



New Guidelines for Quantifying the Severity of Valvular Disease

Written by Maria Vinall

A panel of experts reviewed recommendations and insights for echo grading of aortic stenosis (AS), differentiating primary and secondary mitral regurgitation (MR), and quantifying changes in valvular structure and the severity of tricuspid regurgitation from the 2014 American Heart Association/American College of Cardiology (AHA/ACC) guideline for the management of patients with valvular heart disease [Nishimura RA et al. *J Thorac Cardiovasc Surg.* 2014; *Circulation.* 2014; *J Am Coll Cardiol.* 2014].

The 10 most important new concepts introduced in the 2014 valvular heart disease guideline, reviewed by James D. Thomas, MD, Northwestern University, Chicago, Illinois, USA, are summarized in Table 1.

Philippe Pibarot, DVM, PhD, Quebec Heart and Lung Institute, Montreal, Quebec, Canada, discussed echo grading of AS (Table 2). He noted that in low-flow states, it is difficult to distinguish true- from pseudo-severe AS. The AHA/ACC 2014 guideline recommends a dobutamine stress echo to detect contractile reserve. By augmenting stroke volume by $\geq 20\%$, the mean gradient should increase while the aortic valve area (AVA) remains severe (ie, $\leq 1.0 \text{ cm}^2$) in true-severe AS. For patients without evidence of contractile reserve, a high aortic valve calcium score by multiple-detector computed tomography (CT) is able to differentiate true- from pseudo-severe AS. Aortic valve replacement (AVR) is recommended for symptomatic patients with a gradient increase $\geq 40 \text{ mm Hg}$ and an AVA $\leq 1.0 \text{ cm}^2$ at any dobutamine dose (class IIa, level B).

Paradoxical low-flow, low-gradient AS with preserved left ventricular (LV) ejection fraction is more often seen in elderly women with comorbid hypertension, metabolic syndrome, diabetes mellitus, and diastolic dysfunction, noted Prof Pibarot. AVR is reasonable in these patients if they are normotensive and if severe valve obstruction is the most likely cause of the symptoms (class IIa, level C). Aortic valve calcium scoring by multislice CT may be used to confirm stenosis severity in patients with paradoxical low-flow, low-gradient AS. However, different cut points of aortic valve calcium score should be used in women ($> 1200 \text{ AU}$) vs men (2000 AU) to identify true-severe AS. The flow chart in Figure 1 provides an organized way to determine the appropriate treatment path for the patient.

Paul A. Grayburn, MD, Baylor Scott & White Health, Dallas, Texas, USA, outlined the differences between primary (degenerative) and secondary (functional) MR as reviewed in the AHA/ACC 2014 guideline. In primary MR, the leaflets are abnormal (eg, mitral valve prolapse), and surgical valve repair is the standard. The more difficult secondary MR has normal-appearing leaflets and is caused by LV dilation/dysfunction. Surgery has a class IIb recommendation (except during coronary artery bypass graft), as it is not clear if MR repair provides any benefit.

Secondary MR often results from LV dysfunction and/or remodeling due to either ischemic or nonischemic cardiomyopathy. These patients can also have a relatively preserved LV but significant MR due to an inferoposterior myocardial infarction or pure annular dilation. Clinically, they resemble patients with primary MR and may benefit from intervention targeted to the pathology. Dr Grayburn recommended careful use of specific echo measurements to determine the mechanism of MR (eg, leaflet tenting area, tethering distance, and annulus shape), as well as quantification of MR severity before making a management decision.

Linda D. Gillam, MD, Morristown Medical Center, Morristown, New Jersey, USA, discussed the AHA/ACC 2014 guideline options for assessment of aortic and pulmonic regurgitation. Echocardiography with Doppler is recommended as the primary means for noninvasive evaluation of native valvular regurgitation [Lancellotti P et al. *Eur J Echocardiogr.* 2010]. Two-dimensional echocardiography with color flow and spectral Doppler provides an assessment of valvular structure, mechanism of regurgitation, and adaptation to the volume overloaded state [Skaug TR. *Eur Heart J Cardiovasc Imaging.* 2014].

