Valve guidelines ase

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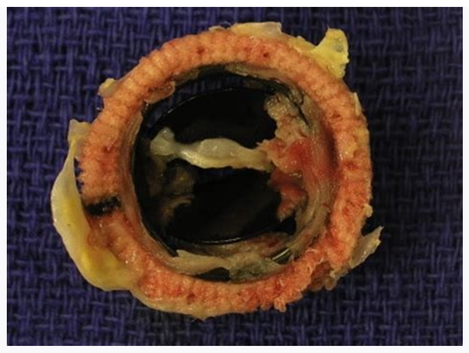

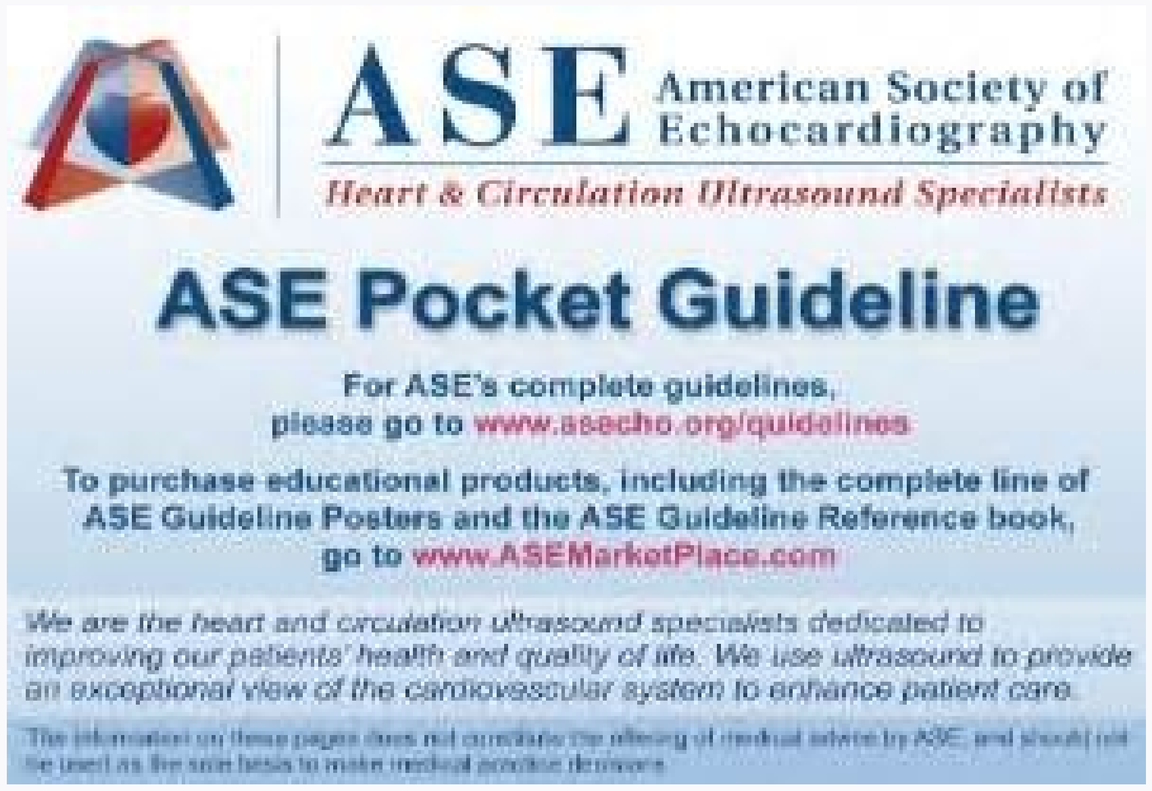

Table 4. Normal ranges and severity partition cutoff values for 2DE-derived LV EF and LA volume

	LV EF (%)	Maximum LA volume/BSA (mL/m2)
Male		
Normal range	52–72	16–34
Mildly abnormal	41–51	35–41
Moderately abnormal	30–40	42–48
Severely abnormal	<30	>48
Female		
Normal range	54–74	16–34
Mildly abnormal	41–53	35–41
Moderately abnormal	30–40	42–48
Severely abnormal	<30	>48

GUIDELINES AND STANDARDS

Echocardiographic Assessment of Valve Stenosis: EAE/ASE Recommendations for Clinical Practice

