Role of MSCT in pre and post Transcatheter aortic valve replacement (TAVR) imaging

Essay

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List of Abbreviations

AAA	:	Abdominal Aortic Aneurysm
AMVL	:	Anterior Mitral Valve Leaflet
CHF	:	Congestive Heart Failure
ECM	:	Extracellular Matrix
ESC	:	European Society of Cardiology
F/Fr	:	French (3 Fr = 1 mm)
LVOT	:	Left Ventricular Outflow Tract
PAR	:	Paraaortic regurgitation
PARTNER	:	Placement of Aortic Transcatheter Valves
PCI	:	Percutaneous Coronary Intervention
PHV	:	Prosthetic Heart Valve
PTFE	:	Polytetrafluoroethylene
PVR	:	Paravalvular regurgitation
SAVR	:	Surgical Aortic Valve Replacement
STJ	:	Sino-Tubular Junction
TAVI	:	Trans-catheter Aortic Valve Implantation
TAVR	:	Trans-catheter Aortic Valve Replacement
TEE	:	Transoesophageal Echocardiography
THV	:	Transcatheter Heart Valve
TTE	:	Transthoracic Echocardiography

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Introduction

Aortic valve stenosis is a progressive disease that evolves from a non-symptomatic valve with thickened and calcified leaflets but without hemodynamic repercussions into an increasingly degenerative valve with extensive calcified and immobile leaflets. As the valve stenosis worsens, symptoms progress from mild to severe, with increasing fatigue and shortness of breath being common complaints and with the condition invariably leading to heart failure. (***Nkomo et al., 2006).***

Its overall prevalence is estimated to be 5%, mostly affecting the elderly population, with 2%–3% of individuals over 75 years of age having severe aortic valve stenosis. (***Rosamond et al., 2008).***

The final symptomatic stage is short and rapidly progressive and is associated with a 2-year survival rate of 50% or less. (***Iung et al., 2003).***

Traditionally, elective surgical aortic valve replacement has been considered the most effective treatment for advanced disease, significantly improving patient symptoms and survival compared with patients who are unwilling or unable to undergo surgery. Unfortunately, not all patients are eligible for surgery, as many as 30% of patients with aortic stenosis are not considered surgical candidates because of comorbidities and estimated extreme surgical mortality risk***. (Iung et al., 2005).***

In recent years, alternative therapeutic options for patients deemed inoperable have emerged with the development of transcatheter-based therapies and specific aortic valve prostheses that can be transported to the aortic root using a nonsurgical endovascular, transaortic, or transapical approach. Once in place, these bioprosthetic valves functionally replace the native valve by displacing it to the aortic root wall during deployment. Given its less invasive nature, this procedure is less strenuous for patients and can therefore be applied in selected patients in a nonsurgical subgroup. The procedure is known as transcatheter aortic valve replacement (TAVR), also referred to as transcatheter aortic valve implantation (TAVI) or percutaneous aortic valve replacement. (***Salgado et al., 2015).***

Recently published data from individual centers, large prospective studies, observational registries, and multicenter randomized controlled trials have validated the efficacy of TAVR compared with the standard of care in patients with severe aortic valve stenosis.These results, together with promising short- and medium-term outcomes, have led to the success and increasingly widespread clinical implementation of this intervention, with over 50,000 procedures now being performed worldwide each year. (***Salgado et al., 2015*** and ***Kodali et al., 2012).***

Nevertheless, not every patient who is refused or is at high risk for surgery is a good candidate for TAVR. A thorough clinical evaluation remains an important part of the global procedural assessment, since the overall condition of some patients may be so severely compromised by frailty, known and/or masked comorbidities, or a deteriorated mental state that even a successful TAVR procedure will have little chance of improving the patient's quality of life. ***(Salgado et al., 2015).***

Therefore prior to TAVR, patients undergo an extensive work-up as certain technical and anatomic criteria must be met, and it is in this respect that noninvasive imaging techniques play a crucial role to determine patient eligibility and to ultimately guide procedure planning. (***Vahanian et al., 2008).***

Computed tomographic (CT) angiography has evolved into an integral part of the preoperative workup for TAVR, primarily in terms of morphologic evaluation of the aortic root and annulus, evaluation of different potential access routes, the development of CT-supported sizing algorithms for improving patient outcomes and assessment of extra-cardiac condition, with ever-growing evidence that integration of CT into TAVR planning actually reduces procedural complications, such as paravalvular regurgitation. (***Binder et al., 2013).***

Until recently, echocardiography has been adequate for the assessment of prosthetic heart valve (PHV) function. Echocardiography offers many advantages in this setting, including noninvasiveness, low cost, bedside availability, and rapid execution. Its greatest strength lies in its ability to provide both anatomic and Doppler imaging–based functional information, such as measurement of pressure gradients over the valve and the valve orifice area. However, the PHV components also generate artifacts at echocardiography, which can hamper assessment. Furthermore, echocardiography is known to be operator dependent. (***Zoghbi et al., 2009).***

Over the past 5 years, CT has been shown to provide information on PHV functioning that is complementary to that obtained with echocardiography. CT is especially helpful in providing details on valve position and geometry, and modes of valve dysfunction or obstruction by helping to identify thrombus, pannus tissue, and abnormal PHV angulation, diagnose PHV endocarditis and determine the presence and extent of mycotic aneurysms. (***Habets et al., 2011).***

Furthermore, CT has the intrinsic advantage of depicting not only the valve itself but also the surrounding cardiac and thoracic anatomy. In addition, CT is frequently used to evaluate complications along the different access routes. (***De Heer et al., 2013).***

Aim of Work

To emphasize on the role of MSCT as a crucial and integral step in pre-procedural patient selection, anatomical assessment and valve sizing prior to TAVR, and to discuss various types of valve dysfunction and potential procedural complications, along with their CT appearances.