Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Bicuspid aortic valve hemodynamics: a fluid-structure interaction study SANTANU CHANDRA, CLARA SEAMAN, PHILIPPE SUCOSKY, University of Notre Dame — The bicuspid aortic valve (BAV) is a congenital defect in which the aortic valve forms with two leaflets instead of three. While calcific aortic valve disease (CAVD) also develops in the normal tricuspid aortic valve (TAV), its progression in the BAV is more rapid. Although studies have suggested a mechano-potential root for the disease, the native BAV hemodynamics remains largely unknown. This study aimed at characterizing BAV hemodynamics and quantifying the degree of wall-shear stress (WSS) abnormality on BAV leaflets. Fluid-structure interaction models validated with particle-image velocimetry were designed to predict the flow and leaflet dynamics in idealized TAV and BAV anatomies. Valvular function was quantified in terms of the effective orifice area. The regional leaflet WSS was characterized in terms of oscillatory shear index, temporal shear magnitude and temporal shear gradient. The predictions indicate the intrinsic degree of stenosis of the BAV anatomy, reveal drastic differences in shear stress magnitude and pulsatility on BAV and TAV leaflets and confirm the side- and site-specificity of the leaflet WSS. Given the ability of abnormal fluid shear stress to trigger valvular inflammation, these results support the existence of a mechano-etiology of CAVD in the BAV.

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Date submitted: 05 Aug 2011 Electronic form version 1.4