Transcatheter Aortic Valve Implantation for Patients with Smaller Anatomy

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Abstract

Transcatheter aortic valve implantation (TAVI) has reached relative maturity for the treatment of severe, symptomatic aortic stenosis (AS). TAVI for patients with smaller anatomy is a challenging procedure due to specific anatomical difficulty and complications including annulus rupture and vascular complications. Prevention of these complications, and the introduction of a newer-generation and lower-profile TAVI system, will encourage the prevalence of TAVI for patients with smaller anatomy.

Keywords

Transcatheter aortic valve implantation, small body size, vascular complication, aortic valve

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Transcatheter aortic valve implantation (TAVI) is evolving rapidly with an exponential growth in the number of procedures in worldwide.^{1,2} As worldwide experience with this modality increases, more and more patients are being offered this alternative to open surgery for the treatment of severe, symptomatic aortic stenosis (AS). Although this technique has reached relative maturity, further optimisation of patient selection and device implantation is essential for achieving improved prognosis.

Patients of small body size (e.g. body surface area <1.4 m²) typically have a smaller annulus size and smaller vascular access. Smaller annulus (e.g. annulus area <300 cm²) may increase the risk of annulus rupture due to relative valve oversizing.³ Annulus rupture or perforation is a rare but catastrophic complication of TAVI associated with a high risk of death, and has been reported to be between 0–1.1 %.^{4,5} Aggressive device oversizing and large calcifications in the epicardial fat area of the annulus were reported as risk factors for annulus rupture.^{3,5,6} Our previous report showed a trend towards higher incidence (2.3 %) of annulus rupture in patients with small body size.⁷ Accurate measurement of the aortic root using multidetector CT is crucial for appropriate device sizing.^{8–10} A smaller valve such as a 20 mm balloon-expandable transcatheter heart valve should also contribute to the reduction of annulus rupture in patients with smaller annulus (see *Figures 1–3*).¹¹

Vascular access is also an important factor in small body sized patients undergoing TAVI. Smaller vascular access increases the sheath to femoral artery ratio, resulting in a higher risk of vascular complications,¹² which have been shown to be associated with a significant increase in mortality.^{12–14} Our previous report showed the incidence of major vascular complications was significantly higher in the small body size group compared with the normal body size group because of the smaller access (13.0 % versus 4.3 %; $p < 0.01$).⁷ Care should be taken to

avoid vascular complications in patients with smaller ilio-femoral access (see *Figure 4*). New emerging TAVI technologies with lower-profile sheath system, SAPIEN 3 (Edwards Lifesciences Inc., Irvine, CA, US) and Evolut R (Medtronic, Santa Rosa, California, US) have the potential to reduce the risk of vascular complications.^{15,16}

Due to the smaller access route, a non-femoral approach is preferred in patients with smaller anatomy. In recent results of national registry, non-femoral access was one of the significant predictors of adverse outcome.¹⁷ Using the newer and lower-profile sheath TAVI system, femoral access will be used more frequently and encourage the prevalence of TAVI for patients with smaller anatomy.

The distance between the coronary ostium and the aortic annulus plane is also a matter of great concern for TAVI in small body size patients. Our previous study showed the distance between the left coronary ostium and the aortic annulus plane was shorter in the small body group.⁷ Rebeiro et al. reported on data from a multicentre registry, which showed that a lower-lying coronary ostium and a shallow sinus of valsalva were associated with coronary obstruction after TAVI.¹⁸ Prevention of coronary occlusion using, for example, coronary protection with prior wire placement into the coronary before valve implantation may be a valuable solution.¹⁹ In the registry data, the coronary obstruction rate was more than twice as high among patients who received a balloon-expandable valve than among those who received a self-expandable valve (0.81 % versus 0.34 %).⁹ A self-expandable valve system will be suitable for the small body patients with the risk of coronary obstruction, however, attention should be paid to the small size of sinus of valsalva with a potential risk of coronary obstruction.

Surgical aortic valve replacement carries a potential risk of abnormally high post-operative gradients especially in patients with severe AS and small aortic annulus size.^{20,21} One study demonstrated that the

Figure 1: Small Anatomy of Aortic Annulus

Figure 2: Small Anatomy of Sinus of Valsalva

Figure 3: Small Anatomy of Sino-tubler Junction

Figure 4: Small Size of Ilio-femoral Access

mean post-procedural transprosthetic gradient was significantly lower in the balloon expandable TAVI cohort compared with surgical aortic valve replacement.²² According to the authors' findings, distention of the aortic annulus due to systematic oversizing and the absence of a sewing ring may have been the potential mechanisms accounting for the superior haemodynamic profile associated with TAVI compared

with standard surgical valves. In patients with smaller body and smaller annulus size, TAVI may have a potential benefit of avoidance of abnormally high post-operative gradients.²³

TAVI for patients with smaller anatomy is challenging in terms of specific anatomical difficulty and complications. In order to avoid these serious complications, meticulous annulus measurement,⁸ evaluation of calcification distribution on the aortic annulus²⁴ and pre-screening of ilio-femoral access¹² are of great importance. In addition to these pre-screening efforts, the prevalence of newer-generation and lower-profile TAVI systems will surely provide safe TAVIs for patients with smaller anatomy. ■

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