COMENTÁRIO EDITORIAL

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Role of intraoperative Echocardiography for Sutureless Perceval Aortic Valve

A novel approach to surgical aortic valve replacement (SAVR) is the implantation of the sutureless bioprosthetic Perceval (LivaNova) aortic valve (AV). However, there are few recommendations available to perform intraoperative transesophageal echocardiographic (TEE) assessment for this valve.

The Perceval AV is a stented, trileaflet, bioprosthetic valve that comes in 4 sizes (S, M, L, and XL) corresponding to valve diameters of 21, 23, 25, and 27 mm, respectively (Table 1). The tissue component of the valve is from bovine pericardium that is encircled by a self-expanding stent, which supports the valve and anchors it in place within the aortic annulus.[1] The base of the valve contains a periannular sealing collar. The bare stent encircles the valve with an outflow ring that sits at the level of the sinotubular junction (STJ) with sinusoidal outpouching struts to fit the sinuses of Valsalva. For clinicians taking care of patients with an unknown prosthetic AV replacement, identifying these unique characteristics (trileaflet, periannular sealing collar, and stent extending to the STJ) on TEE can be suggestive of the presence of a Perceval AV.

Perceval AV implantation is designed to be deployed rapidly (sutureless), similar to a TAVR procedure but through an aortotomy, and different because repositioning and redeployment is possible. There are several advantages over standard SAVR, including the ease of valve placement, shorter cardiopulmonary bypass and aortic cross-clamp times.[2,3]

Patient-related contra-indications to using the Perceval prosthesis include the presence of aortic aneurysmal dilation, ascending aortic dissection, known hypersensitivity to nickel or cobalt alloys, and any anatomical characteristics outside of the specified measurements (Table 1). Additionally, there is limited data currently available regarding the safe use in patients with a mitral or tricuspid valve replacement or annuloplasty[4,5] isolated aortic insufficiency or a congenital bicuspid AV.[5,6] A growing trend in the treatment of recurrent aortic stenosis is a valve-in-valve prosthesis deployment.[7,8]

Pre-implantation Echocardiographic Assessment

Although a cardiac CT scan often is used for patient assessment prior to implanting the Perceval AV, it is not a prerequisite for valve placement as in TAVRs, since the surgeon has direct access to the aortic annulus for confirmatory measurement.[9] The first task of the echocardiographic examination includes measuring the diameters of the aortic annulus and the sinotubular junction. Based on the range of these anatomical measurements, the appropriate valve size can be determined (Table 1). Aortic annular diameters between 19 and 27 mm paired with a sinotubular junction diameter range of r24.7 mm to 35.1 mm can accommodate a Perceval AV successfully. In addition, it is vital to check that the ratio between the sinotubular junction and the annulus diameter is 1.3.[1,10] A ratio greater than 1.3 indicates possible pathological aortic annular or STJ dilation, being a contra-indication to Perceval AV. Correct valve and root sizing by echocardiography is imperative to avoid detrimental consequences, including valve migration, valve stent infolding, and aortic wall damage. Aortic annular diameter wanes initially reported from computed tomographic studies to be more oval than round. On 3D echocardiography, this is clearly appreciated, and 3DE aortic annular measurements from the en face views provide more accurate and reproducible measurements compared with 2D echocardiography.

The amount of aortic annular calcification is also important to communicate to the surgeon, as a thorough debridement of the aortic annulus must be done to ensure a homogenous landing zone and help guarantee a well-seated valve. Eccentric and bulky protruding intraluminal calcifications can be a nidus for poor valve seating and cause a paravalvular leak (PVL).

