One-year outcomes associated with a novel stented bovine pericardial aortic bioprosthesis

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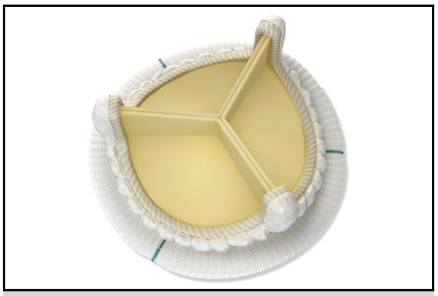
ABSTRACT

Objectives: The study objectives were to evaluate the safety, effectiveness, and hemodynamic performance of a new stented bovine pericardial aortic valve.

Methods: This trial enrolled patients with symptomatic moderate or severe aortic stenosis or chronic, severe aortic regurgitation. We assessed death, valve-related adverse events, functional recovery, and hemodynamic performance at discharge, 3 to 6 months, and 1 year, as required by the US Food and Drug Administration for regulatory approval. The primary analysis compared late linearized rates of valve-related adverse events after implantation with Food and Drug Administration–specified objective performance criteria to determine whether the adverse event rates associated with the valve are within acceptable limits. Adverse events included thromboembolism, thrombosis, all and major hemorrhage, all and major paravalvular leak, and endocarditis.

Results: The primary analysis included 864 patients who received an implant and 904.1 valve-years of follow-up. A total of 577 patients completed the 1-year evaluation. The primary end point was met for death, thromboembolism, thrombosis, all and major paravalvular leak, and endocarditis, but not for all and major hemorrhage. At 1 year, freedom from all death and from valve-related death was 96.4% and 99.7%, respectively. From baseline to 1 year, New York Heart Association class changed as follows: I, 10.8% to 73.7%; II, 48.9% to 22.6%; III, 38.0% to 3.5%; and IV, 2.3% to 0.2%. Effective orifice area increased from 0.9 ± 0.5 to 1.5 ± 0.4 ($P < .0001$), and mean aortic gradient decreased from 42.7 ± 16.5 to 12.5 ± 4.3 ($P < .0001$).

Conclusions: This analysis of a new stented bovine pericardial aortic valve demonstrated low overall mortality and valve-related adverse events, and hemodynamic performance comparable to that of other surgical aortic valves. (J Thorac Cardiovasc Surg 2018;■:1-10)



The Avalus aortic valve bioprosthesis is a novel trileaflet, stented, bovine pericardial valve. Used with permission. © Medtronic 2018.

Central Message

This analysis of a novel stented bovine aortic valve demonstrated low overall mortality and valve-related AEs, and hemodynamic performance comparable to that of other surgical aortic valves.

Perspective

The Avalus (Medtronic, Minneapolis, Minn) valve has an excellent safety profile and favorable clinical outcomes and hemodynamics through the first year after implantation. For all valve-related AEs except all and major hemorrhage, the valve performed well. The unexpected linearized late hemorrhage rates are likely due to preexisting patient conditions requiring anticoagulation and the length of follow-up.

See Editorial Commentary page XXX.

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Funding provided by Medtronic.

Trial registration: Clinicaltrials.gov, NCT02088554.

Read at the 97th Annual Meeting of The American Association for Thoracic Surgery, Boston, Massachusetts, April 29-May 3, 2017.

* Principal investigators of the PERIGON Pivotal trial are listed in Table E1.

Received for publication May 30, 2017; revisions received March 9, 2018; accepted for publication March 25, 2018.

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0022-5223/$36.00

https://doi.org/10.1016/j.jtcvs.2018.03.171

Abbreviations and Acronyms

AE = adverse event
AVR = aortic valve replacement
EOA = effective orifice area
EOAI = effective orifice area index
NYHA = New York Heart Association
OPC = objective performance criteria
PERIGON = PERIcardial SurGical AOrtic Valve ReplacemeNt Pivotal Trial for the Avalus valve
PPM = prosthesis–patient mismatch
PVL = paravalvular leak

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During the past several decades, there has been continued improvement in aortic bioprosthetic valve design to improve valve longevity, ease implantation, reduce transvalvular gradients, decrease thrombogenicity, and aid in later valve-in-valve transcatheter replacement. The Avalus aortic valve bioprosthesis (Medtronic, Minneapolis, Minn) was developed to continue this evolution in aortic tissue valve design. It is a trileaflet, stented, low-profile, bovine pericardial valve with a flexible sewing cuff, a polyester-covered, barium sulfate–impregnated base frame, and alpha amino oleic acid–treated, laser-cut leaflets. The safety and clinical and hemodynamic performance of this novel bioprosthesis are being evaluated in the PERIcardial SurGical AOrtic Valve ReplacemeNt (PERIGON) Pivotal Trial for the Avalus valve, a prospective, nonrandomized, international study. Early results from this trial demonstrated a good safety profile and hemodynamic performance, although bleeding rates exceeded objective performance criteria (OPC).[1] This article reports data from a larger cohort of patients with 1 year of follow-up.

