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CORRESPONDENCE

Research Correspondence

# Transcatheter Aortic Valve Implantation in Degenerate Failing Aortic Homograft Root Replacements

**To the Editor:** As with all bioprosthetic aortic valve substitutes, homografts are prone to late degeneration characterized by dense calcification and valve dysfunction. Reoperation in patients with prior homograft aortic root replacement may carry a substantial risk, particularly in elderly patients and patients with significant comorbidities. Even in relatively fit patients, it can be technically challenging, especially where there have been multiple previous procedures or when there is calcification around the coronary ostia. Transcatheter aortic valve implantation (TAVI) has become a recognized treatment for patients with severe aortic stenosis (AS) who are at high risk from conventional surgery. A small number of reports (1,2) have described the use of TAVI as a valve-in-valve procedure for structural degeneration of bioprostheses, predominantly in stented prostheses.

We describe the first series utilizing TAVI with a self-expanding prosthesis to treat patients with structural degeneration in a prior homograft aortic root replacement.

All TAVI procedures were performed under general anesthesia with transesophageal echocardiography (TEE) guidance. Temporary right ventricular and right atrial pacing wires were placed through the right internal jugular vein. The right femoral artery was intubated with an 18-F Cook sheath after pre-closure with 10-F Prostar (Abbott Vascular Devices, Redwood City, California). The contralateral common femoral artery was cannulated with a 6-F sheath with a 5-F pigtail catheter advancing to aortic root. All arterial cannulation was undertaken utilizing ultrasound guidance. For the left subclavian artery (LSCA) approach (in 1 patient with unsuitable iliofemoral system), the LSCA was exposed by a left infraclavicular incision and cannulated directly with an 18-F Cook sheath. The remainder of the procedure was similar to the transfemoral approach.

The aortic valve was crossed with a soft-tipped straight 0.035-inch wire within a 5-F Amplatz-Left-1 (Cordis Corp., Miami, Florida) catheter. A pre-shaped SuperStiff-Amplatz guidewire (Boston Scientific Corp., Natick, Massachusetts) was placed into the left ventricular apex. Balloon pre-dilation of the homograft was deliberately avoided. Under fluoroscopic and (specifically) TEE guidance, a Medtronic CoreValve was positioned across the homograft. The initial two-thirds of the deployment was effected under rapid ventricular pacing at between 120 and 180 beats/min (dependent upon the individual hemodynamic situation). Both TEE and aortography were performed post-deployment to verify device position and performance. The 18-F Cook sheath was removed under ventricular pacing at ~120 beats/min (to lower systolic blood pressure) with deployment of pre-laid Prostar in all cases (the LSCA was repaired by direct suture). Post-decannulation angiography of the access site was effected in all patients. Before discharge, a transthoracic echocardiogram was performed.

This series consists of 5 consecutive patients. Patient characteristics, procedural details, and outcome were listed in Table 1. Device success, defined as successful deployment of CoreValve prosthesis in optimal aortic position with ≤2+ paraprosthetic aortic regurgitation (AR) and successful retrieval of delivery system, was 80%. In 1 patient, the first device was deployed too deep (ventricular) in position with significant paravalvular regurgitation. A second device was deployed during the same procedure such that 100% procedural success was achieved at the end of the initial procedure in all patients. All patients had marked symptomatic improvement with no more than mild AR at follow-up. Mean aortic gradient was 24.0 ± 16.5 mm Hg before TAVI and 8.2 ± 2.8 mm Hg post-procedurally ($p = 0.07$). There were no access site complications, stroke, requirement for pacemaker, or other complications (according to Valve Academic Research Consortium definitions [3]). Short- and mid-term clinical outcomes were satisfactory.

Several aspects of the procedure are worthy of highlighting. Knowledge of implantation technique of the homograft and its precise size are of pivotal importance. Multislice computed tomography gives a clear picture of the root anatomy and geometry, the distribution of calcium, and most importantly, an accurate measurement of annular size. Significant distortion of root anatomy is not infrequently encountered in these patients, and was a feature to a greater or lesser extent in all of our patients. Balloon valvuloplasty was deliberately avoided principally to avoid the creation of free AR with hemodynamic compromise. Valvuloplasty is not necessary to effect successful deployment in these patients. The less bulky calcifications in patients with homograft roots (as compared with native calcific aortic stenosis) reduces the risk of coronary obstruction. However, low-lying coronary ostia and rigid, less capacious aortic sinuses may increase the risk of coronary obstruction. Therefore, this risk in this subset of patients has to be individually assessed.

The size-26 Medtronic CoreValve, recommended for 20 to 23 mm (native) annulus, was implanted in all patients. It would be unusual to have a large homograft available for the initial implantation. This and the healing/calcification process will almost always result in a small aortic root. The size-26 will be suitable for the vast majority in this setting. With smaller sizes of homograft, there may be a relative degree of over-sizing of the prosthesis, as in our patients. In some ways, this is a desirable feature given the pathophysiological condition of severe AR and the need to effect secure implantation/fixation with a substantial reduction in the regurgitation.

