



## Heart Valve Disease | Patient Guide

### Overview

The heart is a powerful muscle that pumps between 1,500 and 2,000 gallons of blood daily in adults. This one-way circulation is possible thanks to valves — thin membranes attached to the heart that open and close, regulating blood flow and causing that well-known “lubdubb” sound with each heartbeat. When working properly, a heart beats 100,000 times a day. But when the valves become damaged or diseased, the smooth flow of blood is disrupted.

To understand the role of the valves, it is important to recognize that the heart supports two separate circulations. The left side of the heart takes oxygen-rich blood from the lungs and pumps it to the rest of the body. The right side of the heart drains oxygen-poor blood from the rest of the body and sends it to the lungs for recycling. The valves exist to help that flow go in the correct direction.

**To schedule an appointment, call**

**410-328-7877**

Cardiovascular Medicine

**410-328-5842**

Cardiac Surgery

**For more information,  
visit us online at  
[umm.edu/heart](http://umm.edu/heart)**

## THERE ARE FOUR HEART VALVES:

**Tricuspid valve:** The tricuspid valve is located on the right side of the heart between the reservoir chamber (atrium) and the right-sided pumping chamber, known as the right ventricle (RV). It allows blood to fill the RV without going backward to the rest of the body.

**Pulmonary valve:** Also located on the right side of the heart, the pulmonary valve separates the lungs from the right heart. When the right-sided pumping chamber squeezes, the pulmonary valve opens, allowing blood to go to the lungs and then closes to prevent blood from returning to the right-sided pumping chamber.

**Mitral valve:** The mitral valve, located on the left side of the heart, closes off the left atrium from the main pumping chamber of the heart. It allows the left atria to fill maximally with oxygen-rich blood from the lungs, then opens to allow the main pumping chamber to fill maximally with blood. When the main pumping chamber is squeezing blood to the rest of the body, the mitral valve closes, preventing the blood from going backwards to the lungs.

**Aortic valve:** The aortic valve, also located on the heart's left side, closes off the main pumping chamber of the heart (left ventricle) from the rest of the body. The left ventricle fills with oxygenated blood and once filled, squeezes. This squeezing closes the mitral valve and opens the aortic valve, allowing the blood to leave the heart and reach the rest of the body via the aorta (the blood vessel that acts as the main highway out of the heart). The aortic valve then closes, allowing the main pumping chamber to fill anew.

## HEART VALVE DISEASE

Heart valve disease can occur when heart valves no longer function as they should. While some valve issues don't cause symptoms or harm one's health, others can strain and eventually damage the heart.

There are two main conditions associated with valve disease: valvular regurgitation and valvular stenosis. Valvular regurgitation, a leaky valve, occurs when leaflets (tissue flaps) do not close completely, causing blood to leak backward across the valve. This kind of regurgitation is most common in the mitral valve (known as mitral valve regurgitation), although it can occur in the other three valves, as well.

"Because the valve is leaking, to get five gallons of blood to go forward, the heart has to do the equivalent work of pumping 10 gallons," says James Gammie, MD, Professor of Surgery and Chief of Cardiac Surgery at the University of Maryland School of Medicine and co-director of the University of Maryland Heart and Vascular Center. "The heart is always working overtime."

Valvular stenosis occurs when the leaflets become stiffer or fuse together. This narrows the valve's opening and reduces the amount of blood flow. If the narrowing is severe, not enough blood flows forward.

