Aborted sternotomy due to unexpected porcelain aorta: Does transcatheter aortic valve replacement offer an alternative choice?

Jahanzaib Idrees, MD,[a] Eric E. Roselli, MD,[a] Sajjad Raza, MD,[a] Amar Krishnaswamy, MD,[b] Stephanie Mick, MD,[a] Samir Kapadia, MD,[b] Gosta B. Pettersson, MD, PhD,[a] Murat Tuzcu, MD,[b] and Lars G. Svensson, MD, PhD[a]

Objectives: Surgical aortic valve replacement is challenging in patients with severe aortic calcification. Some patients undergo sternotomy and have the operation aborted because of intraoperative discovery of severe calcification. Hypothermic circulatory arrest and transcatheter aortic valve replacement offer clampless treatment options for aortic stenosis. The study objectives are to characterize patients who are referred after sternotomy was aborted for porcelain aorta and to describe the treatment outcomes.

Methods: From 2001 to 2013, 19 patients presented after attempt at surgical aortic valve replacement was aborted because of porcelain aorta. Patients presented with aortic stenosis (n = 16), regurgitation (n = 1), or both (n = 2). Off-pump coronary bypass was performed in 10 patients. At the Cleveland Clinic, patients underwent surgical aortic valve replacement (n = 7) or transcatheter aortic valvve replacement (n = 12). The median interval between aborted aortic valve replacement and definitive treatment was 9.6 months. The mean age was 74 ± 11 years. The mean transvalvular gradient was 51 ± 18 mm Hg, and area was 0.6 cm^2. Axillary cannulation was used in all patients undergoing surgical aortic valve replacement, but only 4 required circulatory arrest. The transcatheter aortic valve replacement approach was transfemoral (n = 5), transapical (n = 6), or transaortic (n = 1).

Results: The mean postoperative gradient was 13 ± 4 mm Hg. There was no mortality, stroke, renal failure, or reoperation for bleeding. One patient required a second valve implantation for paravalvular leak. The median hospital length of stay was 8 days. Five late noncardiac deaths occurred at a median follow-up of 16 months.

Conclusions: Both surgical aortic valve replacement and transcatheter aortic valve replacement are safe and effective options after aborted sternotomy in patients with porcelain aorta who are referred to a high-risk valve center. Procedure selection may be tailored to individual patients on the basis of aortic morphology and comorbidities. Patients with aortic stenosis at risk for calcific aortic disease should be screened with cross-sectional imaging preoperatively. (J Thorac Cardiovasc Surg 2015;149:131-4)

See related commentary on pages 134-6.

Surgical aortic valve replacement (SAVR) is a challenge in patients with porcelain aorta, because the calcified aorta is difficult to manage. Studies have reported significant risks of stroke and mortality in these patients.[1]

The conventional treatment for aortic stenosis is SAVR, but the advent of transcatheter aortic valve replacement (TAVR) has expanded treatment options to operable and higher-risk patients. Because TAVR does not require cardiac arrest, the need to clamp the aorta is avoided, but this treatment has been reserved for high-risk patients with suitable anatomy.[2]

Since the advent of TAVR, we have encountered an increase in patients with severe aortic stenosis in whom SAVR was attempted but aborted because of intraoperative discovery of porcelain aorta. These patients were referred for definitive treatment and possible TAVR.

Both SAVR and TAVR were performed in these patients. The objectives are to characterize patients, describe treatment options, and assess outcomes.

PATIENTS AND METHODS

From 2001 to 2013, 19 patients with a history of aborted SAVR and severe aortic valve dysfunction underwent definitive aortic valve replacement with SAVR (n = 7) or TAVR (n = 12) at the Cleveland Clinic. The mean age at the time of operation was 74 ± 11 years. Aortic valve dysfunction included severe aortic stenosis (n = 16), regurgitation (n = 1), or both (n = 2). The mean preoperative aortic valve gradient was 53 ± 18 mm Hg (SAVR: 46 ± 8 mm Hg, TAVR: 56 ± 16 mm Hg). Table 1 summarizes the patient characteristics for both groups.

From the Department of Thoracic and Cardiovascular Surgery[a] and Interventional Cardiology,[b] Heart and Vascular Institute, Cleveland Clinic, Cleveland, Ohio.

Disclosures: Eric E. Roselli reports consulting fees from Edwards and Medtronic. All other authors have nothing to disclose with regard to commercial support.

Received for publication Aug 2, 2014; revisions received Sept 9, 2014; accepted for publication Sept 11, 2014; available ahead of print Nov 4, 2014.

Address for reprints: Eric E. Roselli, MD, Department of Thoracic and Cardiovascular Surgery, Cleveland Clinic, 9500 Euclid Ave, Desk J4-1, Cleveland, OH 44195-5108 (E-mail: roselle@ccf.org).

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2014.09.035

Abbreviations and Acronyms
SAVR = surgical aortic valve replacement
TAVR = transcatheter aortic valve replacement

The median interval between aborted aortic valve replacement at the outside facility and definitive procedure with SAVR or TAVR at the Cleveland Clinic was 9.6 months. In 10 patients (53%), off-pump coronary artery bypass grafting was performed at the time of aborted aortic valve replacement, and the sternotomy was closed without additional procedures in the remaining 9 patients. Data were collected from chart review and augmented with Social Security Death Index when available. Descriptive statistical analyses are used to present variables for the study. The study was approved by the institutional review board of Cleveland Clinic, with patient consent waived.

