

Heart Surgery: The New Model

Craig R. Saunders, MD

The first successful surgery on the human heart was performed in 1896. It prompted Stephen Padget, MD, one of the most respected physicians of his time to write in his textbook *Surgery of the Chest*:

“Surgery of the heart has probably reached the limits set by nature, no new methods and no new discovery can overcome the natural difficulties that attend a wound of the heart.”



One hundred years later, in 1996, according to the American Heart Association and data from the National Center for Health Statistics, over 5.5 million people underwent cardiac procedures in United States hospitals.

Today we cannot pick up a newspaper or turn on the TV without hearing about healthcare reform and the crisis in medicine; yet, I would submit to you there is no crisis in the practice of medicine. Our country may be in an economic crisis and by extension a crisis in the business of medicine but, there is no crisis in the practice of medicine.

Never before in the history of the human race have physicians and surgeons had more knowledge, more resources and more new methods to “overcome the natural difficulties that attend a wound of the heart.”

Shifting Trends

As in life, change is the only constant when it comes to heart surgery. Cardiac surgery in the United States is in the midst of another sweeping change. Americans are learning more about how to prevent coronary artery disease through diet and exercise and are taking medications like statins to help lower their cholesterol levels. In addition, minimally invasive cardiac catheter-based procedures and stents are opening blocked arteries. While these factors are all helping to reduce the total annual number of coronary bypass procedures, the number of valve surgeries performed in this country is on the rise.

As our population ages, cardiologists are seeing more heart valve disease. When you consider that in a 70-year lifetime, the average human heart valve opens and closes more than 2.5 billion times, it is not surprising that these valves may stiffen or

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weaken. Valvular heart disease does not discriminate. During 2009 there were several much-publicized heart valve operations. Former first lady Barbara Bush and former New York City mayor Ed Koch had aortic valve replacement. Actor Robin Williams had his aortic valve replaced and his mitral valve repaired. Liz Taylor also had surgery to correct a leaky valve.

Remarkable new medical technology and surgical techniques allow cardiac surgeons to treat and cure valve disease in ways that were impossible only a few short years ago. The latest imaging technology gives doctors extraordinary views, almost as if we had eyes inside the beating human heart.

As both the understanding and diagnosis of valve disease have improved, so have the treatment options, which have led to perhaps the most important advancement in concept for today's patients – collaboration.

Across the United States in the nation's best medical centers, valve centers have sprung up in which the collaboration of a multidisciplinary team including the patient's own physician plus cardiologists, surgeons, cardiac imaging specialists and others have raised the bar of cardiac care by providing the mechanism to integrate these new insights from our advanced technology with the knowledge of our past experiences and the Treatment Guidelines of the American College of Cardiology (ACC) and the American Heart Association (AHA).

Signs and Symptoms of Valve Disease:

- Shortness of breath or difficulty catching a breath, first with exercise or exertion and later at rest
- Awakening at night short of breath
- Needing to sleep with extra pillows to breathe better
- Swelling of the hands, feet or ankles
- Weakness and/or dizziness
- Chest pain or discomfort
- Palpitations or irregular heartbeats
- Low or high blood pressure depending on the valve affected