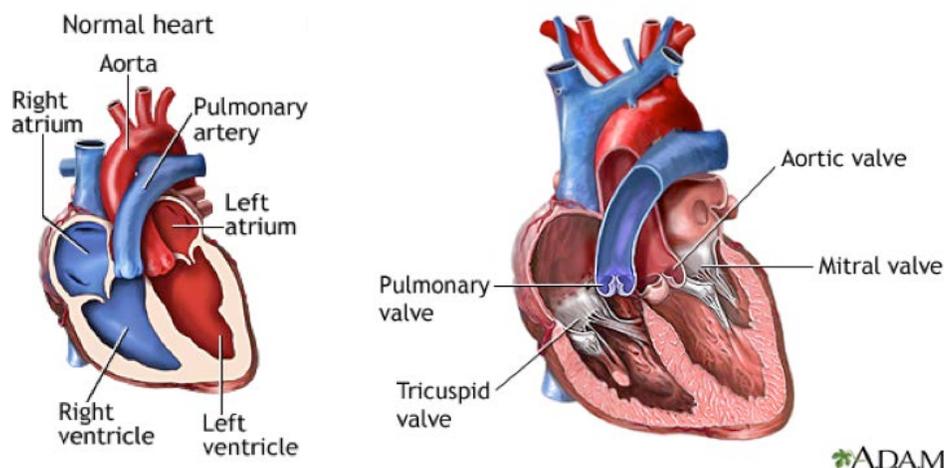


Image sources: [umm.edu/health/medical/ency/articles/double-inlet-left-ventricle](http://umm.edu/health/medical/ency/articles/double-inlet-left-ventricle) (A.D.A.M.)  
[umm.edu/health/medical/ency/articles/heart-murmurs-and-other-sounds](http://umm.edu/health/medical/ency/articles/heart-murmurs-and-other-sounds) (A.D.A.M.)

Heart valve disease can be:

**Congenital:** Congenital valve disease can develop before birth and most often affects the aortic or pulmonary valves. These valves may be the wrong size or have malformed leaflets (tissue flaps). Types of congenital valve disease include:

- *Bicuspid aortic valve disease:* The bicuspid aortic valve has only two leaflets instead of three. The missing leaflet can cause the valve to be stiff or to leak.
- *Pulmonary atresia:* The heart either lacks a functioning pulmonary valve or has a hole between its two bottom chambers and lacks a connection to the lung's blood vessels.
- *Pulmonary stenosis:* The pulmonary valve is thick with a smaller-than-normal opening. Blood doesn't flow properly through the valve and into the lungs.
- *Tricuspid atresia:* The tricuspid valve doesn't develop, preventing blood returning to the right atrium from flowing into the right ventricle.

**Acquired:** Acquired valve disease can occur when problems develop in normal, healthy valves. Common causes are infections or illnesses like rheumatic fever, which is caused by an untreated bacterial infection, or endocarditis, which occurs when bacteria enters the bloodstream and attaches to an area of the heart. Men over age 65 and women over age 75 are also at greater risk for acquired valve disease. Types of acquired valve disease include:

- *Aortic stenosis:* A narrowing of the aortic valve opening, restricting blood flow from the left ventricle to the aorta. If left untreated, this disease can lead to congestive heart failure. Aortic stenosis may also occur in infant and children due to a congenital defect.
- *Mitral regurgitation:* Leakage of blood backward through the mitral valve when the left ventricle contracts due to leaflets not closing effectively. This can increase blood pressure in the left atrium and in the veins running from the lungs to the heart.



- *Structural:* Structural changes can occur to the valves over time and due to aging. Parts of the valve can dilate, while leaflets can become stiff and calcified. The papillary muscles, which are attached to these mitral and tricuspid valve leaflets, can also stretch or tear.
- *Caused by other heart diseases:* Diseases and health conditions like coronary artery disease, heart attacks, aortic aneurysms, syphilis and high blood pressure can also lead to heart valve disease.

### DIAGNOSING VALVE DISEASE

Doctors at the University of Maryland Heart and Vascular Center use the most advanced technology to diagnose heart valve disease and determine the next steps in patients' treatments. After a physical exam, doctors perform one or more of the following tests and procedures:

**Cardiac MRI:** Uses a magnet and radio waves to make images of the heart and provide more detailed information about the valves.

**3D transesophageal electrocardiography (TEE):** Uses a throat probe to create highly detailed images in three dimensions. A special contrast solution provides extra clarity and definition.

**Cardiac CT Angiography:** Uses CT scans to create reconstructions of the heart and valves, and allows for appropriate sizing of catheter based aortic valves.

