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https://doi.org/10.1016/j.jcmg.2017.12.013

Please note: The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

REFERENCES

1. Kirchhof P, Benussi S, Kotecha D, et al. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. Eur Heart J 2016;37:2893–962.

2. Hoit BD. Left atrial size and function: role in prognosis. J Am Coll Cardiol 2014;63:493–505.

3. Kosmala W, Saito M, Kaye G, et al. Incremental value of left atrial structural and functional characteristics for prediction of atrial fibrillation in patients receiving cardiac pacing. Circ Cardiovasc Imaging 2015;8:e002942.

Computed Tomography for Diagnosis and Classification of Bicuspid Aortic Valve Disease in Transcatheter Aortic Valve Replacement

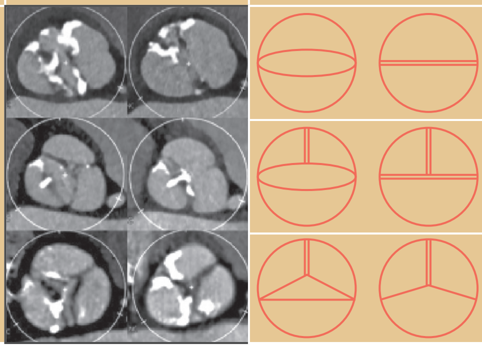
The ongoing shift toward lower risk cohorts for transcatheter aortic valve replacement (TAVR) will increasingly involve patients with bicuspid aortic valve (BAV). Existing data on the prevalence and clinical outcome are inconsistent, which may be attributed to inadequate recognition or population-related differences (1). Echocardiography is commonly used for the diagnosis of BAV, but may have limitations in elderly TAVR populations with more severe aortic valve calcification. A better diagnostic performance has been demonstrated for multidetector computed tomography (MDCT), but this requires a focused search for BAV, and, frequently, only diastolic reconstructions are available in which typical attributes of BAV may not be discernible (2). The aim of this study was to systematically review pre-procedural MDCT scans in a large contemporary TAVR cohort to accurately determine the prevalence of BAV and to compare clinical outcome with patients having tricuspid aortic valve (TAV).

Of consecutive patients (n = 2,103) undergoing TAVR for aortic stenosis between June 2011 and November 2016 in 2 high-volume centers (Kerckhoff Heart Center, Bad Nauheim, Germany, and Friedrich Alexander University, Erlangen, Germany), MDCT scans of 1,966 patients were retrospectively reviewed by 2 experienced readers for the presence of BAV using diastolic and systolic reconstructions (**Figure 1**). BAV was classified as previously described (1), and the presence of a calcium bridge (calcification of the raphe) was noted. Post-procedural echocardiograms were independently assessed for paravalvular regurgitation (PVR) by 2 experienced cardiologists blinded to the clinical data. Device positioning was estimated visually at final aortography. After exclusion of cases with indeterminate phenotype (n = 21) or TAV with acquired fusion (n = 60), BAV was confirmed in 144 of 1,966 (7.3%) patients (**Figure 1**). To adjust for baseline differences, 1-to-1 nearest-neighbor propensity matching was performed. The distribution of implanted devices was balanced between the matched groups (BAV vs. TAV: Sapien XT/3 [Edwards Lifesciences, Irvine, California], 91 vs. 87; Acurate TA/neo [Symetis SA/ Boston Scientific, Marlborough, Massachusetts], 27 vs. 32; Corevalve/Evolute R [Medtronic, Minneapolis, Minnesota], 14 vs. 12; Portico [St. Jude Medical/ Abbott Laboratories, Chicago, Illinois], 5 vs. 8, miscellaneous: 7 vs. 5).

PVR $\geq 2^\circ$ was more frequent in patients with BAV (11.1% vs. 2.8%; p = 0.005), aortic root injury tended to be more frequent in bicuspid anatomies (4.2% vs. 0.7%; p = 0.056), whereas all-cause mortality at 30 days (4.9% vs. 3.5%; p = 0.55) and 1 year (18.2% vs. 19.8%; p = 0.74) were similar. Existing data comparing outcomes of TAVR in BAV and TAV patients are inconsistent, with only a few studies demonstrating inferior results in BAV patients. Suboptimal diagnostic strategies, nonuniform BAV classifications, small cohort sizes, and the predominant use of first-generation devices in previous studies with extraordinarily high rates of PVR $\geq 2^\circ$ similarly affecting BAV and TAV, may have contributed to such discrepancies. Similar to previous reports, the higher rate of PVR $\geq 2^\circ$ was not associated with an increased mortality in BAV patients (3), although this does not conform to the otherwise common finding that relevant PVR is associated with worse prognosis. We assume that in this nonrandomized setting not all confounding variables were fully captured by propensity matching. The tendency for more frequent aortic root injuries in BAV is in line with a recent large-scale analysis (3) and may be attributed to the complex aortic root morphology. Among BAV patients, malpositioning (odds ratio [OR]: 6.32; 95% confidence interval [CI]: 1.68 to 23.87; p = 0.007) and the use of first-generation (OR: 4.93; 95% CI: 1.41 to 17.21; p = 0.012) or self-expanding devices (OR: 4.29; 95% CI: 1.21 to 15.25; p = 0.02) independently predicted PVR $\geq 2^\circ$, which is consistent with earlier reports. Furthermore, a deep prosthesis position (OR: 5.55; 95% CI: 1.18 to 26.19; p = 0.03) and the