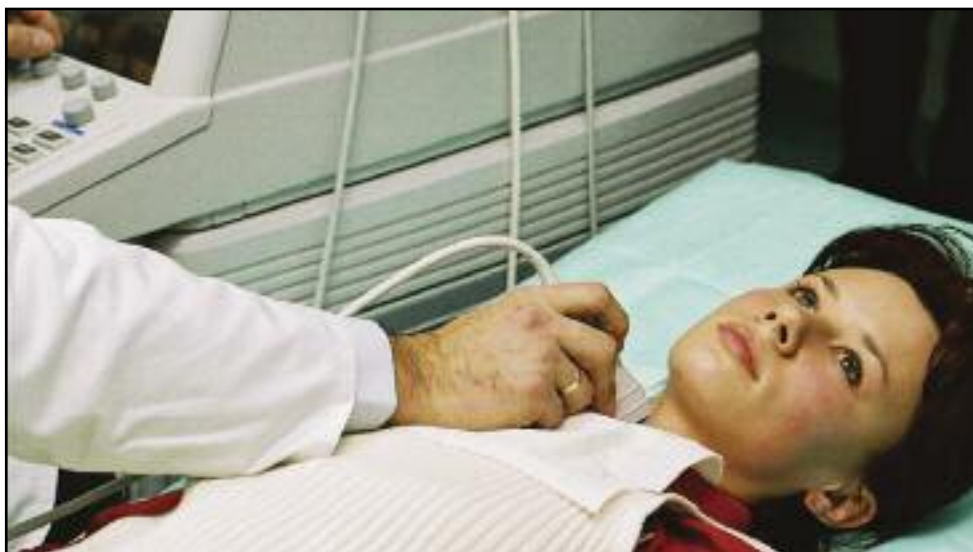


Photo courtesy of Newark Beth Israel Medical Center



This approach has helped us understand that chronic untreated valve disease can lead to permanent irreversible heart muscle damage that can eventually lead to heart failure. It has taught us that the best treatment results are obtained when the disease is treated early – at times even when there are few, if any, symptoms.

Most importantly, this collaboration brings us to a point where the art of medicine and the science of medicine merge. The team of doctors individualizes each patient's care to meet individual and unique needs, thus ensuring the best possible outcome.

What is Valve Disease?

Healthy heart valves assure blood will flow smoothly through the heart in one direction. When a valve fails to close completely, blood is allowed to flow in the reverse direction. This is called regurgitation or insufficiency. Valves can also be narrowed by deposits of calcium; this is called stenosis.

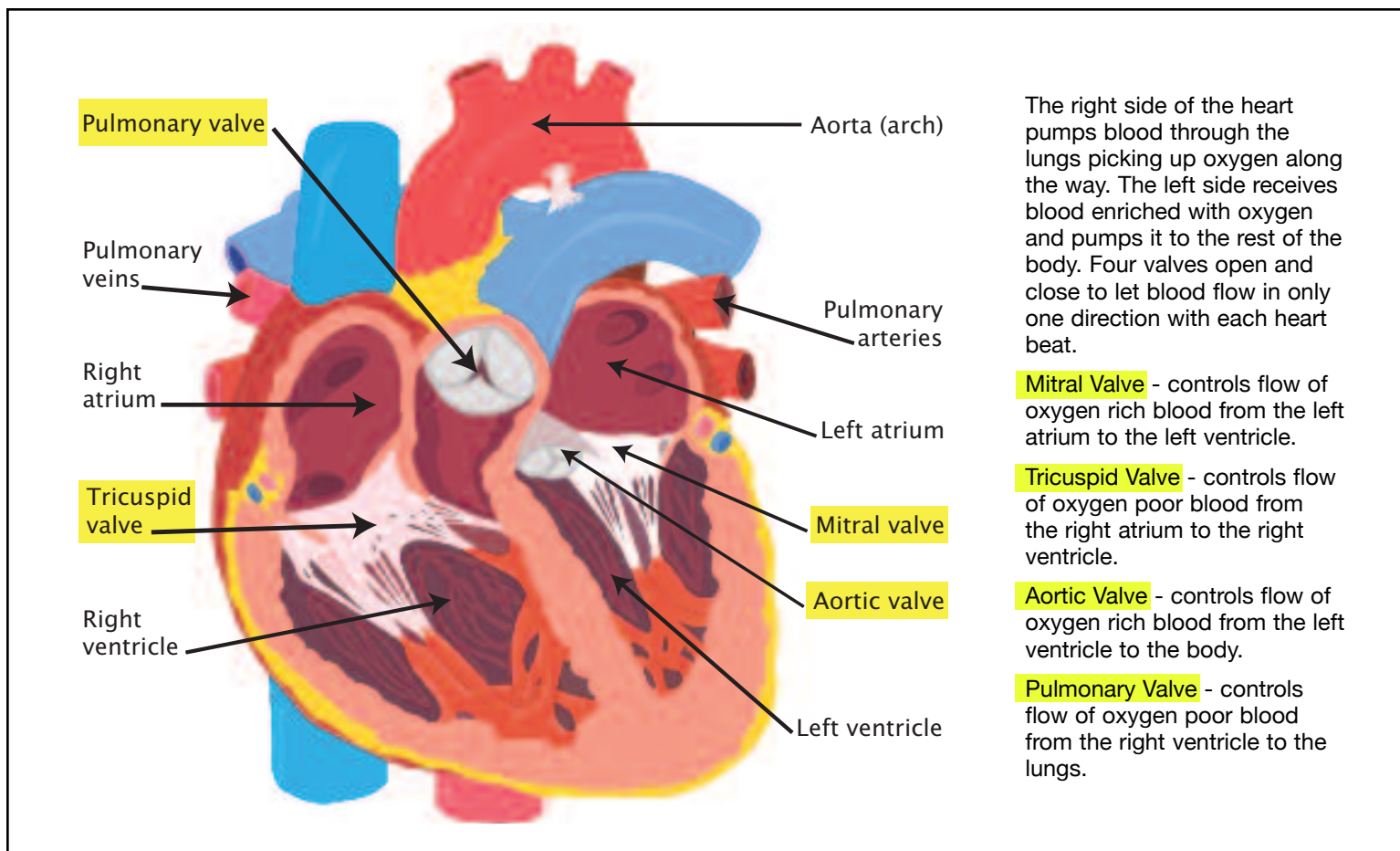
Like any pump, if the valves fail the pump must work harder to do its job. Since the heart is a muscle, it can enlarge to compensate for the diseased valve but only up to a point before permanent damage and heart failure set in.