**Echocardiography:** Uses sound waves to study motion of the heart valves.

**Cardiac catheterization:** Uses a tiny, hollow tube (catheter), inserted through an artery in the arm, leg or wrist and threaded to the heart to show whether backflow is occurring and how fully a valve opens.

### CARDIOGENETIC TESTING

The University of Maryland Heart and Vascular Center is one of a few centers in the region to provide cardiogenetic testing. The testing, performed by a specially-trained group of geneticists and cardiologists, can help families take the needed steps to prevent cardiac emergencies.

## TREATMENTS

Cardiologists treat heart valve disease through either medication and lifestyle changes; or through surgery to repair or replace the valves.

## MEDICINES

In general, valvular disease is a mechanical problem, requiring a mechanical solution. Medications and lifestyle changes can treat symptoms of heart valve disease and even reduce the risk of additional problems, but do not appear to change the natural history of heart valve disease. Overall, people with heart valve disease should maintain a healthy weight, stop smoking, maintain regular physical activity and eat a heart-healthy diet made up of fruits, vegetables, whole grains, fat-free or low-fat dairy products and fish high in omega-3 fatty acids, like salmon and tuna.

Doctors may also prescribe one or more of the following medicines:

- **Angiotensin converting enzyme (ACE) inhibitors:** Opens blood vessels more fully, helps reduce high blood pressure and slows heart failure
- **Antiarrhythmics:** Helps restore normal heart rhythm
- **Antibiotics:** Helps prevent infections
- **Anticoagulants (blood thinners):** Reduces risk of blood clots, which can lead to stroke
- **Beta-blockers:** Helps the heart beat slower, reducing the heart's workload
- **Vasodilators:** Opens and relaxes the blood vessels, lowering the heart's workload. This reduced pressure may prompt blood to flow forward instead of backward through a leaky valve.

Still, medications cannot stop a valve from leaking or open a valve that is too constricted. In some cases, valves will continue to deteriorate and eventually damage the heart. For those patients, surgery to repair or replace the valve is often needed.



## SURGERY

Doctors at the University of Maryland Heart and Vascular Center offer a range of surgical treatments to repair or replace heart valves. They perform more than 200 mitral valve operations and more than 250 aortic valve operations a year. This experience, combined with the latest research and advances in valve disease, leads to excellent patient outcomes.

## VALVE REPAIR

Our surgeons are committed to repairing valves to preserve a patient's own heart tissue and restore valve function.

### Mitral Valve Repair

The mitral valve is the most commonly repaired of all four heart valves. Heart muscles also function better over the long term with repairs rather than mitral valve replacements, and there is also less risk of stroke, bleeding and infection during repair procedures.

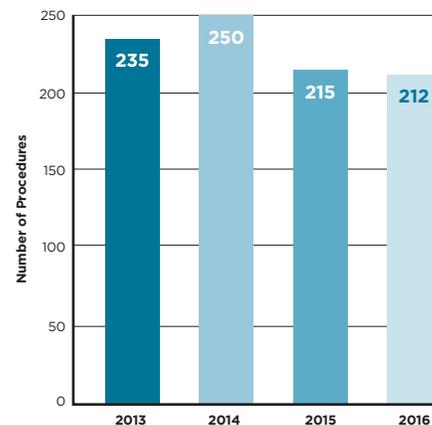
Our surgeons take a range of approaches when repairing the mitral valve, including:

- Sewing in a new ring of plastic, cloth or tissue to support the valve's circular frame (annulus).
- Trimming off the diseased portion of a valve leaflet and closing the defect.
- Reconstructing leaflets and using sutures to support the valve.
- Replacing a leaflet using tissue surrounding the heart (pericardium).

At the University of Maryland Heart and Vascular Center, the majority of mitral valve patients with degenerative mitral regurgitation undergo repair instead of replacement. Benefits of mitral valve repair compared to replacement include a lower risk of stroke, lower risk of infection and improved function of the left ventricle.