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Table 1. Ten Key Messages From the 2014 AHA/ACC Valvular Heart Disease Guideline

1. Multidisciplinary heart valve teams and heart valve centers of excellence	Patients with severe valvular disease should be evaluated by a multidisciplinary team when intervention is considered. Consultation/referral to a heart valve center is reasonable for (1) asymptomatic patients with severe valvular disease, (2) patients benefiting from repair vs replacement, or (3) patients with multiple medical comorbidities
2. Valve disease classified into 4 stages: stage A, at risk for disease; stage B, progressive; stage C, severe (asymptomatic); stage D, severe (symptomatic)	The stages guide the frequency of follow-up and timing of intervention. They are defined by valve anatomy and hemodynamics, LV function, symptoms, and clinical outcomes
3. LV decompensation defined: stage C divided into C1 (compensated) and C2 (decompensated)	Stage C2 (LVEF \leq 60%; end-systolic dimension \geq 40 mm) for severe MR is associated with worse outcomes. Early identification of stage C2 disease is needed
4. Earlier intervention in asymptomatic AS	Need for intervention includes (1) LVEF $<$ 50%, (2) positive exercise test, and (3) severity of stenosis (eg, AV-Vel $>$ 5 m/s)
5. New options for percutaneous treatment of AS and high surgical risk	TAVR is indicated in severe AS with prohibitive surgical risk and life expectancy $>$ 12 mo (class I, level A). TAVR is a reasonable alternative in patients at high surgical risk (class IIa, level B)
6. Primary and secondary MR treated differently	For secondary MR, a ROA $>$ 0.2 cm ² is considered severe [Grigioni F et al. <i>Circulation</i> . 2001]; for primary MR, it is ROA $>$ 0.4 cm ² [Enriquez-Sarano M et al. <i>N Engl J Med</i> . 2005]. This means that MR cannot be graded unless its etiology is known
7. Percutaneous MV repair may be considered for stage D patients with severe primary MR with a reasonable life expectancy but a prohibitive surgical risk (class IIb, level B)	The EVEREST II High Risk Study [Whitlow PL et al. <i>J Am Coll Cardiol</i> . 2012] showed reduced MR severity, NYHA class improvement, and reverse LV remodeling with percutaneous treatment at 12 mo
8. Treatment decisions should be individualized for age, STS risk score, procedure-specific impediments, major organ compromise, and frailty	Surgery for asymptomatic severe MR was associated with greater long-term survival vs medical management [Suri RM et al. <i>JAMA</i> . 2013]; similarly for severe AS. Timing of surgery should consider patient preference, reliability of follow-up, and likelihood of repair and recovery
9. More liberal surgical options for TR available	Tricuspid valve repair or replacement for primary stage D TR is low risk and provides symptomatic improvement. Survival is worse for untreated vs treated secondary TR [Calafiore AM et al. <i>Ann Thorac Surg</i> . 2009]
10. Information in guidelines is organized in knowledge bytes to be more useful at point of care	The data are stored in a centralized content management system from which they can be used in applications, moved into the guidelines, or used for online education, when new data support updates

AHA/ACC, American Heart Association/American College of Cardiology; AS, aortic stenosis; AV-Vel, peak aortic jet velocity; LV, left ventricular; LVEF, left ventricular ejection fraction; MR, mitral regurgitation; MV, mitral valve; ROA, regurgitant orifice area; STS, Society of Thoracic Surgeons; TAVR, transcatheter aortic valve replacement; TR, tricuspid regurgitation.

Source: Nishimura RA et al. *J Thorac Cardiovasc Surg*. 2014.

