Incidence and outcomes of right-sided endocarditis in patients with congenital heart disease after surgical or transcatheter pulmonary valve implantation

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Objectives: To evaluate right-sided endocarditis and compare the incidence, clinical presentations, and outcomes in patients with a surgical and percutaneous pulmonary valve.

Methods: All patients with infective endocarditis occurring between January 2009 and June 2013 were identified and studied. All consecutive patients who received a pulmonary valve surgically or by percutaneous pulmonary valve implantation (PPVI) during the same period were also evaluated for endocarditis.

Results: During the study period, 31 patients were identified with right-sided endocarditis: 13 had valves implanted during the study period and 18 before. The person-time incidence rates of endocarditis were 1.2 and 3.9 cases/100 person-years in the surgical and PPVI groups, respectively ($P = .03$). Clinical presentations, microbiology, and outcomes were comparable in both groups. The implantation-endocarditis time interval was much shorter in the patients in the PPVI group ($P = .0065$). A past history of endocarditis was found to correlate with endocarditis ($P = .004$). Infective endocarditis was more frequent in patients with bovine jugular vein valves compared with others (7.1% vs 0.84%, $P = .0117$; odds ratio, 9). Probability of survival at 12, 24, and 36 months was 99.5%, 93.8%, 93.8% in the surgical group and 98.9%, 96.8%, 92.3% in the PPVI group, respectively ($P = .6$). Event-free probability including endocarditis was comparable ($P = .1$).

Conclusions: There is a higher incidence of endocarditis in patients with PPVI compared with surgical pulmonary valves. Clinical and biological features were comparable in both groups. The role of bovine jugular veins in the development of endocarditis is concerning. However, despite a higher incidence of endocarditis in the PPVI group, the probabilities of survival and event-free survival were similar to the surgical group. (J Thorac Cardiovasc Surg 2014;148:2253-9)

See related commentary on pages 2259-60.

Infective endocarditis (IE) is a life-threatening medical condition that requires immediate attention. Despite significant improvements in the diagnosis and management of IE, mortality remains high. In the congenital heart disease (CHD) population, IE is a concern in patients with prosthetic valves. The diagnosis is usually challenging and delayed, the need for surgery is more frequent, and the prognosis is worse compared with IE in patients with a native valve.[1-3] About half of the patients with CHD-associated IE develop major complications. Overall mortality of CHD-associated IE decreased to 10% in 1990 in comparison with 30% in adults with IE and structural heart disease.[4,5] Mortality from surgery for IE is up to 15%; mortality after 1 year I 40% to 50%.[5,6]

There is a paucity of data on the incidence, clinical presentation, treatment, and outcomes of selective right-sided endocarditis in patients with CHD with surgical or transcatheter pulmonary valve implantation.[7-10] Percutaneous pulmonary valve implantation (PPVI) is now recognized as the treatment of choice for dysfunctional right ventricular outflow tracts (RVOT).[11] After more than a decade, its usefulness has been recognized; it offers a good alternative to surgery for patients with hemodynamically significant RVOT diseases.[12] However, there are increasing reports of endocarditis with the most frequently used valve stent (ie, the Melody valve [Medtronic, Minneapolis, Minn]).[13-16] To date, there are no data comparing surgical and transcatheter endocarditis. We reviewed all cases of right-sided endocarditis in patients who underwent surgical and transcatheter treatment at our center during the same period to study the demographics, clinical presentation, microbiology, treatment, and outcomes.

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Abbreviations and Acronyms

CHD = congenital heart disease
CI = confidence interval
IE = infective endocarditis
PPVI = percutaneous pulmonary valve implantation
PVR = pulmonary valve replacement
RVOT = right ventricular outflow tract

MATERIALS AND METHODS

Data were collected from our institutional review board–approved database. All patients with IE occurring between January 2009 and June 2013 were identified and studied. Diagnosis was made using the modified Duke criteria (Table 1). All patients who received a pulmonary valve surgically (PVR) or percutaneously during the study period at our institution were also identified and included in the study.

Data were collected retrospectively for the surgical group and prospectively for the transcatheter patients (this population was part of a large prospective clinical trial). Patients receiving a valve in any other position either percutaneously or surgically were excluded from the study. Patients followed up abroad were also excluded from the study.