### Mitral Valve Cases (Repair, Replacement or Clips)

Published data demonstrates the most important predictor of successful mitral valve repair is the operating surgeon's experience and volume.



Data set volume includes UMMC and UMSJ procedures.

### Transcatheter Mitral Valve Repair

Our surgeons are also skilled at minimally invasive techniques like transcatheter mitral valve repair, where they thread a catheter through a vein toward the heart and then deliver a metal clip (MitraClip) through the catheter, positioning it between the mitral valve's two leaflets. Once in place, surgeons close the clip's two arms to pull the leaflets together and lock the device in place. The clip moves with the valve, allowing blood to properly flow through each opening.

This non-surgical procedure is performed by a multidisciplinary team, including cardiac surgeons, interventional cardiologists, cardiac anesthesiologists and echocardiography specialists.

### Valvuloplasty

Surgeons can also repair mitral valves using balloon valvuloplasty, a minimally invasive procedure to open narrowed mitral and aortic valves. This procedure is typically most effective for children, teens and young adults with a narrowed valve because the cause is usually a structural defect.



### Tricuspid Valve Repair

Tricuspid valve repair is technically challenging and complex. In addition to the condition of the patient's valve, the success rate depends greatly on the surgeons' skills. University of Maryland Heart and Vascular Center surgeons perform a high volume of tricuspid valve repairs every year. That means they are one of the world's most experienced teams in repairing infected tricuspid valves.

Surgeons use the least-invasive approach possible, often performing the repair using a percutaneous (through the skin) approach instead of open-heart surgery. This is especially helpful for patients with congenital heart disease.

The open procedure, where surgeons stop the heart and use a heart-lung bypass machine to circulate blood while making the repair, is also available.

Benefits of tricuspid valve repair over replacement include:

- Less chance of infection since the valve is the patient's own tissue.
- Less disruption and manipulation of the heart.
- No need to take blood thinners.
- Better outcome and survival rates.

### VALVE REPLACEMENT

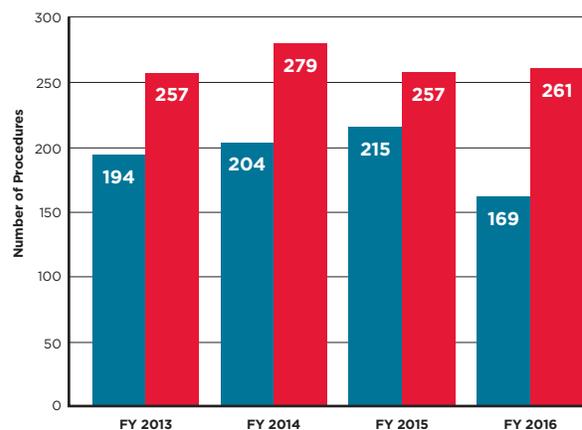
Our surgeons offer some of the latest advances in valve replacement, using both traditional and minimally invasive techniques. The aortic valve and mitral valve are the most-commonly replaced valves.

### Aortic Valve Replacement

Aortic valve regurgitation or stenosis can lead to aortic valve replacement, where surgeons replace the aortic valve through open-heart surgery or a minimally invasive or catheter-based procedure. The team at the University of Maryland Heart and Vascular Center performs hundreds of aortic valve replacements each year.

Between July 1, 2014 and June 30, 2015, University of Maryland Heart and Vascular Center surgeons performed 257 planned (non-emergent) aortic valve procedures.

■ Planned Mitral Valve vs. ■ Planned Aortic Valve Cases  
FY 2013-2016



### Transcatheter Aortic Valve Replacement (TAVR)

University of Maryland Heart and Vascular Center offers multiple options to treat patients with aortic stenosis. The minimally invasive TAVR technique uses a catheter to position a replacement valve inside a diseased or damaged aortic valve. Once the replacement is opened, surgeons pin the valve's old leaflets out of the way, allowing unimpeded flow from the heart to the rest of the body. The procedure avoids open-heart surgery and the need for a heart-lung machine.

