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Valve Migration Into the Left Ventricular Outflow Tract Managed by Coaxial Double-Valve Alignment

Annamaria Nicolino, MD,* Massimo Vischi, MD,† Shahram Moshiri, MD,* Antonio Salsano, MD,‡ Giancarlo Passerone, MD,‡ Francesco Chiarella, MD,† Francesco Santini, MD‡

Pietra Ligure and Genova, Italy

The efficacy and overall safety of transcatheter aortic valve implantation (TAVI) in patients with severe aortic stenosis at high risk for conventional surgery is validated. Nevertheless, infrequent, but severe, intraprocedural complications, often necessitating intraoperative bailout maneuvers, are reported. Among these, valve migration into the left ventricle is particularly dismal and requires conversion to an emergent surgical procedure with a reported disproportionally high mortality rate (1).

We report herein a case in which valve migration into the left ventricular outflow tract (LVOT) was successfully managed by repositioning a second prosthesis, thus avoiding emergent surgery.

An 81-year-old woman with severe symptomatic aortic stenosis and a logistic EuroSCORE of 26% was admitted for transfemoral TAVI. At computed tomography (CT) scan, aortic valve and root measurements showed an annulus diameter of 21 × 23 mm (mean 22 mm), a perimeter of 7.1 cm, an area of 3.7 cm^2 (Figs. 1A and 1B), an aortic root at the level of the sinus of Valsalva of 26 × 28 mm, and a sinotubular junction of 23 × 25 mm, respectively.

Interestingly, calcifications were present only on 2 valve leaflets and very scarcely on the annulus (Fig. 1C). Because of the borderline annular size, a calibrated balloon aortic valvuloplasty was performed, with the evidence that a 20-mm size completely occluded the annulus. A 23-mm Edwards Sapien XT valve (Edwards Lifesciences, Irvine, California) was therefore deployed as for a routine procedure during rapid pacing at the proper annular position (Fig. 2, Online Video 1).

Immediately after valve implantation, however, a self-limiting ventricular tachycardia occurred, and

Figure 1. CT Scan Aortic Valve and Root Measurements

Aortic valve **(A)** and annular measures **(B)**. Aortic valve calcifications involving mainly 2 leaflets and scarcely the annulus **(C)**. CT = computed tomography.

From the *Interventional Cardiology Unit, Santa Corona General Hospital, Pietra Ligure, Italy; the †Division of Cardiology, San Martino Hospital, Genova, Italy; and the ‡Division of Cardiac Surgery, IRCCS San Martino, University of Genova, Genova, Italy. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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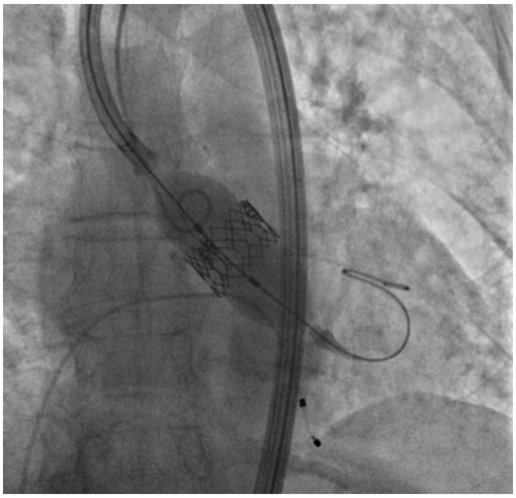

Figure 2. First Valve After Deployment at the Annular Level

Fluoroscopic view showing the first 23-mm Edwards Sapien XT valve deployed in the correct position (Online Video 1).