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Abbreviations: AR = aortic regurgitation, AS = aortic stenosis, AVA = aortic valve area, CSA = cross sectional area, CWD = continuous wave Doppler, D = diameter, HOCM = hypertrophic obstructive cardiomyopathy, LV = left ventricle, LVOT = left ventricular outflow tract, MR = mitral regurgitation, MS = mitral stenosis, MVA = mitral valve area, DP = pressure gradient, RV = right ventricle, RVOT = right ventricular outflow tract, SV = stroke volume, TEE = transesophageal echocardiography, $T_{1/2}$ = pressure half-time, TR = tricuspid regurgitation, TS = tricuspid stenosis, V = velocity, VSD = ventricular septal defect, VTI = velocity time integral

Continuing Medical Education Activity for "Echocardiographic Assessment of Valve Stenosis: EAE/ASE Recommendations for Clinical Practice"
Accreditation Statement:
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Target Audience:
This activity is designed for all cardiovascular physicians, cardiac sonographers and nurses with a primary interest and knowledge base in the field of echocardiography; in addition, residents, researchers, clinicians, sonographers, and other medical professionals having a specific interest in valvular heart disease may be included.
Objectives:
Upon completing this activity, participants will be able to: 1. Demonstrate an increased knowledge of the applications for echocardiographic assessment of valvular stenosis and their impact on cardiac diagnosis. 2. Differentiate the different methods for echocardiographic assessment of valvular stenosis. 3. Recognize the criteria for echocardiographic grading of valvular stenosis. 4. Identify the advantages and disadvantages of the methodologies employed for assessing valvular stenosis and apply the most appropriate methodology in clinical situations 5. Incorporate the echocardiographic methods of valvular stenosis to form an integrative approach to assessment of valvular stenosis 6. Effectively use echocardiographic assessment of valvular stenosis for the diagnosis and therapy for significant valvular stenosis. 7. Assess the common pitfalls in echocardiographic assessment of valvular stenosis and employ appropriate standards for consistency of valvular stenosis assessment.
Author Disclosures:
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Estimated Time to Complete This Activity: 1 hour

I. INTRODUCTION

Valve stenosis is a common heart disorder and an important cause of cardiovascular morbidity and mortality. Echocardiography has become the key tool for the diagnosis and evaluation of valve disease, and is the primary non-invasive imaging method for valve stenosis assessment. Clinical decision-making is based on echocardiographic assessment of the severity of valve stenosis, so it is essential that standards be adopted to maintain accuracy and consistency across echocardiographic laboratories when assessing and reporting valve stenosis. The aim of this paper was to detail the recommended approach to the echocardiographic evaluation of valve stenosis, including recommendations for specific measures of stenosis severity, details of data acquisition and measurement, and grading of severity. These recommendations are based on the scientific literature and on the consensus of a panel of experts.

This document discusses a number of proposed methods for evaluation of stenosis severity. On the basis of a comprehensive literature review and expert consensus, these methods were categorized for clinical practice as:

- Level 1 Recommendation: an appropriate and recommended method for all patients with stenosis of that valve.
- Level 2 Recommendation: a reasonable method for clinical use when additional information is needed in selected patients.
- Level 3 Recommendation: a method not recommended for routine clinical practice although it may be appropriate for research applications and in rare clinical cases.

