Five-year results of the pilot trial of a sutureless valve

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ABSTRACT

Objective: A prospective trial was designed to evaluate the feasibility of the Perceval sutureless aortic valve. We report the 5-year clinical and hemodynamic outcome.

Methods: A total of 30 patients (mean age: 80.4 ± 3.8 years; mean logistic EuroSCORE: 13.2 ± 7.3) received the valve in 3 European centers, between April 2007 and February 2008. Cumulative follow-up was 92.67 patient-years, with a median of 4.2 years. Patients with a small annulus were selected because only sizes 21 and 23 mm (covering annuli diameters from 19 to 23 mm) were available at this early stage of the trial. In 37% of the patients, a 21-mm valve was used; 63% received a 23-mm valve; 14 patients had concomitant coronary artery bypass grafting. Clinical and hemodynamic follow-up evaluation were performed annually, including echocardiography.

Results: Procedural success was 100%. Cardiopulmonary bypass time and cross-clamp time in isolated aortic valve replacement were 46.4 ± 6.7 minutes and 29.3 ± 8.0 minutes, respectively. One patient died during the hospital stay. Postoperative complications included 1 patient with mediastinal bleeding, and 1 with atrioventricular block that led to pacemaker implantation. No stroke occurred in either the early or late period. At the last available follow-up, 22 patients were alive. The mean gradient was 9.3 mm Hg, with an effective orifice area of 1.7 cm² at 5 years. No dislodgement, structural valve deterioration, hemolysis, or valve thrombosis was reported.

Conclusions: This study reports the first and longest experience with a truly sutureless valve, evaluating implantation feasibility and valve safety. Results from up to 5 years of follow up confirmed the performance and safety of this device, even in a medium- to high-risk patient population with a small aortic annulus. (J Thorac Cardiovasc Surg 2015;150:84-8)

The Perceval sutureless valve prosthesis (Sorin Group Italia S.r.l., Saluggia, Italy) has gained wide popularity both in minimal invasive and conventional aortic valve replacement to reduce aortic cross-clamp time and maximize effective valve orifice area by complete resection of the calcified aortic valve. Several studies demonstrated safety and efficacy of the valve prosthesis in both isolated and combined procedures. However, to date, only short-term results have been published, with outcomes of up to 12 months. In this paper, we present the midterm results (up to 5 years) for the first 30 patients included in this pilot trial (first use in humans) involving 3 centers.

METHODS

Approval for the study was granted by the institutional review boards of the university hospitals involved, and by the ethics committees of the hospitals; all patients provided written, informed consent.
The valve prosthesis was loaded onto the delivery device and inserted to the point where it was blocked by the temporary guiding sutures. The prosthetic valve was released in 2 phases: first, the inflow section of the valve, followed by the opening of the outflow part. To optimize the area of contact between the prosthesis and the aortic annulus, a postimplant dilatation was done with a specifically designed balloon catheter at pressures of 4 atm for 30 seconds, while warm water was applied to the valve. Once the prosthesis was completely deployed, the guiding sutures were removed.

After closure of the aortotomy in the usual fashion, and release of the aortic cross-clamp, the valve function was assessed by transesophageal echocardiography in all patients. After the procedure, the patients received anticoagulation treatment according to the standard protocol in use at each center for aortic bioprostheses.

**Reporting on Adverse Events and Statistical Analysis**

Adverse events were reported according to current guidelines. Analyses for descriptive statistics were done with SAS software, version 9.2 (SAS Institute, Cary, NC). All data are expressed as mean ± SD, or as median and quartiles, if not normally distributed. Kaplan-Meier analysis was performed for medium-term survival.

**RESULTS**

Between April 2007 and February 2008, a total of 30 patients underwent aortic valve replacement with the prosthesis. Characteristics of the patients and intraoperative data are given in Table 1. Three patients had undergone previous cardiac surgery.

Operative results and follow-up evaluation at 12 months have been reported previously. Follow-up evaluation was available on a yearly basis for up to 5 years. Cumulative follow-up time was 92.7 years. One patient died during hospital stay, from sudden cardiac arrest (3.3%). Six patients in total died during the first postoperative years, between 45 and 1665 days after surgery, as reported previously, but only 1 of the deaths was valve related (endocarditis and sepsis on day 264). Overall 5-year survival was 71.3% (Figure 2).

Freedom from valve explant was 100% at 5-year follow-up evaluation. One patient had early mediastinal bleeding that led to tamponade and re-exploration on day 3, with a further uneventful course. Two late bleeding events occurred: 1 was gastrointestinal bleeding that led to rehospitalization on day 36, and 1 was retinal bleeding on day 350 without further treatment. One thromboembolic event was observed on day 6: limb ischemia, successfully treated with heparinization. Aside from the patient dying from severe endocarditis and sepsis, a second patient suffered from endocarditis, leading to rehospitalization and complete resolution under antibiotic therapy on day 789. One patient underwent pacemaker implantation early after surgery, owing to new-onset atrioventricular block.

Linearized rates (events per 100 patient-years) and actuarial probabilities of freedom from postoperative mortality and morbidity at 5 years were, respectively: late mortality, 6.5 (95% confidence interval (CI) 1.5-11.5) and 71.3%; bleeding, 2.2 (95% CI 0.0-5.1) and 89.2%; endocarditis,
2.2 (95% CI 0.0-5.1) and 90.7%; grade III atrioventricular block, 1.1 (95% CI 0.0-3.2) and 91.0%. No aortic regurgitation led to reoperation; 1 mild and 1 moderate perivalvular leak occurred at 12-month follow-up evaluation, and 1 mild perivalvular leak occurred at 5 years. No dislodgement of the valve, no structural valve deterioration, hemolysis, stroke, or valve thrombosis was observed within the 5-year follow-up period.

