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2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines

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Abstract

AIM: The “2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease” provides recommendations to guide clinicians in the diagnosis, genetic evaluation and family screening, medical therapy, endovascular and surgical treatment, and long-term surveillance of patients with aortic disease across its multiple clinical presentation subsets (ie, asymptomatic, stable symptomatic, and acute aortic syndromes).

METHODS: A comprehensive literature search was conducted from January 2021 to April 2021, encompassing studies, reviews, and other evidence conducted on human subjects that were published in English from PubMed, EMBASE, the Cochrane Library, CINHL Complete, and other selected databases relevant to this guideline. Additional relevant studies, published through June 2022 during the guideline writing process, were also considered by the writing committee, where appropriate.

STRUCTURE: Recommendations from previously published AHA/ACC guidelines on thoracic aortic disease, peripheral artery disease, and bicuspid aortic valve disease have been updated with new evidence to guide clinicians. In addition, new recommendations addressing comprehensive care for patients with aortic disease have been developed. There is added emphasis on the role of shared decision making, especially in the management of patients with aortic disease both before and during pregnancy. There is also an increased emphasis on the importance of institutional interventional volume and multidisciplinary aortic team expertise in the care of patients with aortic disease.

TOP 10 TAKE-HOME MESSAGES FOR THE DIAGNOSIS AND MANAGEMENT OF AORTIC DISEASE—1. Because outcomes for patients with aortic disease are enhanced at programs with higher volumes, experienced practitioners, and extensive management capabilities,

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Endorsed by the Society of Interventional Radiology and Society for Vascular Medicine

Multidisciplinary Aortic Team care is considered in determining the appropriate timing of intervention.

2. Shared decision-making involving the patient and a multidisciplinary team is highly encouraged to determine the optimal medical, endovascular, and open surgical therapies. In patients with aortic disease who are contemplating pregnancy or who are pregnant, shared decision-making is especially important when considering the cardiovascular risks of pregnancy, the diameter thresholds for prophylactic aortic surgery, and the mode of delivery.

3. Computed tomography, magnetic resonance imaging, and echocardiographic imaging of patients with aortic disease should follow recommended approaches for image acquisition, measurement and reporting of relevant aortic dimensions, and the frequency of surveillance before and after intervention.

4. At centers with Multidisciplinary Aortic Teams and experienced surgeons, the threshold for surgical intervention for sporadic aortic root and ascending aortic aneurysms has been lowered from 5.5 cm to 5.0 cm in selected patients, and even lower in specific scenarios among patients with heritable thoracic aortic aneurysms.

5. In patients who are significantly smaller or taller than average, surgical thresholds may incorporate indexing of the aortic root or ascending aortic diameter to either patient body surface area or height, or aortic cross-sectional area to patient height.

6. Rapid aortic root growth or ascending aortic aneurysm growth, an indication for intervention, is defined as 0.5 cm in 1 year or 0.3 cm per year in 2 consecutive years for those with sporadic aneurysms and 0.3 cm in 1 year for those with heritable thoracic aortic disease or bicuspid aortic valve.

7. In patients undergoing aortic root replacement surgery, valve-sparing aortic root replacement is reasonable if the valve is suitable for repair and when performed by experienced surgeons in a Multidisciplinary Aortic Team.

8. Patients with acute type A aortic dissection, if clinically stable, should be considered for transfer to a high-volume aortic center to improve survival. The operative repair of type A aortic dissection should entail at least an open distal anastomosis rather than just a simple supracoronary interposition graft.

9. There is an increasing role for thoracic endovascular aortic repair in the management of uncomplicated type B aortic dissection. Clinical trials of repair of thoracoabdominal aortic aneurysms with endografts are reporting results that suggest endovascular repair is an option for patients with suitable anatomy.

10. In patients with aneurysms of the aortic root or ascending aorta, or those with aortic dissection, screening of first-degree relatives with aortic imaging is recommended.

PREAMBLE—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 collaborate with other organizations.

Intended Use—Clinical 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 Implementation—Management, 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 Modernization—The AHA/ACC 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 health care 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.

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.³

To 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/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.^{5–7}

Selection of Writing Committee Members—The Joint Committee strives to ensure that the guideline writing committee contains requisite content expertise and is representative of the broader cardiovascular community by selection of experts across a spectrum of backgrounds, representing different geographic regions, sexes, races, ethnicities, intellectual perspectives/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 Entities—The 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 online. Appendix 1 of the guideline lists writing committee members' relevant RWI. For the purposes of full transparency, their comprehensive disclosure information is available in a Supplemental Appendix. Comprehensive disclosure information for the Joint Committee is also available online.

Evidence Review and Evidence Review Committees—In 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 1 question(s) deemed of utmost clinical importance and 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 Medical Therapy—The term guideline-directed medical therapy 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.

Keywords

AHA Scientific Statements; abdominal aortic aneurysm; aortic dissection; aortitis; aortopathy; bicuspid aortic valve; blunt traumatic aortic injury; cardiac surgery; guidelines; endovascular aortic repair; heritable thoracic aortic disease; intramural hematoma; malperfusion syndrome; Marfan syndrome; Loeys-Dietz syndrome; penetrating atherosclerotic ulcer; thoracic aortic aneurysm; thoracoabdominal aortic aneurysm; thoracic endovascular aortic repair; vascular surgery

1. INTRODUCTION

1.1. Methodology and Evidence Review

The recommendations listed in this guideline are, whenever possible, evidence based. An initial extensive evidence review, which included literature derived from research involving human subjects, published in English, and indexed in MEDLINE (through PubMed), EMBASE, the Cochrane Library, the Agency for Healthcare Research and Quality, and other selected databases relevant to this guideline, was conducted from February 2021 to April

2021. Search terms included both key words and index terms (eg, MeSH, Emtree); search terms included but were not limited to the following: *aortic occlusion; aortic aneurysm; aortic aneurysm, thoracic; aortic aneurysm, abdominal; surveillance after endovascular aneurysm repair; diagnostic imaging; monitoring; surveillance; imaging; aorta; aortic; computed tomography; ultrasound; magnetic resonance imaging; arterial occlusive diseases; aortic diseases; aortic atherosclerosis; atherosclerosis; clinical trial; observational study; randomized controlled trial; review; atherosclerotic aortic disease; plaque, atherosclerotic; aorta; aortitis; infectious; autoimmune; aortic rupture; penetrating aortic ulcers; comparative studies; nonexperimental studies; type A aortic dissection; type A; type B; aneurysm, dissecting; aorta and echocardiography*. The final evidence tables are included in the Online Data Supplement and summarize the evidence used by the writing committee to formulate recommendations. References selected and published in the present document are representative and not all-inclusive.