Valve disease can be caused by any number of things such as other heart conditions, age-related changes and infection. Occasionally, people are born with abnormal valves that over the course of time wear out or scar. Valves can also be stretched or distorted by a heart attack, high blood pressure, aneurysms and diseases of the aorta.

Symptoms can resemble other medical problems and do not always relate to the seriousness of the valve condition. Most people with valve disease experience one or more symptoms, but some may have no symptoms at all.

How Is Valve Disease Diagnosed?

The diagnosis of valve disease starts with



a detailed history and physical exam by a cardiologist. The doctor will use a stethoscope to listen for evidence of heart failure or murmurs. A murmur is the swishing sound caused by a turbulent flow of blood across an abnormal valve. An EKG and blood pressure measurements are also used to record the heart's natural electrical current, strength and rhythm.

If the history and physical raises suspicion of valve disease, your physician may order a series of heart imaging tests that may include any or all of the following:

- Chest X-ray shows the lungs and heart outline.
- Stress test helps to determine if there is adequate blood flow to the heart during increasing levels of exercise as well as valve function.
- Nuclear scanning uses radioactive waves, ultrasound or magnetic fields to show abnormalities of blood flow and muscle function.
- Echocardiography uses ultrasound to create a moving picture of the heart

as it contracts and blood flows through the valves and chambers.

- Cardiac catheterization helps determine if there is plaque buildup in the coronary arteries and measures pressures inside the heart to evaluate valve dysfunction.
- Cardiac CT scan is a specialized CT scan synchronized to the heartbeat to define cardiac anatomy.
- Cardiac MRI is magnetic resonance scan showing the flow of blood through the heart as well as the anatomy and viability of the heart muscle.



Fig 7

Fig 8

Fig 9

This series of images shows a mitral valve at the time of minimally invasive surgery for mitral valve prolapse. Figure 7 shows the bulging segment of the posterior leaflet at the bottom center of the picture. Figure 8, a small book has been used to pull up the prolapsing segment and demonstrate the broken chords attached to it. Figure 9 shows the repaired valve. The prolapsing segment has been removed and the valve reconstructed. A fabric ring has also been placed around the valve for additional support and to prevent it from enlarging in the future.

New Advances in Valve Surgery - Research Your Options

What if you or someone you love is told that they need heart valve surgery? What next? When it has been determined that heart valve surgery is the best course of treatment, there are several important options to be considered that the patient should discuss with the cardiac surgeon. The new AHA and ACC treatment guidelines include more precise and quantitative definitions of mild, moderate and severe valve disease based on the patient's symptoms and results of the diagnostic tests.

While the new guidelines may prompt earlier referral of some patients for surgery, perhaps, even before they develop noticeable symptoms, the specific treatment for valve disease is determined by several factors such as the patient's age, overall health, medical history, extent of the disease, location of the valve, signs and symptoms, tolerance for specific medications, expectations for the course of the disease, and the patient's preference.

Minimally Invasive Surgery Versus Traditional Open Surgery

Heart surgery has been transformed by new technology and techniques that apply scopes and robotic instruments through tiny incisions. Cardiac surgery in the new millennium does not always require a long traumatic cut through the breastbone. Many valve procedures can be performed through a series of small incisions made between the ribs.

