Patients with surgically treated congenital cardiac disease increasingly survive into adulthood and face the need for repeat sternotomies for senescent prosthetic valves and conduits. This poses increased risk of chest re-entry injury, and alternatives to redo median sternotomy are important. Although transcatheter aortic valve-in-valve (ViV) and transcatheter pulmonary valve implantation (TPVI) (Melody valve, Medtronic, Minneapolis, Minnesota) have both been separately described (1–3), we describe a combination of aortic ViV and TPVI utilizing 3-dimensional (3D) computed tomography (CT) fluoroscopic coregistration to aid procedural execution. A 24-year-old man with congenital bicuspid aortic stenosis, prior Ross procedure, re-replacement of the right ventricle (RVOT) with congenital bicuspid aortic stenosis, prior Ross procedure, and aortic valve replacement (25-mm Perimount bioprosthesis, Edwards Lifesciences, Irvine, California) was referred for symptomatic aortic and pulmonary conduit stenoses. Aortic valve mean gradient was 52 mm Hg, and mean pulmonary conduit gradient was 38 mm Hg. CT demonstrated pulmonary conduit stenosis and an aortic annular area of 360 mm² (annular dimensions 21.9 mm × 21.5 mm). The distances of the right coronary artery origin and proximal left anterior descending artery from the pulmonary artery were 8.7 mm and 11.9 mm, respectively. Coronary artery relational anatomy was felt to be favorable for intervention with combined transcatheter aortic ViV and TPVI (Figure 1A).

Using standard techniques, a 26-mm transcatheter aortic valve replacement (Sapien-XT, Edwards Lifesciences) was successfully undertaken within the aortic prosthesis. Post-deployment echocardiographic assessment demonstrated normal valve function. A noncontrast rotational angiogram of the cardiac and vascular structures was then performed, and images were matched with previously performed CT reconstructions of the pulmonary conduit. Coregistration using known skeletal landmarks enabled overlay of 3D images onto live fluoroscopy to guide transcatheter pulmonary valve placement. An exchange-length stiff guidewire was placed in the left lower lobe pulmonary artery using a balloon wedge catheter, and serial balloon dilations of the pulmonary conduit were performed using 18- and 22-mm balloons with simultaneous left coronary angiography demonstrating no coronary-conduit interaction. A 22-mm diameter balloon-in-balloon “BIB” catheter (NuMed, Hopkinton, New Jersey) with a mounted stent (PalmaZ-XL-4010, Cordis, Bridgewater, New Jersey) was delivered via a 14-Fr Mullins sheath into the pulmonary conduit. This was used to expand the homograft conduit and prepare a landing zone to minimize future risk of transcatheter pulmonary valve stent fracture. Fluoroscopic and 3D CT overlay facilitated accurate positioning and deployment of the stent. The stent was then post-dilated using a 22-mm balloon, and no stent recoil was noted. A 22-mm transcatheter pulmonary valve was then successfully deployed using a 22-mm delivery system (Ensemble delivery system, Medtronic) within the landing zone created by the stent (Figures 1B and 1C). The peak-to-peak catheter right ventricular outflow tract (RVOT) gradient was reduced to 5 mm Hg. Transesophageal echocardiography showed normal valve function with mild regurgitation. The patient was dismissed from the hospital on day 2 with a mean transaortic gradient of 21 mm Hg, and 11 mm Hg across the RVOT, with no demonstrable regurgitation.

This presentation is unique in that this was a young adult with 3 previous median sternotomies within a period of 6 years, and efforts to avoid a repeated median sternotomy were critical. Multidisciplinary assessment and 3D imaging were essential to procedural planning and execution. Although annular calcification and radiographic signatures of prosthetic valves can often serve as fluoroscopic markers and
assist with valve positioning and deployment during transcatheter valve–ViV implantation, these are not always available or optimal for procedural guidance. The use of 3D CT fluoroscopic coregistration using skeletal landmarks can significantly improve the accuracy of valve positioning and procedural success.

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