1.2. Organization of the Writing Committee

The writing committee consisted of clinicians, cardiologists, internists, interventionalists, surgeons, radiologists, anesthesiologists, a nurse practitioner, and a lay/patient representative. The writing committee included representatives from the ACC, AHA, American Association for Thoracic Surgery, American College of Radiology, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Thoracic Surgeons (STS), and Society for Vascular Surgery (SVS). Appendix 1 of the present document lists writing committee members' relevant RWI. For the purposes of full transparency, the writing committee members' comprehensive disclosure information is available in a Supplemental Appendix.

1.3. Document Review and Approval

The Joint Committee appointed a peer review committee to review the document. The peer review committee was comprised of individuals nominated by ACC, AHA, and the collaborating organizations. Reviewers' RWI information was distributed to the writing committee and is published in this document (Appendix 2).

This document was approved for publication by the governing bodies of the ACC and the AHA and was endorsed by the American Association for Thoracic Surgery, American College of Radiology, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, Society for Vascular Medicine, and Society for Vascular Surgery.

1.4. Scope of the Guideline

In developing the "2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease" (2022 aortic disease guideline), the writing committee reviewed previously published guidelines. Table 1 contains a list of these publications deemed pertinent to this writing effort and is intended for use as a resource, thus obviating the need to repeat existing guideline recommendations.

1.5. Class of Recommendations and Level of Evidence

The 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).¹

2. NORMAL ANATOMY, ABNORMAL ANATOMY, AND DEFINITIONS

2.1. Normal Aortic Anatomy

The aorta is the largest artery in the body and can be divided into 5 main anatomic segments (Figure 1): the root or sinus segment, which extends from the aortic valve annulus to the sinotubular junction; the ascending thoracic aorta, which extends from the sinotubular junction to the innominate artery; the aortic arch, which extends from the innominate to the left subclavian artery; the descending thoracic aorta, which extends from the left subclavian artery to the diaphragm; and the abdominal aorta, which extends from the diaphragm to the level of the aortic bifurcation.

The aortic wall is composed of 3 layers (Figure 2): a thin inner intima, a thicker central media, and a thin outer adventitia. The intima consists of a layer of endothelial cells within a matrix of connective tissue. The media consists of smooth muscle cells, elastic fibers, collagen proteins, and polysaccharides sandwiched in >50 layers known as elastic lamellae. The media provides strength and distensibility to the aorta, features that are critical to circulatory function. The adventitia is composed of connective tissue, fibroblasts, nerves, and the vasa vasorum, which perfuse the outer aortic wall and a substantial portion of the media.

2.2. Aortic Landing Zones

In addition to the standard anatomic descriptors of the aortic anatomy, there is a more technical classification of aortic anatomy that is used to plan, guide, and report aortic interventions, especially endovascular stent-grafting. Because the clinical success of thoracic aortic endovascular procedures is influenced by the proximal sealing zone, in this system the thoracic and abdominal aorta are divided into 11 landing zones, as detailed in Figure 3.

Note that Roselli et al² have proposed a modification of zone 0, dividing it into 3 subsegments, in which 0A extends from the annulus to the distal margin of the highest coronary, 0B extends above the coronary to the distal margin of the right pulmonary artery, and 0C extends from the right pulmonary artery to the distal end of the origin of the innominate artery.

2.3. Definitions of Dilation and Aneurysm of the Aortic Root and Ascending Thoracic Aorta

The conventional definition of an arterial aneurysm is any artery that is dilated to at least 1.5 times its expected normal diameter.³ This definition applies well to the abdominal and descending thoracic aorta. However, it has long been recognized that this definition fails

when it comes to defining aneurysms of the aortic root and ascending thoracic aorta. For example, a man in his 40s would be expected to have an average aortic root diameter of 3.5 cm; applying the standard definition of 1.5 times reference diameter, his aortic root would have to reach 5.25 cm before it would be considered an aneurysm, whereas most experts would consider his aorta to be an aneurysm well below that diameter. Indeed, if this patient had Marfan syndrome or a familial thoracic aortic aneurysm, aortic repair would be recommended at a diameter of 5.0 cm, a size that would not even be large enough to be termed an “aneurysm.”

The most important consideration in deciding the diameter thresholds at which to call the root and ascending aorta dilated or aneurysmal is based on the natural history of such abnormal aortas. Borger et al⁴ studied 201 patients with bicuspid aortic valve (BAV) undergoing aortic valve replacement (AVR) (those undergoing concomitant replacement of the ascending aorta were excluded) and followed them for 10 to 15 years; they found that those with baseline aortic diameters of 4.5 cm to 4.9 cm had a significantly increased risk of aneurysm, dissection, or sudden death ($P<0.001$) compared with those with diameters <4.5 cm (Figure 4).