The University of Maryland Heart and Vascular Center began offering the procedure in 2011, making it one of the first in the region to perform TAVR. As a result, the center was instrumental in clinical trials leading to the replacement valve's FDA approval.

### Types of Replacement Valves

At the University of Maryland Heart and Vascular Center, surgeons use both mechanical and biological replacement valves.

*Mechanical valves:* Made of strong and durable materials, these often last throughout a patient's lifetime. Patients with these valves must take blood thinners.

*Biological valves:* Made from animal tissue. About 10 percent of patients with these valves need a replacement after 10 years, and about 20 percent need one after 20 years. But University of Maryland Heart and Vascular Center physicians increasingly recommend biological valves because of their excellent outcomes, durability and safety (they do not require blood thinners).

*Tissue valves:* Also known as bioprosthetic valves, these valves are from animals or made from animal tissue. These valves can last up to 20 years.

### CLINICAL TRIALS

The University of Maryland Medical Center, along with its partner the University of Maryland School of Medicine, is widely recognized for its significant research in the field of valve disease. Surgeons are shaping the future of valve care through innovative clinical trials, often providing techniques and treatments not available at other area hospitals. The University of Maryland Heart and Vascular Center is also among a select number of centers nationwide evaluating new valves. That means patients receive early access to innovative treatments in valve care. The variety of valves offered through clinical trials allows center surgeons to treat a range of low- to high-risk patients.

Some of the groundbreaking research and trials include:

- Trial: assesses the worth of concomitant tricuspid valve repair during mitral valve surgery (CTSN multicenter trial)
- Comparing mitral valve repair and mitral valve replacement for severe ischemic mitral regurgitation.
- Finding ways to reduce contrast exposure for patients being evaluated for TAVR. (Thanks to the center's innovation, patients with severely compromised renal function can now undergo advanced CT imaging with substantially less risk of worsening renal function.)
- Evaluating new, catheter-based valves, providing patients with early access.
- Evaluating a new, suture-free valve that does not require stitching and calls for half the normal time spent on a heart-lung bypass machine.
- Evaluating MitraClip, a device for heart failure patients with functional mitral regurgitation who are not candidates for mitral valve surgery.



The TAVR valves in use at UMMC include:

**CoreValve Evolut R:** A heart valve for people with aortic valve disease/aortic stenosis. Made from the tough lining of a pig's heart, the valve is held together by a metal frame and is designed to work like a patient's own heart valve. The CoreValve Evolut R is a recapturable and repositionable valve device, meaning surgeons can remove and then reposition the valve within the patient's body as needed. The University of Maryland Medical Center is participating in the trial for low-risk patients.

**Edwards Sapien 3:** This heart valve is currently for patients with severe symptomatic aortic stenosis and intermediate to high risk for surgical aortic valve replacement. It is made of the lining of a cow's heart and sown into a cobalt chromium (metal frame).

## PREPARING FOR SURGERY

Preparation for valve surgery depends on the specific procedure. In general, patients should:

- Eat healthy foods and get plenty of rest in the weeks before surgery.
- Check with their doctors about continuing or stopping regular medicines.
- Receive preliminary tests like EKGs and blood tests in the days before surgery.
- Bathe with an antiseptic soap the night before the procedure.

The day of surgery, a technician may shave hair on the chest and abdomen before the procedure begins.

Anesthesiologists will also meet with patients beforehand to discuss past medical history, any food or medicine allergies and any past adverse reactions to anesthesia. Most patients receive general anesthesia for valve repair or replacement surgeries.

During surgery, surgeons may connect patients to a heart-lung bypass machine. Hearts are stopped when connected to the machine, leaving the machine to do the work.

Most repair and replacement surgeries take between two to five hours.

## AFTER SURGERY

At the University of Maryland Heart and Vascular Center, the average length of stay for valve surgeries varies depending on the procedure. Nationally, the average is five to seven days.

Normal recovery time also varies, with most patients returning to their daily lifestyles within four to eight weeks. Patients receiving minimally invasive procedures may experience a shorter recovery time.