The deployment and accurate positioning of the prosthesis is challenging owing to a general paucity of anatomic landmarks on fluoroscopy and severe AR leading to device instability. TEE was

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**Table 1** Patient Characteristics, Procedural Details, and Clinical Outcomes

| | Patient #1 | Patient #2 | Patient #3 | Patient #4 | Patient #5 |
|---|---|---|---|---|---|
| Age, yrs | 78 | 76 | 87 | 79 | 47 |
| Sex | M | F | M | M | F |
| NYHA functional class | III | IV | III | III | IV |
| Logistic EuroSCORE | 26 | 18 | 25 | 12 | 15 |
| STS score | 4.2 | 3.0 | 5.0 | 7.6 | 3.1 |
| No. of previous AVRs | 2 | 1 | 2 | 1 | 2 |
| Duration of last homografts, yrs | 15 | 13 | 14 | 6 | 12 |
| Pre-procedure | | | | | |
| Homograft size, mm | 24 | 22 | 22 | 24 | 22 |
| CT annular size, mm | 24×24 | 20×21 | 21×23 | 23×23 | 22×24 |
| Height of coronary ostia, R/L, mm | 17/18.2 | 5.6/7.8 | 12.0/12.5 | 14.8/16.3 | 16/17.1 |
| Rhythm | SR | SR | Pacing* | SR | SR |
| IHD, ≥70% stenosis | No | No | Yes | No | No |
| LV ejection fraction, % | 65 | 70 | 60 | 45 | 40 |
| AV mean gradient, mm Hg | 27 | 49 | 10 | 8 | 26 |
| AR severity | Severe | Severe | Severe | Severe | Severe |
| Procedure detail | | | | | |
| Access route | TF | TF | TF | LSCA† | TF |
| CoreValve size, mm | 26 | 26 | 26 | 26/26† | 26 |
| Post-implant | | | | | |
| AR severity | Trivial | Trivial | Mild | None | Mild |
| AV peak gradient, mm Hg | 8 | 17‡ | 4 | 10 | 7 |
| Need PPM? | No | No | N/A* | No | No |
| Procedural success | Yes | Yes | Yes | No/Yes† | Yes |
| Hospital/ICU stay, days | 6/1 | 5/1 | 6/1 | 25/2§ | 8/2 |
| Pre-discharge TTE, AR severity | No AR | No AR | Mild | No AR | Mild |
| Follow-up, days | 90 | 102 | 140 | 295 | 713 |
| NYHA functional class | I | II | II | II | I |
| Follow-up TTE | | | | | |
| AR severity | No AR | No AR | No AR | No AR | Mild |
| AV peak gradient, mm Hg | 9 | 12 | 5 | 9 | 6 |
| LV ejection fraction, % | 65 | 70 | 60 | 45 | 45 |

*Patient had pre-existing permanent pacemaker for sick sinus syndrome. †Patient had severe peripheral vascular disease in iliofemoral arteries; thus, the left subclavian artery (LSCA) was used. With the first valve deployment resulting in significant paraprosthetic aortic regurgitation (AR), valve-in-valve with second CoreValve was needed, which was successful. ‡Small aortic root and presence of lump of calcium at the root resulted in CoreValve appearing mildly constrained; the mean gradient was reduced to 12 mm Hg at follow-up. §Patient had urinary retention and traumatic urethral catheterization requiring prolonged in-patient care and urological consultations.

AV = aortic valve; AVR = aortic valve replacement; CT = computed tomography; EuroSCORE = European System for Cardiac Operative Risk Evaluation; ICU = intensive care unit; IHD = ischemic heart disease; L = left; LV = left ventricular; N/A = not available; NYHA = New York Heart Association; PPM = new permanent pacemaker; R = right; SR = sinus rhythm; STS = Society for Thoracic Surgeons; TF = transfemoral; TTE = transthoracic echocardiography.

used to guide valve positioning to a much greater extent than in patients with calcific aortic stenosis, aided by the very frequent use of low-volume root injections. Valve stability during deployment is dramatically enhanced by rapid ventricular pacing to reduce not only pressure but also the antegrade stroke and regurgitant volume per beat. In our view, the configuration, mode of deployment, and method of fixation of the self-expanding CoreValve offer attractive features in the setting of severe AR within a failing stentless aortic bioprosthesis, such as an aortic homograft.

This is the first series to demonstrate the feasibility of using TAVI with the self-expanding Medtronic CoreValves to treat patients with severe AR due to structural degeneration of a prior aortic homograft root replacement. The early results are encouraging; however, owing to the small size of the study, further studies are recommended to evaluate the role of this approach.

**Pak Hei Chan, MD**
**Carlo Di Mario, MD, PhD**
**Simon W. Davies, MD**
**Andrea Kelleher, MD**
**Richard Trimlett, MBBS, MS**
***Neil Moat, MBBS, MS**

*Transcatheter Valve Programme
Royal Brompton Hospital
Sydney Street
London SW3 6NP
United Kingdom
E-mail: N.Moat@rbht.nhs.uk

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