Valve Sizing for Pure Aortic Regurgitation During Transcatheter Aortic Valve Replacement

Deformation Dynamic of the Aortic Annulus in Different Valve Pathology May Be Different

We read with great interest the report by Seiffert et al. (1) on the initial German experience with transapical implantation of a second-generation transcatheter heart valve for the treatment of aortic regurgitation. With the development of second-generation transcatheter aortic valve replacement (TAVR) devices, TAVR indications have been expanded to high-risk patients with pure aortic regurgitation. We are particularly interested in the measurement of the aortic annular size in patients with pure aortic regurgitation. However, the measurement method was not detailed in this paper. It is well known that accurate assessment of the aortic annulus anatomy including its size and shape is of paramount importance in TAVR to avoid complications such as device dislodgment, paravalvular leakage, and annular rupture. In addition, with regard to this unique beating heart procedure, assessing the dynamic aspects of aortic annular functional anatomy, such as potential time-dependent changes throughout the cardiac cycle, may be particularly important (2). Recent evidence confirmed a dynamic motion of the aortic annulus during the cardiac cycle in both normal and stenotic aortic valves (2,3). With regard to patients with calcified aortic stenosis undergoing TAVR, these changes are almost negligible because tissue properties allow very little expansion (2). However, the deformation dynamics of the aortic annulus may be dramatically different in patients with noncalcified aortic regurgitation.

At our institution, 6 high-risk patients with severe pure aortic regurgitation underwent TAVR using another type of second-generation TAVR device. During preoperative computed tomography angiography, image acquisition was performed during an inspiratory breath hold, while the electrocardiogram was recorded simultaneously to allow retrospective gating of the data. The 3-dimensional dataset of the contrast-enhanced scan was reconstructed in 10% increments over the cardiac cycle, generating 4-dimensional computed tomography data for assessment of the dynamic motion of the aortic valve annulus. Our results revealed a potentially dramatic change in the geometric morphology of the aortic valve annulus (the basal ring) during the cardiac cycle (Figure 1). In some cases, the aortic valve annulus even became irregularly shaped during the diastolic phase (Figure 2). The underlying reasons for this unique phenomenon may be the pliability of a non-calcified aortic valve, senile fibroelastic degeneration of the aortic annulus, and the Venturi effect caused by regurgitation flow. Although these results still need further validation, caution should be used in annular sizing in patients with pure aortic regurgitation undergoing TAVR. Deformation dynamics of the aortic valve annulus in different valve pathologies may be very different.

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FIGURE 1 Variation in Aortic Annulus Dimensions (Basal Ring) Between Mid-Diastolic and Mid-Systolic Phase

The data are from 6 high-risk patients with severe aortic regurgitation (mean age, 74 years of age). Marked differences were noted between 2 phases for long-diameter, short-diameter, cross-sectional area as well as the perimeter, indicating a potentially dramatic change in aortic valve annulus geometry during the cardiac cycle. Min (D) — minimal value, mid-diastolic phase; Max (S) — maximum value, mid-systolic phase.

FIGURE 2 Computed Tomography Angiogram Image of Aortic Valve Annulus in Mid-Diastolic and Mid-Systolic Phases

Computed tomography angiogram of the aortic valve annulus (dotted lines indicate basal ring) in the mid-diastolic and mid-systolic phases of 2 patients with severe regurgitation. The dramatic change in aortic valve annulus geometric morphology could be clearly identified. The shape of the aortic valve annulus even becomes irregular during the diastolic phase.