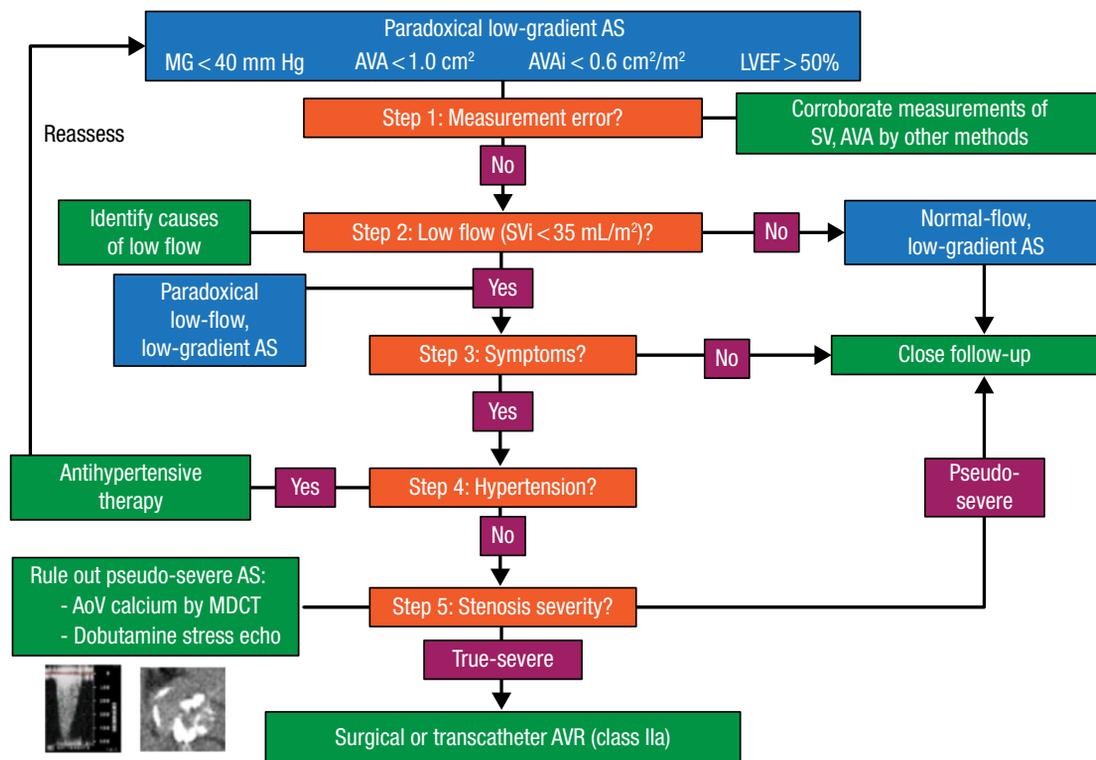
Table 2. Echo-Determined Staging of Symptomatic Severe AS

Gradient Type	Stage	Surgery/TAVR Indication	Valve Hemodynamics			
			MG, mm Hg	AVA, cm ²	LVEF, %	SVi, mL/m ²
High gradient	D1	I	\geq 40			
"Classical" low flow, low gradient	D2	IIa	$<$ 40	\leq 1	$<$ 50	
"Paradoxical" low flow, low gradient	D3	IIa	$<$ 40	\leq 1	\geq 50	$<$ 35
Normal flow, low gradient	NA	NA	$<$ 40	\leq 1	\geq 50	\geq 35

AS, aortic stenosis; AVA, aortic valve area; LVEF, left ventricular ejection fraction; MG, mean gradient; NA, not addressed in guideline; SVi, stroke volume index; TAVR, transcatheter aortic valve replacement.

Source: Nishimura RA et al. *J Thorac Cardiovasc Surg*. 2014.

Figure 1. Decision Making in “Paradoxical” Low-Gradient AS



AoV, aortic valve; AS, aortic stenosis; AVA, aortic valve area; AVAi, aortic valve area index; AVR, aortic valve replacement; LVEF, left ventricular ejection fraction; MDCT, multidetector computed tomography; MG, mean gradient; SV, stroke volume; SVi, stroke volume index.

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Echocardiographic quantification of aortic regurgitation can be best estimated using a variety of techniques, including color flow jet width, vena contracta width, proximal isovelocity surface area, descending aortic flow reversal, and quantification of regurgitant volume and fraction. In addition, assessment of the valve anatomy, etiology of dysfunction, and cardiac chambers is used in the management of valvular regurgitation and timing of surgery. In the future, real-time 3D imaging will provide enhanced measurements of flow convergence, vena contracta, and the regurgitant jet for improved quantitation of valvular regurgitation. The assessment of pulmonary regurgitation has much less validated methodology. Assessment of the valve morphology (typically congenital disease or iatrogenic), color flow analysis, and measurement of right ventricle size and function are most helpful. Dr Gillam reminded the audience to be aware of severe low-pressure pulmonary regurgitation, which can have laminar flow and thus sometimes be missed.

