Aortic Root Anatomy Is Related to the Bicuspid Aortic Valve Phenotype

BACKGROUND: Bicuspid aortic valve (BAV) is associated with an asymmetric (not circular) aortic root, resulting in variability in the aortic root diameter measurements obtained using different techniques. The objective of this study was to describe aortic root asymmetry, including its orientation in the thorax, in relation to the various phenotypes of BAV and its impact on aortic root diameter measurements obtained using transthoracic echocardiography.

METHODS: Aortic root asymmetry, orientation of the largest root diameter, and orientation of the valve opening were studied using computed tomographic scans of patients with BAV without significant aortic valve dysfunction referred for evaluation of a thoracic aortic aneurysm. Eighty-five patients with BAV were evaluated; BAV with fusion of the left and the right coronary cusps (L-R BAV), with or without raphe (n = 63), was compared with BAV with fusion of the right coronary and noncoronary cusps (N-R BAV), with or without raphe (n = 22).

RESULTS: Asymmetry of the aortic root and its orientation in the thorax can be predicted from BAV phenotype: orientation of the valve opening differed from orientation of the largest root diameter by nearly 75° in both groups. The angle of the largest root diameter with the reference sagittal plane was 64.3° in the L-R BAV group versus 143.1° in the N-R BAV group ($P < .0001$). Therefore, using the parasternal long-axis view on transthoracic echocardiography, in N-R BAV, the ultrasound beam is roughly parallel to the valve opening orientation and almost orthogonal to the maximum diameter of the root. On the contrary, in L-R BAV, the ultrasound beam is roughly perpendicular to the valve opening orientation and almost parallel to the maximum diameter of the root. Consequently, the parasternal long-axis view on transthoracic echocardiography significantly underestimates maximal aortic root diameter in N-R BAV and modestly underestimates root diameter in L-R BAV (-6.1 ± 0.96 vs -2.3 ± 0.47 mm, $P = .0008$).

CONCLUSIONS: Aortic root morphology in patients with BAV can be predicted by BAV phenotype: the largest root diameter is roughly perpendicular to the orientation of the valve opening. Therefore, echocardiographic measurements according to present recommendations (parasternal long-axis view) underestimate maximal diameter in patients with N-R BAV.