To evaluate the risk of type A aortic dissection at various diameters below the traditional 5.5 cm threshold for prophylactic aortic repair, Paruchuri et al⁵ plotted a distribution curve of ascending aortic size in a community sample from the MESA (Multi-Ethnic Study of Atherosclerosis) database. They then analyzed the number of dissections (numerator) at each aortic diameter and the population at risk at each aortic diameter (denominator). They found that, relative to a control aortic diameter of 3.4 cm, a diameter of 4.0 cm to 4.4 cm conferred an 89-fold increased risk of dissection, and a diameter of 4.5 cm conferred a 6000-fold increased risk (Figure 5), albeit these are only relative risk estimates and do not inform absolute risk. It follows that the increase in risk at 4.0 cm to 4.4 cm justifies defining an aorta of this size “dilated,” and the abrupt increase in risk at a diameter of 4.5 cm justifies defining an aorta of this size as an “aneurysm.” Using this approach, of the subjects in the MESA database, only 2.6% would be considered to have a dilated aorta and only 0.2% to have an aneurysm.

This definition of a dilated ascending aorta being 4.0 cm is consistent with what was proposed in the 2014 European Society of Cardiology guidelines on the diagnosis and treatment of aortic diseases, in which aortic “dilation” was similarly defined as an aorta diameter of >4.0 cm.⁶

Finally, in the clinical setting, the term “dilation” is preferred to “ectasia” to describe mild aortic enlargement. Historically, there has been a lack of uniformity in the use of “ectasia” in image interpretation. Many radiologists use “ectatic” rather than “dilated” to describe a mildly enlarged aorta, whereas others use “ectatic” to describe an abnormal aortic shape, such as a “tortuous” aorta.⁷ Even more problematic is the fact that some imaging groups use the term “ectasia” to describe larger aortas, such as those 4.5 cm to 5.4 cm in diameter,⁸ which overlaps with what most experts would consider to be an aneurysm. Lastly, in imaging of the coronary arteries, “ectasia” is typically used to describe diffuse (rather than

focal) coronary artery dilation,⁹ which may lead to some clinical uncertainty when “ectasia” is applied to the aorta.

2.3.1. Normalizing Aortic Root and Ascending Aortic Diameters for Body

Size—As with the aortic diameter thresholds for surgery presented in this guideline, it is recognized that the 4.0 cm and 4.5 cm diameter thresholds discussed previously are intended for those whose height, body surface area (BSA), or both is within 1 to 2 standard deviations of the mean. For male and female patients who are significantly shorter or taller than average, these diameters need to be adjusted downward or upward, accordingly. Several methods to normalize aortic diameter are currently used in clinical practice and clinical research.

The Z-Score: The z-score is routinely used to assess aortic dilation in the pediatric population, as changes in a child’s age and body size make it especially challenging to define normal aortic size and to distinguish normal from pathologic aortic growth. Nomograms have been established correlating BSA and aortic root diameter to generate the z-score. One limitation of the reliance on BSA is that there are multiple formulae to calculate BSA that yield different results for the same patient. A second limitation is that multiple z-score calculators exist, each performing differently.¹⁰ Finally, most of the literature on the natural history of acute aortic syndromes (AAS) is based on aortic diameters, whereas reports of outcome based on z-scores are limited, so the z-score is not typically used to report the degree of aortic dilation in adults.

The Aortic Size Index and Aortic Height Index: Most often, in the clinical care of adult patients, aortic diameters are normalized using a ratio of aortic diameter to BSA or aortic diameter to the patient’s height. In 2006, Davies et al¹¹ showed that aortic size index (ASI), which is defined as aortic diameter (cm)/BSA(m²), is a better predictor of adverse aortic events than diameter alone, and that a simple nomogram could be used to stratify those with aortic aneurysms into low-, medium-, and high-risk groups. However, it is unclear whether the weight of an adult has a significant impact on the expected normal aortic diameter, and one would not expect a patient’s aorta to grow or shrink with significant fluctuations in weight. Zafar et al¹² therefore examined whether aortic height index (AHI), which is defined as aortic diameter (cm)/patient height (m), might perform better than the ASI, and they reported that the AHI performed at least as well as the ASI¹² and had the advantage of being simpler to calculate.

The Cross-Sectional Area to Height Ratio: Another approach to normalizing aortic size to height was proposed by Svensson et al in 2002¹³ in which they calculated a ratio of the cross-sectional area of the aorta (cm²) to the patient’s height (m). The initial studies used a cross-sectional area to height ratio of >10 cm²/m as a threshold for intervention because of a significant increase in risk of adverse events; notably, in more contemporary reports, this group has shown the simpler cross-sectional area to height ratio of 10 cm²/m (rather than >10 cm²/m) as the threshold predictive of increased risk.^{14,15}

2.4. Definitions and Classification of Acute Aortic Syndrome (AAS)

AAS are life-threatening conditions in which there is a breach in the integrity of the aortic wall. The most common AAS are aortic dissection, intramural hematoma (IMH), and penetrating atherosclerotic ulcer (PAU), all of which can lead to rupture (Figure 6).

2.4.1. Aortic Dissection—Aortic dissection is the most common of the AAS. Aortic dissection occurs when there is an intimal tear that allows the blood to pass through the tear and into the aortic media, splitting the intima in 2 longitudinally, creating a dissection flap that divides the true lumen from a newly formed false lumen (Figure 6). The dissection flap can propagate in an antegrade or retrograde fashion and lead to a number of life-threatening complications, including acute aortic regurgitation (AR), myocardial ischemia, cardiac tamponade, acute stroke, or malperfusion syndromes. The blood surging in the false lumen may rupture back through the intima into the true lumen, creating a reentry tear. If the blood in the false lumen instead tears through the outer media and adventitia, aortic rupture will result. The incidence of aortic dissection is estimated to be 5 to 30 cases per million people per year, with men more commonly affected. Most dissections occur in those between the ages of 50 to 70 years, although patients with Marfan syndrome, BAV, Loeys-Dietz syndrome, and vascular Ehlers-Danlos syndrome, present at younger ages.

