Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Hemodynamics in an Aorta with Bicuspid and Trileaflet Valves[1]

ANVAR GILMANOV, FOTIS SOTIROPOULOS, Univ of Minn - Minneapolis —

Bicuspid aortic valve (BAV) is a congenital heart defect that has been associated with serious aortopathies, such as ascending aortic aneurysm, aortic stenosis, aortic regurgitation, infective endocarditis, aortic dissection, calcific aortic valve and dilatation of ascending aorta. Two main hypotheses - the genetic and the hemodynamic are discussed in literature to explain the development and progression of aortopathies in patients with BAV. In this study we seek to investigate the possible role of hemodynamic factors as causes of BAV-associated aortopathy. We employ the Curvilinear Immersed Boundary (CURVIB) method coupled with an efficient thin-shell finite element (TS-FE) formulation for tissues to carry out fluid-structure interaction simulations of a healthy tri-leaflet aortic valve (TAV) and a BAV placed in the same anatomic aorta. The computed results reveal major differences between the TAV and BAV flow patterns. These include: the dynamics of the aortic valve vortex ring formation and break up; the large scale flow patterns in the ascending aorta; and the shear stress magnitude on the aortic wall. The computed results are in qualitative agreement with in vivo Magnetic Resonance Imaging (MRI) data and suggest that the linkages between BAV aortopathy and hemodynamics deserve further investigation.

[1]This work is supported by the Lillehei Heart Institute at the University of Minnesota and the Minnesota Supercomputing Institute.

Anvar Gilmanov
Univ of Minn - Minneapolis

Date submitted: 30 Jul 2015 Electronic form version 1.4