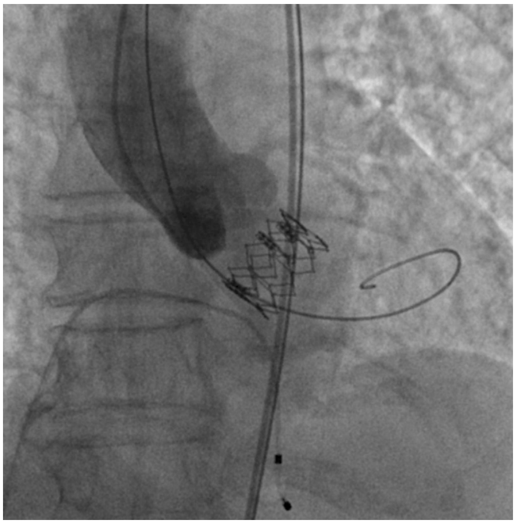

Figure 3. Migrated Valve at the Subannular Level

Fluoroscopic view showing the 23-mm Edwards Sapien XT valve migrated into the left ventricular outflow tract (Online Video 2).

fluoroscopy showed the valve had migrated into the LVOT (Fig. 3, Online Video 2). In view of the rapidly deteriorating hemodynamics with marked hypotension (90/60 mm Hg) and bradycardia requiring inotropic support, tracheal intubation, and ventricular pacing, having excluded by transesophageal echocardiography (TEE) any involvement of the mitral valve, the heart team decided on an emergency, lifesaving, second aortic valve deployment with the contemporary intent to reposition the previous prosthesis. The decision was taken in view of the patient's prohibitive overall clinical conditions for surgery, including a very high frailty score (Geriatric Status Scale) (1).

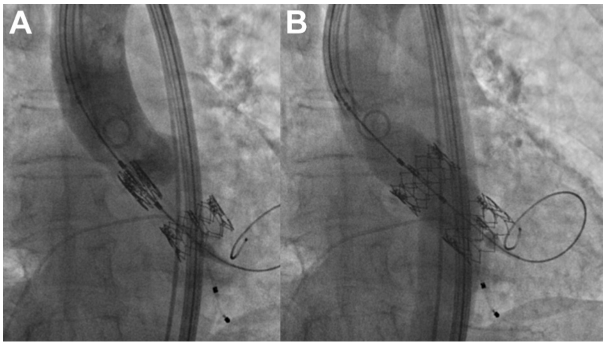

Figure 4. Deployment of the Second Valve

Fluoroscopic view showing the second 23-mm Edwards Sapien XT valve in position before **(A)** and after **(B)** balloon dilation, respectively (Online Video 3).

Again, a second 23-mm Edwards Sapien XT valve was deployed, slightly overinflated by means of a balloon prepared with 2 ml of extradilute contrast medium, and in a higher position than the previous valve in the aortic annulus (Figs. 4A and 4B, Online Video 3). Furthermore, after balloon deflection and without rapid pacing, by using the delivery system tip of the second valve balloon catheter, the lower-edge mash frame of the first inserted valve was engaged and carefully pulled back to a stable position in the LVOT, coaxial to the second deployed prosthesis (Fig. 5, Online Video 4). The patient regained hemodynamic stability, allowing rapid withdrawal of inotropic support. TEE excluded any mitral regurgitation or restriction of the anterior mitral leaflet motion. The patient was discharged on day 7 after permanent pacemaker implantation for persistent complete atrioventricular block.

At 12 months of follow-up, the patient is stable in New York Heart Association functional class I and with no adverse events in the interim period. The electrocardiogram shows sinus rhythm and normal atrioventricular conduction, with no pacemaker intervention. Serial echocardiograms, radiographic controls, and CT angiography (Fig. 6, Online Video 5) showed stable valve positions and no mitral dysfunction.