JACC: CARDIOVASCULAR IMAGING, VOL. 11, NO. 10, 2018
OCTOBER 2018:1535–53

FIGURE 1 Bicuspid Aortic Valve Classification



	MDCT (systole, diastole)	Schematic (systole, diastole)	Sievers et al.*	Jilaihawi et al.	Fusion Site
Bicuspid (n = 144)			Type 0 (n = 6)	Bicommissural, no raphe (n = 6/4.2%)	NA
			Type 1 (n = 138)	Bicommissural, complete raphe (n = 60/41.7%)	N-R 18.3% N-L 1.7% L-R 80.0%
				Tricommissural, incomplete raphe (n = 78/54.1%)	N-R 9.0% N-L 1.3% L-R 89.7%

*Type 2 did not occur in the study cohort. L = left-coronary cusp; MDCT = multidetector computed tomography; N = non; NA = not available; R = right.

concomitant presence of coronary cusp fusion and calcium bridge (OR: 7.69; 95% CI: 2.08 to 28.46; $p = 0.002$) were independent predictors of permanent pacemaker implantation. Jilaihawi et al. (1) recently presumed that the underlying pathomechanism was an offset of the prosthesis toward the conduction system, but statistical significance had not been demonstrated since only patients with coronary cusp fusion had been considered.

The present study comprises the largest consecutive TAVR cohort systematically assessed for the presence of BAV using MDCT with concise diagnostic criteria in all patients, hence minimizing the risk of underestimating the prevalence of BAV and providing a comprehensive overview of the various spectra of BAV morphologies. Given that BAV is associated with procedural challenges, the proper identification and classification of BAV phenotypes is vital and requires an elaborate imaging strategy that includes MDCT with systolic reconstructions.

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https://doi.org/10.1016/j.jcmg.2017.12.010

Please note: Dr. Kim is a proctor for Symetis SA and St. Jude Medical/Abbott; and has received lecture honoraria from Symetis SA and St. Jude Medical/Abbott. Dr. Gaede has received travel grants from Edwards Lifesciences and Symetis SA. Dr. Husser has received minor travel grants from Edwards Lifesciences; and minor travel grants and proctor for Symetis SA. Dr. Liebetrau has received lecture honoraria from Abbott, AstraZeneca, Bayer, Berlin Chemie, Boehringer Ingelheim, Daiichi-Sankyo, and Pfizer-Bristol-Myers Squibb; and travel accommodation/meeting expenses from Bayer and Daiichi-Sankyo. Dr. Renker has received lecture honoraria from St. Jude Medical/Abbott. Dr. Rolf has received lecture honoraria from AstraZeneca, Boehringer, Pfizer, MSD, and Bristol-Myers Squibb. Dr. Fischer-Rasokat has received lecture honoraria from Abbott, AstraZeneca, and Bayer. Dr. Doss is a proctor for St. Jude Medical/Abbott. Dr. Hamm is a member of the Advisory board for Medtronic. Dr. H. Möllmann has received proctor fees and/or speaker honoraria from Abbott, Biotronic, Edwards Lifesciences, St. Jude Medical, and Symetis SA. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose. Drs. Kim and Gaede contributed equally to this work and are joint first authors.

REFERENCES

1. Jilaihawi H, Chen M, Webb J, et al. A bicuspid aortic valve imaging classification for the TAVR era. J Am Coll Cardiol Img 2016;9:1145–58.

2. Alkadhi H, Leschka S, Trindade PT, et al. Cardiac CT for the differentiation of bicuspid and tricuspid aortic valves: comparison with echocardiography and surgery. AJR Am J Roentgenol 2010;195:900–8.

3. Yoon SH, Bleiziffer S, De Backer O, et al. Outcomes in transcatheter aortic valve replacement for bicuspid versus tricuspid aortic valve stenosis. J Am Coll Cardiol 2017;69:2579–89.