It is essential in clinical practice to use an integrative approach when

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Reviewer Relationships With Industry and Other Entities (Comprehensive) e224Disease stages in patients with valvular heart disease should be classified (Stages A, B, C, and D) on the basis of symptoms, valve anatomy, the severity of valve dysfunction, and the response of the ventricle and pulmonary circulation.In the evaluation of a patient with valvular heart disease, history and physical examination findings should be correlated with the results of noninvasive testing (ie, ECG, chest x-ray, transthoracic echocardiogram). If there is discordance between the physical examination and initial noninvasive testing, consider further noninvasive (computed tomography, cardiac magnetic resonance imaging, stress testing) or invasive (transesophageal echocardiography, cardiac catheterization) testing to determine optimal treatment strategy.For patients with valvular heart disease and atrial fibrillation (except for patients with rheumatic mitral stenosis or a mechanical prosthesis), the decision to use oral anticoagulation to prevent thromboembolic events, with either a vitamin K antagonist or a non–vitamin K antagonist anticoagulant, should be made in a shared decision-making process based on the CHA2DS2-VASc score. Patients with rheumatic mitral stenosis or a mechanical prosthesis and atrial fibrillation should receive oral anticoagulation with a vitamin K antagonist.All patients with severe valvular heart disease being considered for valve intervention should be evaluated by a multidisciplinary team, with either referral to or consultation with a Primary or Comprehensive Valve Center.Treatment of severe aortic stenosis with either a transcatheter or surgical valve prosthesis should be based primarily on symptoms or reduced ventricular systolic function. Earlier intervention may be considered if indicated by results of exercise testing, biomarkers, rapid progression, or the presence of very severe stenosis.Indications for transcatheter aortic valve implantation are expanding as a result of multiple randomized trials of transcatheter aortic valve implantation versus surgical aortic valve replacement. The choice of type of intervention for a patient with severe aortic stenosis should be a shared decision-making process that considers the lifetime risks and benefits associated with type of valve (mechanical versus bioprosthetic) and type of approach (transcatheter versus surgical).Indications for intervention for valvular regurgitation are relief of symptoms and prevention of the irreversible long-term consequences of left ventricular volume overload. Thresholds for intervention now are lower than they were previously because of more durable treatment options and lower procedural risks.A mitral transcatheter edge-to-edge repair is of benefit to patients with severely symptomatic primary mitral regurgitation who are at high or prohibitive risk for surgery, as well as to a select subset of patients with secondary mitral regurgitation who remain severely symptomatic despite guideline-directed management and therapy for heart failure.Patients presenting with severe symptomatic isolated tricuspid regurgitation, commonly associated with device leads and atrial fibrillation, may benefit from surgical intervention to reduce symptoms and recurrent hospitalizations if done before the onset of severe right ventricular dysfunction or end-organ damage to the liver and kidney.Bioprosthetic valve dysfunction may occur because of either degeneration of the valve leaflets or valve thrombosis. Catheter-based treatment for prosthetic valve dysfunction is reasonable in selected patients for bioprosthetic leaflet degeneration or paravalvular leak in the absence of active infection.Since 1980, the American College of Cardiology (ACC) and American Heart Association (AHA) have translated scientific evidence into clinical practice guidelines with recommendations to improve cardiovascular health. These guidelines, which are based on systematic methods to evaluate and classify evidence, provide a foundation for the delivery of quality cardiovascular care. The ACC and AHA sponsor the development and publication of clinical practice guidelines without commercial support, and members volunteer their time to the writing and review efforts. Guidelines are official policy of the ACC and AHA. For some guidelines, the ACC and AHA partner with other organizations.Intended UseClinical practice guidelines provide recommendations applicable to patients with or at risk of developing cardiovascular disease. The focus is on medical practice in the United States, but these guidelines are relevant to patients throughout the world. Although guidelines may be used to inform regulatory or payer decisions, the intent is to improve quality of care and align with patients' interests. Guidelines are intended to define practices meeting the needs of patients in most, but not all, circumstances, and should not replace clinical judgment.Clinical ImplementationManagement, in accordance with guideline recommendations, is effective only when followed by both practitioners and patients. Adherence to recommendations can be enhanced by shared decision-making between clinicians and patients, with patient engagement in selecting interventions on the basis of individual values, preferences, and associated conditions and comorbidities.Methodology and ModernizationThe ACC/AHA Joint Committee on Clinical Practice Guidelines (Joint Committee) continuously reviews, updates, and modifies guideline methodology on the basis of published standards from organizations, including the Institute of Medicine,1,2 and on the basis of internal reevaluation. Similarly, presentation and delivery of guidelines are reevaluated and modified in response to evolving technologies and other factors to optimally facilitate dissemination of information to healthcare professionals at the point of care.Numerous modifications to the guidelines have been implemented to make them shorter and enhance "user-friendliness." Guidelines are written and presented in a modular "knowledge chunk" format, in which each chunk includes a table of recommendations, a brief synopsis, recommendation-specific supportive text and, when appropriate, flow diagrams or additional tables. Hyperlinked references are provided for each modular knowledge chunk to facilitate quick access and review. Word limit targets and a web supplement for useful but noncritical tables and figures are 2 recent modifications.In recognition of the importance of cost–value considerations, in certain guidelines, when appropriate and feasible, an analysis of value for a drug, device, or intervention may be performed in accordance with the ACC/AHA methodology.3To ensure that guideline recommendations remain current, new data will be reviewed on an ongoing basis by the writing committee and staff. Going forward, targeted sections or knowledge chunks will be revised dynamically after publication and timely peer review of potentially practice-changing science. The previous designations of "full revision" and "focused update" will be phased out. For additional information and policies on guideline development, readers may consult the ACC/AHA guideline methodology manual4 and other methodology articles.5–7Selection of Writing Committee MembersThe Joint Committee strives to ensure that the guideline