2.4.1.1. Definition: Aortic dissection has traditionally been defined as “acute” during the first 2 weeks after symptom onset and “chronic” when beyond the second week. Investigators from the International Registry of Acute Aortic Dissection (IRAD) proposed that aortic dissection be divided into 4 temporal types: hyperacute (<24 h), acute (2–7 d), subacute (8–30 d), and chronic (>30 d).² The most contemporary temporal classification system, proposed by the SVS and STS, similarly divides aortic dissection into 4 temporal types, as shown in Table 3, to improve prognostication and guide decision making about the timing and types of potential intervention.

Acute aortic dissection of the ascending aorta is highly lethal in symptomatic patients left untreated, with an early mortality of 1% to 2% per hour after symptom onset.³ The mortality rate is increased among patients who present with or develop complications of cardiac tamponade (with or without cardiogenic shock), acute myocardial ischemia or infarction, stroke, or organ malperfusion.³ Patients with uncomplicated acute type B aortic dissection have a 30-day mortality rate of 10%. However, when patients with acute type B aortic dissection develop complications, such as malperfusion or rupture, the mortality rate increases to 20% by day 2 and to 25% by day 30.³

2.4.1.2. Classification: There are 2 commonly used anatomic classification systems for aortic dissection (Figure 7): the DeBakey system and the Stanford system.

The DeBakey system categorizes dissections into types I, II, and III, based on the origin of the intimal tear and the extent of the dissection:

- Type I: Dissection tear originates in the ascending aorta and propagates distally to include the aortic arch and typically the descending aorta
- Type II: Dissection tear is confined only to the ascending aorta

- Type III: Dissection tear originates in the descending thoracic aorta and propagates most often distally
 - Type IIIa: Dissection tear is confined only to the descending thoracic aorta
 - Type IIIb: Dissection tear originates in the descending thoracic aorta and extends below the diaphragm

The Stanford classification system divides dissections into 2 categories according to whether the ascending aorta is involved or not, regardless of the site of origin:

- Type A: All dissections involving the ascending aorta, irrespective of the site of the intimal tear
- Type B: All dissections that do not involve the ascending aorta (including dissections that involve the aortic arch but spare the ascending aorta)

In 2019, the European Association for Cardio-Thoracic Surgery and the European Society for Vascular Surgery published an expert consensus document⁴ for the treatment of thoracic arch pathologies, in which they added a third category called “non-A-non-B dissection,” to be used for patients whose proximal dissection flap begins in the aortic arch. Most recently, in 2020, the SVS and the STS proposed an entirely new classification scheme that defines the aortic dissection anatomy in more granular detail⁵: Dissections are defined anatomically according to the location of intimal tears and the proximal and distal extent of the dissection process (Figure 8).

A_D indicates type A is used for any dissection with an entry tear in zone 0 and extends distally the zone denoted by the subscript D (eg, A₉); B_{PD}, type B is used for any dissection with an entry tear in zone 1 or beyond; the proximal and distal extents of the dissection are denoted by subscripts P and D, respectively (eg, B₃₉). I_D, when a dissection begins in zone 0 but the location of the entry tear has not been identified, it will be considered “Indeterminate”; it will be designated with an I and its distal extent denoted by the subscript D (eg, I₉).

2.4.1.3. Malperfusion: Malperfusion syndrome occurs when there is end-organ ischemia related to inadequate perfusion of the aortic branch vessels. The relationship of the true and false lumens in an aortic dissection has a critical role in maintaining stable perfusion of end-organs. Initially, the true lumen collapses because of the loss of transmural pressure across the dissection flap and the subsequent elastic recoil of the medial smooth muscle. Simultaneously, the false lumen expands immediately because of reduced elastic recoil, depth of the dissection plane within the media, and percentage of the wall circumference involved. Any of the aortic branches are at risk for malperfusion as the false lumen expands and compresses the true lumen and can occur in multiple vascular beds simultaneously as the dissection propagates distally. Dynamic obstruction occurs when the septum of the dissected intima prolapses across into the ostia of a branch, usually during systole, thereby not allowing adequate flow to perfuse the vessel (Figure 9). The ostia itself remains

anatomically undamaged. When the dissection tear extends into the vessel proper and creates a stenosis or thrombosis in the artery, static obstruction occurs (Figure 9).

2.4.2. Intramural Hematoma—IMH describes the presence of blood within the medial layer of the aortic wall in the absence of an overt intimal tear or patent false lumen. The blood may arise from either rupture of the vasa vasorum causing bleeding within the media⁷ or small intimal tears that are not visualized on standard imaging examinations.⁸ IMH is diagnosed by computed tomographic angiography (CTA), magnetic resonance imaging (MRI), and echocardiography by the presence of a circular or crescent-shaped thickening of the aortic wall of >5 mm in the absence of detectable blood flow⁹ (Figure 6). Of patients presenting with suspected AAS, studies suggest that 5% to 25% have IMH, a proportion that approaches 30% to 40% in the Asian literature.^{8–11}

The natural history of IMH is variable. Fewer than 10% of IMH cases resolve spontaneously, whereas 16% to 47% progress to aortic dissection if the intimal layer ruptures and creates an entry tear.^{7,12}

2.4.3. Penetrating Atherosclerotic Ulcer—A PAU begins with an ulceration of an atherosclerotic plaque, which leads to a focal disruption in the aortic intima that allows blood to penetrate into the medial layer and is often associated with an IMH of variable size.¹⁰ PAUs most often appear in the middle or distal descending thoracic aorta, less frequently in the aortic arch and abdominal aorta, and rarely in the ascending aorta.^{8,10} PAUs can vary in size, and often multiple PAUs are present.¹⁰ The true incidence is unknown but is estimated to account for 2% to 7% of all cases of AAS.¹⁰ Typically, patients with PAU are older (>70 years of age) than those with classic aortic dissection and present more often with extensive and diffuse atherosclerotic disease involving both the aorta and coronary arteries.¹⁰ Additional common comorbidities include hypertension, tobacco use, chronic obstructive pulmonary disease, and renal insufficiency. PAU can occur in younger patients but often in the setting of a connective tissue disorder, and men are more commonly affected than women.⁸ The natural history of PAU is not well defined, as they can remain stable, enlarge, or progress to either IMH, dissection, pseudoaneurysm, or aortic rupture.⁸ The risk of rupture has been reported to be up to 40%.¹³ The optimal management strategy must be individualized, considering the clinical presentation, the imaging features of the PAU, and the patient's comorbidities.

