Introduction to the JVS-VS Special Issue, "Aneurysms"

David A. Vorp, PhD

It is truly my pleasure to have served as guest Co-Editor for this special issue of the *Journal of Vascular Surgery—Vascular Science*, "Aneurysms," along with my friend Alan Daugherty from the University of Kentucky. I am grateful to Editor-in-Chief Alan Dardik and Associate Editors John Curci and Gale Tang for the invitation to do so.

As I was embarking on my independent academic career over 30 years ago, I was fascinated by the problem of arterial aneurysms. As a trained mechanical engineer with an interest in vascular mechanics, I—perhaps naively—viewed aneurysms then as the perfect biomechanics problem. The health danger with aneurysms is rupture, which represents a structural failure of the artery, and failure is a mechanical phenomenon. Therefore, my conclusion was that biomechanics alone should be able to predict aneurysm rupture. Little did I know then how much biology and natural history came before rupture that I needed to understand. When I began working with vascular surgeon-scientists and basic scientists interested in the disease, I learned greatly from them in terms of the pathobiology that led to the aneurysmal wall weakening and stiffening that we reported from our early mechanical testing.[1-3] And I know that they learned from me in terms of aneurysmal tissue mechanics and the fact that aneurysm wall stresses are not fully explained by the diameter of the dilated vessel (ie, the Law of Laplace).[4] I was incredibly fortunate at that stage of my career to be in an environment that lent itself to taking a multidisciplinary approach to a complex vascular disease, which is now the primary characteristic of the many teams today studying aneurysms.

The importance of biomechanics to understanding the disease is quite clear when looking at the growing body of work in this regard over the past 25+ years. My initial intuition that aneurysms are a perfect biomechanics problem has withstood the test of time, but now with the benefit of additional perspective of how the natural history and pathobiology of the disease play a prominent role. For example, our early work established the importance of patient-specific modeling and geometry in the assessment of wall stress distributions in abdominal aortic aneurysms (AAAs).[5-7] We then introduced the concept of the Rupture Potential Index, or the local ratio of aneurysm wall stress to wall strength, theoretically ranging in value from 0 to 1.[8-11] We established the "Jekyll & Hyde" nature of the intraluminal thrombus commonly found in AAA, showing that it is both protective in terms of wall stress[7,12] and deleterious in terms of pathobiology of the wall through its potentially causing of hypoxia and localized weakening.[13,14] It is satisfying to see many groups now using these concepts to further our understanding of aneurysms, which, I still dream, will lead to an improved management of patients by considering all aspects of the disease, including pathobiology and biomechanics.

In this issue, you will find papers addressing a wide array of topics related to aneurysms, including the continuing quest to identify a pharmaceutical-based treatment for AAA, the role of thrombosis in aneurysms, hemodynamic and biomechanical considerations, and a novel device for arterial repair. Also presented are rigorous literature reviews on other important aspects of aneurysm disease. Original research articles include Bruijn et al, suggesting that AAA is a fibrotic disease (which might explain the difficulty in finding adequate pharmaceutical intervention strategies to date); Thanigaimani et al, who examined the association of immunosuppressant drug prescriptions with the growth of small AAAs; and Xu et al, who showed that metformin—the world's most prescribed oral medication for the management of type II diabetes—suppresses experimental AAA progression. Zschäpitz et al present a biomechanics-based study showing that peak wall stress correlates highly with AAA geometric measures; Schepers et al demonstrate in experimental animal models and human tissue samples that thrombus deposition likely plays some role in outcomes of patients suffering aortic dissection; and Kenawy et al present a promising alternative to aortic cross-clamping in repair procedures to decrease distal ischemia and reperfusion injury. My own contribution to this special issue—Gueldner et al—is one result of many discussions over many years (and many drinks!) with my friend and colleague John Curci to establish as human-like of a murine model of AAA as possible for high-throughput assessment of regenerative treatment options for the disease.[15]

I am grateful for the authors who have contributed to this compilation and cheer them on as they continue their important work. I am also grateful for the many aneurysm patients over the years who have provided

JVS—Vascular Science 2023;4:100110
2666-3503

https://doi.org/10.1016/j.jvssci.2023.100110

consent to be studied so that we can better understand this disease.

I hope you enjoy reading this issue.

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