Postoperative hemodynamics showed low mean and peak gradients, as well as an effective orifice area index that was revealed to be stable over time (Table 2). Functional results are given as postoperative NYHA class in Table 3. Taking into account that 93.3% of patients were in NYHA class III, and 6.7% in NYHA class IV preoperatively, most remained in NYHA class I and II during the follow-up period.

**DISCUSSION**

For aortic valve stenosis, aortic valve replacement is still the treatment of choice. Transapical or transfemoral aortic valve implantation (TAVI) has been proposed as an alternative treatment in cases with high surgical risk. Because the TAVI approaches may occur with reduced valve orifice area and paravalvular leakage, owing to the fact that the calcified valve is left in place, alternative approaches, such as sutureless valves, have been reintroduced after the earliest attempts. In the late 1960s, the Magovern-Cromie prosthesis, a caged-ball mechanical prosthesis...
with anchoring spikes, was implanted, with acceptable results, even at long-term follow up.10,11

Various modern “sutureless” valve prototypes have been in introduced in recent years to reduce cross-clamp times: Most of the clinical experience to date has been with the ATS 3f Enable bioprosthesis12 (ATS, Minneapolis, Minn), the Edwards Intuity valve13 (Edwards Life Sciences, Irvine, Calif), and the Perceval sutureless aortic valve prosthesis3 (Sorin Group, Saluggia, Italy). The Perceval valve was introduced into clinical practice with a pilot trial (first use in humans, data within this article), followed by 2 prospective European trials (PIVOTAL [150 patients] and CAVALIER [658 patients]), both aiming at 5-year follow up with echocardiography core-lab reviewed data. At the latest 2014 European Association for Cardio-Thoracic Surgery meeting (abstract texts available through the organization website), data were shown from these trials, and the corresponding papers are in review. Data from a subgroup of patients with concomitant procedures have already been published.14 The first North-American experience occurred in Canada.15 In the United States, a prospective Investigational Device Exemption trial is running and has included 300 patients.

The surgical approach with full access to the aortic annulus allows for safe and complete decalcification of the annulus under direct vision to create a smooth annulus, thus preventing paravalvular leakages by proper fitting of the prosthesis into the annulus. The deployment system, together with dilatation of the valve, results in proper fixation without any valve dislodgement over time. The prosthesis can even be implanted in minimally invasive procedures, as demonstrated recently,16 and in redo cases, including calcified homografts.12

Our results confirm the safety and efficacy of the Perceval sutureless aortic valve, and for the first time, demonstrate the advanced clinical and hemodynamic outcomes for up to 5 years, despite the advanced age of the enrolled population. The valve implantation resulted in significant improvement of patients’ symptoms, as well as reduction of transvalvular pressure gradients, which were shown to be stable over time. In addition, in patients requiring combined aortic valve replacement, along with concomitant procedures, sutureless valves may be advantageous, because the total cross-clamp times are significantly shorter.

The Perceval valve is currently commercially available throughout Europe. In addition, several countries (eg, Belgium, Germany, and Turkey) have approved reimbursement for this new prosthesis. The actual cost of the valve is higher than that for routine stented valves, but several groups have shown an overall reduction in hospital costs for patients who have used this device.17 The rapid deployment technique can lead to shorter operation and cardiopulmonary bypass times, and to faster postoperative recovery with shorter hospital stays.

The learning curve is short. Two proctored implantations are advised by the manufacturer. Paravalvular leakage can be avoided by proper decalcification of the annulus, proper placement technique, and thorough control of valve position visually and on transthoracic echocardiography during the weaning phase from cardiopulmonary bypass. Practically all centers that use the valve have seen a complete disappearance of paravalvular leaks in their growing experience with the device. The level of the aortotomy is slightly higher than the usual transverse incision for a routine stented valve, but the difference is subtle: An incision approximately 1 cm higher than the usual incision level is sufficient. An illustrative video segment, showing the entire implantation procedure, was previously published as supplemental material.5

Several centers have compared outcomes with sutureless valves to those with TAVI procedures (in moderate- to high-risk patients), revealing better results for sutureless valves regarding mortality, paravalvular leak rates, and vascular complications.18,19 In conclusion, this study reports the first and longest human experience with a truly sutureless valve, evaluating implant feasibility and valve safety. Results up to 5-year follow up confirmed the performance and safety of this device even in a medium- to high-risk patient population.

### Conflict of Interest Statement

All funding for this trial was provided by Sorin. B. Meuris, F. Laborde, and M. Shrestha receive lecture fees from Sorin.
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References

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EDITORIAL COMMENTARY

Encouraging durability results for sutureless aortic valve: The new gold standard for aortic valve replacement?

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Aortic valve replacement using stented valves is the conventional standard approach in the treatment of aortic valve disease. Despite the excellent long-term results with biological stented valves, sutureless technology recently has been developed as an alternative to stented valves in high-risk patients to simplify the surgical implantation and reduce the operative times.1-3 The Perceval S (Sorin Group, Milan, Italy) sutureless valve is new self-expanding prosthesis made of bovine pericardium mounted in a nitinol stent. Several studies