The regurgitant volume of TR might increase dynamically despite unchanged effective regurgitant orifice area, thus exaggerating TR severity on echocardiographic assessment. Meanwhile, functional TR from various chronic and acute cardiomyopathies may significantly reverse either by itself or after medical treatment. Thus, integrated analysis on both cardiac imaging and clinical data of functional TR is requested before surgical decisions are made.

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APPENDIX

For supplementary videos and their legends, please see the online version of this article.

Bicuspid Aortic Valve Phenotype and Aortopathy: Nomenclature and Role of Aortic Hemodynamics

We read with great interest the recently published paper by Kang et al. (1) regarding the importance of bicuspid aortic valve (BAV) phenotypic classification and its association with valvular dysfunction and aortopathy. The findings provide new and valuable data regarding risk stratification of BAV patients according toleaflet morphology. Of particular interest is the potential utility of this information, combined with knowledge of family history and hemodynamics (2), to provide a better understanding of patient prognosis.

Unfortunately, in the context of the existing literature, the authors chose unconventional nomenclature to stratify BAV phenotypes. In the paper, the term BAV-RL designates valves with free leaflets in the lateral position rather than the more common practice of describing fusion of the right and left coronary leaflets (3–5). Although somewhat arbitrary, this terminology contradicts the classification scheme adapted from one of the key references (3) and produces yet another naming scheme. The question of what constitutes a BAV-RL is sure to cause confusion amongst the community and in future research efforts where nomenclature swapping propagates and goes unnoticed. This highlights a growing need for a uniform classification scheme, similar to that proposed by Sievers et al. (4).

Furthermore, the discussion of aortic hemodynamic changes as a potential link between valve morphology and development of aortopathy is somewhat incomplete. Although we strongly agree that BAVs alter aortic hemodynamics, as has recently been shown by us and others, the assertion that left-handed helical flow exists in the BAV phenotype with free leaflets in the lateral position is unproven, with a single-center report in the literature.

Our experience is that the orientation of the flow helix is predominantly right-handed. We and others have shown that the incomplete opening of the BAV results in an abnormal flow jet dependent on the position of a conjoint leaflet. In the case of lateral leaflet fusion, the conjoint leaflet can cause a flow jet to reflect off of the inner arch curvature and impinge on the greater arch at a more downstream position, thereby causing helical flow with right-handed orientation (5). In addition, the authors did not address recent developments that have shown that magnetic resonance imaging can be used to directly quantify the impact of aortic valve disease on the aortic wall by means of metrics such as segmental wall shear stress (5).

In this context, aortic wall shear stress is altered regardless of the orientation of helix flow and may be a more fundamental parameter to investigate for abnormal aortic remodeling.

In essence, we believe that the data of Kang et al. (1) are an important step toward understanding the role genetics and mechanotransduction may play in BAV-mediated aortopathy. We agree that advanced imaging techniques offer promising diagnostic imaging tools. However, a consistent description of the subtle variations in valve morphology, as well as newly developed in vivo metrics of hemodynamic changes associated with aortic valve disease, should not be overlooked: without a uniform classification scheme, we run the risk of confounding future efforts.

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REPLY: Bicuspid Aortic Valve Phenotype and Aortopathy: Nomenclature and Role of Aortic Hemodynamics

We thank for Drs. Barker, Robinson, and Markl for their interest in our paper (1). They were concerned about the potential confusion caused by our using the term BAV-RL to designate the spatial orientation of a bicuspid aortic valve (BAV) in cases where the right or left coronary cusp is fused with the noncoronary cusp.
mentioned that most investigators have used BAV-RL to designate valves with fusion of the right and left coronary cusps. Although it is correct that classifications based on the specific cusps that are fused may be more commonly used, we believe that the BAV phenotype can also be classified by mentioning the spatial orientation after fusion. Sometimes, it may in fact be impossible to determine the individual cusps involved. Furthermore, phenotype classification using spatial orientation (BAV-RL versus BAV-AP) may better represent the functional significance. Such classification has been used before, for example, in embryological (2) and imaging research (3,4). To avoid confusion, we made sure to explain the terms used in our paper (BAV-RL and BAV-AP) in the table and figure legends.

The potential association between the flow helix in the aorta and aortopathy type in patients with BAV is another very important topic (5). The predominant pattern of the flow helix may well be dependent on BAV phenotype. Dr. Barker and colleagues showed that the orientation of the flow helix is predominantly right-handed, but they predominantly analyzed patients with 1 specific pattern (fusion of the right and left coronary cusps, 12 of 15 patients). Previous observations have shown that right-handed helical flow is predominant in BAV patients with fusion of the right and left cusps, as opposed to left-handed helical flow in BAV patients with fusion of the right and noncoronary cusps. Thus, we believe that our statement regarding a potential association between BAV phenotype and helical flow orientation has valid support from scientific observations by other investigators.

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Previous research (2) had shown that pre-procedural MDCT can provide accurate operator-defined optimized implant angles (OIA’s) and that implant angle prediction is related to MDCT image quality. Rotational angiography intraprocedure predicts the OIA even more accurately than does MDCT (3,4), and an OIA appears to be associated with less paravalvular regurgitation (PVR) (4).

We have several comments on the study design. The authors ingeniously attempted to mitigate the confounding impact of operator experience by randomly assigning patients from December 2009 to June 2011 into angiography (Cohort B) and MDCT (Cohort A) cohorts in a 1:4 fashion, respectively. In chronologically spaced research in which operator experience likely matters, it is almost impossible to completely mitigate bias. Cohort B patients had numerically lower implantation time and contrast and radiation exposure—were the 11 and 24 patients in Cohorts B and A, respectively, sufficient to definitively exclude this potential bias? Operator experience had previously been linked with procedural outcomes. Further analysis in a larger cohort from this randomized cohort (MDCT vs. B) may be worthwhile.

Second, the study mandated that an aortogram not be performed up front in the MDCT group, and this at least partially accounted for the procedural parameter difference. Nonetheless, remarkably, no MDCT cohort patient needed more than one aortogram, whilst 89% of angiography-cohort patients needed more than one aortogram.

Last, issues on benefit on clinical outcome. We are unclear regarding the reduced need for balloon post-dilation in the MDCT cohort—as this is not related to valve malpositioning per se, which would potentially be a consequence of a poor implant fluoroscopic angle. The study unfortunately did not correct for potential confounders such as valve undersizing and valve calcification, particularly with regard to outcomes such as PVR.

MDCT improves TAVR sizing and most data suggest a reduction in PVR. The idea of “better angle, better outcomes” seems intuitive but more data is needed. Further data to confirm the overall clinical outcome improvement from MDCT is eagerly awaited.

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Please note: Dr. Walters has served on the advisory board of Siemens. Dr. Poon has reported that he has no relationships relevant to the contents of this paper to disclose.

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MDCT in TAVR for Better Implant Angle and Outcomes

We read with interest the paper by Samim et al. (1) on the use of automated 3-dimensional analysis of pre-procedural multidetector computed tomography (MDCT) to predict an optimal C-arm angle for transcatheter aortic valve replacement (TAVR) and the potential improvement in outcomes.