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Valve-Sparing Root Replacement Compared With Composite Valve Graft Procedures in Patients With Aortic Root Dilation

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ABSTRACT

BACKGROUND Although aortic valve-sparing (AVS) operations are established alternatives to composite valve graft (CVG) procedures for patients with aortic root aneurysms, comparative long-term outcomes are lacking.

OBJECTIVES This study sought to compare the results of patients undergoing AVS procedures with those undergoing CVG operations.

METHODS From 1990 to 2010, a total of 616 patients age <70 years and without aortic stenosis underwent elective aortic root surgery (AVS, n = 253; CVG with a bioprosthesis [bio-CVG], n = 180; CVG with a mechanical prosthesis [m-CVG], n = 183). A propensity score was used as a covariate to adjust for unbalanced variables in group comparisons. Mean age was 46 ± 14 years, 83.3% were male, and mean follow-up was 9.8 ± 5.3 years.

RESULTS Patients undergoing AVS had higher rates of Marfan syndrome and lower rates of bicuspid aortic valve than those undergoing bio-CVG or m-CVG procedures. In-hospital mortality (0.3%) and stroke rate (1.3%) were similar among groups. After adjusting for clinical covariates, both bio-CVG and m-CVG procedures were associated with increased long-term major adverse valve-related events compared with patients undergoing AVS (hazard ratio [HR]: 3.4, p = 0.005; and HR: 5.2, p < 0.001, respectively). They were also associated with increased cardiac mortality (HR: 7.0, p = 0.001; and HR: 6.4, p = 0.003). Furthermore, bio-CVG procedures were associated with increased risk of reoperations (HR: 6.9; p = 0.003), and m-CVG procedures were associated with increased risk of anticoagulant-related hemorrhage (HR: 5.6; p = 0.008) compared with AVS procedures.

CONCLUSIONS This comparative study showed that AVS procedures were associated with reduced cardiac mortality and valve-related complications when compared with bio-CVG and m-CVG. AVS is the treatment of choice for young patients with aortic root aneurysm and normal or near-normal aortic cusps. (J Am Coll Cardiol 2016;68:1838–47)

Aortic valve-sparing (AVS) operations have become established alternatives to composite valve graft (CVG) procedures for patients with aortic root aneurysms and favorable aortic cusp morphology (1-5). Theoretical benefits of AVS procedures include avoiding the complications associated with prosthetic valves, specifically the risks of systemic thromboembolism and lifelong anticoagulation associated with mechanical valves, or the risks of structural valve deterioration (SVD) and need for reoperation associated with bioprosthetic valves. Although valve-sparing root-replacement

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techniques have been available for more than 30 years (6,7), the proportion of AVS operations among patients undergoing root replacement in the United States has remained approximately 15% and is not increasing (8). Reluctance to perform AVS may be caused in part by concerns regarding the durability of these procedures and the lack of comparative data regarding the long-term safety and effectiveness of AVS compared with traditional CVG procedures.

SEE PAGE 1848

Several groups have reported their experience with AVS (1–5), but no large series comparing the long-term outcomes after different approaches to the aortic root have been published. The objective of this study was therefore to compare the early and late results of patients undergoing AVS with those of patients undergoing CVG operations with biologic or mechanical aortic valve prostheses.

METHODS

STUDY POPULATION. All patients who underwent elective aortic root replacement procedures at the Peter Munk Cardiac Centre from January 1990 to December 2010 were identified through the cardiovascular surgery database (n = 1,187). We excluded patients with aortic stenosis, age ≥70 years, aneurysm caused by aortic dissection, infective endocarditis, and all nonelective operations. For patients who underwent more than 1 root-replacement procedure, only the index operation was included. Patients who underwent either reimplantation or remodeling procedures were included in the AVS group. Patients undergoing AVS had aortic root aneurysms and normal or near-normal aortic cusp morphology. The operative techniques for AVS procedures have been described in detail (2,9,10). Patients who underwent CVG procedures were included in the mechanical-CVG (m-CVG) and bioprosthetic-CVG (bio-CVG) groups. The final study cohort consisted of 616 patients <70 years of age who underwent elective root replacement for an aortic root aneurysm without aortic stenosis (AVS, n = 253; bio-CVG, n = 180; m-CVG, n = 183). The decision to perform an AVS operation was largely determined by the quality of the aortic cusps and experience of the surgeon.