writing committee members have requisite content expertise and are representative of the broader cardiovascular community. Experts are selected across a spectrum of backgrounds, representing different geographic regions, sexes, races, ethnicities, intellectual perspectives or biases, and clinical practice settings. Organizations and professional societies with related interests and expertise are invited to participate as partners or collaborators.Relationships With Industry and Other EntitiesThe ACC and AHA have rigorous policies and methods to ensure that documents are developed without bias or improper influence. The complete policy on relationships with industry and other entities (RWI) can be found at . Appendix 1 of the guideline lists writing committee members' relevant RWI; for the purposes of full transparency, their comprehensive disclosure information is available online (. Comprehensive disclosure information for the Joint Committee is also available at Review and Evidence Review CommitteesIn developing recommendations, the writing committee uses evidence-based methodologies that are based on all available data.4–5 Literature searches focus on randomized controlled trials (RCTs) but also include registries, nonrandomized comparative and descriptive studies, case series, cohort studies, systematic reviews, and expert opinion. Only key references are cited.An independent evidence review committee is commissioned when there are one or more questions deemed of utmost clinical importance that merit formal systematic review to determine which patients are most likely to benefit from a drug, device, or treatment strategy, and to what degree. Criteria for commissioning an evidence review committee and formal systematic review include absence of a current authoritative systematic review, feasibility of defining the benefit and risk in a time frame consistent with the writing of a guideline, relevance to a substantial number of patients, and likelihood that the findings can be translated into actionable recommendations. Evidence review committee members may include methodologists, epidemiologists, clinicians, and biostatisticians. Recommendations developed by the writing committee on the basis of the systematic review are marked "SR."Guideline-Directed Management and TherapyThe term guideline-directed management and therapy (GDMT) encompasses clinical evaluation, diagnostic testing, and both pharmacological and procedural treatments. For these and all recommended drug treatment regimens, the reader should confirm dosage with product insert material and evaluate for contraindications and interactions. Recommendations are limited to drugs, devices, and treatments approved for clinical use in the United States.Patrick T. O'Gara, MD, MACC, FAHAChair, ACC/AHA Joint Committee on Clinical Practice Guidelines1. Introduction1.1. Methodology and Evidence ReviewThe recommendations listed in this document are, whenever possible, evidence based. An extensive review was conducted on literature published through March 1, 2020. Searches were extended to studies, reviews, and other evidence involving human subjects that were published in English and indexed in PubMed, EMBASE, Cochrane, Agency for Healthcare Research and Quality Reports, and other selected databases relevant to this guideline. Key search words included but were not limited to the following: valvular heart disease, aortic stenosis, aortic regurgitation, bicuspid aortic valve, mitral stenosis, mitral regurgitation, tricuspid stenosis, tricuspid regurgitation, pulmonic stenosis, pulmonic regurgitation, prosthetic valves, anticoagulation therapy, infective endocarditis, cardiac surgery, transcatheter aortic valve replacement or implantation, and percutaneous mitra-clip. Additionally, the committee reviewed documents related to the subject matter previously published by the ACC and AHA. The references selected and published in this document are representative and not all-inclusive.1.2. Organization of the Writing CommitteeThe writing committee was composed of clinicians, which included cardiologists, interventionalists, surgeons, anesthesiologists, and a patient representative. Members were required to disclose all RWI relevant to the data under consideration.1.3. Document Review and ApprovalThis document was reviewed by 2 official reviewers each nominated by the ACC and the AHA, as well as content reviewers nominated by the ACC and AHA. Reviewers' RWI information was distributed to the writing committee and is published in this document (Appendix 2).1.4. Scope of the GuidelineThe focus of this guideline is the diagnosis and management of adult patients with valvular heart disease (VHD). A full revision of the original 1998 VHD guideline was made in 2006, and an update was made in 2008.1 Another full revision was made in 2014,2 with an update in 2017.3 There was an additional statement of clarification specifically