International Journal of Cardiology xxx (xxxx) xxx

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Editorial

(Intermediate) size matters

Transcatheter aortic valve implantation (TAVI) has become a pillar in the treatment of severe aortic valve stenosis [1]. Amongst others, technological developments, device iterations, growing experience, and improved imaging have contributed to the major accomplishments of TAVI during recent years [2]. An important insight is that appropriate sizing is a prerequisite to obtain good results. Oversizing increases the risk of annular rupture or coronary obstruction [3], whereas undersizing is associated with an increased risk of paravalvular regurgitation (PVR) or device embolization [4].

The balloon-expandable SAPIEN 3 device is the most commonly used transcatheter heart valve (THV). It is available in four different sizes (20, 23, 26, 29 mm) that cover an annulus range between 18.6 mm and 29.5 mm. If the annulus diameter is between two sizes, there is a small overlap in which both sizes may be used. The fact that valve sizes are offered in 3-mm increments gives rise to the question of how far a precise and customized size selection is possible. Hence, according to the sizing chart of the manufacturer, a 26-mm SAPIEN 3 could be implanted in both a patient with an area-derived annulus diameter of 23.5 mm and 26.4 mm. In contrast, the Myval THV offers a sizing matrix that includes the conventional sizes (20, 23, 26, 29 mm) and intermediate sizes (21.5, 24.5, 27.5 mm) as well as extra-large sizes (30.5, 32 mm).

Kawashima et al. introduce results from a retrospective multicenter survey with a focus on the size selection using the balloon-expandable Myval THV [5]. The aim was to assess how frequently and for which reasons the so-called intermediate sizes were selected instead of using the conventional sizes. The main finding is that intermediate sizes accounted for 42.1% over the entire annular range. Factors that favored upsizing were male sex and larger aortic annulus and sinus of Valsalva, whereas downsizing was due to more severe aortic valve calcification. The authors conclude that intermediate sizes of the Myval THV are used frequently and that the availability of such addresses an unmet need for a more granular size selection. It should be emphasized that the present study does not provide a comparison of outcomes between conventional and intermediate sizes. However, it only represents a descriptive summary of the operators' preference regarding size selection.

In the absence of intermediate sizes, it has become common practice to modify the size of the SAPIEN 3 device by means of using either more or less filling of the balloon to accommodate borderline annulus dimensions in order to minimize the need for post-dilatation and the risk of PVR or annular rupture. At least for the immediate outcome, this practice seems to be feasible [6]. On the other hand, the long-term impact of over- or underexpanding the stent frame is completely unknown. Potential consequences of overexpansion might be suboptimal coaptation of the prosthetic leaflets, whereas underexpansion and less foreshortening of the stent frame might result in a central overlap of prosthetic leaflets with increased gradients. Sathanantan et al. demonstrated bench test results of under- or overfilling of the SAPIEN 3 device, showing a considerable variation in the finally achieved stent diameter (10% under- or overfilling resulted in stent diameters ranging from 22.4 to 23.4 mm for the 23-mm size, 25.1 to 26.9 mm for the 26-mm size, and 28.3 to 30.3 mm for the 29-mm size). Overexpansion led to a visible restriction of the prosthetic leaflets and valvular regurgitation, as demonstrated by high-speed video and hydrodynamic testing. This particularly affected 23-mm and 26-mm valve sizes, whereas no functional impairment of the 29-mm valve size was observed. Furthermore, maximal overexpansion of a 26-mm valve even resulted in leaflet tear [7].

In order to address the question whether the limited size availability of the SAPIEN 3 system affects outcomes, we should consider contemporary data of the PARTNER 3 trial, which constitutes the culmination of technological progress, learning curve, increasing experience, and sophisticated imaging in the setting of a low-risk cohort. Indeed, the results of this trial were excellent, with rates of PVR $\geq$ moderate in 0.8%, permanent pacemaker implantation in 6.5%, annular rupture in 0.2%, and no case of device embolization, whereas the rate of moderate prosthesis-patient mismatch of 29.9% was still relatively high [8]. The recently published 2-year data showed higher transprosthetic mean gradients in the TAVI cohort (13.6 ± 5.5 mmHg vs. 11.8 ± 4.8 mmHg; $p = 0.06$), and an increased rate of leaflet thrombosis ($n = 13$ [2.6%] vs. $n = 3$ [0.7%]; $p = 0.02$) when compared with the surgical cohort [9].

The only published data available on the MYVAL THV show excellent outcomes as well, including no case of PVR $\geq$ moderate, annular rupture, device embolization, permanent pacemaker implantation, transprosthetic mean gradients of 8.0 mmHg at 30 days, and no case of leaflet thrombosis at 12 months [10]. Even though a direct comparison of these results is inappropriate, the improved outcomes in terms of hemodynamic performance and permanent pacemaker implantation raise the question whether the more granular sizing of the Myval platform may provide advantages. In the absence of an appropriately designed randomized trial, which probably will require a very large sample size to detect any difference of clinical relevance, this issue remains a matter of speculation.

