



Medtronic

BEATING HEART BYPASS SURGERY

What Every Patient Should Know



Introduction

This booklet provides general information about Coronary Artery Disease (CAD) and Beating Heart Coronary Artery Bypass Grafting [often called “CABG” pronounced “cabbage” or “bypass”] surgery. This booklet is written for patients, although family members or friends may find it useful as well. This booklet is not intended as a substitute for an informed discussion with a surgeon.

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Beating Heart CABG Surgery: Revolutionary Progress in the Surgical Treatment of Coronary Artery Disease

Until a few years ago, most patients having Coronary Artery Bypass Grafting (CABG) surgery were placed on the heart-lung machine, which substituted for the patient's own heart and lungs and allowed surgeons to perform their delicate, precise cutting and sewing on a still heart.

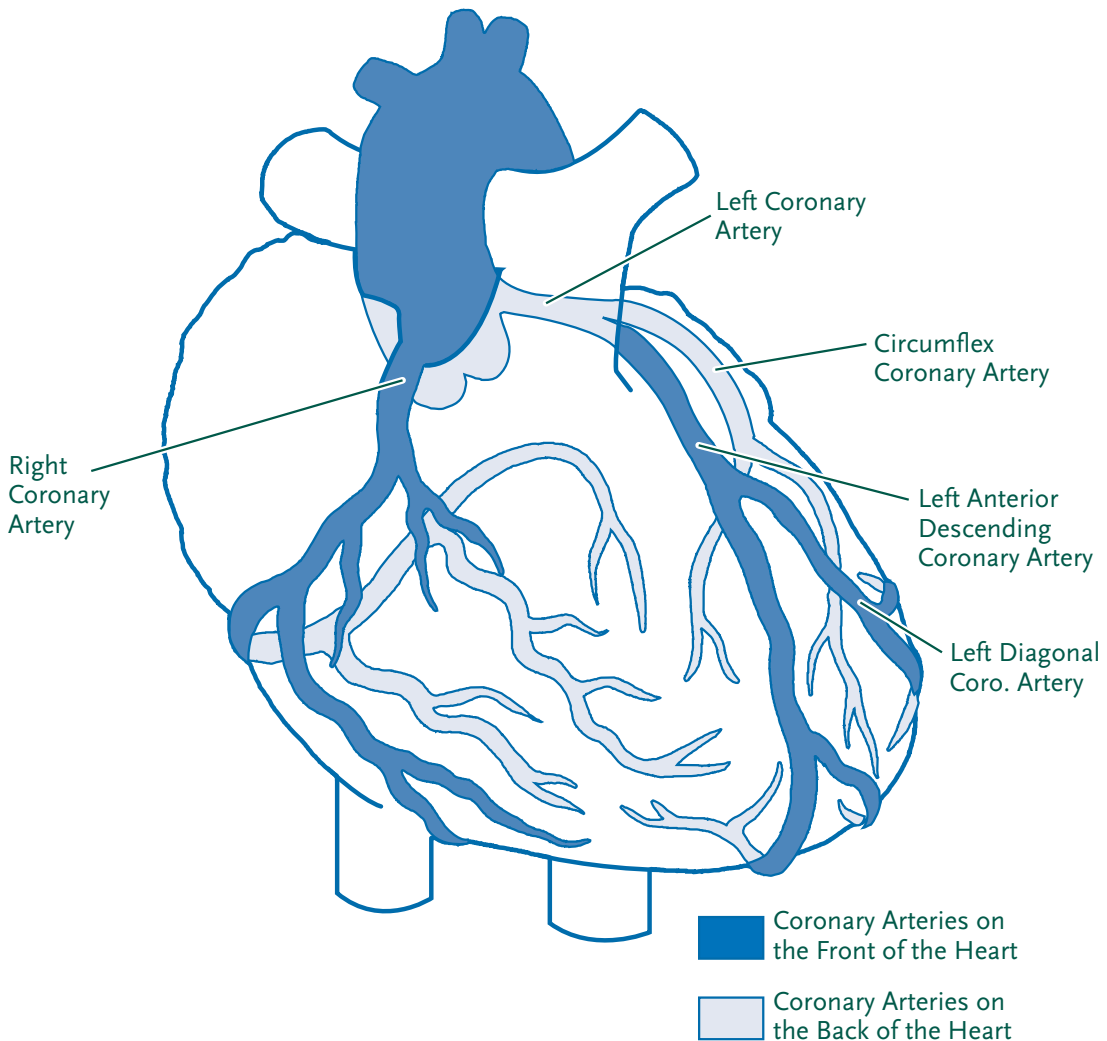
Now, surgeons and medical device companies have collaborated to develop improvements on the well-established, traditional bypass surgery procedure. Working together, they have developed Beating Heart CABG surgery products and techniques, with the goal of making the procedure less traumatic and the patient's stay in the hospital shorter, improving comfort and speeding recovery.

