Infected Endocarditis in Children:
A Current Diagnostic Trend and the Embolic Complications

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Twenty-three cases of IE, of which 91% had underlying congenital heart
diseases were diagnosed by positive blood culture or vegetative lesion detected
by 2-D ECHO when a patient revealed clinically suspicious episodes. VSD
and TOF were the most common underlying heart diseases. The vegetation
was detected successfully by 2-D ECHO in 91% of the cases. The causative
organisms were identified in 83% of the cases. Streptococcus viridans and
Staphylococcus aureus were the two major organisms detected. Candida
albicans was found in 3 postoperative and fatal cases. Embolic complications
occurred in 7 cases (30.5%): five cases of pulmonary infarction and two of
cerebral infarction. The overall mortality was 22%. We recommend early
surgical intervention whenever a patient reveals a very large vegetation with
animated movability, and emphasize the importance of a proper prophylactic
regimen.

INFECTIVE endocarditis (IE) remains one of
the most serious complications of congenital
heart disease (CHD), though the management
and treatment of CHD have progressed dramati-
cally. It has been reported that mortality from
IE declined after the introduction of effective
antibiotics, whereas the incidence of IE has not
deprecated significantly in these past decades.1,2
Thus, the importance of prompt diagnosis which
may give the patient a better prognosis should be
stressed. Such prompt diagnosis is facilitated,
according to our recent experience, by the use of
two-dimensional echocardiography (2-D ECHO)
to detect vegetative lesion.

PATIENTS AND METHODS
Twenty-three consecutive patients with IE
who were admitted between 1977 and 1985 to
either Kurume University Hospital or St. Mary’s
Hospital were entered in this study. Their ages
ranged from 2 to 15 years. The diagnosis of IE
was established by either positive blood culture
or the detection, using 2-D ECHO in several
different echocardiographic views, of a vegetative
lesion by focusing upon lesions of interest in the
heart and vessels, or by both methods when a
patient revealed clinically suspicious episodes
such as prolonged pyrexia and embolism. 2-D
ECHO using a 3.0 MHZ sector or linear scanner
was recorded serially when the vegetative lesion
was detected. Then the size and the movability
of the vegetation were investigated. Any embolic
complication was diagnosed by chest roentgeno-
graphy for pulmonary infarction and by CT scan
for cerebral infarction in addition to clinical
symptoms such as chest pain or paralysis.

RESULTS
Twenty-one out of the 23 cases had an under-
<table>
<thead>
<tr>
<th>AFFECTED SITES IN THE HEART</th>
<th>DETAILS</th>
<th>TYPE OF CHD</th>
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<tbody>
<tr>
<td><strong>RIGHT SIDE</strong></td>
<td>TV</td>
<td>VSD, TGA 6</td>
</tr>
<tr>
<td>(14)</td>
<td>PA, PV</td>
<td>TOF(PO) 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDA 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VSD 1</td>
</tr>
<tr>
<td></td>
<td>RAVW</td>
<td>VSD 1</td>
</tr>
<tr>
<td></td>
<td>LVIS</td>
<td>VSD 1</td>
</tr>
<tr>
<td><strong>LEFT SIDE</strong></td>
<td>MV</td>
<td>VSD 2</td>
</tr>
<tr>
<td>(4)</td>
<td></td>
<td>ECD(PO) 1</td>
</tr>
<tr>
<td></td>
<td>MV</td>
<td>VSD 1</td>
</tr>
<tr>
<td><strong>BOTH SIDES</strong></td>
<td>MV, TV</td>
<td>VSD 1</td>
</tr>
<tr>
<td>(2)</td>
<td></td>
<td>TOF(PO) 1</td>
</tr>
</tbody>
</table>


Fig.1. Affected sites and complications of infective endocarditis.

<table>
<thead>
<tr>
<th>AFFECTED SITES IN THE HEART</th>
<th>CHD</th>
<th>FATAL CASE</th>
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<tbody>
<tr>
<td><strong>RIGHT SIDE</strong></td>
<td>(+)</td>
<td>14 PE</td>
</tr>
<tr>
<td>(14)</td>
<td></td>
<td>(5) ------ 1</td>
</tr>
<tr>
<td></td>
<td>LEFT SIDE</td>
<td>(+) 2</td>
</tr>
<tr>
<td>(4)</td>
<td></td>
<td>(-) 2 BA  (1) ------ 1</td>
</tr>
<tr>
<td></td>
<td>BOTH SIDES</td>
<td>(+) 3 CI  (1) ------ 1</td>
</tr>
<tr>
<td></td>
<td>UNIDENTIFIED</td>
<td></td>
</tr>
</tbody>
</table>

PE: Pulmonary embolus, BA: Brain abscess, CI: Cerebral Infarction, (): Number of cases

Fig.2. Affected sites and underlying heart diseases of infective endocarditis.