Minimally invasive surgical approaches to valve repair and replacement may provide lower rates of complication, less pain, quicker recovery and a shorter hospital stay. The small scar, often times only three to four inches long, is often completely hidden and many patients can return to normal activities within two weeks.

There are many different approaches to minimally invasive surgery, depending upon the valve in question and the surgeon's preferences. Not all surgeons are adept at minimally invasive procedures and those who aren't may contradict the importance of this approach. Whatever approach is used, the most important factors are the surgeon's experience and the advanced technology that can ensure the treatment is tailored to safely meet the patient's individual needs.

Repair Versus Replacement

When surgery is recommended, the advantages of heart valve repair instead of valve replacement cannot be overstated. Repairing a valve involves the surgeon modifying the tissue or underlying structures to restore competency to the valve, allowing the patients to keep their own valve instead of implanting an artificial valve.

The mitral valve is the most commonly repaired valve and involves lower risk to the patient than valve replacement. It requires no anticoagulation such as Coumadin (warfarin) and studies confirm that it improves outcomes and survival.

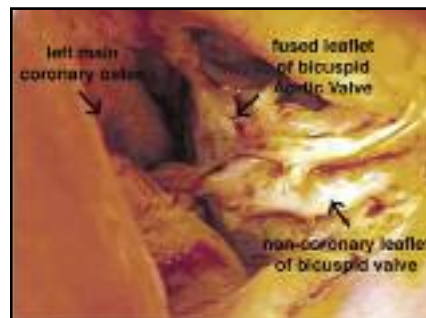


Fig 1



Fig 2

Figure 1 shows an abnormal aortic valve with only two leaflets (bicuspid) that has, over the course of time, become calcified and grown closed. The flow of blood through the valve is limited. In Fig. 2 the patient's own valve has been replaced with a valve made out of the lining of a cow's heart (bovine pericardium).



Fig 3



Fig 4

This patient has a normal three leaflet valve (tricuspid) but it has become thickened and calcified with age (Fig.3). In Fig. 4 the patient's own valve has been replaced with the actual leaflets of a pig valve mounted on fabric stents for support.



Fig 5



Fig 6 a



Fig 6 b

In some patients undergoing valve surgery, the standard sternal splitting incision seen in Figure 5 can be replaced with a minimally invasive incision only three to four inches long (Fig. 6 a, 6 b). This allows for a faster recovery and a more satisfying cosmetic result.

The Cardiac Roundtable data reports that only 50 to 60 percent of all patients having mitral valve surgery in the United States today have their valves repaired.

Not all mitral valves should or can be repaired so the 50 to 60 percent repair rate should not be criticized but, in valve centers of excellence approximately 85 to 90 percent of valves deemed repairable preoperatively are successfully repaired.

People with mitral valve disease who are referred for surgery should be aware that not all cardiothoracic surgeons routinely repair mitral valves and even fewer do so minimally invasively. Since each reduction in the size of the incision has the potential to make the patient's recovery quicker and easier, it is no surprise that informed patients are actively seeking minimally invasive surgery.

Early diagnosis and treatment of valve disease can mean a complete return to normal activities in a short span of time with no recurrence. Combining the latest technology with the correct timing of the surgery allows the cardiac team to make a successful repair before permanent damage is done to the heart.

Aortic valves are less commonly repaired. Based on studies of large numbers of patients who have undergone aortic valve surgery, usually the best result is achieved with aortic valve replacement. Exceptions may include young patients with bicuspid valves, mild forms of healed infections and some patients whose valve is insufficient due to diseases of the aorta.

Aortic stenosis, a stiffening of the aortic valve, is an example of a valve condition for which people who receive early evaluation and treatment experience better outcomes. Stenosis is often diagnosed in people over the age of 80; yet, age alone should not exclude a patient from consideration for valve surgery.

Valve replacement is the treatment of choice when a valve is severely malformed or destroyed. There are two main types of replacement valves—mechanical and tissue. Mechanical valves are now made from a space-age plastic called pyrolite carbon. Tissue valves are either manufactured from the



Photos courtesy of Newark Beth Israel Medical Center

lining of a cow's heart (bovine pericardium) or the actual valve from a pig. Occasionally, valves from a human cadaver can be used for special circumstances.

For patients who are not candidates for minimally invasive or open-heart surgery due to other health issues, experimental catheter-based procedures for valve implantation are being studied as a treatment option. The development and research for this technology is still evolving but is promising good results for specially selected patients.

