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Understanding the Asymmetrical Vena Contracta Area

The Difficult Relationship Between 2D and 3D Measurements

We read with great interest the paper by Hyodo et al. (1) and the accompanying editorial by Little (2). We would like to provide a few additional details for presenting a more comprehensive view to the development of the concept of the 3-dimensional (3D) vena contracta area (VCA) of a mitral regurgitant jet over the past years. Khanna et al. (3) deserve to be mentioned as the first to describe direct planimetry of the VCA in a real-time 3D dataset. In 2008, our group (4) validated the basic concept of the asymmetrical VCA by a systematic analysis of the relationship between 2D vena contracta width (VCW) and 3D VCA in dependence of the asymmetry of the VCA in both organic and functional mitral regurgitation (MR). This work revealed the systematic underestimation of asymmetrical VCAs by 2-dimensional (2D) VCW measurements being typically found in functional MR. Based on these results, we determined a larger cutoff value of 0.6 cm^2 for 3D VCA compared with 0.4 cm^2 for 2D-derived effective regurgitant orifice area (EROA) and accordingly 0.8 cm for mean VCW (4- and 2-chamber views) instead of 4-chamber–based VCW of 0.7 cm for severe MR for all etiologies including functional MR. Later in the year 2008, Little et al. (5) provided a thorough in vitro and in vivo validation of the accuracy of 3D VCA measurements against independent methods. In 2009, Yosefy et al. (6) further validated the superiority of 3D VCA measurements compared with 2D VCA measurements in both central and eccentric jets. In 2011, Zeng et al. (7) also examined the asymmetry of the VCA and proposed a cutoff value of 0.41 cm^2 for differentiation of moderate from severe MR that can be applied in all etiologies and orifice shapes. After all these investigations and a growing understanding and acceptance of the asymmetry of the 3D VCA, a new cutoff value that can be clinically applied is urgently needed. But why are the 2 cutoff values—the 0.6 cm^2 by Kahlert et al. (4) and the 0.41 cm^2 by Zeng et al. (7)—so different and which might be closer to the truth?

Kahlert et al. (4) derived their 3D cutoff value of 0.6 cm^2 by extrapolating symmetrical 2D EROAs to asymmetrical 3D VCAs, thus correcting the previous cutoff value for the underestimation by 2D methods, whereas Zeng et al. (7) derived their 3D VCA cutoff value of 0.41 cm^2 from conventional MR grading based on an integration of 2D methods, including 2D proximal isovelocity surface area, 2D VCW, and 2D jet area, which is important to understand why the 0.41 cm^2 value was so much closer to the previously proposed 2D cutoff values of 0.4 cm^2 for organic MR and 0.2 cm^2 for functional MR.

Understanding the 3D VCA means to acknowledge its asymmetry and to understand the limitations of 2D estimates of the VCA including VCW and EROA by PISA. As a consequence, further clinical studies are needed to define new cutoff values for 3D VCA based on independent parameters of MR severity and clinical progress.

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