for surgery for aortic dilation in patients with bicuspid aortic valves (BAV) in 2016.4 The present guideline will replace the 2014 guideline and 2017 focused update. Some recommendations from the earlier VHD guidelines have been updated as warranted by new evidence or a better understanding of earlier evidence, whereas others that were inaccurate, irrelevant, or overlapping were deleted or modified. Throughout, our goal was to provide the clinician with concise, evidence-based, contemporary recommendations and the supporting documentation to encourage their use. Where applicable, sections were divided into subsections of 1) diagnosis and follow-up, 2) medical therapy, and 3) intervention. The purpose of these subsections is to categorize the Class of Recommendation according to the clinical decision-making pathways that caregivers use in the management of patients with VHD.The document recommends a combination of lifestyle modifications and medications that constitute components of GDMT. For both GDMT and other recommended drug treatment regimens, the reader is advised to confirm dosages with product insert material and to carefully evaluate for contraindications and drug–drug interactions. Table 1 is a list of associated guidelines that may be of interest to the reader.Table 1. Associated Guidelines and Related ReferencesTitleOrganizationPublication Year (Reference)Recommendations for Evaluation of the Severity of Native Valvular Regurgitation With Two-Dimensional and Doppler EchocardiographyASE20175European Association of Echocardiography Recommendations for the Assessment of Valvular Regurgitation, Part 2: Mitral and Tricuspid Regurgitation (Native Valve Disease)EAE20106Guidelines for the Management of Patients With Atrial FibrillationACC/AHA/ESC2006, 2008, 20197–9Guidelines for the Management of Adults With Congenital Heart DiseaseACC/AHA201810Echocardiographic Assessment of Valve Stenosis: EAE/ASE Recommendations for Clinical PracticeEAE/ASE200911Recommendations on the Echocardiographic Assessment of Aortic Valve Stenosis: A Focused Update from the European Association of Cardiovascular Imaging and the American Society of EchocardiographyEACI/ASE201712Guidelines for the Evaluation of Valvular Regurgitation After Percutaneous Valve Repair or Replacement: A Report from the American Society of EchocardiographyASE201913Recommendations for Evaluation of Prosthetic Valves With Echocardiography and Doppler UltrasoundASE200914Guideline for the Diagnosis and Treatment of Hypertrophic CardiomyopathyACCF/AHA201115202016Guidelines on the Management of Cardiovascular Diseases During PregnancyESC2011, 201817, 18Antithrombotic and Thrombolytic Therapy for Valvular Disease: Antithrombotic Therapy and Prevention of ThrombosisACCP201219Guidelines on the Management of Valvular Heart DiseaseESC/EACTS201220201721Guideline for the Management of Heart FailureACCF/AHA201722Table 2. Applying Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, Treatments, or Diagnostic Testing in Patient Care (Updated May 2019)*1.5. Class of Recommendation and Level of EvidenceThe Class of Recommendation (COR) indicates the strength of recommendation, encompassing the estimated magnitude and certainty of benefit in proportion to risk. The Level of Evidence (LOE) rates the quality of scientific evidence supporting the intervention on the basis of the type, quantity, and consistency of data from clinical trials and other sources (Table 2).11.6. AbbreviationsAbbreviationMeaning/Phrase2D2-dimensional3D3-dimensionalACEangiotensin-converting enzymeAFatrial fibrillationARBangiotensin receptor blockeraPTTactivated partial thromboplastin timeARaortic regurgitationASaortic stenosisAVRaortic valve replacementBAVbicuspid aortic valveBNPB-type natriuretic peptideCABGcoronary artery bypass graft surgeryCADcoronary artery diseaseCMRcardiac magnetic resonanceCORClass of RecommendationCTcomputed tomographyECGelectrocardiogramGDMTguideline-directed management and therapyHFheart failureIEinfective endocarditisINRinternational normalized ratioLAleft atrium (left atrial)LMWHlow-molecular-weight heparinLOELevel of EvidenceLVleft ventricle (left ventricular)LVEDDleft ventricular end-diastolic dimensionLVEFleft ventricular ejection fractionLVESDleft ventricular end-systolic dimensionMDTmultidisciplinary teamMRmitral regurgitationMSmitral stenosisNOACnon–vitamin K oral anticoagulantNYHANew York Heart AssociationPCIpercutaneous coronary interventionPETpositron emission tomographyPMBCpercutaneous mitral balloon commissurotomyRCTrandomized controlled trialRVright ventricle (right ventricular)SAVRsurgical aortic valve replacementTAVItranscatheter aortic valve implantationTEEtransesophageal echocardiography (echocardiogram)TEERtranscatheter edge-to-edge repairTRtricuspid regurgitationTTEtransthoracic echocardiography (echocardiogram)UFHunfractionated heparinVHDvalvular heart diseaseViVvalve-in-valveVKAvitamin K