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REVIEW

Imaging Guidance for Transcatheter Aortic Valve Replacement: Is Transoesophageal Echocardiography the Gold Standard?

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Q4 Transcatheter aortic valve replacement (TAVR) is traditionally performed under cardiac imaging guidance [1–4]. In the early TAVR experience, intra-procedural transoesophageal echocardiography (TOE) is recommended to guide device deployment, in the context of general anaesthesia (GA). Intra-procedural TOE imaging is particularly useful during TAVR deployment as a contrast-saving strategy for patients with renal impairment. Evidence has emerged recently demonstrating that in selected patients, transthoracic echocardiography (TTE) can be used to provide intra-procedural guidance for TAVR. Additionally, there is a growing body of evidence supporting the performance of TAVR using fluoroscopy alone, without additional cardiac imaging. This article aims to provide a contemporary review of the various procedural imaging approaches for TAVR guidance, comparing the relative strengths and weaknesses of each approach (Table 1).

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Keywords Transcatheter aortic valve replacement • Transoesophageal echocardiography • Transthoracic echocardiography • Fluoroscopy

Pre-procedural Echocardiographic Assessment for TAVR

Echocardiography plays an important role in the pre-procedural assessment, intra-procedural guidance and post-procedural monitoring and detection of complications following TAVR (Table 2).

Pre-procedural echocardiographic assessment for TAVR is predominantly performed using TTE imaging (Table 2). Routine pre-procedural TOE is not conventional practice, and is not supported by evidence. A detailed baseline study should occur, including assessment of left ventricular size and ejection fraction, the presence of concentric left ventricular remodelling or hypertrophy, and the presence of basal septal hypertrophy. Knowledge of baseline left ventricular systolic function enables detection of new regional motion abnormalities during the procedure (Table 1). Baseline mitral valve function should be assessed, Q6 documenting the degree and mechanism of mitral regurgitation. This is important, as changes in mitral regurgitation following TAVR deployment may result from several important mechanisms, including injury to the mitral valve apparatus, systolic anterior motion of the mitral valve, or severe acute aortic regurgitation. Significant post-TAVR mitral regurgitation (moderate or severe) has been reported to be associated with higher early mortality (odds ratio: 1.49; 95% confidence intervals (CI): 1.12–2.00; P = 0.004) [1]. Additionally, international TAVR registry data have demonstrated that the presence of moderate

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Table 1 **Relative advantages and disadvantages of various guiding imaging modalities for TAVR: comparing TOE and fluoroscopy, TTE and fluoroscopy, and fluoroscopy alone for guiding TAVR.**

Imaging modality	TOE and fluoroscopy	TTE and fluoroscopy	Fluoroscopy alone
Advantages	• Superior imaging quality to TTE	• Non-invasive	• Does not require additional equipment or specialist echocardiologist during TAVR
	• 3D TOE and particularly the addition of fusion imaging provides incremental benefit in guiding TAVR	• Can provide diagnostic and accurate imaging information for selected patents	• Potential to reduce procedure time and cost
	• Real-time imaging during the procedure		• Ability to perform TAVR on patients with severe lung disease (TAVR can be done under local anaesthesia)
	• Accurate assessment of procedural complications		• Early patient mobility post procedure
	• Can be used for all TAVR delivery approaches (transfemoral, transapical and direct aortic)		
	• Reduces the amount of contrast used during TAVR implantation (particularly relevant for patients with renal impairment)		
Disadvantages	• Invasive and usually performed with GA	• Imaging quality reliant on good imaging windows	• Difficult to immediately and accurately assess for complications such as pericardial effusion/tamponade, PAR
	• Small risks of serious complications (e.g. oesophageal perforation, aspiration, oropharyngeal damage)	• Limited diagnostic utility in patients with poor imaging windows (e.g. obesity, supine positioning during TAVR)	• Significant exposure to contrast, especially in patients with renal impairment
		• Difficult to use in transapical TAVR placement	• Increased radiation dose with longer procedural time and more cine imaging
		• Risk of infection by interfering with sterile field	

Abbreviations: Transcatheter aortic valve replacement = TAVR; Transoesophageal echocardiography = TOE; General anaesthesia = GA; Transthoracic echocardiography = TTE; Para-valvular aortic regurgitation = PAR.

or ≥ 2 post-TAVR mitral regurgitation was a strong predictor of one-year mortality [2,3]. Right ventricular systolic function should also be detailed, with an estimate of the pulmonary artery systolic pressure. In a study of 353 patients undergoing TAVR, with assessment of pulmonary artery systolic pressure by echocardiography pre- and at 90 days after TAVR, the presence of mild to moderate, and severe pulmonary hypertension, was associated with higher two-year mortality rates (27.3% and 48.4%, respectively; P = 0.001) [4]. Patients with persistent severe pulmonary hypertension post-TAVR had a worse prognosis than patients whose pulmonary artery systolic pressure decreased below 60 mmHg (two-year mortality rates: 50% vs 18.6%; P = 0.001) [4].

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