2.5. Classification of Thoracoabdominal Aortic Aneurysm (TAAA)

When descending thoracic aortic aneurysms (TAA) extend into the abdominal aorta, they are referred to as thoracoabdominal aortic aneurysms (TAAA). The Crawford classification of TAAA, later modified by Safi et al¹ (Figure 10), not only describes the extent of an aneurysm but also may predict the morbidity and mortality associated with aneurysm repair.²

2.6. Classification of Endoleaks

Endovascular stent-grafting is widely used in the repair of aortic aneurysms. One of the limitations of endografting is the occurrence of endoleaks, either early or late following the

procedure. There are 5 types of endoleaks, as detailed in Figure 11. An endoleak results in the persistence of blood flow outside the graft and within the aneurysm sac, preventing its complete thrombosis. Consequently, patients with endografts require lifelong surveillance imaging to monitor for the appearance of endoleaks.¹

3. IMAGING AND MEASUREMENTS

3.1. Aortic Imaging Techniques to Determine Presence and Progression of Aortic Disease

Recommendations for Aortic Imaging Techniques to Determine Presence and Progression of Aortic Disease

Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
1	B-NR	1. In patients with known or suspected aortic disease, aortic diameters should be measured at reproducible anatomic landmarks perpendicular to axis of blood flow, and these measurement methods should be reported in a clear and consistent manner. In cases of asymmetric or oval contour, the longest diameter and its perpendicular diameter should be reported. ^{3,4}
1	C-LD	2. In patients with known or suspected aortic disease, episodic and cumulative ionizing radiation doses should be kept as low as feasible while maintaining diagnostic image quality. ⁵⁻⁷
1	C-EO	3. In patients with known or suspected aortic disease, when performing CT or MR imaging, it is recommended that the root and ascending aortic diameters be measured from inner-edge to inner-edge, using an electrocardiographic-synchronized technique. If there are aortic wall abnormalities, such as atherosclerosis or discrete wall thickening (more common in the distal aorta), the outer-edge to outer-edge diameter should be reported (Table 4).
1	C-EO	4. In patients with known or suspected aortic disease, the aortic root diameter should be recorded as maximum sinus to sinus measurement. In the setting of known asymmetry, multiple measurements should be reported, and both short- and long-axis images of the root should be obtained to avoid underestimation of the diameter.
2a	C-LD	5. In patients with known or suspected aortic disease, it is reasonable that a dilated root or ascending aorta be indexed to patient height or BSA in the report, to aid in clinical risk assessment. ⁸⁻¹¹
2a	C-EO	6. In patients with known or suspected aortic disease, when performing echocardiography, it is reasonable to measure the aorta from leading-edge to leading-edge, perpendicular to the axis of blood flow.
2b	C-EO	Using inner-edge to inner-edge measurements may also be considered, particularly on short-axis imaging.

Synopsis—Optimized depiction of aortic anatomy and pathology requires dedicated aortic imaging protocols. Computed tomography (CT), magnetic resonance imaging (MRI), transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE), and abdominal aortic ultrasound all have important roles in these evaluations (Table 5). Selection of an imaging modality may be based on patient-specific factors, including hemodynamic stability, contrast allergy, renal function, and patient tolerance (eg, given relatively longer examination times and the confined space associated with MRI, occasionally requiring sedation). The institutional availability of an imaging modality or an expert imaging physician may also direct modality selection. The ubiquity of CT scanners, combined with rapid acquisition of intuitive, high-resolution 3-dimensional (3D) imaging data sets, has led to the wide adoption of this modality for the assessment of suspected aortic pathology and for periprocedural vascular evaluation, in most cases supplanting diagnostic catheter angiography.¹²

Recommendation-Specific Supportive Text

1. Measurements should be obtained perpendicular to the long axis of the aorta at specified segmental locations (Figure 12), with measurements also taken at the locations of any abnormalities. If a 3D data set has been acquired, dedicated multiplanar reformats orthogonal to aortic flow axis should be created at each level of measurement. This approach provides structured, repeatable measurement reporting on serial imaging and avoids oblique imaging that may overestimate the aortic diameter at levels of greater curvature and tortuosity.^{3,4}
2. The cancer risk associated with CT scans remains a controversial issue; however, the risk is generally agreed to be greatest early in life and substantially attenuated later in life.^{5,6} Consideration of the indication for aortic imaging, optimization of the tube settings for CT protocols, and use of alternative modalities such as MRI are all valid approaches to mitigate patient radiation exposure.⁷
3. On CT and MRI, the root diameter can be measured from the commissure to the opposite sinus, or from sinus to sinus, which results in larger dimensions (Figure 12).¹³ Measuring from sinus to sinus and from inner-edge to inner-edge on CT and MRI has shown good correlation with TTE for measurements of the root and ascending segments,¹⁴ as well as improved confidence in the determination of aortic root margins on MRI and lower interobserver and intraobserver variability.¹⁵ Measurement of graft material (eg, interposed surgical or endostent) may likewise include an inner-edge to inner-edge measurement for determination of the functional lumen and potential use in extension treatment planning. The use of electrocardiographic-gated images decreases motion artifact and improves edge depiction in aortic root imaging, with diminished measurement variability.¹⁶ If there are aortic wall changes (eg, atherosclerosis, mural thrombus), as is more commonly noted in the arch and distal aorta, or discrete wall thickening (eg, aortitis or IMH), the outer margins of the abnormal segments are measured.
4. The shape of the aortic root can be asymmetric, and the difference between the minimum (short-axis) and maximum (long-axis) root diameters can be significant, particularly in those with bicuspid valves.¹⁷ To avoid underestimation, multiple measurements should be reported, with either each of the sinus-to-sinus diameters or both short- and long-axis diameters, to avoid underestimation of the true root size.
5. The cross-sectional aortic area to patient height ratio has been shown to be associated with risk of aortic dissection and death in patients with tricuspid or bicuspid valves^{9,10} (see Section 2.3.1, “Normalizing Aortic Root and Ascending Aortic Diameters for Body Size”), and both ASI and AHI have been shown to predict risk of adverse events (rupture, dissection, or death).¹¹
6. There is a wealth of historical data regarding using TTE to measure the aortic root (at end-diastole) from the leading-edge of the anterior wall to the leading-edge of the posterior wall, identifying the largest diameter.^{18,19} These data led to the determination of normal limits adjusted for age, sex, and body size²⁰ and