Sophisticated Cardiovascular Imaging

The role of the non-invasive cardiologist cannot be overstated. Incorporating advanced cardiovascular imaging is critical not only to the accurate and complete analysis of valve disease, but also for the assessment of treatment results. This requires the hospital to keep pace with the expanding imaging capabilities and maintain a team of dedicated cardiac imaging specialists. Important modalities utilized in the evaluation of valve disease include three-dimensional echocardiography, live transesophageal echocardiography (TEE) and high-end non-invasive imaging such as cardiac MRI/MRA and multi-slice cardiac CT Scan.

The echocardiographer has become a critical part of the surgical team and instrumental in first defining the correct diagnosis, second, in defining the anatomy and approach to the surgical repair and thirdly, accessing the surgical result while still in the operating room and directing necessary corrections if indicated.

Best Results at High Volume Centers

Research studies have shown that heart valve repairs and replacements are much more likely to be accomplished successfully and patients quickly returned to normal daily activities with fewer complications, if the valve center has a long and stellar history of performing these procedures.

In other words, the cardiac teams at high volume centers have more experience that results in better skills and better outcomes. High volume centers perform 100 or more of a particular procedure each year. Unfortunately, according to the data of the Cardiac Round Table, only 12 percent of valve repairs or replacements performed in the United States are currently done in high volume centers. For the benefit of patients, all valve procedures should be performed in a

highly experienced center with expert physicians, nurses and staff who can provide the full spectrum of diagnostic services and clinical care to maximize the chances for complete recovery.

Protecting Your Valve

The patient is the most important member of the healthcare team. After the doctors have made the diagnosis and performed the appropriate treatment, the final responsibility lies with the patient to provide the proper care for the new valve.

If you have valve disease or have had your valve repaired or replaced, there are some things that you can do to prevent further disease.

The importance of the proper diet and regular exercise may sound routine and unimportant but their significance cannot be overstated. You are what you eat and a finely tuned machine needs high-grade fuel.

Always tell your physician and dentist that you have valve disease or have had valve surgery. You may need to take antibiotics before you undergo any procedure that may cause bleeding—this includes basic teeth cleaning. Bacteria released during these procedures can enter the bloodstream and lodge in the heart. Good care of your teeth and gums is a must.

Call a physician promptly when you have symptoms of an infection such as increased temperature, swelling or pus from a wound. Take all your medications as prescribed by your physician. Keep a list of the medications you take, along with the dosage, with you at all times.

Anticoagulation (blood thinners) are a special issue. If you are on Coumadin (warfarin), dietary precautions and a close relationship with your doctor's office will be necessary to maintain safe and adequate blood levels.

Remember to see your doctor for regular visits.♥

Craig R. Saunders, MD, Chairman of Cardiothoracic Surgery for the Saint Barnabas Health Care System for more than 10 years, is a distinguished cardiothoracic surgeon who continues to pioneer innovative surgical techniques for the treatment of heart disease. Former Head of Affiliate Programs for the Cleveland Clinic Department of Cardiothoracic Surgery, Dr. Saunders has served on the editorial and advisory board of national medical journals. He has published, and lectures and performs surgery worldwide.



Common Causes of Valve Disease

Degenerative disease most commonly affects the mitral valve. Age-related changes can cause improper valve movement that is commonly known as mitral valve prolapse. Over time, the floppy valve causes leakage. This degenerative condition affects 4 to 5 percent of the general population but is more common in women.

Calcification due to aging causes a hardening, thickening and narrowing of the valves. The aortic valve is affected the most.

Coronary artery disease restricts blood flow to the heart muscle through a build-up of plaque in the arteries. Plaque can also build-up inside the heart and affect the valves.

Rheumatic fever is caused by an untreated bacterial infection, usually Strep. throat. Luckily, the introduction of antibiotics to treat this infection has dramatically reduced this infection and its affect on the heart valves. The infection usually occurs in children, but the heart problems associated with it may not be seen for up to 40 years later. At the time of infection, the heart valves become inflamed, the leaflets stick together and become scarred, rigid, thickened and shortened. This can lead to mitral valve regurgitation later in life.

Bacterial endocarditis can damage the valves through the infectious process. Bacteria enter the bloodstream and attack the heart valves causing growths and holes in the valves and scarring. This can lead to leaky valves.

Congenital heart defects are types of malformations of the heart that are present at birth and can include an absence of one or more valves.