Korean Circ J. 2021 Mar;51(3):232-234
https://doi.org/10.4070/kcj.2020.0547
pISSN 1738-5520·eISSN 1738-5555

kcj
Korean Circulation Journal

Editorial

Check for updates

The Lower, The Better? Think Beyond the Gradient after Transcatheter Aortic Valve Replacement for Small Annulus

Ching-Wei Lee, MD[1,2,3], and Shih-Hsien Sung, MD, PhD[1,3]

[1]Division of Cardiology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan
[2]Department of Medical Affairs and Planning, Taipei Veterans General Hospital, Taipei, Taiwan
[3]Cardiovascular Research Center, National Yang-Ming University, Taipei, Taiwan

▸ See the article "Comparison of Transcatheter Aortic Valve Replacement between Self-Expanding versus Balloon-Expandable Valves in Patients with Small Aortic Annulus" in volume 51 on page 222.

OPEN ACCESS

Received: Dec 24, 2020
Accepted: Jan 6, 2021

Correspondence to
Shih-Hsien Sung, MD, PhD
Division of Cardiology, Department of Medicine, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 11217, Taiwan.
E-mail: mr.sungsh@gmail.com

ORCID iDs
Ching-Wei Lee
https://orcid.org/0000-0001-9871-6514
Shih-Hsien Sung
https://orcid.org/0000-0001-9441-1836

Funding
The authors received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest
The authors have no financial conflicts of interest.

Patient with severe aortic stenosis and small aortic annulus poses a clinical challenge when dealing with either surgical or transcatheter aortic valve replacement (TAVR). The main concern of the small anatomy is the increasing risk of suboptimal prosthetic valvular hemodynamics and the subsequent prosthesis-patient mismatch (PPM). From the surgical perspective, several special designs, including supra-annular position, stentless valve, sutureless valve, and streamlined sewing ring with external mounting valve were attempted to get larger effective orifice area (EOA) of prosthetic valve.[1] Aortic root enlargement is also an attractive surgical technique to put a larger prosthetic valve when encountering small anatomy. On the other hand, the transcatheter heart valve (THV) carries important features, such as the absence of sewing ring and oversizing deployment, which facilitate larger EOA as compare to traditional surgical valves. The superior hemodynamic performance of THV over surgical valves has been observed in the randomized controlled trials.[2][3]

As compared to the Western countries, small anatomy is more prevalent in the Asian. Lee et al.[4] have reported a single-center study of 70 patients with severe aortic stenosis and small annulus (mean diameter of ≤23 mm or minimal diameter of ≤21 mm) underwent TAVR with either a self-expanding valve (SE-THV) or a balloon-expandable valve (BE-THV). While SE-THV was associated with larger EOA, better hemodynamic performance, and less PPM, the procedural safety and clinical outcome at 1-year were comparable between the different valve platforms. In addition, the pacemaker implantation rate and the presence of para-valvular leakage (SE-THV vs. BE-THV: 46.7% vs. 32.0%, p=0.347) were also similar between BE-THV and SE-THV.

However, the result of this study should be interpreted cautiously. Although the valvular hemodynamic is superior with SE-THV, the Doppler-derived trans-prosthetic gradients are usually higher and the estimated EOA is smaller, as compare with the catheter-derived measures due to pressure recovery phenomenon.[5] In general, the difference is negligible in the absence of a small aortic root. Furthermore, the discordance of trans-valvular gradients between Doppler-derived measurements and invasive measurements is described among different type of THV. Aalaei-Andabili et al.[6] have demonstrated a significant difference between invasive measurement and Doppler-derived gradients (7.5±3 mmHg vs. 11.4±4.5

Data Sharing Statement
The data generated in this study is available from the corresponding author upon reasonable request.

Author Contributions
Conceptualization: Lee CW, Sung SH; Investigation: Lee CW; Supervision: Sung SH; Writing - original draft: Lee CW; Writing - review & editing: Sung SH.

mmHg, p<0.001) after BE-THV implantation. In contrast, there was no significant difference by either measurement for SE-THV (invasive vs. Doppler-derived gradient: 10.3±3.4 mmHg vs. 8.5±4.6 mmHg, p=0.18). Theoretically, only catheter can directly measure the pressure gradient across the prosthesis. By echocardiogram, the pressure gradient and EOA are calculated by Bernoulli's equation according to the difference of flow velocity along with Doppler alignment. Therefore, we need invasive data to conclude the true hemodynamic performance between SE-THV and BE-THV.

