REVIEW

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Misconceptions and Facts About Aortic Stenosis

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ABSTRACT

Aortic stenosis is the most common valvular heart disease leading to intervention, and it is typically a disease of the elderly. Recent clinical advances have expanded the role of transcatheter aortic valve intervention in patients with severe aortic stenosis, making aortic valve intervention feasible and effective even in patients at intermediate, high, and prohibitive surgical risk. With the rapid advances in treatment, proper diagnosis becomes crucial for a wide range of patients with aortic stenosis: from "concordant" high-gradient aortic stenosis to "discordant" low-gradient aortic stenosis. The latter group commonly presents a clinical challenge requiring thoughtful and comprehensive evaluation to determine eligibility for aortic valve intervention. Providers at all levels should be familiar with basic diagnostic caveats and misconceptions when evaluating patients with possible aortic stenosis.

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Calcific aortic stenosis affecting anatomically trileaflet aortic valve usually develops late in life and accounts for a majority of severe aortic stenosis cases at the age of 70 years or older.[1] Severe aortic stenosis at a younger age is commonly caused by an anatomically abnormal valve, typically bicuspid.[1,2] While the recognition and grading of aortic stenosis appear relatively straightforward, there are important caveats that are relevant to practicing clinicians at all levels. The current review highlights several misconceptions about diagnostic aspects of aortic stenosis.

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MISCONCEPTION #1. CARDIAC AUSCULTATION HAS A LOW YIELD IN THE CURRENT ERA OF WIDESPREAD USE OF CARDIAC ULTRASOUND

Facts

Trainees and practicing physicians experience more and more time constraints in the current practice of medicine, which limit performance of high-quality physical examination. Additionally, widely available technology has taken a toll on skills of physical examination among many physicians, even cardiologists.[3,4] A recent study demonstrated similar overall cardiac auscultatory proficiency for common valvular lesions among cardiologists and internists.[5] However, there are still reasons to believe that proper physical examination has a role in identifying patients with aortic stenosis and in grading the severity of aortic stenosis. In a study from Italy, primary care physicians were asked to perform cardiac auscultation on their patients aged ≥65 years and refer them for echocardiography if a clearly audible systolic murmur was present. Among patients sent for an echocardiogram, only 11% had completely normal valves, and 7.2% had some degree of aortic stenosis.[6] In a study from Japan, a country with a well-established health-checkup system, close to 40% of aortic stenosis patients were not diagnosed until they were symptomatic. Importantly, patients diagnosed with aortic stenosis in the

symptomatic phase experienced more adverse events upon follow-up than patients diagnosed in the asymptomatic phase.[7]

While physical examination findings do not have high accuracy in grading the severity of aortic stenosis, they still can be useful in some patients. Thus, carotid upstroke delay, soft second heart sound, and late peaking of the systolic murmur hint toward more severe aortic stenosis.[8] Occasionally, echocardiography may underestimate the degree of aortic stenosis severity if the highest Doppler velocity through the aortic valve is not obtained. When there is a discrepancy between the physical examination findings and echocardiography report, the physician may want to further explore the possibility of severe aortic stenosis, especially if the patient remains symptomatic.[9]

CLINICAL SIGNIFICANCE

- Proper recognition and grading of aortic stenosis is relevant to practicing clinicians at all levels.
- Standard 2-dimensional echocardiographic estimation of the aortic valve area may lead to patient misclassification if used as a single measure of the aortic stenosis severity.
- Low-gradient aortic stenosis represents a clinical challenge and requires thoughtful and comprehensive evaluation to determine eligibility for aortic valve intervention.

MISCONCEPTION #2. ECHOCARDIOGRAPHY IS HIGHLY ACCURATE IN DIAGNOSING AND GRADING AORTIC STENOSIS

Facts

Echocardiography is the primary modality in diagnosing and grading aortic stenosis, and in many cases provides accurate and useful clinical information. The most important parameters reported during routine echocardiographic examination include Doppler-derived peak velocity through the aortic valve, mean pressure gradient across the aortic valve, and estimated aortic valve area. By convention, peak velocity $\geq$4 m/s, mean gradient $\geq$40 mm Hg, and estimated aortic valve area $\leq$1 cm^2 are diagnostic for severe aortic stenosis. Transaortic flow velocity $\geq$4 m/s (which corresponds to mean gradient $\geq$40 mm Hg) is a simple and reproducible echocardiographic measure of severe aortic stenosis obtained by continuous wave Doppler echocardiography. It has been shown to have high prognostic value in studies assessing the natural history of untreated aortic stenosis.[9] However, obtaining the true transaortic velocity can be challenging due to eccentricity of the aortic flow jet and requires routine acquisition of the Doppler velocities by using multiple insonation angles; failure to capture the highest velocity results in underestimating the grade of the aortic stenosis (eg, labeling patients with severe aortic stenosis as moderate).

A more important problem with using transaortic velocity and mean gradient as a single measure of the aortic stenosis severity is the fact that these are flow-dependent variables.[10] For any given degree of aortic valve narrowing as assessed by aortic valve area, conditions that create a hyperdynamic state such as anemia or volume depletion can exaggerate transaortic flow velocities, while low-flow states such as left ventricular dysfunction can result in blunted transaortic velocities and gradients. Therefore, knowing the aortic valve area is essential in determining the severity of aortic stenosis.[11] As a result, up to 40% of aortic stenosis patients are labeled as "low gradient aortic stenosis" due to discordance between the transaortic velocity/gradient (<4 m/s and <40 mm Hg, respectively) and the aortic valve area ($\leq$1 cm^2).[10] While the approach to low-gradient aortic stenosis is evolving, one should keep in mind the limitations of 2-dimensional (2D) echocardiography in determining the aortic valve area, which contributes to the complexity of this entity. The aortic valve area by 2D echocardiogram is an estimate based on Doppler-derived velocity information and left ventricular outflow tract area derivation. The latter appears to be the Achilles heel of this approach: it is based on a single measurement of the left ventricular outflow tract diameter and on the assumption that the left ventricular outflow tract is circular. In reality, however, 3D echocardiographic, computed tomography and cardiac magnetic resonance imaging studies have demonstrated that the left ventricular outflow tract more commonly exhibits an elliptical shape and may not be accurately estimated by the conventional approach.[11-13] Therefore, standard 2D echocardiographic estimation of the aortic valve area may lead to patient misclassification, if used as a single measure of the aortic stenosis severity.

MISCONCEPTIONS #3. STRESS TESTING IS CONTRAINDICATED IN PATIENTS WITH SUSPECTED SEVERE AORTIC STENOSIS

Facts

Exercise stress testing is contraindicated in *symptomatic* patients with "concordant" severe aortic stenosis (peak transaortic velocity $\geq$4 m/s, mean gradient $\geq$40 mm Hg, and estimated aortic valve area $\leq$1 cm^2).[14] Similarly, stress testing should not be performed in patients with "concordant" aortic stenosis and decreased left ventricular ejection fraction (<50%) regardless of symptoms because this constitutes class I indication for aortic valve replacement.[9] However, apparently asymptomatic patients with "concordant" severe aortic stenosis and preserved left ventricular ejection fraction should be considered for exercise testing (preferably exercise echocardiography). Exercise testing is considered safe in these settings, provided there is close monitoring and physician supervision.[15] Aortic stenosis is