CLINICAL VIGNETTE

Intravascular ultrasound for transcatheter pulmonary valve replacement

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A 20-year-old man with tetralogy of Fallot underwent total defect repair at the age of 3 years with the transannular patch of the pulmonary valve. The patient was scheduled for percutaneous pulmonary valve implantation due to significant pulmonary insufficiency with a regurgitant volume of 36 ml and a regurgitant fraction of 36% measured by cardiac magnetic resonance (CMR) imaging. The pulmonary dimensions on CMR imaging were 21 × 25 mm (FIGURE 1A). Intravascular ultrasound (IVUS) was performed using the Visions PV.035" digital catheter (Philips Volcano, San Diego, California, United States). It provided a large imaging field (maximally 60 mm in diameter) at 10-MHz frequency, which is much lower than for coronary vessel imaging. It showed the pulmonary outflow tract of an elliptical shape, assessed at the site of its maximal dimension, and visible valve cusps: systolic measurements were 23.8 × 38.9 mm with a corresponding area of 7.3 cm^2 (FIGURE 1B) and an effective pulmonary area derived diameter of 30.6 mm (substantially larger than the corresponding diameter measured based on preinterventional CMR imaging).

A cobalt-chromium 39-mm stent was deployed on a 30-mm balloon-in-balloon catheter (BIB, NuMED, Hopkinton, New York, United States) (FIGURE 1C). Intravascular ultrasound was used to verify stent expansion, the oval shape, and stent inner diameters of 28.2 × 29 mm (FIGURE 1D). An Edwards SAPIEN 3 29-mm transcatheter heart valve (Edwards Lifesciences Corp., Irvine, California, United States) was then successfully implanted (FIGURE 1E). Intravascular ultrasound verified the inner-valve diameters of 28.1 × 28.2 mm (100% of the nominal expansion) and visualized symmetrical leaflet motion with a corresponding valve orifice of 20.7 × 22.5 mm in size (area of 3.64 cm^2) and the valve orifice area indexed to body surface area of 1.82 cm^2/m^2, thereby excluding the patient–prosthesis mismatch (FIGURE 1F).

This is the first report of IVUS-guided transcatheter Edwards SAPIEN 3 heart valve deployment in the right ventricular outflow tract (RVOT) including stent and valve frame sizing with an online insight into the mechanism of valve deployment and the associated normalization of lumen eccentricity. Transcatheter heart valve frame geometry and its expansion influence long-term durability and hemodynamic outcomes of implantation.[1,2] The current guidance of transcatheter pulmonary valve replacement (including device sizing) relies upon the results of preprocedural CMR imaging and periprocedural angiography with low-pressure balloon inflations for precise RVOT measurements.[3] We showed that IVUS offers an online tomographic perspective and the highest visual resolution for the guidance of transcatheter treatment of dysfunctional RVOT.[4]

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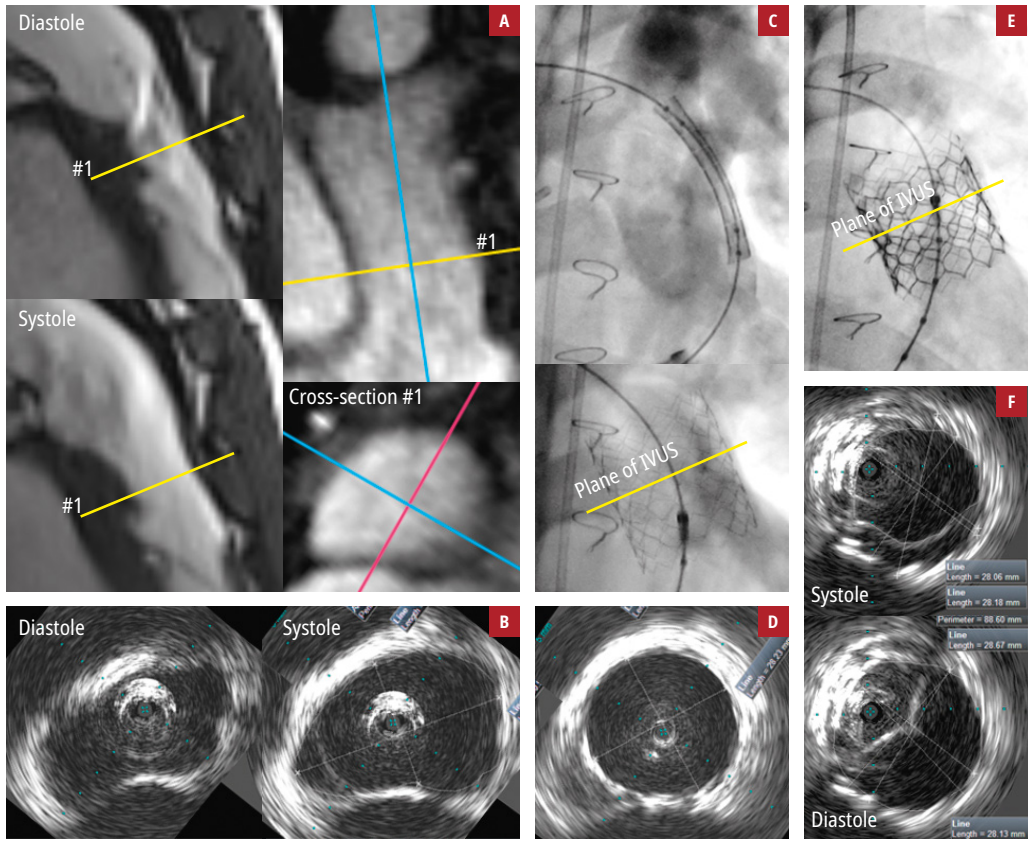

FIGURE 1 Guidance for percutaneous pulmonary valve implantation: **A** – cardiac magnetic resonance imaging before the intervention; **B** – intravascular ultrasound (IVUS) before the intervention; **C** – angiography during stent implantation; **D** – intravascular ultrasound after stenting; **E** – angiography after Edwards SAPIEN 3 valve implantation; **F** – intravascular ultrasound after Edwards SAPIEN 3 valve implantation

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