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Comparison of tricuspid and bicuspid aortic valve hemodynamics under steady flow conditions CLARA SEAMAN, University of Notre Dame, JAMES WARD, University of Notre, PHILIPPE SUCOSKY, University of Notre Dame — The bicuspid aortic valve (BAV), a congenital valvular defect consisting of two leaflets instead of three, is associated with a high prevalence of calcific aortic valve disease (CAVD). CAVD also develops in the normal tricuspid aortic valve (TAV) but its progression in the BAV is more severe and rapid. Although hemodynamic abnormalities are increasingly considered potential pathogenic contributor, the native BAV hemodynamics remain largely unknown. Therefore, this study aims at comparing experimentally the hemodynamic environments in TAV and BAV anatomies. Particle-image velocimetry was used to characterize the flow downstream of a native TAV and a model BAV mounted in a left-heart simulator and subjected to three steady flow rates characterizing different phases of the cardiac cycle. While the TAV developed a jet aligned along the valve axis, the BAV was shown to develop a skewed systolic jet with skewness decreasing with increasing flow rate. Measurement of the transvalvular pressure revealed a valvular resistance up to 50% larger in the BAV than in the TAV. The increase in velocity between the TAV and BAV leads to an increase in shear stress downstream of the valve. This study reveals strong hemodynamic abnormalities in the BAV, which may contribute to CAVD pathogenesis.

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