Recently, Hase et al.[7] have demonstrated SE-THV has superior hemodynamic performance over BE-THV for patients with small annulus in Optimized CathEter Valvular iNtervention-Transcatheter Aortic Valve Implantation registry. Among patients with extremely small annulus (mean diameter of ≤21 mm), 1-year survival rate was slightly higher with BE-THV than SE-THV (91.3% vs. 82.2%, p=0.09). In another randomized controlled study, Portico THV (Abbott Structural Heart, St. Paul, MN, USA) has exerted larger EOA and less gradient than BE-THV at 24 months. However, the all-cause mortality at 24 months is significantly higher with Portico valve than BE-THV (22.7% vs. 15.6%, p=0.03).[8] Regarding surgical prosthetic aortic valve, Kim et al.[9] reported superior valvular hemodynamics, and better regression of left ventricular mass index in patients with supra-annular implantation rather than intra-annulus prothesis. But, the mortality rate, and major adverse events, including stroke, infective endocarditis and re-operation were similar between surgical approaches.

As expanding indications of TAVR, for those with younger age and longer life-expectancy, it is reasonable to choose a proper aortic prosthesis which can exert lowest complications as well as better efficacy and durability. Even though we know that pursuing lower trans-valvular pressure gradient and higher EOA of prosthetic valve is an ideal goal, we should also judge every patient by clinical characteristics and take other factors into consideration, including coronary accessibility and risk of permanent pacemaker. For the particular patients, the ongoing study—The Small Annuli Randomized To Evolut or Sapien trial will compare valve safety and performance in randomized head-to-head fashion. We hope future studies will explore the net clinical impacts, the left ventricular remodeling, and many unanswered questions in patients with small anatomy.

REFERENCES

1. Freitas-Ferraz AB, Tirado-Conte G, Dagenais F, et al. Aortic stenosis and small aortic annulus. *Circulation* 2019;139:2685-702.
PUBMED | CROSSREF
2. Pibarot P, Weissman NJ, Stewart WJ, et al. Incidence and sequelae of prosthesis-patient mismatch in transcatheter versus surgical valve replacement in high-risk patients with severe aortic stenosis: a PARTNER trial cohort--a analysis. *J Am Coll Cardiol* 2014;64:1323-34.
PUBMED | CROSSREF
3. Thyregod HGH, Ihlemann N, Jørgensen TH, et al. Five-year clinical and echocardiographic outcomes from the nordic aortic valve intervention (NOTION) randomized clinical trial in lower surgical risk patients. *Circulation*. 2019 [Epub ahead of print].
PUBMED | CROSSREF
4. Lee YJ, Lee SJ, Hong SJ, et al. Comparison of transcatheter aortic valve replacement between self-expanding versus balloon-expandable valves in patients with small aortic annulus. *Korean Circ J* 2021;51:222-31.
CROSSREF

https://doi.org/10.4070/kcj.2020.0547

5. Baumgartner H, Khan S, DeRobertis M, Czer L, Maurer G. Discrepancies between Doppler and catheter gradients in aortic prosthetic valves in vitro. A manifestation of localized gradients and pressure recovery. *Circulation* 1990;82:1467-75.
PUBMED | CROSSREF
6. Aalaei-Andabili SH, Park KE, Choi CY, et al. Relationship between invasive and echocardiographic transvalvular gradients after transcatheter aortic valve replacement. *Cardiol Ther* 2020;9:201-6.
PUBMED | CROSSREF
7. Hase H, Yoshijima N, Yanagisawa R, et al. Transcatheter aortic valve replacement with Evolut R versus Sapien 3 in Japanese patients with a small aortic annulus: the OCEAN-TAVI registry. *Catheter Cardiovasc Interv*. 2020 [Epub ahead of print].
PUBMED | CROSSREF
8. Makkar RR, Cheng W, Waksman R, et al. Self-expanding intra-annular versus commercially available transcatheter heart valves in high and extreme risk patients with severe aortic stenosis (PORTICO IDE): a randomised, controlled, non-inferiority trial. *Lancet* 2020;396:669-83.
PUBMED | CROSSREF
9. Kim SH, Kim HJ, Kim JB, et al. Supra-annular versus intra-annular prostheses in aortic valve replacement: impact on haemodynamics and clinical outcomes. *Interact Cardiovasc Thorac Surg* 2019;28:58-64.
PUBMED | CROSSREF