lying congenital heart disease (91%) (Fig. 1). Ventricular septal defect (VSD), in 11 cases, was the most common followed by tetralogy of Fallot (TOF) in 7 cases, and patent ductus arteriosus (PDA), endocardial cushion defect (ECD), and transposition of the great arteries (TGA) in 1 case each. Seven of these 21 cases were postoperative, and of these 7, 6 had TOF (Fig. 2). The causative organisms were identified in 19 of the 23 cases (83%). Streptococcus viridans (6 cases) and Staphylococcus aureus (5 cases) were the two major organisms identified, followed by anaerobes and Serratia marcescens. Candida albicans was found in 3 cases, all of which were fatal (Fig. 3). A vegetative lesion detected by 2-D ECHO was found in 21 cases (91%). In 14 of these, the vegetation was located in the right side of the heart (61%), i.e. in the tricuspid valve (6 cases; 43%), the pulmonary artery or the pulmonary valve (6 cases; 43%), the right ventricular anterior wall (1 case; 7%) or the intraventricular septum (1 case; 7%). All four left sided vegetations were located in the mitral valve, and two had no underlying heart disease. A vegetative lesion was found in both sides of the heart in 2 cases. Embolic complications during the clinical course of IE occurred in 7 cases. Five were pulmonary embolus manifested by chest pain. One of these 5 died suddenly because of massive pulmonary infarction and hemorrhaging (Fig. 4). The other
<table>
<thead>
<tr>
<th>ORGANISMS</th>
<th>TYPE OF CHD</th>
</tr>
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<tbody>
<tr>
<td>S. viridans</td>
<td>VSD</td>
</tr>
<tr>
<td>Enterococcus sp.</td>
<td>ECD</td>
</tr>
<tr>
<td>S. aureus</td>
<td>VSD, TOF, NSHD</td>
</tr>
<tr>
<td>S. marcescens</td>
<td>VSD+PS, NSHD</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>VSD, TOF, PDA</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>TOF(PO), VSD+PDA</td>
</tr>
<tr>
<td>Negative Culture</td>
<td>VSD, TOF, TGA</td>
</tr>
</tbody>
</table>

| Total               | 23 cases       |

NSHD: No Structural Heart Disease

Fig. 3. Causative organisms of infective endocarditis.

Fig. 4. 3-year-old boy in the postoperative state of tetralogy of Fallot. The vegetation was detected in the main pulmonary artery. The patient died from sudden onset of massive pulmonary hemorrhage.

2 cases suffered fatal intracranial embolus. According to the 2-D ECHO results recorded serially before and after the embolic episodes, the size of the vegetation was not observed to have changed. The overall mortality for IE was 17.4% (4/23 cases).

DISCUSSION

Most pediatric IE (close to 90%) has underlying congenital heart disease, usually VSD and TOF. The incidence of TOF is dominant, especially in postoperative IE. In our series, 6 of 7 postoperative cases of IE had TOF. A possible explanation for the close correlation of TOF with postoperative IE is the use of artificial materials in the multiple surgical interventions, such as the closure of the ventricular septum and the reconstruction of the right ventricular outflow tract and pulmonary artery. Furthermore, a certain degree of turbulent flow in RV or PA may remain postoperatively in most cases, which may be the cause of intimal damage. Another possibility is that preoperative prolonged hypoxemia may play a certain role in creating intimal damage.

It is clear that prompt and correct diagnosis of IE is essential, as it may alter the outcome of the condition. The routine use of 2-D ECHO in clinical pediatrics has resulted in much more precise and prompt detection of the vegetative lesion of IE. The sensitivity of 2-D ECHO for diagnosing the vegetative lesion has been reported to be about 80 to 90%; sensitivity in our study was 83%. The efficacy of 2-D ECHO is evident in our study. However, we must note that 2-D ECHO also has some potential problems such as: 1) vegetation of less than 2 to 3 mm may be undetected, 2) a proper gain setting should be es-

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tablished to avoid misinterpretation and 3) increases in beam width may result in the loss of azimuthal resolution in the distant field, causing images to appear falsely large.\textsuperscript{8,9}

We experienced a relatively high incidence of embolic complications in IE (30%). Five embolic complications occurred in the lung, manifested by sudden onset of chest pain and an abnormal shadow on the plane chest roentgenogram. Symptoms such as chest pain subsided spontaneously within a few days in all but one case. It has been reported that pulmonary embolus is the most frequently recognized complication of IE, although massive life-threatening pulmonary embolization is extremely rare.\textsuperscript{10} Unfortunately, we lost one postoperative patient who died suddenly with massive hemoptysis.

We should, therefore, consider an expansion of the surgical indications for IE. In general, the surgical indications for IE are: 1) appreciable or worsening congestive heart failure, 2) infections uncontrollable by antibiotics, particularly fungal, gram negative bacillary or staphylococcal infections, 3) recurrent embolization, 4) progressive spread of intracardiac infections, as manifested by conduction system disturbances, aneurysma, fistula formation or suppurative pericarditis, and 5) prosthetic valve endocarditis\textsuperscript{11-13} In addition to conventional indications, we recommend surgical intervention in cases where there is huge vegetation with animated movability in the heart and vessels. The prophylaxis of IE is extremely important for patients with predisposing factors. According to the new revision of the prophylactic regimen for IE issued by the American Heart Association,\textsuperscript{14} the cardiologist as well as the general practitioner should make every effort to reduce the risk of IE by means of the proper prescription of antibiotics.

REFERENCES


6. MINTZ GS, KOTLER MN, SEGAL BL, PARRY WR: Comparison of two-dimensional and M-mode echocardiography in the evaluation of patients with infective endocarditis. \textit{Am J Cardiol} 43: 738, 1979