Beating Heart CABG surgery has been performed successfully on thousands of patients worldwide, and surgeons continue to recommend it for those patients who are appropriate candidates for this type of procedure.



The Heart and its Blood Supply

The heart is a muscular organ that continuously pumps blood rich with oxygen throughout the entire body. In order to function properly, the heart muscle itself must also receive oxygen-rich blood. This blood is delivered through blood vessels on the surface of the heart, called the coronary arteries.



Coronary Artery Disease

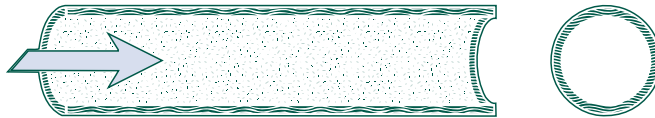
According to the American Heart Association’s most current (1997) statistics, an estimated 12 million people have coronary artery disease (CAD). In addition, coronary heart disease caused 466,101 deaths in 1997, and it is the single leading cause of death in America today.

Atherosclerosis

The coronary arteries can become blocked by a build-up of cholesterol fats. This build-up is called “atherosclerotic plaque”—often simply referred to as “plaque.” Plaque deposits can make the arteries stiff and irregular, resulting in “hardening of the arteries.”

CAD can appear as a single blockage or multiple blockages, and can vary in severity and location. These blockages in the coronary arteries can have a variety of effects on heart function, but basically, the blockages mean that these small, but very important vessels are no longer able to supply the heart with adequate oxygen and nutrients.

Any narrowing, or blockage, of the coronary arteries reduces the blood supply to the heart. Heart cells are very demanding in terms of their use of oxygen, and they are quite sensitive to oxygen levels. A blockage reduces oxygen delivery and does not allow the heart to properly function.



Normal or Clear Artery



Plaque Forming in Occluded Artery



Normal Artery

10% Blocked

40% Blocked

90% Blocked

Risk Factors for CAD

The following factors can increase one's risk for coronary artery disease:

- Family history of CAD
- Smoking
- High cholesterol
- High blood pressure
- Obesity
- Male gender
- Age

Diagnosis

After taking a detailed medical history of your symptoms and risk factors (including excessive weight, smoking, high cholesterol and a family history of CAD), as well as a physical exam, your doctor may use some of the following tests to diagnose CAD:

- **Electrocardiogram (EKG or ECG):** This painless test provides a graphic record of the heart's electrical activity as it contracts and rests. The electrocardiogram can detect abnormal heartbeats, areas of damage, inadequate blood flow, and possible heart enlargement.

- **Stress Tests**

- **Exercise Stress Test:** This test helps doctors find out how well the heart handles work. The test can show if the blood supply is reduced in the arteries that supply the heart. The patient being tested is hooked up to heart monitoring equipment and walks slowly on a treadmill. The treadmill speed and incline is increased while the doctor monitors the patient's heart rate, breathing, blood pressure, electrocardiogram (EKG or ECG), and the level of tiredness during the test.

- **Thallium Stress Test:** The thallium stress test evaluates myocardial perfusion (blood flow). This test shows how well blood flows to the heart muscle. It is usually done in conjunction with an exercise stress test. A small amount of harmless radioactive material is injected into a vein, usually in the arm. A scanning camera records the radioactive material as it enters the heart muscle through the coronary arteries. If there are blockages in the coronary arteries, no radioactive material will be seen in the heart muscle fed by those coronary arteries.

- **Dobutamine Stress**

Echocardiogram: This test evaluates coronary artery disease in patients who are unable to exercise on a treadmill. Dobutamine is a medication that increases heart rate and blood pressure similar to the effect of exercise. After receiving the dobutamine medication, the patient is monitored to assess the heart's performance while being "stressed" by dobutamine.

