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Surgical Experience for Prosthetic Valve Infective Endocarditis

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Abstract:

Background: To explore the diagnosis and treatment strategy of prosthetic valve endocarditis (PVE).

Materials and methods: From December 2014 to January 2019, a total of 19 PVE patients came to our hospital for treatment. These articles review the clinical symptoms, diagnosis, treatment process and prognosis of these patients, and discuss the disease characteristics and treatment strategy of PVE.

Results: 4 patients died before operation, 15 patients received surgical heart valve replacement, and 3 patients died of septic shock after operation. All 12 discharged patients were followed up and their cardiac functions were obviously improved at present.

Conclusion: Hospital internal infection control can effectively reduce the occurrence of early-onset PVE. Joint consultation of physicians and surgeons is helpful for early diagnosis and formulation of optimal treatment strategies. Grasping surgical indications, thorough removal of infected tissues during surgery and reconstruction of cardiac morphology and structure are the keys to the success of surgical intervention.

Keywords: Heart valve replacement; Infective endocarditis; Prothetic valve endocarditis; Mechanical valve; Biological valve

Background

Infective Endocarditis (IE) is a serious disease with high morbidity and mortality, of which prosthetic valve endocarditis (PVE), as the most serious complication for valve replacement surgery, accounts for about 20%. Its difficult surgical indications, complex Complication and high mortality are still one of the major challenges in heart valve surgery at present [1-3]. From November 2009 to January 2019, a total of 19 PVE patients came to our hospital and achieved satisfactory therapeutic effects. This article reviews their diagnosis and treatment process, and discusses the key points of treatment and surgical procedure.

Materials and Methods

General information

A total of 19 patients were included in this study, including 14 males and 5 females, aged 20-76(47.6 ± 17.4) years old, with an average of 47.7(males, 40.9; females, 66.6) years old. All patients met the diagnostic criteria for IE proposed by Durack et al. [4] of Duke University in 1994. At the time of previous admission, in addition to regurgitation or stenosis of the valve itself, there were 3 cases of IE, 1 case of left atrial thrombus, 1 case of constrictive pericarditis, 1 case of Coronary Heart Disease (CAD) and 1 case of Congenital Heart Disease (CHD). Previous surgical procedures: Mitral Valve Replacement (MVR) in 6 cases, by using mechanical valve in 5 cases and biological valve in 1 case; Aortic valve replacement (AVR) in 5 cases, all by using mechanical valves; Mitral valve replacement+Aortic valve replacement (MVR+AVR) in 2 cases, by using 1 mechanical valve and 1 biological valve; Aortic valve replacement+Mitral valvuloplasty (AVR+MVP) in 1 case, by using mechanical valve. Mitral valve replacement+tricuspid valvuloplasty (MVR+TVP) in 1 case, by using biological valve. Tricuspid valve replacement (TVR) in 1 case, by using mechanical valve. Aortic valve replacement +Mitral valve replacement+Tricuspid valve replacement (AVR +MVR+TVR) in 1 case, all by using mechanical valves; Aortic valve replacement+Mitral valve replacement+Atrial septal defect repair+Ventricular septal defect repair (AVR+MVR+ASDR+VSDR) in 1 case, all by using mechanical valves; Aortic valve replacement+Coronary artery bypass grafting (AVR+CABG) in 1 case, by using biological valve. In total, 18 mechanical valves and 5 biological valves were implanted.

PVE occurred on 2-20 years after valve replacement (mean 6.2 years, 4.3 years for male, 11.5 years for female), of which 14 cases (73.7%) occurred 1 year after operation. On readmission, 16 cases (84.2%) were accompanied by high fever and chills, body temperature ranged from 38.4°C-41.0°C, lasting for 1 week-1 year. In addition, 4 cases were accompanied by chest tightness, 2 cases with lower libs edema, 1 case with palpitation, and 1 case with abdominal distension. Complication: 4 cases with hypertension, 3 cases with old cerebral infarction, 3 cases

with pulmonary hypertension, 2 cases with pleural effusion, 2 cases with left atrial thrombus, 2 cases with hepatitis, 2 case with arrhythmia, 1 case with systemic lupus erythematosus, 1 case with Sjogren's syndrome. All patients underwent multiple blood cultures upon admission, with a positive rate of 89.4%: 8 cases of staphylococcus, 6 cases of candida, 4 cases of Streptococcus, 1 case of pseudomonas, 1 case of Salmonella, of which 3 cases were complicated by more than two pathogens. Echocardiography showed prosthetic valve margin vegetations in 7 cases, perivalvular leakage in 5 cases, and perivalvular thrombosis in 2 cases. Left ventricular ejection fraction (LVEF) ranged from 43%-74%, with an average of 63.4%. After admission, all patients were treated with more than 2 kinds of antibiotics, and examined by blood culture repeatedly. Antibiotic use was adjusted according to the results of blood culture and drug sensitivity in microbiology department.

