

Strategy for surgical treatment of infective endocarditis in children

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Background: The mortality of infective endocarditis (IE) in children is high and it is controversial over timing of surgery for this disease. This study was undertaken to explore the strategy of surgical treatment for IE in children.

Methods: Of 43 patients with IE, 38 had underlying heart diseases, including congenital heart disease (30 patients), rheumatic heart disease (6), hypertrophic cardiomyopathy (1), and postoperative Falot's tetralogy (1). In these patients, 28 underwent surgery, and 10 were treated by medication. In the remaining 5 patients who did not have any underlying heart diseases, 4 showed post-IE valve lesions, and 1 valve lesion. Three of the 5 patients were subjected to surgical treatment but the remaining 2 were treated by medication.

Results: All the 31 patients who had undergone surgical treatment recovered. Two of the 12 patients who had received medication died. Twenty-seven patients undergoing surgical treatment were followed up, and no death or recurrent endocarditis occurred. The life quality of the patients was improved markedly.

Conclusions: Similar clinical characteristics and echocardiographic manifestations of IE were noted in children and adults. Surgery is effective in the treatment of infective endocarditis, and the timing of surgery is crucial. Most children with IE have abnormalities of the heart or congenital heart disease. Hence, these patients should be treated early to avoid the occurrence of IE.

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Introduction

Infective endocarditis (IE) is a common disease but difficult to handle, especially in children, whose situation is very dangerous.^[1-3] Drug treatment has a high mortality and relapse rate, and operation is one of the effective treatments but there is much controversy over the indications and timing of surgery.^[4-6] The bifurcation leads to lots of chances to save lives of patients. We try to discuss the indications of surgery for IE children by summarizing our experience in the treatment of this disease during the period of 1999-2003.

Methods

General information

In 43 patients, 28 were male and 15 female aged between 3-12 years. They were diagnosed as having IE according to the Duke criteria.^[7] The 31 patients who received operation had been confirmed before surgery. Drug therapy was prescribed for 12 patients, 2 of whom died from organ failure (multiple organ embolism) because of loss of the chance for operation. Ten patients were not operated on because of infective nidus or lack of finances. There were 38 patients with underlying heart diseases, including congenital heart disease (30 patients) (interventricular septal defect in 12 patients, patent ductus arteriosus in 10, stenosis of the outflow tract of the right ventricle in 2, rupture of aneurysms of the aortic sinus in 2, bicuspid aortic valve in 1, arterial septal defect in 1, Falot's tetralogy in 1, and complete transposition of great arteries combined with arterial septal defect in 1), rheumatic heart disease (6), hypertrophic cardiomyopathy (1), and postoperative Falot's tetralogy (1). Among them, 28 received operation and 10 drug therapy. In 5 patients without underlying heart disease, 4 had valve lesion resulting from IE and 1 had no valve lesion. All patients had a history of infection characterized by persistent fever, and part of the patients showed cardiac insufficiency. Infection of the respiratory tract was the most common causative factor. Laboratory examination demonstrated rapid blood sedimentation,

Table. The clinical data of the IE children

Disease	Cases	Embolism	Echyma	Positive blood culture	Surgery	Death
Interventricular septal defect	12	1	12	6	8	1
PDA	10	0	10	2	8	0
Stenosis of outflow tract of right ventricle	2	0	2	0	2	0
Rupture of aneurysms	2	1	2	0	2	0
Bicuspid aortic valve	1	1	1	0	1 (valve replacement)	0
Artrial septal defect	1	0	1	0	1	0
Falot's tetralogy	1	0	1	0	1	0
Transposition of great arteries with ventricular septal defect	1	1	1	1	0	1
Rheumatic heart disease	6	0	5	2	5 (valve replacement)	0
Hypertrophic cardiomyopathy	1	1	1	1	0	0
Surgery after Falot's tetralogy	1	0	0	1	0	0
Valve lesion of IE	4	0	3	2	3 (valve replacement)	0
No valve lesion of IE	1	0	0	1	0	0

increased level of C-reaction protein, decreased level of hemoglobin, and hematuria. Five (11.6%) of the 43 patients had a history of embolism, and echyma was found in 39 patients (90.7%), 30 of whom were proved by thoracic ultrasound, and 9 by esophageal ultrasound but not thoracic ultrasound. In 16 patients (37.2%), blood culture showed *Streptococcus mitis* (a flora of *streptococcus viridans*) (7 patients), *Stenotrophomonas maltophilia* (4), *Staphylococcus aureus* (2), and other bacteria (3).

