Transcatheter Valve Therapies: Current and Future Application

Written by Mary Mosley

Transcatheter aortic valve replacement (TAVR) has been demonstrated to be an alternative to surgical AVR in high-risk patients, especially older, frail patients with numerous comorbidities. Martin B. Leon, MD, New York-Presbyterian Hospital/Columbia University Medical Center, New York, New York, USA, stated 3 notable accomplishments in the decade since TAVR was introduced: 1) its inclusion in the American Heart Association and American College of Cardiology Guidelines for the Management of Patients with Valvular Heart Disease (with a Class IIa recommendation for inoperable or high-risk surgical patients) [Nishimura RA et al. *Circulation*. 2014; *J Am Coll Cardiol*. 2014], 2) the development of the multidisciplinary heart valve team concept that is responsible for the success of TAVR and improved patient care, and 3) the ability to conduct rigorous clinical research in an emerging field. Building on the success with this transcatheter approach to valve replacement, there is movement toward a transfemoral (TF) approach for aortic valves, development of next-generation devices to address paravalvular regurgitation (PVR), and the development of mitral valve replacement strategies.

Vasilis Babaliaros, MD, Emory University School of Medicine, Atlanta, Georgia, USA, presented data from his institution that showed the percutaneous minimalist TF approach for TAVR (M-TF TAVR) is as safe and effective as the standard approach for TAVR (S-TF TAVR) in an experienced center. The cost was significantly lower with the minimalist vs the standard approach ($45,485 vs $55,377; $P < .0001$), with much of the savings coming from the shorter length of stay and time in the intensive care unit (ICU).

Milestones that must be achieved before moving to M-TF TAVR, he stated, are perfecting the percutaneous access and the preprocedural planning and imaging; some 300 S-TF TAVR must be performed to have sufficient experience to perform M-TF TAVR. Two roadblocks to using the minimalist approach are the discomfort of the cardiac anesthesia and cardiac surgery fields, and the critical need for transesophageal echocardiography (TEE). However, he stated transthoracic echocardiography combined with fluoroscopy is very powerful and could provide the required imaging.

M-TF TAVR (n = 70) performed in the catheterization laboratory using conscious sedation and transthoracic echocardiography combined with fluoroscopy was compared with S-TF TAVR (n = 72) using a hybrid approach with general anesthesia and TEE. At baseline, the patients were similar, with high STS scores of about 11%, similar echocardiography results, and numerous comorbidities, including diabetes, sleep apnea, and prior bypass surgery. More patients in the M-TF TAVR group had prior mitral valve surgery.

The procedure success was similar with M-TF TAVR and S-TF TAVR (100% and 96%, respectively; $P = .24$) as was procedure-related mortality (0 and 3 deaths, respectively; $P = .24$). Intubation was required in 1 patient in the M-TF TAVR because of a technical error ($P < .001$ vs S-TF TAVR).

With the minimalist vs the standard approach, less time was required for x-ray (28 vs 32 minutes; $P = .01$), the procedure (93 vs 125 minutes; $P < .001$), and the room (150 vs 218 minutes; $P < .001$). Some of the reduction in time was because of experience, stated Dr Babaliaros.

The outcomes with the M-TF TAVR and S-TF TAVR approaches in this experience at Emory are detailed in Table 1. Notably, there were no deaths with the minimal approach and fewer patients went to the ICU. Most M-TF TAVR patients were discharged directly to their home rather than a skilled nursing facility or rehabilitation center.

There was no difference in vascular complications, new left bundle branch block, or the need for a pacemaker. At 30 days, the aortic valve area was similar with M-TF TAVR and S-TF TAVR

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Table 1. Outcomes With the Minimalist and Standard Approach for Transfemoral Aortic Valve Replacement

Outcome	Outcomes		
	Minimalist Approach n = 70	Standard Approach n = 72	*P* value
In-hospital mortality	0 (0)	3 (4.2)	.24
ICU care	53 (75)	69 (100)	< .001
ICU time – hours[a]	22 (2-28)	28 (23-48)	< .001
Hospital stay – days[a]	4 (3-7)	6 (4-9)	< .01
Hospital stay: procedure to discharge – days[a]	3 (2-4)	5 (3-6.5)	< .001
30-day mortality	0 (0)	4 (6)	.12
30-day stroke or TIA	3 (4.3)	1 (1.4)	.35

Data are number (%) unless otherwise indicated.

