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ASSESSMENT OF WALL STRESS DISTRIBUTION IN THORACIC ASCENDING AORTIC ANEURYSM: SIMULATION, PREDICTION, AND PREVENTION To the Editor:

We read with great interest the recent study by Wang and colleagues¹ regarding wall stress distribution on ascending thoracic aortic aneurysms stratified by maximal diameter. Using finite element analysis and 3-dimensional models derived from computed tomography angiography, they found an elevation of peak wall stress in aneurysms with a diameter of 5.0 cm or more. More important, in aneurysms less than 5.0 cm, poor correlation was identified between diameter and peak wall stress, suggesting that small aneurysms could still bear excessive tensile strain that might lead to acute aortic syndromes such as dissection.²

We have 2 questions about the simulation. First, the current study, together with a previous study from the same group, referred to one article from which the data of mechanical properties of ascending aortic tissue were obtained.^{1,3} However, the original article did not report those data, and the parameters of aneurysms with bicuspid and tricuspid aortic valves were different between the 2 articles. Second, the finite element analysis considered the aortic tissue as a uniform material and showed that peak stress was mostly located on the lesser curvature of the ascending aorta, where a significant elevation of material stiffness was also observed, according to previous in vitro mechanical testing studies.⁴ Heterogeneity of tissue stiffness among locations and between aortas with bicuspid and tricuspid aortic valves may magnify the

differences in magnitude and distribution pattern of wall stress between simulations and in vivo conditions.

The aortic biomechanics, namely, material and structural stiffness, wall stress/strain, and shear stress, can be assessed by multimodality imaging. In addition to computed tomography angiography, echocardiography is also an important tool to measure biomechanics. Evidence showed that echocardiographic strain imaging allowed in vivo measurement of aortic tissue stiffness, which was strongly correlated with ex vivo testing.⁴ Analysis of wall shear stress from magnetic resonance imaging was also extensively reported.⁵ Thus, we postulate that multimodality imaging could be integrated to evaluate biomechanics from different perspectives and to establish individualized models for postprocessing and analysis.

It is well accepted that the current surgical indications are imperfect because of a relatively low effectiveness of maximal aortic diameter in predicting acute aortic dissection or rupture. Now we have several cardiovascular imaging that can be exploited for patient-specific analysis of in vivo biomechanics. So far, the prognostic value of current models has not been validated in prospective studies, and the gap between biomechanical parameters and outcomes still exists. We believe that with further modifications, the effectiveness of those models will be tested in clinical trials, predict acute aortic syndromes with higher accuracy, and risk stratify patients who have progressive aortic dilatation.

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