antagonist2. General Principles2.1. Evaluation of the Patient With Known or Suspected Native VHDPatients with VHD may present with a heart murmur, symptoms, or incidental findings of valvular abnormalities on noninvasive testing. Irrespective of the presentation, all patients with known or suspected VHD should undergo an initial meticulous history and physical examination. A detailed physical examination should be performed to diagnose and assess the severity of valve lesions. An electrocardiogram (ECG) to confirm heart rhythm and a chest x-ray to assess the presence or absence of pulmonary congestion or other lung pathology may be helpful in the initial assessment of patients with known or suspected VHD. A comprehensive transthoracic echocardiogram (TTE) with 2-dimensional (2D) imaging and Doppler interrogation should be performed for diagnosis and evaluation of known or suspected VHD. The TTE also provides additional information, such as the effect of the valve lesion on the cardiac chambers and great vessels, as well as an assessment of other valve lesions. To determine the optimal treatment for a patient with VHD, ancillary testing may be required, such as transesophageal echocardiography (TEE), computed tomography (CT), cardiac magnetic resonance (CMR) imaging, stress testing, Holter monitoring, diagnostic hemodynamic cardiac catheterization, or positron emission tomography (PET) combined with CT imaging. If intervention is contemplated, surgical or procedural risk should be estimated and other factors also considered, including comorbidities, frailty, and patient preferences and values (Table 3).Table 3. Evaluation of Patients With Known or Suspected VHDReasonTestIndicationInitial evaluation: All patients with known or suspected valve diseaseTTE*Establishes chamber size and function, valve morphology and severity, and effect on pulmonary and systemic circulationHistory and physicalEstablishes symptom severity, comorbidities, valve disease presence and severity, and presence of HFECGEstablishes rhythm, LV function, and presence or absence of hypertrophyFurther diagnostic testing: Information required for equivocal symptom status, discrepancy between examination and echocardiogram, further definition of valve disease, or assessing response of the ventricles and pulmonary circulation to load and to exerciseChest x-rayImportant for the symptomatic patient; establishes heart size and presence or absence of pulmonary vascular congestion, intrinsic lung disease, and calcification of aorta and pericardiumTEEProvides high-quality assessment of mitral and prosthetic valve, including definition of intracardiac masses and possible associated abnormalities (eg, intracardiac abscess, LA thrombus)CMRProvides assessment of LV volumes and function, valve severity, and aortic diseasePET CTAids in determination of active infection or inflammationStress testingGives an objective measure of exercise capacityCatheterizationProvides measurement of intracardiac and pulmonary pressures, valve severity, and hemodynamic response to exercise and drugsFurther risk stratification: Information on future risk of the valve disease, which is important for determination of timing of interventionBiomarkersProvide indirect assessment of filling pressures and myocardial damageTTE strainHelps assess intrinsic myocardial performanceCMRAssesses fibrosis by gadolinium enhancementStress testingProvides prognostic markersProcedural riskQuantified by STS (Predicted Risk of Mortality) and TAVI scoresFrailty scoreProvides assessment of risk of procedure and chance of recovery of quality of lifePreprocedural testing: Testing required before valve interventionDental examinationRules out potential infection sourcesCT coronary angiogram or invasive coronary angiogramGives an assessment of coronary anatomyCT: PeripheralAssesses femoral access for TAVI and other transcatheter proceduresCT: CardiacAssesses suitability for TAVI and other transcatheter procedures2.2. Definitions of Severity of Valve DiseaseClassification of valve disease severity is based on multiple criteria, including symptoms, valve anatomy, valve hemodynamics and the effects of valve dysfunction on ventricular and vascular function (eg, end-organ damage). Surgical and transcatheter interventions are performed primarily on patients with severe VHD, but diagnosis, patient education, periodic monitoring, and medical therapy are essential elements in the management of patients at risk of VHD and with mild to moderate valve dysfunction. This document provides a classification of the progression of VHD, with 4 stages (A to D). Indications for intervention and periodic monitoring are dependent on 1) the presence or absence of symptoms, 2) the severity of VHD, 3) the response of the LV and/or RV to volume or pressure overload caused by VHD, and 4) the effects on the pulmonary or systemic circulation (Table 4). The purpose of valvular intervention