Surgical procedure

Surgical incision was made through standard median sternotomy in 13 patients. The other two patients received VATS surgery and Da Vinci robot assisted surgery respectively. After systemic heparinization, CPB was initiated with direct cannulation of the ascending aorta and the vena cavae. The left atrium was approached through right atriotomy and the trans-atrial septal incision. The left atrium appendage was carefully explored in all cases and the existing mural thrombus was removed meticulously. Removed the original prosthetic valve and trimmed the autologous valve ring. Then performed MVR or other combined operation thereafter.

Results

Perioperative outcomes

3 patients died of multiple organ failure due to septic shock in the Preoperative period (2 for candida albicans, 1 for staphylococcus), and 1 patient suffered from sudden cerebral infarction due to vegetation shedding before operation.

Other 15 patients underwent valve replacement surgery: MVR in 8 cases (1 patient underwent total thoracoscopic mitral valve replacement), all by using mechanical valves. MVR+TVP in 3 cases, including 2 mechanical valves and 1 biological valve. MVR +AVR+TVP in 1 case, by using biological valve; AVR in 2 cases, by using mechanical valve; Bentall and Pulmonary valve replacement (PVR) in 1 case, by using woven vascular prosthesis (Gelweave, Scotland) and mechnical valve. In total of 12 mechanical valves and 12 biological valves were implanted. Intraoperative cardiopulmonary bypass time ranged from 92-494 mins (average 162.3 mins) and aorta clamping time ranged from 56-221 mins (average 109 mins). Including the patients who received VATS MVR and Da Vinci robot assisted MVR, three patients died after the operation due to septic shock (2 for staphylococcus, 1 for candida albicans). Reexamination of other patients showed significant improvement in cardiac function, LVEF ranged from 52%-74% (average 64.3%).

Pathological results showed the vegetations consisted of hyperplastic fibrous tissue with granulation tissue formation, hemosiderin deposition with cellulose-like necrosis and acute inflammatory cell infiltration, and thrombosis.

Follow-up

All 12 discharged patients were successfully followed up for 3 months to 5 years. All patients receiving redo-valve replacement have no obvious discomfort at present, their cardiac function is obviously improved compared with that before operation, and the results of ultrasound reexamination show no obvious abnormality.

Discussion

PVE mostly occurs within 5 years after valve replacement, with a worldwide incidence rate of 1.4%-3.1%, concentrating within 1 year after operation. The incidence rate of PVE after standard median sternotomy valve replacement is lower than that of transcatheter valve replacement. With the improvement of the medical technique in recent years, the increase of surgical skills and more attention doctors paid to hospital infection control, the incidence of PVE continues to show a downward trend. According to the interval between PVE and previous cardiac surgery, PVE can be divided into two types: early onset and late onset. The former is usually caused by the surgical process itself or perioperative nosocomial infection, while the latter is more similar to simple community acquired IE [5,6]. This classification is of great guiding significance for treatment strategies, but there is no definite conclusion on the boundary between them in the world at present. We prefer to use one year as a marker to distinguish the two types. According to this classification standard, of all the 19 patients included in this study, 14 cases (73.7%) belong to late-onset PVE and 5 cases (26.3%) belong to early-onset PVE. The low incidence of the onset PVE may thank to our department's emphasis on hospital infection control.

Previous IE history, rheumatic heart disease, diabetes and renal insufficiency are high risk factors for PVE. While male, early onset PVE, preoperative mechanical ventilation, and NYHA Class IV mostly predict poor prognosis and higher possibility of in-hospital death, which is consistent with our experience. Therefore, surgical intervention should be carried out for such patients before hemodynamic deterioration. The most common clinical manifestation of PVE is hyperpyrexia. Besides, literatures reported that about 90% of patients will have fever. So patients with fever of unknown cause after valve replacement should be highly suspected of the possibility of PVE. In addition, 7%-50% of patients may have systemic embolism, most of which are spleen. Therefore, splenomegaly, anemia and elevated Erythrocyte Sedimentation Rate (ESR) are common clinical manifestations. Bruises appearing in bulbar conjunctiva, oral mucosa and extremities are the most common manifestations of peripheral parts of the body [7,8].

