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Bicuspid Aortic Valve–Family Screening and Indications for Intervention

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TO THE EDITOR

Bicuspid aortic valve (BAV) is the most common adult congenital heart disease, with a prevalence as high as 2%.[1] Almost 50% of aortic valve stenosis is attributable to BAV.[1-3] Instead of the typical 3 leaflets in the normal heart, BAV is characterized by 2 unequal-sized leaflets that create flow disturbance. These changes in valve structure lead to flow turbulence that leads to aortic valve stenosis, regurgitation, or root dilatation.[2] Systematic screening is required for at-risk populations because early recognition drives appropriate and timely intervention.

BAV morphology has different variants. The morphology determines the natural history, clinical presentation, and long-term prognosis. The most common variant of BAV is fusion of the right and left aortic valve leaflets. This variant constitutes almost 70% of all BAV cases and is associated with aortic coarctation. The second most common variant is fusion of the right and noncoronary leaflets. This variant is seen in 28% of BAV cases and is associated with higher rates of aortic valve complications (stenosis and regurgitation) and less association with aortic root dilatation.[4] The third variant of BAV is fusion of the left and noncoronary leaflets (1.4% of BAV cases). This variant is also associated with aortic valve structural complication but is less common than the other 2 variants (Figure).[4]

In BAV, the aortic leaflets tend to calcify progressively and in more diffuse fashion compared to the degenerative aortic valve disease, jeopardizing valve structure and function.[2,5] Further, early calcification of BAV is the leading cause of aortic valve insufficiency because of ascending aortic dilatation that occurs in 50% of patients with BAV at young ages.[6] When the aortic root reaches 6 cm, aortic dissection risk increases 9-fold.[7] Interestingly, 32% of first-degree relatives of BAV patients were found to have aortic dilatation irrespective of their aortic valve morphology.[8,9]

Diagnosis

BAV with normal function is largely asymptomatic. Symptoms usually reflect the development of an underlying valvular dysfunction and progressive aortopathy. Decreased exercise tolerance and exertional dizziness are indicative of valvular stenosis, while palpitations, exertional dyspnea, and atypical chest pain are characteristic of valvular insufficiency.[10] Often, auscultation findings of BAV are nonspecific, ranging from an ejection click with or without systolic ejection murmur in valvular stenosis to diastolic murmur in valvular insufficiency. Therefore, echocardiography is required to establish the anatomic and functional valvular diagnosis, as well as to identify any coexisting structural features such as septal defects (Figure). Echocardiography assessment should include ascending aortic diameters and root measurements.[11]

Genetics, Screening, and Surveillance

BAV follows an autosomal dominant inheritance; first-degree family members are at 10-fold increased risk.[12,13] Although most BAV cases are isolated, BAV could be a representation of a genetic syndrome that involves other

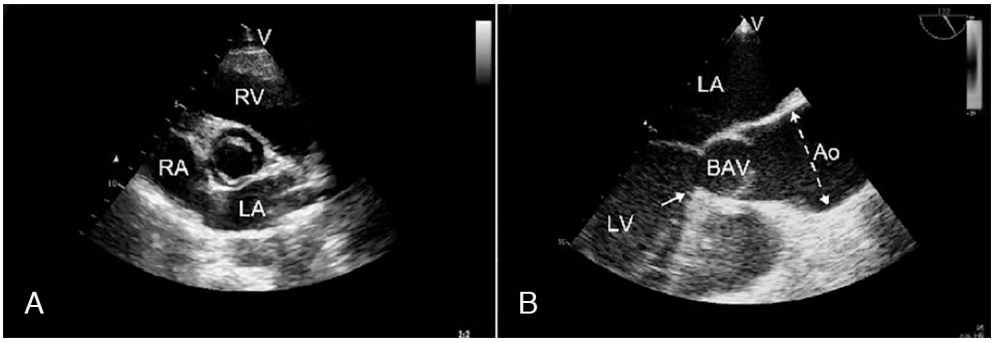

Figure. Echocardiogram showing (A) bicuspid aortic valve with fused right and left cusps and (B) dilated aortic root. Ao, aorta; BAV, bicuspid aortic valve; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle; V, ventricle.