is to improve symptoms, prolong survival, and minimize the risk of VHD-related complications, such as irreversible ventricular dysfunction, pulmonary hypertension, stroke, and atrial fibrillation (AF). Thus, the criteria for "severe" VHD are based on predictors of clinical outcome from observational studies, registry data, and randomized clinical trials (RCTs) of patients with VHD. Of course, severity is a continuous variable; categorizing disease into stages, from A to D, simply provides a framework, or starting point, for diagnosis and management, and it is recognized that not all patients will fit perfectly into a specific stage. Some patients will have symptoms or end-organ damage with valve hemodynamics that do not quite meet specific disease severity criteria, and numerical measures may not match exactly across all categories. Conversely, other patients may remain asymptomatic without obvious evidence of end-organ damage despite apparently severe VHD. Criteria for the stages of each individual valve lesion are listed in Section 3.1 (Table 13), Section 4.2 (Table 15), Section 6.1 (Table 16), Section 7.2 (Table 17), Section 7.3 (Table 18), and Section 8.1 (Table 20).Table 4. Stages of VHDStageDefinitionDescriptionAAt riskPatients with risk factors for development of VHDBProgressivePatients with progressive VHD (mild to moderate severity and asymptomatic)CAsymptomatic severeAsymptomatic patients who have the criteria for severe VHD: C1: Asymptomatic patients with severe VHD in whom the LV or RV remains compensated C2: Asymptomatic patients with severe VHD with decompensation of the LV or RVDSymptomatic severePatients who have developed symptoms as a result of VHD2.3. Diagnosis and Follow-Up2.3.1. Diagnostic Testing: Initial DiagnosisTTE is the standard diagnostic test in the initial evaluation of patients with known or suspected VHD.1–4 TTE allows accurate assessment of valve anatomy and etiology, concurrent valve disease, and associated abnormalities, such as aortic dilation. Left ventricular (LV) anatomy and function are characterized by linear dimensions, as well as by 2D and 3D volumes and ejection fraction (LVEF), and it is recognized that decisions are most robust when based on sequential studies, given the inherent measurement variability for these parameters.5 Doppler echocardiography provides accurate noninvasive determination of valve hemodynamics.1,2,6 For stenotic lesions, key measurements are maximum velocity, mean gradient, and valve area. For regurgitant lesions, calculation of regurgitant orifice area, volume, and fraction is performed, when possible in the context of a multiparameter severity grade based on color Doppler imaging, continuous- and pulsed-wave Doppler recordings, and the presence or absence of distal flow reversals. Pulmonary systolic pressure also is estimated, along with qualitative evaluation of right ventricular (RV) size and function.7 In selected patients, additional testing, such as stress testing, TEE, cardiac catheterization, and CT or CMR imaging, might be indicated. However, both the performance and interpretation of these diagnostic tests require meticulous attention to detail, as well as expertise in cardiac imaging and evaluation of hemodynamics. Because echocardiography remains the mainstay of the initial evaluation of all patients with VHD, it is recommended that the laboratory be an Intersocietal Accreditation Commission (IAC)–accredited program.82.3.2. Diagnostic Testing: Changing Signs or SymptomsPatients with VHD should be instructed to promptly report any change in symptom status. The onset of symptoms or a change in the physical examination should raise concern about the cardiac response to the valve lesion, necessitating a repeat TTE. A repeat comprehensive TTE study can determine whether symptoms are caused by progressive valve dysfunction, deterioration of the ventricular response to the volume or pressure overload, or another etiology. New signs on physical examination also warrant a repeat TTE.1–7 This requires that patients with known VHD have access to a primary care provider and a cardiovascular specialist.2.3.3. Diagnostic Testing: Routine Follow-UpAfter initial evaluation of an asymptomatic patient with VHD, the clinician should continue regular follow-up with periodic examinations and TTE. The purpose of follow-up is to prevent the irreversible consequences of severe VHD, primarily affecting the status of the ventricles and pulmonary circulation, which may occur in the absence of symptoms. At a minimum, a yearly history and physical examination are necessary. The frequency of repeat 2D and Doppler echocardiography is based on the type and severity of the valve lesion, the known rate of progression of the specific valve lesion, and the effect of the valve lesion on the affected ventricle (Table 5).1–14 Patients with Stages C2 and D disease are not included in this table because they would