ICU, intensive care unit; TIA, transient ischemic attack.

[a]Median (interquartile range)

(1.77 vs 1.75 cm^2; $P = .79$), as was the aortic valve mean gradient (10.0 vs 10.3 mm Hg; $P = .68$), and moderate or severe paravalvular leak (2 vs 4 patients; $P = .40$). Event-free survival was similar at about day 400.

ADDRESSING PARAVALVULAR REGURGITATION AFTER TAVR

The issue of PVR after TAVR, which has been shown to impact late mortality in several studies, may be addressed with next-generation devices, stated Susheel Kodali, MD, New York-Presbyterian Hospital/Columbia University Medical Center, New York, New York, USA.

The etiology of PVR is multifactorial, including annular sizing, malposition of the valve, and patient anatomy not suitable to obtain a complete seal. The landing zone for the device will determine the PVR results in some patients. In some patient anatomy, a space filler may be required to fill the gaps or a subannular fixation to seal the inflow properly to obtain a seal at the aortic root, annulus, or left ventricular outflow tract (LVOT). However, there are no data yet on the type of device that is best for specific types of anatomy.

The SAPIEN 3 transcatheter heart valve is a space filler made of bovine pericardial tissue with a new leaflet shape, frame geometry, and high radial strength (comparable with the SAPIEN XT), with an ultralow profile stent for delivery that is compatible with a 14F eSheath. The Edwards Commander delivery system has dual articulation for improved coaxiality in challenging anatomies, such as crossing the native annulus, an ultralow profile that is compatible with a 14F eSheath, and smaller vessel diameters for minimum access. The smaller crimped profile of the SAPIEN 3 vs the SAPIEN and SAPIEN XT (6.7, 8.3, and 8 mm, respectively) makes the TF approach possible in more patients, stated Dr Kodali. The Edwards Certitude delivery system has an ultralow profile system compatible with an 18F Sheath, integrated pusher, articulation for ease of coaxial positioning, and an ergonomic handle.

The 30-day results of the SAPIEN 3 trial with 50 high-risk and 100 intermediate- or high-risk patients was presented as a Hot Line trial at EuroPCR 2014 [NCT01808287]. The trial was conducted in Europe and Canada. The access was TF in 64% and transapical or transaortic (TAA) in 36% of patients, which was more than usually seen in this type of trial using a 14F e-Sheath, said Dr Kodali. All-cause mortality at 30 days was 2.1% vs 11.1% in the TF and TAA groups, respectively. This difference may reflect some procedural issues, he said. The procedural success was high at 99.3% with a low (3.3%) rate of postdilatation. PVR was low at 2.6% in the TF group and 5.1% in the TAA group.

The Direct Flow nonmetallic valve made of bovine trileaflet bovine pericardial tissue has an 18F delivery and retrieval system with 3 positioning guide wires for inflation and position. It can be used to treat annulus sizes ranging from 19 to 28 mm with its valve sizes of 23, 25, 27, and 29 mm. In the DISCOVER trial with 100 high-risk

patients, the procedural success was 99% and at 30 days the rates of all-cause mortality and stroke were 1% and 4%, respectively. A new pacemaker was needed in 17% of patients [Schofer J et al. *J Am Coll Cardiol.* 2014]. The rates of PVR were low. The capacity to reposition the Direct Flow valve to optimize results and eliminate aortic regurgitation before permanent fixation is a key feature of the Direct Flow valve.

In the REPRISE II study with 120 high-risk patients, using the Lotus valve system with a braided nitinol frame, central radiopaque positioning marker, adaptive seal, and locking mechanism, the valve was delivered successfully in all patients and it was successfully repositioned in 31 of 31 patients and successfully retrieved in 6 of 6 patients [Meredith IT et al. *J Am Coll Cardiol.* 2014. In review]. The rates of all-cause mortality and stroke at 30 days were 4.2% and 5.9%, respectively. The rate of moderate PVR at discharge on day 7 was 2% in 110 patients and was 1.1% at 6 months in 89 patients.

The PARTNER II, REPRISE III, and SALUS studies with the next generation of devices will provide insights on their performance and ability to reduce PVR and thus long-term outcomes after TAVR.