Table. Screening and Surgical Intervention Recommendations for Bicuspid Aortic Valve Patients

Guideline	Family Screening Recommendations	Ascending Aorta Threshold for Surgery
ACC/AHA Thoracic Aortic Disease Guidelines, 2010[11]	First-degree relatives of patients with a bicuspid aortic valve, premature onset of thoracic aortic disease with minimal risk factors, and/or a familial form of thoracic aortic aneurysm and dissection	40-50 mm
AHA/ACC Valvular Heart Disease Guidelines, 2014[16]	NA	>55 mm[a]
ACC/AHA Surgery for Aortic Dilatation in Patients with BAV, 2016[6]	NA	>55 mm[a]
European Society of Cardiology Valvular Heart Disease Guidelines, 2012[17]	Screening of first-degree relatives of patients with bicuspid aortic valve with aortic root disease should be considered	55 mm
European Society of Cardiology Aortic Disease Guidelines, 2014[18]	Screening of first-degree relatives of patients with bicuspid aortic valve may be considered	>50 mm with risk factors
Society of Thoracic Surgeons Clinical Practice Guidelines, 2013[19]	First-degree relatives of patients with bicuspid aortic valve should undergo imaging of the aorta	>50 mm
Canadian Cardiovascular Society Guidelines, 2014[20]	Clinical screening and imaging screening are recommended	50-55 mm

[a]The threshold for the ascending aortic root diameter is 50 mm in patients with BAV and a family history of aortic dissection or progressive aortic expansion of 5 mm per year or more.
ACC, American College of Cardiology; AHA, American Heart Association; NA, not available.

congenital heart defects such as coarctation of the aorta, hypoplastic left heart syndrome, or ventricular septal defect.[14] A significant percentage of patients with BAV require a cardiac intervention during their lifetimes, up to 40% during patients' fifth decade.[15] Therefore, current guidelines recommend screening the first-degree relatives of patients with BAV (Table).[6,11,16-20]

Following the first screening echocardiography, serial surveillance imaging of patients with identified BAV is necessary to monitor for progressive valvular dysfunction. Young patients (<30 years) with a mean gradient ≥30 mmHg are required to have annual echocardiography and electrocardiogram, while the requirement is every other year for patients with a mean gradient <30 mmHg.[10,16] Once the ascending aorta diameter reaches the 40-mm cutoff, regardless of the patient's age, annual echocardiography should be obtained, preferably with a baseline computed tomography or magnetic resonance imaging for adequate visualization.[6,11] Surgical intervention is advised in asymptomatic patients with an ascending aorta diameter >55 mm or a diameter of 45 mm with severe aortic valve stenosis, severe aortic valve insufficiency, or a positive family history of aortic dissection or aneurysmal rupture. Surgery is recommended for patients with progressive aortic root dilatation of ≥5 mm per year.[6]

Women of childbearing age who have BAV with an aortic diameter >45 mm should be advised against pregnancy. Similarly, athletes with an ascending aorta or root diameter >45 mm should refrain from high-intensity sports.[21] All patients with BAV are strongly urged to quit smoking and maintain a well-controlled blood pressure. First-line agents to control blood pressure are beta-adrenergic blockers because of their noted effect of wall shear stress reduction. Angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) are advantageous as well because of their acknowledged afterload reduction.[21] Hypertension management is guided by the valvular disorder and aortic dilatation associated with BAV. In patients with aortic stenosis, beta blockers are recommended while monitoring diastolic blood pressure to avoid the reduction in coronary perfusion. In patients with BAV and aortic insufficiency, long-term vasodilator therapy is recommended (ACEIs, ARBs, or dihydropyridine calcium channel blockers). In the setting of aortic dilatation, beta blockers were found to be beneficial in asymptomatic mild to moderate dilatation as they have negative inotropic and chronotropic effect and lessen the growth rate.[22]

Summary

All first-degree family members of patients with BAV should be screened for BAV with full echocardiogram. This practice will identify individuals with BAV and risk stratify them for complications related to aortic valve or aortic root dilatation.

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