Post-implantation Echocardiographic Assessment

The initial step in evaluating the success of Perceval placement after deployment is to assess the valve

Table 1 **Valve Sizes and hemodynamic parameters**

Valve Size	Aortic Annulus Diameter (mm)	Sinotubular Junction Diameter (mm)	Mean Gradient (mmHg)	Effective orifice area (cm^2)
S (21)	19 - 21	≤ 24.7 – 27.3	10.1 ± 4.2	1.3 ± 0.3
M (23)	21 - 23	≤ 27.3 – 29.9	9.4 ± 5.5	1.5 ± 0.4
L (25)	23 - 25	≤ 29.9 – 32.5	8.5 ± 4.6	1.5 ± 0.4
XL (27)	25 - 27	≤ 32.5 – 35.1	9.7 ± 4.7	1.6 ± 0.4

position. The goal is to have a well-seated valve in the aortic root without rocking motion; the valve prosthesis and the aortic annulus should be flush with uninterrupted circumferential contact with the aortic inner lumen. The valve ring is hyperechoic, thus creating acoustic shadowing in midesophageal aortic long-axis view. As such, a deep transgastric view may be beneficial when evaluating the position of the valve.

Evaluation of valve position also entails evaluating patency of the valve stent frame and sinusoidal struts. An undersized valve can result in valve migration. An oversized valve can lead to excessive compression or rupture of the aorta and disruption of valve integrity, resulting in stent infolding. Patient-prosthesis mismatch can be an issue with any valve type, but given the intimate relationship of the valve stent frame and the annular valve ring for the Perceval AV, ensuring proper valve seating is crucial. However, it is not necessary that the outflow ring of the valve be flush with the aortic wall at the level of the sinotubular junction. A deep transgastric long-axis view should be obtained to evaluate hemodynamic parameters (Table 1).[10]

The reported incidence of PVL after Perceval implantation ranges from 4% to 8%.[10,11] Assessing PVL can be accomplished best in the midesophageal aortic long-axis view. Any PVL greater than mild should be addressed by either increasing the size of the valve prosthesis or redeploying the valve in a more optimal position.[1,10] Redeployment of the valve simply entails removing the valve (since it is not sutured) and collapsing the valve back onto the prosthesis-mounted holder prior to redeployment.

Pitfalls of Perceval AV Implantation

Prosthetic PVL can occur with any AV replacement, however, with the Perceval AV this potential pitfall can be easily corrected.

Central AV regurgitation can be observed, but in instances where the valve is properly sized prior to deployment, this is generally graded to mild. Coaptation of all 3 leaflets of the prosthetic valve is best viewed in the midesophageal AV short-axis view. Evaluating that the prosthesis commissural struts are properly oriented with the native commissures is best done in this view. Due to acoustic shadowing, this may be technically difficult but a 3D view may be helpful in the evaluation for proper leaflet function and mobility. In addition to prosthesis leaflet motion, confirmation that there is preserved diastolic anterior mitral leaflet movement is crucial to a successful outcome.[12]

Although visually inspected by the surgeon, it is always imperative to assure coronary ostia patency, demonstrating coronary blood flow with color flow Doppler or surrogate markers for coronary hypoperfusion (left ventricular wall motion abnormalities, right ventricule dysfunction, and functional mitral regurgitation). This prompt the echocardiographer to advise the surgeon of the need to reposition the valve. The patient can develop dysrhythmias, likely from the radial shear force of the expanding valve on the atrioventricular node.[4,10]

TEE is useful for perceval AV implantation to guide appropriate device implantation and to diagnose and treat complications that may occur during valve implantation. The suggestions provided may serve as a guide for safe implantation of the Perceval AV (Table 2).

Table 2 **Valve Sizes and hemodynamic parameters**

Perceval AV TEE Findings / Evaluation
Perceval valve appearance on TEE
Trileaflet valve
Hyperechoic periannular ring
Hyperechoic coronary sinus strut
Outflow ring abutting sinotubular junction
Intraoperative evaluation of Perceval valve
Measure diameter of aortic annulus
Measure diameter of sinotubular junction
Assess ratio of annulus:STJ < 1.3
Assure patency of stent from postdeployment
Evaluate valve seating
Assess level of PVL ≤ Mild
Interrogate valve for mean and peak gradients (Table 1)

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