A large number of studies have shown that coagulase-negative staphylococcus and *staphylococcus* aureus are the most common pathogens in early infection, and gram-negative bacilli, enterococcus, streptococcus and fungi can also be seen in PVE, of which streptococcus is more common in PVE after 4 months

of valve replacement, in addition, about 20% results of patients' blood culture continue to be negative [9]. In our study, the blood culture results of mostly (80%) early-onset PVE patients indicated staphylococcus, including 2 *staphylococcus* aureus, 1 coagulase negative staphylococcus and 1 epidermidis, which were consistent with the former research results. At present, vancomycin, gentamicin, cefepime and rifampicin are recommended for PVE patients with early onset and negative blood culture internationally. However, some experts also point out that penicillin, gentamicin and oxacillin are more effective for patients whose onset time is more than 4 months from surgery due to the reduction of staphylococcus and gram-negative bacilli infection [10,11]. In our study, six patients died of septic shock caused by candida albicans (n=3) and staphylococcus (n=3) respectively, which means clinicians should pay more attention to patients whose blood cultures are positive for these two bacteria.

Because these pathogens are invasive and have extensive drug resistance, congestive heart failure can occur in the early stage, which simple drug therapy is difficult to be effective. Studies showed that early redo valve replacement surgery can significantly reduce the rate of 30-day mortality and improve the rate of long-term survival of patients compared with simple drug therapy [12-15]. Surgeons should fully consider the specific situation and clinical background of each patient when evaluating the necessity and timing of surgical intervention. Some studies have pointed out that the management of PVE patients by multidisciplinary joint consultation composed of experts from cardiac surgery, cardiology and infection department can reduce the hospital and short-term mortality by up to 50% [16,17]. However, PVE patients with ischemic or hemorrhagic stroke may be more suitable for conservative treatment. Because the inherent risks of cardiac surgery lead to the nervous system complication of such patients, resulting in an increase in mortality [18,19]. Of the 3 patients with old cerebral infarction included in our study, 2 died during the perioperative period. Besides, due to psychological pressure and economic burden caused by surgical risks, about 25% of patients with surgical indications still refuse to receive surgical treatment worldwide [20].

There are two main goals of surgical operations for PVE patients: remove the prosthetic valve and infective tissue completely, and reconstruct the cardiac morphology. The types of prosthetic valve that can be selected include mechanical valves, biological valves, autologous and allogeneic grafts, etc. [21-23]. Experts have been disputing the choice of prosthetic valves for IE and PVE patients for years. The 2014 American Heart Association/American Heart Association (ACC/AHA) guidelines recommended the use of bioprosthetic valves for patients over 65 years old, while mechanical valves were applicable for patients under 65 years old. However, the guidelines did not provide specific surgical recommendations for IE patients. The 2015 guidelines of the European Heart Association's Management Working Group did not recommend prosthetic valve types for specific populations, but rather recommended a tailored method for selecting valves according to each patient's situation [3]. Kim et al. study [24] showed that the recurrence rate of biological valves in 5 years was lower than mechanical valves (2.1% vs. 3.6%), but Moon et al. study [23] confirmed that there was no significant difference between two kinds of valve. In terms of survival rate, some studies claimed that there is no significant difference in long-term survival rate between the two types of valves [25-29], but some studies also reported that patients applying biological valves have lower long-term survival rate [22]. In our study, according to ACC/AHA guidelines, we implanted 13 mechanical valves and 2 biological valves divided by patients' age. The current follow-up results support the correctness of this choice.

Conclusion

Multidisciplinary joint consultation is helpful to formulate treatment plan and surgical strategy for PVE patients. The key point for successful surgery is to completely remove damaged prosthetic valve and perivalvular necrotic tissue, and then reconstruct the cardiac structure. Due to the small number of cases included in our study, and the short follow-up time, its long-term efficacy has to be confirmed by large-scale randomized controlled trials.

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