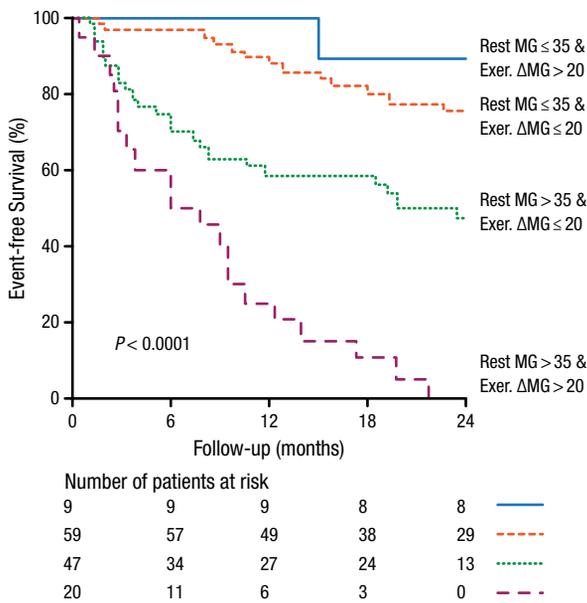
Lawrence Rudski, MD, McGill University, Montreal, Quebec, Canada, discussed AHA/ACC guideline methods

to quantify the severity of tricuspid regurgitation, which may lead to right-sided failure with clinical implications, such as peritoneal and lower extremity edema, gut congestion, atrial fibrillation, and possibly increased risk of death.

Although there are limitations, the simplest and quickest way to measure tricuspid regurgitation severity is with color Doppler. The larger the color jet, the more significant the tricuspid regurgitation. This works well for mild or very severe tricuspid regurgitation, but when the degree of tricuspid regurgitation is uncertain, quantitation is mandatory. Proximal isovelocity surface area and derived effective orifice area, as well as vena contracta, are commonly employed quantitative methods and use color. Hepatic vein systolic flow reversal, triangulation and increased density of the tricuspid regurgitation signal, and increased right atrial and ventricular size are also useful tools for comprehensive, noninvasive quantitation of tricuspid regurgitation. Echo remains the most commonly used standard tool for assessment, but magnetic resonance imaging is still useful in some situations



Figure 2. Significance of Exercise Gradient



MG, mean gradient.

Marechaux S et al. Usefulness of exercise-stress echocardiography for risk stratification of true asymptomatic patients with aortic valve stenosis. *Eur Heart J*. 2010;31(11):1390-1397. By permission of European Society of Cardiology.

to quantify the impact of tricuspid regurgitation on right ventricular volumes and function.

Paul Sorajja, MD, Minneapolis Heart Institute, Abbot Northwestern Hospital, Minneapolis, Minnesota, USA, addressed assessment of the functional severity of asymptomatic AS with stress testing. The AHA/ACC 2014 guideline recommends exercise stress testing for asymptomatic patients to assess physiologic changes and whether symptoms can be precipitated (class IIa). A “positive” test is one with symptoms, an ischemic echocardiogram, or a blood pressure reduction and is associated with a poor prognosis unless AVR is performed (class IIa). One study has shown that exercise-induced increases in the transaortic gradient add incremental prognostic value in AS patients with a normal exercise response (Figure 2) [Maréchaux S et al. *Eur Heart J*. 2010].

Exercise testing is also recommended to evaluate the gradient and pulmonary artery systolic pressure in mitral stenosis where there is a discrepancy between the rest echo findings and the clinical symptoms or signs. The AHA/ACC 2014 guideline also states that exercise testing is reasonable for similar discrepancies with chronic primary MR (class IIa) or to establish symptom status (class IIa). For both mitral stenosis and regurgitation, exercise testing is useful for identification of those patients at higher risk of adverse clinical outcomes.



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