Transcatheter aortic valve replacement (TAVR) for patients with a bicuspid aortic valve (BAV) is challenging as the extent and location of valve calcification as well as bulky leaflets and an enlarged root may increase the risk of transcatheter heart valve (THV) displacement, distortion, or malfunctioning. We report successful TAVR for an 84-year-old man with a BAV. The THV was implanted closer to the aorta than usual to avoid spreading of the bulky leaflets over the THV outflow. Following implantation, there was trivial paravalvular leakage, with no distortion or malfunction detected.

Keywords: transcatheter aortic valve replacement, bicuspid aortic valve, DynaCT
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Cerebral infarction 1 year prior to admission, and magnetic resonance angiography revealed severe stenosis in the right internal carotid artery (cervical portion, C1). Moreover, he had a history of diabetes mellitus with insulin and severe respiratory dysfunction. The case was discussed during a heart multi-disciplinary meeting, and a less invasive alternative approach for aortic valve replacement was decided. The patient provided written informed consent after our explanation of the suspicion of a BAV. In preoperative planning, we decided on a landing zone slightly closer to the aorta than usual to avoid spreading of the bulky leaflets over the outflow of the transcatheter heart valve (THV).

Under general anesthesia, we performed TAVR using a transfemoral approach. Intraoperative transesophageal echocardiogram (TEE) results confirmed the presence of a BAV (Fig. 1). In a preoperative MSCT examination, fluoroscopy did not reveal the annulus clearly, because of scant calcification at the annulus. We successfully implanted a 26-mm Sapien stent-valve (Edwards Lifesciences Inc., Irvine, California, USA) in the ideal landing zone using the DynaCT technique [Axiom Artis (Siemens Inc., Erlangen, Germany)], which allowed for exact delineation of the annulus (Fig. 2). TEE showed that the THV was positioned in the ideal landing zone without any stent distortion (Fig. 3). Paravalvular leakage was trivial, and the peak transvalvular gradient was 13 mmHg. The patient was extubated in the operative room.

Fig. 1  Intraoperative transesophageal echocardiography (TEE) short-axis view showing the bicuspid valve in diastole (A) and systole (B). TEE findings confirmed the bicuspid anatomy of the leaflets, with one including the ostium of the left main (anterior leaflet) and non-coronary cusp (posterior leaflet).

Fig. 2  Intraoperative fluoroscopic image (A) showing calcification of the cusp (arrowheads), but not the annular position (broken line). DynaCT accurately revealed the annular position (B) and a transcatheter heart valve was successfully implanted in the ideal landing zone (C). (LCO: left coronary orifice; RCO: right coronary orifice; L: left coronary cusp; R: right coronary cusp; N: non-coronary cusp; NR: non-right commissure; LN: left-non commissure; LR: left-right commissure)
postoperative course was uneventful, and he was discharged on postoperative day 9.

Comment

A BAV is a common congenital cardiac anomaly, which is reported to exist in 30%–50% of adult patients undergoing aortic valve replacement surgery for severe aortic stenosis. Generally, a BAV is considered to contraindicate TAVR, because of poor stability of the prosthetic valve or paravalvular regurgitation due to distortion of the native valve leaflets. Therefore, only a few reports regarding TAVR for a patient with a BAV have been presented. However, those describe relatively acceptable outcomes in high-risk patients with BAV-related stenosis. For example, Wijesinghe, et al. reported 11 patients with symptomatic severe BAV stenosis who underwent TAVR successfully at 3 Canadian tertiary hospitals.

Close preoperative and intraoperative analyses of the aortic valve anatomy are mandatory for successful TAVR, especially in BAV cases. Delgado, et al. reported a successful outcome of TAVR in a BAV case, in which they made full use of preoperative MSCT to analyze the aortic valve anatomy, as well as the extent and location of valve calcification. In addition, Kempfert, et al. reported that an intraoperative DynaCT technique, which we usually employ, is useful for TAVR, as the DynaCT affords exact delineation of the annulus. In the present case, because there was little calcification at the annulus, we could not clearly visualize the annulus with fluoroscopy. Nevertheless, we successfully implanted a THV in the ideal landing zone using the DynaCT technique.

There are some potential complications in TAVR in BAV cases. The bulky native leaflets, which are usually larger than a tricuspid valve, may overlap the THV in the usual deployment, resulting in a decrease in the effective orifice area index (EOAI). Wijesinghe, et al. noted that patients with bulky leaflets may be at a high risk of failure and considered that the chance of obtaining a successful result was low. To avoid that scenario, we accurately deployed the THV closer to the aorta than usual in the present case and had a good outcome. Furthermore, the elliptic shape of the bicuspid valve annulus and presence of asymmetric heavy calcification are important factors for good deployment of the THV with good function. In an intraoperative study, Zegni, et al. found that severe valvular calcification in BAV cases tends to be elliptical rather than circular, resulting in a gap at one of the commissures, and suggested that a BAV may have a potentially negative impact on deployment of a THV. On the other hand, Wijesinghe, et al. reported that a BAV does not necessarily preclude symmetric expansion of a balloon-expandable valve because such expansion appeared to be relatively circular on TEE in all 11 cases investigated. These reports suggest that acceptable outcomes may depend on anatomical features, such as the extent and location of valve calcification, bulky leaflets, and an enlarged root. Further investigations are required to offer patients with a BAV a good outcome with the lowest operative risk.

In conclusion, we report a successful TAVR for a patient with a BAV. Additional studies are required to clarify the feasibility of implanting a THV in BAV cases.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Authors’ Contributions

All authors critically read, discussed, and approved the final draft of the manuscript.

Disclosure Statement

The authors declare that they have no competing interests.
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