provided insight regarding the prevalence and prognostic importance of aortic dilation. Additionally, measuring from leading-edge to leading-edge on TTE has shown good correlation with inner-edge to inner-edge measurements obtained on CT and MRI.¹⁴ The method of inner-edge to inner-edge measurement on TTE images may also be considered, with some experienced investigators showing excellent measurement agreement.¹⁵

3.2. Conventions of Measurements

Reproducible and accurate measurements of the aorta are critical for characterizing aortic disease and guiding treatment decisions. Measurements should be obtained perpendicular to the long axis of the aorta at specified segmental locations (Figure 13),¹ with measurements also taken at the location of any abnormality. Unfortunately, there is no widely accepted standard for aortic diameter measurements (eg, inner-edge to inner-edge, outer-edge to outer-edge) across imaging modalities. There is a wealth of historical data regarding using TTE to measure the aortic root (at end-diastole) from the leading-edge of the anterior wall to the leading-edge of the posterior wall, thus identifying the largest diameter.^{2,3} These data allowed for the creation of normal limits adjusted for age, sex, and body size⁴ and provided insight regarding the prevalence and prognostic importance of aortic dilation.

On CT and MRI, the root diameter can be measured from the commissure to the opposite sinus, or from sinus to sinus, which results in larger dimensions (Figure 13).⁵ Measuring from sinus-to-sinus and from inner-edge to inner-edge on CT and MRI has shown good correlation with TTE for measurements of the root and ascending segments,⁶ as well as improved confidence in the delineation of aortic root margins on MRI and lower interobserver and interobserver variability.⁷

Although aortic dilation as measured by diameter is a well-known risk factor for the occurrence of aortic dissection and rupture,⁸ most dissections occur in aortas with diameters that do not meet the threshold for preventive surgery.⁹ This has led investigators to search for better metrics for risk stratification and treatment guidance. For instance, research has shown that ascending aortic area indexed to height is associated with aortic dissection and adverse outcomes in patients with tricuspid or bicuspid valves.^{10,11} Male sex, age, height, weight, and the presence of traditional cardiovascular risk factors have also been found to correlate with increased aortic size in large population-based studies.¹² Aortic length is known to increase over time; spurred by this fact, and by the observation that intimal entry tears run in a transverse direction, researchers have found that excessive elongation of the ascending aorta may be predictive of dissection and thus represents a potentially relevant measurement.¹³

Measurements of the arch and further distal segments should also be performed perpendicular to the aortic axis, with care taken to avoid oblique imaging that may overestimate the aortic diameter at levels of greater curvature and tortuosity. In the setting of wall changes (eg, discrete thickening from atherosclerosis, aortitis, IMH, or other processes), the abnormal wall should be measured from outer-edge to outer-edge. To assess abdominal aortic dimensions, ultrasonographic images may be obtained in a dedicated examination or

as part of a surface echocardiographic examination. Several studies have shown that the volume of an AAA may progress despite a stable diameter.^{14,15}

3.2.1. Computed Tomography—CT can image the entire aorta and its branches with high spatial resolution and fast acquisition. The use of electrocardiographic-gated technique decreases motion artifact of the root and ascending aorta,¹ significantly increasing the precision of measurements and diagnostic confidence. When necessary, CT can be performed without the use of iodinated contrast, and such noncontrast imaging can still accurately provide diameter assessment of aortic aneurysms that can suffice for surveillance of patients who cannot tolerate or cooperate with MRI, although aortic wall delineation may be challenging in some instances (eg, at the aortic root level). The use of iodinated intravenous contrast allows for delineation between aortic lumen and wall and generally improves assessment of wall changes. In some instances, the potential concern of patient contrast allergy or renal toxicity may be a consideration. However, according to recent consensus statements from the American College of Radiology and the National Kidney Foundation,² the risk of acute kidney injury developing in patients with impaired renal function after exposure to intravenous iodinated contrast media has likely been overestimated given the difficulty distinguishing coincident from contrast-induced nephropathy.

CT has a very high sensitivity and specificity for acute aortic syndromes (AAS, aortic dissection, IMH, PAU)³ and traumatic aortic injuries. Moreover, CT can identify concomitant coronary involvement,⁴ branch vessel involvement, and hemopericardium, and may aid in identification of dissection entry tears. In patients whose CT is negative for AAS, the images may provide insight regarding other causes of the presenting chest pain.⁵ When imaging patients with a suspected AAS, a noncontrast series of images is typically obtained first, to better distinguish IMH, if present, from other causes of aortic wall thickening. Then, a series of arterial phase contrast-enhanced images is obtained with thin slice to allow for reconstructions (computed tomographic angiography [CTA]), extending from the thoracic inlet to the level of the femoral arteries, to define the full extent of any dissection and thereby guide therapy. For consistency in this document, CT is used to refer to computed tomography modality broadly, with specific imaging techniques chosen dependent on a given clinical indication and patient history.