Soon after surgery, specialists encourage patients to breathe deeply and resume light activities like eating, drinking and walking. Under a surgeon's care, patients should gradually build up their exercise and activity level.

Most patients have follow-up appointments with their surgeons four to six weeks after their procedures.

## VALVE LIFESPAN

**Mechanical valves:** According to the American Heart Association (AHA), most mechanical valves will last the remainder of a patient's lifetime.

**Bioprosthetic/tissue valves:** Tissue valves can last between 10 and 20 years, the AHA says.

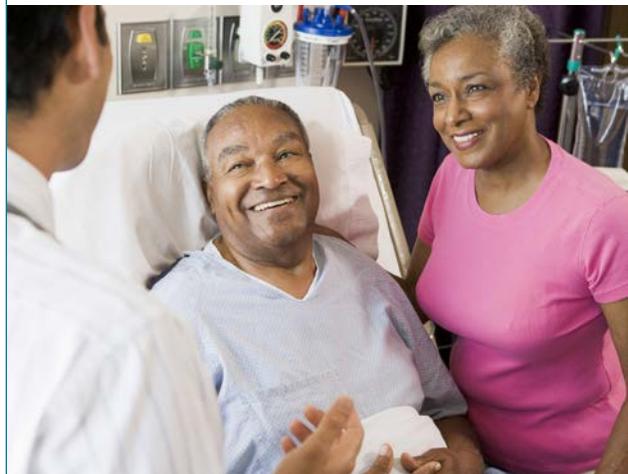
For more information about the benefits of each valve, see page 4.

## PATIENT EXPERIENCE

The University of Maryland Heart and Vascular Center scores high in patient satisfaction, with a majority of patients stating University of Maryland Medical Center is the best hospital possible for their cardiac care and that they would definitely recommend it to friends and family.

According to patient satisfaction surveys from 2015, a majority of cardiac patients also said:

- Doctors and nurses always treated them with courtesy and respect.
- Doctors and nurses always listened carefully to them.
- Pain during the hospital stay was always well controlled.
- Hospital staff always did everything they could to help with pain.
- Hospital staff always explained the reasons for new medicines.





### **WHY SHOULD YOU CHOOSE THE UNIVERSITY OF MARYLAND HEART AND VASCULAR CENTER?**

At the University of Maryland Medical Center, the heart valve physicians and surgeons are part of the University of Maryland Heart and Vascular Center — a comprehensive heart center with expertise in cardiovascular medicine, cardiac surgery and vascular surgery, and a national referral center for the toughest cardiovascular cases. They are fellowship-trained, with extensive experience performing everything from complex, open surgeries to the latest minimally invasive procedures for valve repair and replacement. As a result, patients from across the region and with a range of valve diseases travel to the center for care.

The center's valve surgeons perform hundreds of valve procedures each year. That volume, combined with its surgeons' top-level expertise, leads to excellent patient outcomes. Backed by the University of Maryland Medical Center — one of the top academic medical centers in the country — surgeons also have access to advanced technology, as well as the latest research for heart patients. They embrace a multi-disciplinary approach, incorporating primary care physicians, cardiologists, interventional cardiologists, cardiac anesthesiologists and echocardiography specialists into patients' individualized treatment plans.

### **MEET THE TEAM**

You can find our heart valve experts at:

- University of Maryland Medical Center
- R Adams Cowley Shock Trauma Center
- University of Maryland St. Joseph's Hospital
- Prince George's Hospital Center

Physicians and surgeons at each location hold faculty positions at the University of Maryland School of Medicine. To learn more or to contact one of our qualified surgeons, visit [umm.edu/heart](http://umm.edu/heart) or call:

#### **Cardiovascular Medicine: 410-328-7877**

Mark Vesely, MD  
Anuj Gupta, MD

#### **Cardiac Surgery: 410-328-5842**

James Gammie, MD  
Bartley Griffith, MD  
Bradley Taylor, MD  
Murtaza Dawood, MD  
Si Pham, MD  
Zachary Kon, MD