Surgical Aortic Valve Replacement

The surgical approach was via redo sternotomy (median, 6; minimally invasive, 1). Bioprosthetic valves were used in 5 patients, and a mechanical valve was used in 2 patients. Two patients in this group also had bicuspid aortic valve. The median prosthetic valve size was 25 mm. The aorta was not clampable in 4 patients because of severe calcification of the ascending aorta, and hypothermic circulatory arrest with retrograde brain perfusion was used. The ascending aorta was replaced in all 4 patients. In the other 3 patients, the ascending aorta was relatively spared of calcification near the brachiocephalic artery, and it was possible to crossclamp the aorta in that region to avoid circulatory arrest. In no patients was there adequate healthy aorta for both clamping and cannulating. Right axillary artery cannulation was applied in all 7 patients. Nine concomitant procedures were performed in 6 patients for coexisting cardiac disease. These included ascending aortic replacement (n = 4), coronary bypass (n = 3), mitral valve repair (n = 1), and tricuspid valve repair (n = 1). One patient with severe radiation heart disease required all 4 procedures along with SAVR.

Transcatheter Aortic Valve Replacement

This technique was used in 12 patients. The approach was transfemoral in 5 patients. The other 7 patients had severe peripheral arterial disease prohibiting this approach. These were treated using transapical (n = 6) or transaortic (n = 1) access. Balloon-expandable valves (Sapien, Edwards Lifesciences, Santa Rosa, Calif) were used in all patients in this group. Valve sizes were 23 mm in 4 patients and 26 mm in 8 patients.

In 1 patient in this group, intraoperative prosthetic paravalvular leak developed that was managed with placement of an additional valve-in-valve. Another developed hemodynamic instability and required temporary use of an intra-aortic balloon pump.

TABLE 1. Preprocedural patient characteristics

	Overall	SAVR	TAVR
	N = 19	n = 7	n = 12
Age (mean y)	74 ± 11	62 ± 12	78 ± 3
Male	12	3 (43)	9 (75)
NYHA class II/III	17	6 (86)	11 (92)
Hypertension	13	6 (86)	7 (58)
COPD	4	1 (14)	3 (25)
Cancer	5	2 (17)	3 (25)
Prior stroke	3	0 (0)	3 (25)
Cardiac comorbidities			
Coronary artery disease	12	7 (100)	5 (42)
Ascending aortic aneurysm	1	1 (14)	0 (0)
Radiation heart disease	2	1 (14)	1 (8)
Mitral valve disease	1	2 (28)	0 (0)
Tricuspid valve disease	1	1 (14)	0 (0)

COPD, Chronic obstructive pulmonary disease; *NYHA*, New York Heart Association; *SAVR*, surgical aortic valve replacement; *TAVR*, transcatheter aortic valve replacement.

RESULTS

The mean postoperative gradients were 13 ± 4 mm Hg (SAVR: 14 ± 3, TAVR: 14 ± 4 mm Hg). At a median follow-up of 16 months, there was no operative mortality, paravalvular leak, stroke, renal failure, or reoperation for bleeding. There were 5 late deaths, 4 in the TAVR group and 1 after SAVR. The patient who died post-SAVR had lung cancer and died approximately 1 year postoperatively of pneumonia associated with the lung cancer. The remaining 4 deaths in the TAVR group all occurred in patients with multiple comorbidities. One patient died 5 months post-TAVR of persistent heart failure due to diastolic dysfunction and severe mitral and tricuspid regurgitation despite a well-functioning TAVR. One patient died of complications related to respiratory failure 2 months post-transaortic TAVR at a long-term care facility. She had a recent history of lung cancer treated with radiation on continuous oxygen and required a tracheostomy postprocedure. One patient died 17 months post-TAVR of complications related to a chronic gastrointestinal bleed, and 1 patient died 3 years later of acute on chronic renal failure despite a well-functioning TAVR valve. No patients required valve-related reintervention during late follow-up.

DISCUSSION

The conventional approach for treatment of severe aortic stenosis is SAVR, but the procedure can be technically challenging when the aorta is severely calcified, and this also increases the risk of stroke.[1-3] Studies have reported a mortality of up to 14% in these patients.[3] This experience demonstrates that both SAVR and TAVR can be safely performed at a valve center specializing in the treatment of high-risk patients. TAVR expands options by providing a clampless alternative for replacing the aortic valve in patients with calcified aorta who may be too high risk for SAVR.[4-6] Use of axillary artery cannulation with or without hypothermic circulatory arrest may facilitate SAVR in these patients who are otherwise candidates for aortic valve replacement.

The choice of procedure type was based on a thorough preoperative assessment to determine the operative risk, anatomic feasibility, and need for additional procedures for cardiac comorbidities. SAVR was the preferred choice in patients with multiple cardiac comorbidities requiring additional procedures, such as coronary bypass, ascending aortic replacement, and mitral or tricuspid valve repair. SAVR also was more often performed during the earlier period of this experience when TAVR was not as readily available. Conversely, TAVR was preferred in patients