Methods

In the 5 patients who received emergency operation, 2 had progressively enlarged echyma, 1 failed to anti-infection therapy, and 2 had deteriorated cardiac function. Other patients received operation when their situation had been stabilized after antibiotic therapy for 10 days to 12 weeks.

Most echymas were located near the ventricular septum defect (VSD), the patent ductus arteriosus (PDA), the medial surface or the right outflow tract of the right ventricle, which were seen during operation. The lesions of the valves were characterized by incrustation and deformation of different degrees or ulceration. Echyma of different size, shaped like polyp or cauliflower, single or multiple, could be seen on the surface of the lesion. The echyma, yellow or light green, could cause perforation of the valves, while involving the chordae tendineae. Orthopedic procedures were performed under extracorporeal circulation. The infectious nidus was removed as clearly as possible to stabilize hemodynamics. Antibiotic therapy with sensitive drugs was maintained in the patients receiving emergency operation for 4-6 weeks postoperation, and routine cardiac operation was performed in others.

In the drug therapy group, the patients received sensitive antibiotics for 6-8 weeks.

Results

In this series, 28 patients with heart disease complicated by IE and 3 patients with IE-caused valve lesion

were cured surgically. Body temperature and blood-routine of the patients were normal at the time of discharge from the hospital, and echocardiography showed no residual fractional flow. Nine patients after valve replacement showed normal function of the mechanical valve. No death or relapse was observed in the 27 patients in the follow up of 3-24 months, and their life-quality was improved. In the 12 patients of the drug therapy group, 2 died of exacerbated infection with brain embolism, 8 were followed up, and 2 were lost to follow up 1-24 months after discharge. After anti-infection therapy for improving cardiac function, 3 patients were cured, 4 showed normal body temperature and cardiac function II or III, and 1 died.

Discussion

Most children with IE have an abnormal cardiac structure. In IE patients 75%-90% have congenital heart disease, whereas rheumatic heart disease is rare.^[8-10] The main pathogen of IE in children is *streptococcus*, with a rate of 40%,^[11,12] which is similar to that in this study. The clinical manifestations and echocardiographic findings of IE in children resemble those of adult valve-endocarditis or artificial-valve-endocarditis.^[13] The results of the 31 patients of this series who had received surgery were significantly better than those in the drug therapy group, suggesting that surgery is an effective treatment of infectious endocarditis, especially in patients with congenital or acquired cardiac disease.^[14,15] Proper timing of surgery is essential to the treatment of IE.^[16] The important procedures of surgery include correction of malformation, closure of abnormal channels, replacement of diseased valve, and removal of echyma and vomica. Operatively, the manipulation should be gentle to prevent embolism caused by drop of echyma, avoid use of heterogenous material, and clear off echyma and severely damaged tissues with diluted iodine and normal saline. Satisfactory outcome of surgery was obtained after complete clearance of the nidus and proper use of antibiotics for 4-6 weeks after operation. Because

an early and accurate diagnosis is crucial, history taking and physical examination should be done carefully. IE should be considered in a child with repeated fever, anemia of unknown reason, hematuria and facial edema. Body temperature must be monitored strictly in addition to blood culture, echocardiography and esophageal ultrasound if possible. Besides, hemodynamics is the main risk factor of death in the perioperative period. The risk factors for surgery included deterioration of heart failure before operation, relapse of IE, artificial-valve IE and young patients.^[17] Thus surgery should be adopted before the occurrence of severe and refractory hemodynamic disorder in young patients. In this series, good result was obtained in 2 patients who had received emergency operation because of failure to handle heart failure. If ephyma at the cardiac chamber wall or valve was bigger than 10 mm, there would be a high risk of embolism.^[18,19] Clinically, IE children with negative results of blood culture in the empirical antibiotic therapy have fever that is hard to explain. Emergency operation is indicated for patients with deteriorating heart failure, ephyma larger than 10 mm, and refractory infection during drug therapy. Selective operation, however, is indicated for patients with normal body temperature for more than 8 weeks after use of sensitive antibiotics according to the blood culture outcome and without progressive heart failure or enlarged ephyma. The prognosis of patients after surgery could not be predicted by blood culture, but staphylococcus-positive blood culture is a high risk for a second operation.^[20] One patient in this series died of multiple organ failure before surgery because of a 2-week infection of *Staphylococcus aureus*. Hence, the operation should be performed in IE children with fundamental heart disease, especially with a *Staphylococcus aureus* infection when their general condition is relatively good. Most IE children have congenital heart disease, malformed vessels or abnormal channels of the heart leading to blood shunt and turbulent flow, which increases the possibility of infection. Children with congenital heart disease should be treated surgically as early as possible to avoid the occurrence of IE.

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