Aortic Valve Disease

Rick A. Nishimura, MD

It is important to diagnose and treat diseases of the aortic valve. Untreated aortic valve disease can eventually result in heart failure, severe infection, and even sudden death. Some patients present with severe symptoms, whereas others have few, if any symptoms. The diagnosis may be made on a routine physical examination. Regular medical follow-up, treatment to prevent infection of the valve (infective endocarditis), and optimal timing of surgery are necessary to avoid the severe consequences of improper function of the aortic valve.

Structure and Function of the Aortic Valve
Cardiac valves are structures that are designed to work like one-way doors (Figures 1 and 2). They let blood flow in from one chamber or vessel to another, and then close to prevent the blood from regurgitating backward. The aortic valve consists of 3 half-moon–shaped pocket-like flaps of delicate tissue, referred to as cusps. When the aortic valve is closed, the cusps are perfectly aligned and separate the large pumping chamber of the heart (the left ventricle) from the large artery (aorta) that supplies blood to the body. During the period when the left ventricle contracts and pumps the blood (systole), the aortic valve opens widely and blood flows freely from the left ventricle to the aorta. When the left ventricle then relaxes (diastole), the aortic valve closes completely so that the blood remains in the aorta. During diastole, blood flows into the left ventricle from the lungs through the left atrium across the mitral valve, thus refilling the ventricle for the next contraction.

Diagnostic Procedures for Aortic Valve Disease
Abnormalities of the cardiac valves can cause an obstruction to flow (valve stenosis), a leakage backward (valve regurgitation), or both. These abnormalities can usually be detected on physical examination with a stethoscope, as the turbulent blood resulting from valve stenosis or regurgitation will cause a heart murmur. Echocardiography, a noninvasive test that creates a sonar-like picture of the heart, is a common test used in patients with suspected or known aortic valve disease. Echocardiography can reliably confirm the presence and severity of the aortic valve disease, as well as determine the response of the left ventricle to the extra workload on the heart. In selected instances, exercise testing and cardiac catheterization may be required to provide further information about the valve disease.

Aortic Stenosis
Aortic stenosis is a term that refers to narrowing of the aortic valve opening during systole (Figure 1). This can be caused by a congenital abnormality of the valve (for instance, one could be born with a valve that has only 2 cusps instead of the normal 3) and thus may be detected in childhood or young adulthood. Aortic stenosis can also be caused by progressive calcium and scar tissue buildup on an abnormal congenital valve or from the damage of an episode of rheumatic fever, both of which become apparent in middle age. The most common cause of aortic stenosis today is a buildup of calcium on the valve cusps that occurs with age (senile degenerative stenosis).

Many patients with aortic stenosis will not have any symptoms, and the diagnosis is made on the basis of a heart murmur heard on examination. When the aortic stenosis becomes severe, symptoms such as shortness of breath (dyspnea), chest pain (angina), and dizziness (near-syncope) may occur. The presence of significant aortic stenosis causes the left ventricle muscle to thicken to overcome the stress of the obstruction (a response called hypertrophy). The thick muscle itself can become stiff and cause a high pressure in the left ventricle when it fills with blood; this pressure is transmitted to the lungs and causes symptoms of shortness of breath. Other symptoms include chest pain and dizziness, usually with exertion. Sudden death may occur if the stenosis is severe.
In selected young adults and children, a stenotic aortic valve may be opened by inflating a balloon attached at the end of a catheter (aortic balloon valvotomy). The conventional treatment for severe aortic stenosis in most patients, however, is open-heart surgery with insertion of an artificial valve. When a person has symptoms of severe aortic stenosis, the outlook is poor if valve replacement is not done. After successful valve surgery, most patients are able to lead a

Figure 1. Schematic drawing of the heart during contraction of the heart (systole). A, In the normal individual, the left ventricle contracts and fully opens the thin aortic valve cusps, with blood flowing freely from the left ventricle into the aorta. B, In this patient with aortic stenosis, there is an abnormal calcified aortic valve that cannot open fully. This causes an obstruction to blood flow from the left ventricle to the aorta, resulting in a compensatory increase in the thickness of the left ventricle.

Figure 2. Schematic drawing of the heart during filling (diastole). A, In the normal individual, the left ventricle is relaxed and fills with blood from the lungs. The aortic valve is fully closed, preventing any backflow of blood from the aorta to the left ventricle. B, In this patient with aortic regurgitation, there is an abnormal aortic valve (with only 2 cusps) that does not close fully. The blood will then flow backward from the aorta into the left ventricle during diastole. This results in a stretching of the heart cavity, as well as an increase in thickness of the heart muscle.
normal life with excellent long-term survival. There are several types of artificial valves, which either consist of metal discs that open and close (mechanical prostheses) or are made from a heart valve or heart tissue from animals (tissue prostheses). The advantage of mechanical prostheses is that they last years longer than tissue prostheses; the disadvantage of the mechanical prostheses is that patients need to take a blood-thinning pill every day to prevent blood clots from forming on the artificial surfaces.

**Aortic Regurgitation**

Aortic regurgitation occurs when there is a leakage of the valve backward into the left ventricle during diastole (Figure 2). This can be caused by structural abnormalities of the valve, similar to those seen in aortic stenosis. Enlargement of the aorta can stretch the valve cusps and produce aortic regurgitation. The acute onset of aortic regurgitation can occur when there is an infection of the aortic valve (called infective endocarditis) or a tear in the aorta.

Chronic aortic regurgitation may be present for decades before any symptoms occur. The left ventricle is able to compensate for the large volume of blood that flows backward by enlarging the cavity and increasing the thickness of the muscle. This mechanism allows the heart to pump out both the amount of blood required by the body and the blood that has gone backward into the left ventricle. When symptoms do occur, patients usually experience shortness of breath or chest discomfort. Long-standing aortic regurgitation may result in irreversible damage to the muscle of the left ventricle, even in the absence of symptoms.

An aortic valve replacement operation should be performed whenever there is severe aortic regurgitation and the patient develops symptoms. Even in the absence of symptoms, aortic valve replacement may be necessary in some patients to prevent the irreversible damage to the heart muscle caused by the extra volume load. If surgery is performed before damage to the heart muscle becomes irreversible, the outlook is excellent, and most patients can return to a normal lifestyle.

**Conclusion**

Aortic valve disease can be caused by aortic stenosis, aortic regurgitation, or a combination of both. All patients with aortic valve disease should follow measures prescribed by their physician to prevent infection of the abnormal valve. Abnormal valves produce turbulent blood flow and can be infected by bacteria. Antibiotics should be taken before dental or most surgical procedures to kill any bacteria that would be released in the blood stream during the procedure. This is referred to as infective endocarditis prophylaxis. Patients with aortic valve disease need periodic follow-up with a history, physical examination, and in many instances, serial echocardiograms. Appropriate, timely treatment with open-heart surgery may be life saving, even in the absence of symptoms.

**Suggested Resources**