Transcatheter heart valve migration is a largely, but not entirely, preventable complication with current balloon-expandable valves. An asymmetrically calcified aortic valve and a borderline annular size may have favored prosthesis migration by preventing proper annular anchoring. The choice of a 23-mm prosthesis was made to minimize

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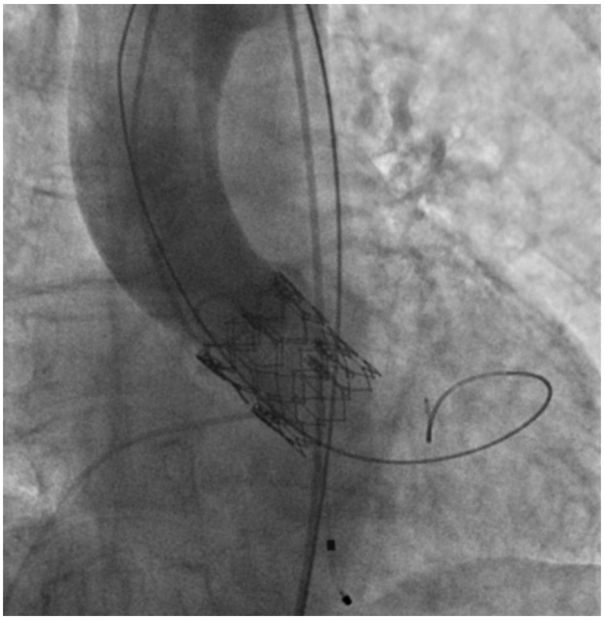

Figure 5. Coaxial Position of the 2 Valves

Fluoroscopic view showing the coaxial double-valve LVOT alignment achieved after balloon catheter retrieval (Online Video 4).

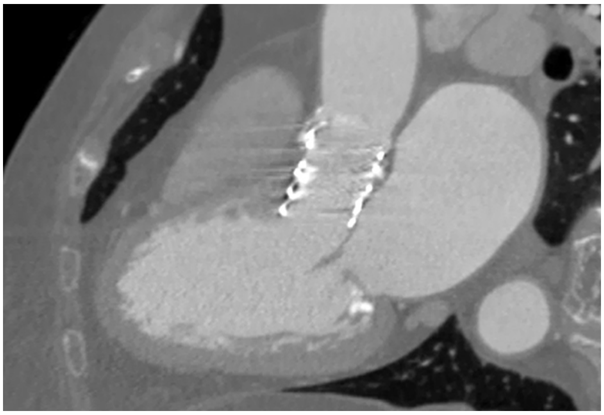

Figure 6. Cine CT Scan at Follow-Up

Contrast material–enhanced electrocardiographically gated computed tomographic (CT) angiography showing the *stable* coaxial alignment of the 2 deployed valves at 9 months of follow-up (Online Video 5).

complications of a smallish aortic root and after calibrated measurements. It is conceivable that a more aggressive valve dilation in the first instance might have prevented valve migration. During the procedure, the position of the pigtail was higher than recommended but still deemed satisfactory to visualize the annulus during aortography. We chose to inflate the valve according to the "2-step implantation technique" to gain the opportunity to adjust the position should it have become necessary. Retrospectively, the potential impact of the 2-step technique on valve migration cannot be excluded. Nevertheless, the evidence that the valve prosthesis stayed in position for a given time frame seems to underscore that the applied radial forces rather than the application time might have had more of an impact on the final result.

Although prevention with meticulous image analysis and sizing remains the key to success, the prompt availability of an interdisciplinary surgical and interventional safety net to manage bailout maneuvers in potentially fatal complications are confirmed to be mandatory. In our case, excluded any mitral valve involvement, the decision to proceed with a second deployment was taken in view of the patient's prohibitive clinical conditions, further worsen by the casualty, and by the reported evidence of poor surgical results in an emergency setting (1,2).

Although our approach was successful, the potential for a disastrous outcome and therefore the need for extensive planning should never be underestimated.

Reprint requests and correspondence: Dr. Francesco Santini, Division of Cardiac Surgery, IRCCS Azienda Ospedaliera Universitaria San Martino–IST, Largo Rosanna Benzi 10, 16132 Genova, Italy. E-mail: francesco.santini@univr.it

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Key Words: computed tomography (CT) ■ embolization ■ hemodynamic status ■ percutaneous aortic valve replacement.

APPENDIX

For supplemental videos, please see the online version of this article.