered six patients having endocarditis of a patch inserted surgically for closure of a ventricular septal defect. During this period, 344 patients had undergone closure of the ventricular septal defect (tetralogy of Fallot: \( n = 247 \); ventricular septal defect: \( n = 96 \)). Our surgeons prefer to use Dacron to close the ventricular septal defect instead of peri-cardium since, using Dacron, there are no chances of degeneration or aneurysmal formation. Our experience confirms the experience of Gersony and Hayes [5] and Anderson et al. [6], namely that surgical closure of a ventricular septal defect does not eliminate the chance of contracting endocarditis.

The very high mortality of endocarditis related to a patch is also confirmed in this report. Five patients died of intractable congestive cardiac failure. The patient who survived, and was treated successfully with antibiotics, did not show evidence of dehiscence of the patch and, echocardiographically, the vegetation was of relatively small size.

Echocardiography is an excellent technique for visualizing Dacron patches because of the bright echoes from its interface with the ventricular septum [4]. Previous studies have shown good correlation of the echocardiographic appearance of patch dehiscence and the angiographic presence of a left to right shunt. Shunts with flow of 1.5:1.0 or less were, however, occasionally missed. In some cases,
persistent small drop-outs were wrongly interpreted as residual shunts. Doppler interrogation is helpful in these cases. The presence of a turbulent signal in the right ventricular cavity confirms the presence of a left-to-right shunt. In addition, the detection of a continuous signal in the area of discontinuity of the right sinus confirms an aorto-right ventricular communication.

The presence of a large mass and clinical features of congestive cardiac failure carry a poor prognosis, all our patients with one or more of these features dying. Although the number of cases is few, the period of presentation following operation did not have any bearing on the subsequent course of illness. The size of the mass did not have any bearing on the time of presentation either, since patients presenting with early endocarditis also had large masses attached to their patch.

We conclude that cross-sectional echocardiography is a useful adjunct in the diagnosis of post-operative endocarditis following closure of ventricular septal defect. The use of Doppler technique provides additional hemodynamic information on the presence of residual shunts and additional complications such as aorto-right ventricular communications or aortic regurgitation. The presence of large vegetations and patch dehiscence on echocardiography implies a poor prognosis.

References