

# Diagnostic Tests

There are several diagnostic tests that may be used to identify a heart problem or check the status of a previous surgical procedure. Among the more common tests are:



## Cardiac Catheterization

### Diagnostic Catheterization

In this invasive procedure, a hollow tube or catheter is inserted into a vein in the arm or leg and then moved up into the heart. A contrast dye is injected and fluoroscopic pictures are taken of the heart chambers, blood vessels and heart valves. The pressures and oxygen content of the different heart chambers can also be measured.

Usually a few weeks before the procedure, the physician will order pre-operative testing (such as a chest x-ray, EKG, echocardiogram and/or blood work). Your child will come to the hospital on the morning of the procedure and will receive sedation. Recovery will require several hours after the procedure. During this time, the nurses will monitor blood pressure, pulse, the insertion site for signs of bleeding, and pulse oximetry, a measurement of the amount of oxygen in the blood.

### Interventional Catheterization

These procedures are similar to diagnostic catheterization, except the goal is placement of the catheter to treat an underlying condition.

### Balloon Angioplasty

This procedure is used to correct a narrow blood vessel by inserting a balloon-tipped catheter and inflating the balloon at the point of narrowing to stretch the blood vessel.

### Balloon Valvuloplasty

Similar to Balloon Angioplasty, this procedure is used to correct a narrow valve by inserting a balloon-tipped catheter and inflating the balloon at the point of narrowing to stretch the valve.

## **Arrhythmia Ablation**

This procedure uses specially designed catheters that are inserted into heart chambers to locate and then destroy, or ablate, the source or sources of heart rate irregularity.

## **Catheter Device Techniques**

This procedure uses specially designed catheters to guide clotting materials or devices, such as coils, to close or occlude abnormal vessels or certain holes between heart chambers.

- **Stents**

Stents are placed in narrowed blood vessels around the heart, such as the pulmonary arteries. The stent is a small wire mesh tube, usually made out of stainless steel.

The stent is usually placed during a cardiac catheterization. The collapsed stent is placed over a tiny balloon near the end of a catheter. The catheter is advanced through the groin and then the balloon is positioned in the narrowed vessel. X-ray is used to help see the correct position of the stent. The balloon is then inflated and the stent expands, pushing the narrowed vessel open. The balloon is then deflated, and the catheter removed, leaving the stent in place.

Patients need to take aspirin or other blood thinners for a period of time after the stent placement. This helps prevent blood from clotting around the stent until the body's own cells grow over the stent. Additionally, stents can be expanded or made larger, for example, as a child's vessels grow larger. This is done by reinserting a larger-ballooned catheter in the cardiac catheterization laboratory, and inflating the balloon, further expanding the stent in place.

- **Septal Closure Devices**

Holes in the septum (wall) of heart (ASDs, VSDs, or PFOs) can also be closed in the cardiac catheterization laboratory, using a septal closure device. This can be done instead of surgery, if the location, size and borders of the hole are appropriate. Those characteristics also determine which of several FDA approved devices may be appropriate to close the hole.

Devices are threaded up through a catheter that enters the patient through a blood vessel in the groin. The catheter is advanced across the hole and part of the device is pushed out into the chamber on the left side of the heart. The catheter is then pulled back to the right side of the heart, and the remainder of the device is pushed out, sandwiching the wall with the hole between the two sides of the device.

Devices are made of thin metal, some connected with fabric. The device closes the hole by covering both the left and right side of the septum. The device serves as a bridge, allowing the patient's own cells to grow across it, completely sealing it. Patients need to take aspirin or other blood thinner for a period of time after device placement. This helps blood from clotting on the device until the body's own cells grow over the device.

Patients also need to follow SBE prophylaxis until the device is sealed.



## **Chest X-ray**

The chest x-ray is a noninvasive test that provides radiological pictures of the structures in the chest, such as the heart, lungs, ribs, and sternum, or breast bone. It also provides information as to the size and position of the heart. A chest x-ray is useful in the diagnosis of pneumonia, tumors, collapsed lung, congestive heart failure and/or rib fractures. In addition, it is used to check placement of tubes and catheters in the chest, such as central lines, chest tubes, or nasogastric tubes threaded through the nasal passage to reach the stomach.

The level of radiation exposure from a chest x-ray is minimal. However, with repeated x-rays, it is advisable to cover genital areas with an x-ray-proof shield.



## **Computerized Axial Tomography (CT Scan)**

The CT scan, or CAT scan, is a computerized x-ray providing cross-sectional pictures of the chest, which show in great detail the internal structures and any abnormalities. Some CT scans may require contrast dye administered either by mouth or through an intravenous line. Because it is necessary for the patient to remain very still during the test, younger patients may require sedation.



## **Echocardiogram**

An echocardiogram is a noninvasive test using ultrasound technology to produce a picture from the sound waves that reflect from the tissue or organ being examined. A transducer, which transforms input energy of one form into output energy of another form, is placed over the chest. The machine then produces high frequency sound waves, which bounce off the heart structures and are sent back through the transducer to be plotted onto a graphic recording. This test is useful in evaluating the structure and function of the heart and valves.

There are two types of echocardiograms: transthoracic, through the chest wall from the front, and transesophageal, through the feeding tube or esophagus, which shows the heart from the rear view.



## **Electrocardiogram (ECG/EKG)**

The ECG (EKG) is a noninvasive test in which electrodes are placed on the arms, legs, and chest. A graphic tracing of the electrical activity of the heart is produced and can assist in detecting abnormalities in the rhythm and structure of the heart.



## **Electrophysiology Studies (EP Studies)**

An EP study is an invasive measure of the heart's electrical activity. A hollow catheter is placed into the right atrium of the heart then electrical stimuli are delivered through the catheter, while EKGs and computers monitor the cardiac electrical response. This procedure is helpful in the diagnosis of difficult dysrhythmias and conduction disturbances. The procedure is usually done in the cardiac catheterization lab.



## **Holter Monitor**

The Holter Monitor is a 24-, 48-, or 72-hour continuous monitor of a patient's ECG. A logbook is kept of the different activities and times at which they take place so that they may be later correlated with the ECG tracing.



## **Magnetic Resonance Imaging (MRI)**

This is a noninvasive test using non-x-ray magnetic waves to form cross-sectional plain pictures similar to those of a CT scan. This test may require administration of

a contrast dye and/or sedation. An MRI test should not be done for those patients with pacemakers, mechanical prosthetic valves or other implanted medical devices.



### **Prebirth Testing**

There are two types of prebirth testing. A Level II Ultrasound is similar to a regular pregnancy ultrasound, but with much more detailed imaging of the entire fetus. The other, a fetal echocardiogram, is a noninvasive transabdominal ultrasound test of the fetal heart that can be done, usually after 14 weeks of pregnancy when the baby's heart is large enough to get a clear picture.



### **Stress Testing**

The stress test is used to evaluate the heart's response to physical stress. It reveals the heart muscle's response to increased oxygen demands and also the blood flow to the heart tissue. The patient's heart rate, electrical activity, blood pressure, and respiratory rate are all monitored during the test and EKG tracings are produced before, during, and after the procedure.

Stress testing can be done with physical exercise on a treadmill or a stationary bike or can be done by administering medications to induce a stress response on the heart.

Stress tests may be done in conjunction with echocardiography or other x-ray examinations of the heart.