What is the key message of the present survey? A more granular size selection may allow for an optimal accommodation to complex variants of the aortic root anatomy; for instance, when the sinotubular junction is smaller than the annulus, or a shallow sinus increases the risk of coronary obstruction. In fact, the availability of more sizes will make size selection much easier for the operator. Currently, it is unknown whether more granular sizing will positively affect relevant clinical endpoints, but it seems very unlikely that this will have detrimental effects. Of

https://doi.org/10.1016/j.ijcard.2021.08.028
Received 16 July 2021; Accepted 16 August 2021
Available online 21 August 2021
0167-5273/© 2021 Published by Elsevier B.V.

course, the availability of more sizes will complicate logistical aspects and increase the cost for the manufacturer. Ultimately, the present data point out that, if available, intermediate sizes will be used.

Conflicts of interest statement

WK: proctor for Symetis SA/Boston Scientific and St. Jude Medical/Abbott, received speaker fees from Symetis SA, St. Jude Medical, and Edwards Lifesciences. YHC: speakers fees of Edwards Lifesciences, CytoSorbents and CryoLife.

Acknowledgment

We thank Elizabeth Martinson, PhD, from the KHFI Editorial Office for her editorial assistance.

References

[1] G.C.M. Siontis, P. Overtchouk, T.J. Cahill, T. Modine, B. Prendergast, F. Praz, et al., Transcatheter aortic valve implantation vs. surgical aortic valve replacement for treatment of symptomatic severe aortic stenosis: an updated meta-analysis, Eur. Heart J. 40 (2019) 3143–3153.

[2] W.K. Kim, C.W. Hamm, The future of TAVI, Eur. Heart J. 38 (2017) 2704–2707.

[3] M. Barbanti, T.H. Yang, J. Rodes Cabau, C. Tamburino, D.A. Wood, H. Jilaihawi, et al., Anatomical and procedural features associated with aortic root rupture during balloon-expandable transcatheter aortic valve replacement, Circulation 128 (2013) 244–253.

[4] W.K. Kim, U. Schafer, D. Tchetche, H. Nef, M. Arnold, P. Avanzas, et al., Incidence and outcome of peri-procedural transcatheter heart valve embolization and migration: the TRAVEL registry (TranscatheteR HeArt Valve EmboLization and Migration), Eur. Heart J. 40 (2019) 3156–3165.

[5] H. Kawashima, P.W. Serruys, D. Mylotte, L. Rosseel, I.J. Amat-Santos, R.S. Rao, et al., Operator preference and determinants of size selection when additional intermediate-size aortic transcatheter heart valves are made available, Int. J. Cardiol. 338 (2021) 168–173.

[6] A. Shivaraju, S. Kodali, C. Thilo, I. Ott, H. Schunkert, W. von Scheidt, et al., Overexpansion of the SAPIEN 3 transcatheter heart valve: a feasibility study, JACC Cardiovasc. Interv. 8 (2015) 2041–2043.

[7] J. Sathananthan, S. Sellers, A. Barlow, R. Fraser, V. Stanova, A. Cheung, et al., Overexpansion of the SAPIEN 3 transcatheter heart valve: an ex vivo bench study, JACC Cardiovasc. Interv. 11 (2018) 1696–1705.

[8] M.J. Mack, M.B. Leon, V.H. Thourani, R. Makkar, S.K. Kodali, M. Russo, et al., Transcatheter aortic-valve replacement with a balloon-expandable valve in low-risk patients, N. Engl. J. Med. 380 (2019) 1695–1705.

[9] M.B. Leon, M.J. Mack, R.T. Hahn, V.H. Thourani, R. Makkar, S.K. Kodali, et al., Outcomes 2 years after transcatheter aortic valve replacement in patients at low surgical risk, J. Am. Coll. Cardiol. 77 (2021) 1149–1161.

[10] S.K. Sharma, R.S. Rao, P. Chandra, P.K. Goel, P. Bharadwaj, G. Joseph, et al., First-in-human evaluation of a novel balloon-expandable transcatheter heart valve in patients with severe symptomatic native aortic stenosis: the MyVal-1 study, EuroIntervention 16 (2020) 421–429.

Won-Keun Kim[a,b,c,d,*], Yeong-Hoon Choi[b,d]

[a] *Kerckhoff Heart Center, Department of Cardiology, Bad Nauheim, Germany*

[b] *Kerckhoff Heart Center, Department of Cardiac Surgery, Bad Nauheim, Germany*

[c] *Justus-Liebig University of Giessen, Department of Cardiology, Giessen, Germany*

[d] *German Center for Cardiovascular Research (DZHK), Partner Site RhineMain, Bad Nauheim, Germany*

[*] Corresponding author at: Kerckhoff Heart Center, Department of Cardiology/Cardiac Surgery, Benekestr. 2-8, 61231 Bad Nauheim, Germany.

E-mail address: w.kim@kerckhoff-klinik.de (W.-K. Kim).