DATA COLLECTION AND DEFINITIONS. The perioperative clinical data were prospectively collected on all patients undergoing cardiac surgery in our institutional database. Patients were contacted by telephone or electronically to determine morbid outcomes and to confirm vital status. Echocardiogram reports were reviewed and patients' cardiologists contacted to determine valve-related complications. The follow-up period was closed in March 2015. The mean follow-up duration was 9.8 ± 5.3 years; 113 (18.3%) patients were followed up for >15 years, and 16 (2.6%) for >20 years. Clinical follow-up was complete in 95.1% of patients and duration of follow-up was dissimilar between groups ($p < 0.001$). The AVS, bio-CVG, and m-CVG groups had mean follow-up of 8.9 ± 5.1 years, 10.7 ± 5.5 years, and 10.2 ± 5.3 years, respectively. The Research Ethics Board of the University Health Network approved the study and waived the need for individual patient consent.

Valve-related morbidity and mortality were defined according to the multisociety 2008 valve-reporting guidelines (11). Valve-related complications included SVD, nonstructural valve dysfunction, valve thrombosis, thromboembolism (i.e., neurological events and peripheral embolic events), operated valve endocarditis, reintervention, and bleeding. Anticoagulant-related hemorrhage (ARH) was defined as any bleeding event that occurred

ABBREVIATIONS AND ACRONYMS

ARH = anticoagulant-related hemorrhage

AVS = aortic valve sparing

bio-CVG = biologic composite valve graft

CVG = composite valve graft

HR = hazard ratio

MAVRE = major adverse valve-related events

m-CVG = mechanical composite valve graft

SVD = structural valve deterioration

TABLE 1 Baseline Characteristics of Patients Undergoing Aortic Root Replacement

	AVS (n = 253)	bio-CVG (n = 180)	m-CVG (n = 183)	p Value
Age, yrs	44 ± 14	50 ± 15	47 ± 14	<0.001
Male	201 (79.4)	160 (88.9)	152 (83.1)	0.03
Hypertension	89 (35.2)	62 (34.4)	69 (37.7)	0.79
Diabetes	4 (1.6)	7 (3.9)	12 (6.6)	0.03
Dyslipidemia	45 (17.8)	41 (22.8)	33 (18.0)	0.39
Bicuspid aortic valve	25 (10.2)	89 (51.7)	65 (36.5)	<0.001
Marfan syndrome	111 (43.9)	10 (5.6)	19 (10.4)	<0.001
Aortic insufficiency	188 (74.3)	171 (95.0)	165 (90.2)	<0.001
Cerebrovascular disease	6 (2.4)	2 (1.1)	12 (6.6)	0.01
Peripheral vascular disease	1 (0.4)	5 (2.8)	0 (0.0)	0.02
Renal failure	0 (0.0)	0 (0.0)	3 (1.6)	0.05
Severe pulmonary disease	7 (2.8)	3 (1.7)	5 (2.7)	0.80
Atrial fibrillation or flutter	6 (2.4)	6 (3.3)	15 (8.2)	0.01
Smoking history	106 (42.1)	92 (51.1)	81 (44.3)	0.21
Ejection fraction <40%	16 (6.3)	38 (21.1)	41 (22.4)	<0.001
New York Heart Association functional class				<0.001
No restrictions	179 (70.8)	47 (26.1)	58 (31.7)	
Symptoms with exertion	60 (23.7)	76 (42.2)	63 (34.4)	
Symptoms with normal daily activity	11 (4.3)	48 (26.7)	50 (27.3)	
Unprovoked symptoms	3 (1.2)	5 (2.8)	11 (6.0)	

Values are mean ± SD or n (%).

AVS = aortic valve sparing; bio-CVG = bioprosthetic composite valve graft; m-CVG = mechanical composite valve graft.