3.2.2. Magnetic Resonance Imaging—MRI provides coverage of the entire aorta and branch vessels, can characterize aortic wall changes in the setting of inflammation¹ and AAS, and offers physiologic assessment of ventricular and valve function plus flow quantification. MRI uses no ionizing radiation and can often be performed without intravenous contrast. MRI is therefore often a primary option for assessing congenital aortic abnormalities and is well-suited for serial imaging in younger patients. The use of electrocardiographic-gated imaging decreases motion artifact of the aortic root² and of 3D datasets, critical for achieving precise, repeatable measurements.³ Limitations of MRI include spatial resolution that, although good, is typically inferior to that of CT, as well as the appearance of artifacts in patients with indwelling metallic material or devices. Additionally, MRI is not as widely available as CT for aortic imaging, has a

longer acquisition time, and the ability to monitor and treat unstable patients in the scanner is limited. This modality is therefore less commonly used in patients with suspected acute aortic pathology,⁴ especially when patients are unstable. Various MRI sequences are available for aortic depiction, including magnetic resonance angiography (MRA), which involves volumetric acquisition of aortic anatomy, with slice thickness allowing for reconstruction of images in multiple planes. Intravenous gadolinium-based contrast media are often used in MRA, although there is a very small risk of inducing nephrogenic systemic fibrosis in patients with underlying kidney disease, a risk that is particularly low with group II gadolinium-based contrast agents.^{5,6} Additional sequences are often used for aortic anatomic depiction that do not require intravenous contrast media, such as cine gradient echo bright blood and spin echo dark blood sequences. For consistency in this document, we use MRI to refer to the modality of magnetic resonance imaging defined broadly, which potentially includes many sequences that are often combined in complementary manner within an imaging protocol.

3.2.3. Echocardiography

Transthoracic Echocardiography (TTE): TTE is the most common imaging modality used in the initial nonemergency assessment of the thoracic aorta.^{1,2} TTE is particularly useful in imaging the aortic root and ascending aorta and in delineating aortic valve anatomy and function. Although not ideal for imaging of the aortic arch, TTE often does visualize the aortic arch branch vessels and the proximal descending aorta and can aid in diagnosis of coarctation of the aorta (CoA) and patent ductus arteriosus. TTE is portable and can be performed at the bedside with a high spatial and temporal resolution. It can be useful in the evaluation of patients with AAS to detect complications, including aortic valve regurgitation, left ventricular dysfunction, and cardiac tamponade. TTE is useful in the longitudinal surveillance of aortic root and ascending aortic dilation, provided those aortic segments are well visualized.

Transesophageal Echocardiography (TEE): TEE provides high-resolution images of most of the thoracic aorta, apart from a short segment of the distal ascending aorta just proximal to the innominate artery, attributable to acoustic shadowing from the trachea. TEE is also very useful in detailing aortic valve anatomy and function. TEE is particularly useful in the intraoperative evaluation of patients with AAS in guiding both operative and endovascular repair strategies and the assessment of true and false lumen flows before and immediately after aortic repair.^{1,2}

3.2.4. Intravascular Ultrasound—Intravascular ultrasound is an endovascular technology designed to provide high-resolution intraluminal imaging of localized arterial and venous disease.¹ Intravascular ultrasound is particularly useful in guiding the endovascular management of complex pathologies of the thoracic and abdominal aorta, because it reveals aortic size, tortuosity, plaque burden, calcification, branch vessel ostia, and intravascular filling defects (eg, thrombus, dissection flap), in addition to permitting landing zone assessment.¹ Such intravascular ultrasound imaging data may help to identify patients for whom endovascular treatment is high-risk or contraindicated. Intravascular ultrasound is especially useful in the setting of aortic dissection^{2–4} to distinguish true and false lumen

anatomy and thereby guide endovascular or open repair. Intravascular ultrasound may be used to guide deployment of endovascular stents and, during final assessment, to reduce the volume of iodinated contrast used.⁵ Importantly, intravascular ultrasound requires an operator who is familiar with both the acquisition and interpretation of images.

3.2.5. Abdominal Ultrasound—Vascular ultrasound is an effective and rapid imaging modality and is the recommended diagnostic tool in screening for and surveillance of AAA.^{1–3} The ultrasonic criterion for AAA is a diameter >3.0 cm, using primarily the outer-edge to outer-edge measurement convention in the anterior-posterior or transverse view.^{4–6} The sensitivity of ultrasound to detect the presence of an aneurysm approaches 100%,⁷ although interobserver variability exists, and successful imaging can be limited by obesity and superimposed bowel gas.⁸

Using B-mode imaging, color Doppler, and spectral waveform analysis, a comprehensive ultrasound evaluation of the abdominal aorta can quickly detect other aortic pathologies, such as plaque or mobile atheroma formation, arterial stenoses, mural thrombus, inflammation, dissection, pseudoaneurysm, contained rupture, and aortocaval fistulae, and these findings may prompt the need for further imaging with CT or MRI. Abdominal ultrasound can also be used for surveillance of patients who have undergone endovascular repair of AAA (EVAR); it can detect aneurysm sac expansion, which may indicate the presence of an endoleak (Figure 11), defined as abnormal flow outside of the aortic endograft, a finding that typically warrants confirmation by CT. The use of contrast-enhanced color duplex ultrasound has shown promising results in enhanced sensitivity in detection of endoleaks,⁹ although its use requires ongoing study.

