Editorial

CT based sizing may reduce pacemaker implantation and paravalvular leaks after sutureless and rapid deployment valve implantation

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Sutureless and rapid deployment (SURD) aortic bioprostheses were developed in parallel with transcatheter heart valves (THV), to simplify surgical aortic valve replacement (AVR) in complex scenarios like minimally invasive AVR, AVR in the heavily calcified aortic annulus/root, and AVR in the small aortic annulus. SURD valves share some advantageous features with both sutured aortic bioprostheses (removal of the native valve, decalcification of the annulus, controlled deployment under direct visual control) and transcatheter valves [no need to stitch the annulus, increased effective orifice area due to the absence of pledgets and the mechanical thrust exerted by the inflow stent on the left ventricular outflow tract (LVOT)], and have been shown to be useful and effective in several specific contexts (1).

Innovative anchoring mechanism, new specific complications

Similar to THV, the sealing and good anchoring of the SURD bioprostheses relies on the oversizing of the valve stent compared to the patient's aortic annulus, and similar to THV, the mis-sizing of SURD bioprostheses may lead to specific complications. Insufficient oversizing may result in ineffective sealing and paravalvular leakage (PVL) or, in extreme situations, in the ventricular displacement of the SURD valve. On the other hand, excessive oversizing can make the lodgment of the prosthesis in the annulus arduous, and in extreme situations may lead to infolding of the inflow stent or to the aortic displacement of the prosthesis (2). Interestingly enough, less extreme degrees of oversizing have also been associated with specific complications. Previous studies reported an increased rate of conduction disturbances requiring pace-maker implantation in SURD patients, possibly due to excessive pressure and trauma to the conduction system (3). Furthermore, failure to achieve a near-complete, circular expansion of the valve stent has been associated with altered leaflet function, increased trans-prosthetic gradients, subclinical thrombosis and early valve failure (4). Finally, delayed stent infolding leading to the appearance of significant PVL has been reported (5).

Sizing the aortic annulus: mechanistic measure or craftsmanship?

There is a common belief among cardiac surgeons that the surgical obturator-based sizing of the aortic annulus represents the gold-standard measure against which all other sizing strategies should be tested. However, surgical sizing is an all but objective measure, and is affected by several factors—visual assessment, amount and distribution of calcium, stiffness of the cardiac structures, and fragility of the aortic wall. Surgical sizing requires judgement and experience, and may be complex—especially in complex settings where a SURD prosthesis is preferable, as in patients with small or calcific annuli, or in minimally invasive approaches with suboptimal exposure. Moreover, surgical sizers are often non-metric, and the manufacturer-suggested sizing strategy may differ significantly between different prostheses (6). As a matter of fact, sizing of both the commercially available SURD valves, as recommended

by the manufacturer and/or key opinion leaders, requires some empirical judgement of factors like "The friction with which the sizer passes through the annulus", or "The residual space between the sizer and the annulus itself". As a consequence, in border-line cases, surgeons are still asked to choose between the risks of downsizing (PVL, ventricular displacement) and those related to excessive oversizing (arduous lodging of the valve, valve stent infolding or pop-up, increased gradients, increased risk of conduction disturbances and, possibly, of subclinical thrombosis and early failure). According to our experience, most surgeons will opt for the latter: this could explain the recent observation that SURD patients requiring valve in valve implantation need the procedure twice as early as patients with sutured bioprostheses: excessive oversizing might have been a causative factor for most of the reported early failures of SURD valves—possibly a major one (7).

CT based sizing of the aortic annulus is an established routine

Trans-catheter AVR (TAVR) is a valid alternative to AVR for many patients. The development of an effective, CT based sizing strategy has played a major role in the surge in trans-catheter valves: CT based sizing of the aortic virtual basal ring is extremely easy and reproducible, and provides the operator with a true and objective measure of the aortic annulus during both systole and diastole. It has been validated in several clinical trials and successfully used in thousands of patients, and its role is so well established that the early history of TAVR, when complex procedures and suboptimal results were not rare, is often referred to as the "Pre-CT era" (8). The CT derived measure of the aortic annulus can be used to calculate exactly the amount of oversizing that will be achieved with a specific valve (4). Moreover, cardiac CT offers a unique opportunity to analyse in detail several features of the aortic valve (morphology, amount and distribution of calcium, height of the coronary arteries, dimensions of the aortic root and ascending aorta). All this information may offer invaluable support when choosing the brand and size of the SURD prosthesis to be implanted.

What is the optimal sizing strategy for SURD AVR?

Theoretically, SURD AVR offers the advantageous features of valved stents while avoiding their drawbacks: as a consequence, minimally invasive SURD AVR should be considered as the 1st line option for AVR in patients with an aortic root anatomy unfavourable for TAVR. However, similarly to TAVR, SURD AVR has been associated with an increased risk of PVL and PMK implantation (1-5).

There are several good reasons to believe that PVL and PMK implantation after SURD AVR are related to mis-sizing. PVL with self-expandable SURD bioprostheses is usually due to valve stent infolding caused by gross oversizing. On the other hand, balloon expandable SURD bioprosthesis patients may develop PVL as a consequence of excessive downsizing or inadequate decalcification. As for TAVR, PMK implantation might be related to the implantation height and to excessive oversizing with both valves.

A lot of resources have been invested to develop the optimal tools and sizing strategies for SURD-AVR (1). CT based sizing offers the indisputable advantage of knowing *a priori* the exact amount of oversizing that will be obtained with any specific device. This information can integrate the delicate process of surgical sizing, allowing surgeons to start the operation with a defined project, and to perfect the results of AVR.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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