be considered candidates for intervention. The follow-up interval may be extended in patients with mild regurgitation who show no change over a 10- to 15-year period. In addition to routine periodic imaging, the onset of symptoms or a change in the physical examination should raise concern about the cardiac response to the valve lesion, necessitating a repeat TTE.Table 5. Frequency of Echocardiograms in Asymptomatic Patients With VHD and Normal LV FunctionStageType of Valve LesionAortic Stenosis*Aortic RegurgitationMitral StenosisMitral RegurgitationProgressive (Stage B)Every 3–5 y (mild severity; Vmax 2.0–2.9 m/s)Every 3–5 y (mild severity)Every 3–5 y (MV area >1.5 cm2)Every 3–5 y (mild severity)Every 1–2 y moderate severity; Vmax 3.0–3.9 m/s)Every 1–2 y (moderate severity)Every 1–2 y (moderate severity)Severe asymptomatic(Stage C1)Every 6–12 mo (Vmax ≥4 m/s)Every 6–12 moEvery 1–2 y (MV area 1.0–1.5 cm2)Every 6–12 moDilating LV: More frequentlyEvery year (MV area 15 Life expectancy 15Life expectancy 15Life expectancy 15Life expectancy 3 months after implantation or, 2) with native VHD excluding rheumatic MS (Figure 1).Figure 1. Anticoagulation for AF in Patients With VHD. Colors correspond to Table 2. AF indicates atrial fibrillation; MS, mitral stenosis; NOAC, non–vitamin K oral anticoagulant; VHD, valvular heart disease; and VKA, vitamin K antagonist.Recommendation-Specific Supportive TextThe 4 large RCTs8–14 comparing NOACs with warfarin included small numbers of patients with VHD, prior valve repair, and bioprosthetic valves (excluding moderate to severe rheumatic MS and mechanical heart valves). In addition to the subsequent meta-analyses,1,15–17 examinations of insurance claims data and large registries18 have consistently confirmed no signal for a differential effect between NOAC and VKA therapy.19,20 More consistently observed is a net clinical benefit, with fewer events in patients using NOACs than in patients on VKA therapy. Validation of the CHA2DS2-VASc risk schema in patients with VHD (excluding moderate to severe rheumatic MS and mechanical heart valves) has been performed in large registries,2 confirming the applicability of this score. Bioprosthetic valves do not appear to be independent predictors of thromboembolic events in patients with AF.19The coexistence of AF and rheumatic MS is common and confers a substantial risk of thromboembolic events. These patients have been specifically excluded from NOAC trials, yet a single registry study and a US claims database analysis do suggest that NOACs may be potentially preferable.21,22 These findings need further validation, and currently the use of NOACs cannot be supported over VKA (target international normalized ratio [INR] of 2.5).Postoperative AF after VHD intervention is associated with increased stroke and mortality rates3,4 irrespective of the CHA2DS2-VASc score. Anticoagulation in this setting may reduce these endpoints. There are conflicting data about the safety and efficacy of NOAC therapy in patients early after implantation of a bioprosthesis.5,6,23 Until more data are available, the writing committee favors using VKA for patients with AF in the first 3 months after surgical or transcatheter bioprosthetic valve implantation to prevent thromboembolic events. The optimal duration of anticoagulation is not well defined. Repeat evaluation is encouraged in all patients to detect arrhythmia recurrence in the context of their CHA2DS2-VASc scores.The phase II study comparing dabigatran to warfarin (RE-ALIGN [Randomized, Phase II Study to Evaluate the Safety and Pharmacokinetics of Oral Dabigatran Etexilate in Patients after Heart Valve Replacement]) was halted prematurely because of excess stroke and bleeding in the dabigatran group. Until there is an explanation of why these adverse events occurred, there is insufficient evidence to support the use of NOACs for patients with mechanical heart valves.72.5. Evaluation of Surgical and Interventional RiskSynopsisRisk assessment has become a foundational element of the preprocedural evaluation of patients with VHD for whom intervention to correct the valve lesion may be contemplated. Although there are limitations to the scoring systems used to estimate the risk of adverse outcomes, these estimates provide a useful point of reference against which procedural benefits can be weighed. Numerical estimates of risk are just one component of the multidisciplinary team (MDT) assessment process, and factors not routinely included in risk algorithms (eg, liver disease, porcelain aorta) add important dimensions. The availability of TAVI for treatment of symptomatic severe aortic stenosis (AS) across the surgical risk spectrum emphasizes the need to have discussions about younger age at implantation, valve durability, and the potential need for permanent pacemaker implantation. For young patients (eg,

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