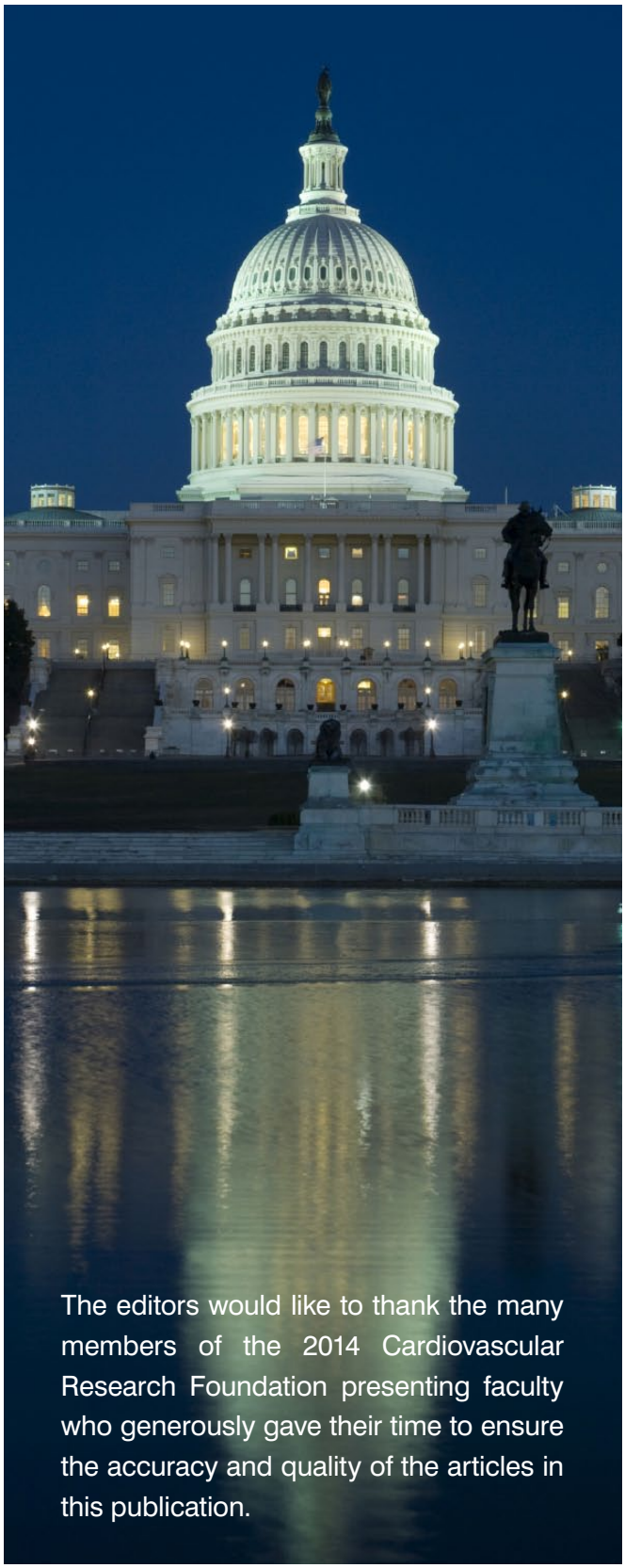
TRANSCATHETER MITRAL VALVE REPLACEMENT

Transcatheter mitral valve replacement (TMVR) is being developed, stated Vinod H. Thourani, MD, Emory Hospital Midtown, Atlanta, Georgia, USA, and refinement is needed to improve patient selection and procedural steps and to determine the optimal regimen for postoperative anticoagulation.

The mitral valve is a very dynamic structure with many moving components that make replacement complex, stated Dr Thourani. Some 16 transcatheter mitral implant devices are being developed or are in preclinical or clinical testing.

TMVR has been used only for compassionate care, not within a clinical trial, and the results in these first-in-human (FIH) implants have supported moving forward to feasibility trials with several of these devices, including the Neovasc Tiara, CardiAQ, Tendyne transapical, and the Edwards Fortis devices.

Some of the challenges identified by the preclinical and FIH work are the need to improve the transfemoral approach; the complexity of the saddle-shaped orifice and its size, which may be addressed with 3D computed tomography; LVOT obstruction, which may be aided by capturing the anterior leaflet and atrial positioning; ensuring that only radial force is being used and that calcium or elasticity is not be included; and ensuring that adjacent structures are not distorted or impinged.



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