4. MULTIDISCIPLINARY AORTIC TEAMS

Recommendations for Multidisciplinary Aortic Teams

COR	LOE	Recommendations
1	C-EO	1. For patients with acute aortic disease that requires urgent repair, a multidisciplinary team should determine the most suitable intervention.
2a	C-LD	2. For patients who are asymptomatic with extensive aortic disease, or who may benefit from complex open and endovascular aortic repairs, or with multiple comorbidities for whom intervention is considered, referral to a high-volume center (performing at least 30–40 aortic procedures annually) with experienced surgeons in a Multidisciplinary Aortic Team is reasonable to optimize treatment outcomes. ^{1–6}

Synopsis

Evidence-based standards for medical and surgical conditions recognize the critical relationship among both hospital and surgeon case volumes and patient outcomes. Clinical excellence is further enhanced by collaborative, multispecialty teams to foster the best treatment of patients, especially for complex presentations with multiorgan threats. Although there is no agreed on definition of a Multidisciplinary Aortic Team, an appropriate framework might be: A specialized hospital team with an exceptionally high concentration of expertise in the evaluation and management of aortic disease, in which care is delivered in a comprehensive, multidisciplinary manner.⁷ The concept of comprehensive heart valve

centers was formally codified in the “2020 ACC/AHA Guideline for the Management of the Patient With Valvular Heart Disease,”⁸ which emphasized the numerous essential components of such centers, ranging from physician expertise, experience, and technical skill to data collection, research, and education, to institutional facilities and resources. Although the specific components of such teams may differ from center to center, the most common features that distinguish Multidisciplinary Aortic Teams include: Having cardiac surgical, vascular surgical, and endovascular specialists with extensive experience managing complex aortic disease at a center with a high volume of aortic interventions; having imaging specialists with expertise in aortic disease to perform and interpret CT, MRI, and echocardiography; anesthesiologists experienced in the management of acute aortic disease and cerebrospinal fluid drainage; and an intensive care unit (ICU) experienced in the management of acute aortic disease.

Recommendation-Specific Supportive Text

1. In cardiovascular care, we have long recognized the critical value of collaborative multidisciplinary expertise in cardiac transplantation and mechanical circulatory support conducted only at centers of excellence. More recently, we have seen the rise in multidisciplinary heart teams focused on the care of patients with complex coronary artery disease and patients with complex heart valve disease; indeed, the important role of multidisciplinary heart valve teams was emphasized in the “2020 ACC/AHA Guideline for the Management of the Patient With Valvular Heart Disease.”⁸ There is ample evidence that patients with complex aortic disease may similarly benefit from treatment by such multidisciplinary teams.⁶ Andersen et al¹ compared the outcomes of patients with acute type A aortic dissection undergoing open surgical repair before and after implementation of a multidisciplinary thoracic aortic surgery program and found that operative mortality declined dramatically after implementation of the multidisciplinary team and that the significant mortality advantage persisted over a 5-year follow-up ($P=0.002$). Likewise, in a report from England,² hospitals with multidisciplinary thoracic aortic programs reported significant reductions in mortality compared with hospitals without such programs.
2. In a study of 230 736 Medicare beneficiaries undergoing AAA repair between 2001 and 2006, in which hospital procedural volume for both open and endovascular repair was divided into quintiles, the adjusted mortality decreased as hospital volume increased, by quintile, especially among the group undergoing open surgical repair.³ The benefits of high case volume on surgical outcome apply similarly to patients with TAA. Hughes et al⁴ analyzed >13 000 elective aortic root and aortic valve-ascending aortic procedures performed at 741 North American hospitals from 2004 to 2007. They found a negative association between the hospital volume and the adjusted odds ratio (OR) for mortality ($P<0.001$), particularly at a hospital volume of <30 to 40 procedures annually (Figure 14). The inverse relationship between center case volume and mortality was shown again in a more contemporary series by Mori et

al⁹ of >53 000 proximal thoracic aortic surgeries in the United States from 2011 to 2016 in which the risk of operative mortality decreased significantly when the annual center volume exceeded 20 to 25 cases (only 116 US centers performed >20 cases/y), and decreased significantly further still at an annual center volume of >50 cases (only 24 US centers performed >50 cases/y) (Figure 15). Perhaps the most consistent correlation between case volume and mortality rate is among patients with acute aortic dissection. In a retrospective review of 232 patients with acute type A aortic dissection who underwent urgent surgery in a single center in the United Kingdom, the 30-day mortality rate was significantly lower among those operated on by a surgeon with aortic expertise versus a nonaortic expert, at 10% versus 26%, respectively ($P=0.02$). Moreover, aortic specialists performed aortic root procedures significantly more often (43.0% versus 17.3%; $P=0.001$), and their cross-clamp times were significantly shorter.⁵ Finally, Umana-Pizano et al¹⁰ found that the mortality rate of acute type A aortic dissection repair was 14% versus 24% for high-volume and low-volume surgeons, respectively. Clearly not all patients with thoracic aortic disease (TAD) can be treated by Multidisciplinary Aortic Teams, especially in the setting of AAS. Nevertheless, when patients are referred for elective aortic intervention, especially at aortic diameter thresholds that are borderline, the lower surgical mortality rate with expert aortic surgeons at high-volume centers may justify early aortic repair. Similarly, when aortic procedures are relatively new or complex, the best outcomes are likely to be at centers with high-volume operators who have experience with such novel techniques. Consequently, throughout this guideline is a number of recommendations in which it is specified that certain open surgical or endovascular aortic repairs be performed by experienced operators in centers with Multidisciplinary Aortic Teams.

5. SHARED DECISION-MAKING

Recommendations for Shared Decision-Making

COR	LOE	Recommendations
1	C-LD	1. In patients with aortic disease, shared decision-making is recommended when determining the appropriate thresholds for intervention, deciding on the type of surgical repair, choosing between open surgical versus endovascular approaches; and in medical management and surveillance. ¹⁻⁶
1	C-EO	2. In patients with aortic disease who are contemplating pregnancy or who are pregnant, shared decision-making is recommended when considering the cardiovascular risks of pregnancy, the diameter thresholds for prophylactic aortic surgery, and the mode of delivery.

Synopsis

Shared decision-making is increasingly used in patient-centered care as advocated by the National Academy of Medicine.⁷ Although no randomized trials have evaluated the value and effectiveness of shared decision-making, multiple position papers advocate strongly for the incorporation of shared decision-making in the care of patients with thoracic and AAAs.²⁻⁵ Decision aids have been developed for shared decision-making in patients with AAAs to help improve the patient understanding of the disease and treatment options.¹