MATERIALS AND METHODS

Study Design

The trial enrolled patients with symptomatic moderate or severe aortic stenosis or chronic, severe aortic regurgitation to receive a new bovine stented aortic valve. The trial design was based on recommendations of the US Food and Drug Administration and the International Organization for Standardization for cardiac valve prostheses to fulfill requirements for regulatory approval.[2,3] The trial was conducted at 19 sites in the United States, 13 sites in Europe, and 4 sites in Canada (Table E1).

Device Description

The Avalus bioprosthesis is indicated for the replacement of a diseased, damaged, or malfunctioning native or prosthetic aortic valve. It comprises a polyester-covered base frame and trileaflet support frame that are injection-molded using a polyetheretherketone material. The base frame contains barium sulfate for radiographic visualization. The laser-cut leaflets consist of bovine pericardial tissue cross-linked in buffered glutaraldehyde. The valve is treated with alpha amino oleic acid to mitigate calcification.[4] The base frame cover contains a polyester sewing ring with markers for suturing and for seating the valve in the supra-annular position. The valve is available in sizes of 17, 19, 21, 23, 25, 27, and 29 mm.

Patient Selection

Inclusion criteria. Patients with moderate or greater aortic stenosis or regurgitation with a clinical indication for aortic valve replacement (AVR) were considered for participation in the study. Concomitant procedures were allowed, but were limited to left atrial appendage ligation, coronary artery bypass graft, closure of a patent foramen ovale, ascending aortic aneurysm or dissection repair not requiring circulatory arrest, and resection of a subaortic membrane not requiring myectomy. These limitations were recommended by regulatory agencies and went into effect after the first 120 patients were enrolled.

Exclusion criteria. Patients were excluded for preexisting prosthetic valve or annuloplasty device; need for replacement or repair of the mitral, pulmonary, or tricuspid valve; previous implant and explant of study valve; active endocarditis, myocarditis, or other systemic infection; anatomic abnormality that increased surgical risk of morbidity or mortality (ie, ascending aortic aneurysm or dissection repair requiring circulatory arrest, acute type A aortic dissection, ventricular aneurysm, porcelain aorta, hostile mediastinum, hypertrophic obstructive cardiomyopathy, documented pulmonary hypertension [systolic >60 mm Hg]); noncardiac major/progressive disease with life expectancy of less than 2 years; renal failure (defined as dialysis therapy or glomerular filtration rate <30 mL/min/1.73 m^2); hyperparathyroidism; participation in another investigational trial or observational study; pregnant, lactating, or planning pregnancy during the trial period; documented history of substance abuse; greater than mild mitral valve or tricuspid valve regurgitation on echocardiography; systolic ejection fraction less than 20% on echocardiography; grade IV diastolic dysfunction; documented bleeding diatheses; prior acute preoperative neurologic deficit or myocardial infarction without return to baseline or stabilization 30 days or more before enrollment; or need for emergency surgery.

Procedure

Surgeons were allowed to use their preferred surgical approach for AVR, which included median sternotomy (79.4%), hemisternotomy (13.7%), right thoracotomy (5.4%), and other techniques (1.5%). Cardioplegia and cardiopulmonary bypass strategies were also left to the surgeon's discretion. Supra-annular (84.3%) positioning of the valve was recommended by the manufacturer, but intra-annular (14.9%), subannular (0.6%), and other (0.2%) positions were allowed. The most common suturing techniques were noneverting mattress sutures (49.0%) and simple interrupted sutures (29.9%). Pledgets were used in 54.4% of patients. Postoperative anticoagulation per local institutional practice was recommended.

Primary End Points

The primary safety end points were death and valve-related thromboembolism, thrombosis, hemorrhage, paravalvular leak (PVL), endocarditis, hemolysis, structural valve deterioration, nonstructural