A detailed review of the medical history of all patients was undertaken, including demographic characteristics, number of surgeries, number of cardiac catheterizations, type of conduit, history of endocarditis and comorbidities (any associated chronic medical condition, syndrome, genetic abnormalities, chronic infection). All had a detailed echocardiogram before, during, and after implantation. Follow-up outcomes were recorded. Patients were diagnosed as having IE based on the modified Duke criteria. Clinical presentation, bacteriologic diagnosis, evolution, and treatment were recorded.

Prevention of endocarditis in the PPVI group evolved over time. When we started the PPVI program, the patients were free of infection at the time of implantation and received antibioprophylaxis at the time of the procedure. Since mid-2011, the same protocol has been used for all patients receiving a valve, either surgically or percutaneously. Before the valve procedure, all patients undergo dental clearance. Cefamandole is given in the operating room or in the catheterization laboratory at the start of the procedure and is continued for 24 hours.

Statistical Analysis

Analyses were performed using MedCalc software (Mariakerke, Belgium). A comparison between the surgical and transcatheter PPVI groups was performed for endocarditis. Endocarditis occurring on conduits placed before the study began were excluded from the calculation of the incidence of IE.

The person-time incidence rate with the 95% confidence interval (CI) for a Poisson distribution was calculated for the PPVI group and the surgical group. The probability of survival and the probability of cardiovascular event/endocarditis–free survival were calculated for each group using the Kaplan-Meyer method. Survival probability included death and heart transplantation; cardiovascular events included IE, surgery for IE, or death. Data are presented as the mean value ± SD when variables were normally distributed, and the median value with 95% CI when it was not. The PPVI and surgical groups were compared using the Wilcoxon test for quantitative variables and the χ^2 test or Fisher test for qualitative variables. The relationship between risk factors for IE (sex, age, type of CHD, age at PVR, pulmonary arterial stenting and the number of procedures, history of infectious history, history of IE and comorbidities, type of prosthetic material for pulmonary valve) and IE was assessed using Cox proportional hazard regression analysis. Only factors significantly associated with IE with $P < .05$ where used in the multivariate model.

RESULTS

Endocarditis Occurring Between January 2009 and June 2013

During the study period, 31 patients were identified with right-sided endocarditis: 13 had valves implanted during the study period and 18 had right ventricle to pulmonary artery conduits implanted before 2009. Twenty-three patients had a surgical conduit and 8 patients had Melody valve implantation (Table 2). In the surgical group, 3 had homografts, 3 had a nonvalve conduit, and 17 had a bioprosthesis (14 Contegra [Medtronic], 1 Hemashield [St Jude Medical, St Paul, Minn], 1 Magma [Edward Lifesciences, Irvine, Calif], and 1 Hancock [Medtronic]).

When we compared surgical IE and PPVI IE, gender and the number of previous surgeries were similar (Table 2). The implantation-IE time interval was different in the 2 groups; IE occurred much earlier in the PPVI group compared with the surgical group ($P = .0065$). Only 5 of 23 occurrences of IE during the study period had RVOT conduits implanted during the study period; all others had RVOT conduits implanted before January 2009. In addition, early onset of IE (defined as endocarditis within 1 year of implantation) was more frequent in the PPVI group and this tended to reach statistical significance ($P = .052$).

The severity of the clinical presentation at diagnosis was not different in the 2 groups. In the surgical group, severe presentation was always associated with *Staphylococcus aureus* infection. Gradients across the RVOT increased globally in both groups during IE and were similar before and during IE. In the surgical group, vegetation was seen in the RVOT in 18 patients. In the PPVI group with IE, vegetation was identified in the RVOT in 6 of 8 cases. The size of the vegetation was not reported but the increase in the RVOT gradient in most of these patients in both groups indicates that the vegetation was significant. The need for surgery to remove the infected material was not different in for surgical and transcatheter IE (Table 2). The microbiological diagnosis for IE was also similar in both groups (Table 3).

Overall mortality (related or unrelated to IE) at last follow-up was 19%: 37% in the PPVI group and 13% in the surgical group (P = NS). In the surgical group with IE (n = 23), 2 patients had surgery to remove the infected conduit, 2 were treated medically (1 died 5.5 months after the onset of IE of febrile shock) and 1 had early heart transplantation for intractable endocarditis. In the PPVI group with IE (n = 8), 2 died acutely of severe cardiogenic shock; another had balloon dilation of the RVOT and died 6 months after onset of IE. Death was caused by biventricular heart failure and not IE. One patient needed emergency balloon dilation of the RVOT followed by surgery, 1 patient needed surgery, and 3 patients were treated medically.