- **Coronary Catheterization:** This test is used to explore the coronary arteries. A small, soft tube called a catheter is put into an artery in an arm or leg and passed into the arteries of the heart. A dye that shows up on film is injected through the catheter and into the heart. The heart and blood vessels are then filmed while they function. The picture that is seen, called an angiogram or arteriogram, can show problems such as blockages in the coronary arteries.

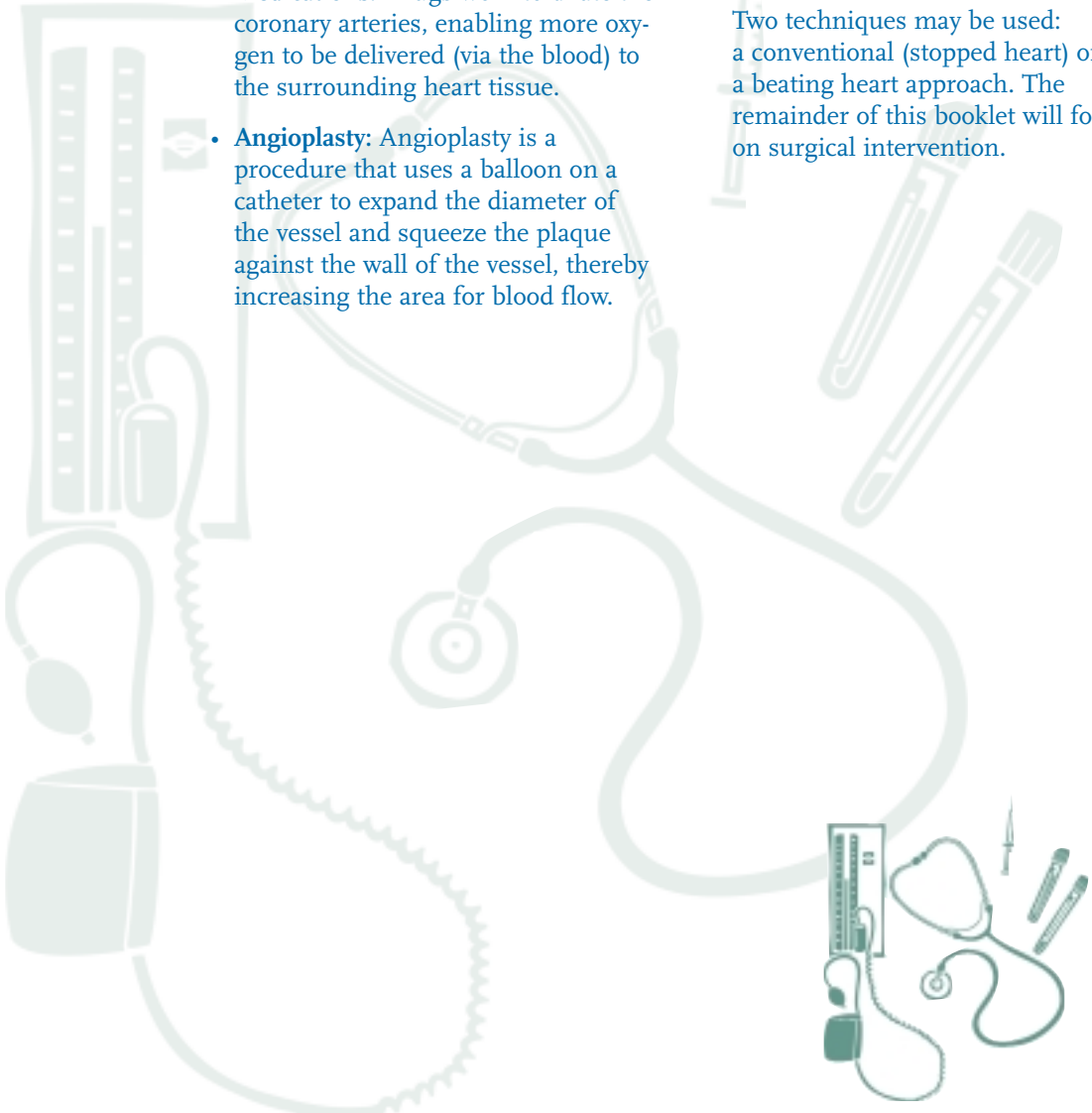
Your doctor will choose the appropriate diagnostic tests to correctly diagnose your CAD.

CAD Treatment Basics: Restore Blood Flow to the Heart Muscle

Each year many patients with CAD will need treatment to increase the flow of blood to the heart. Treatment options include:

- **Medications:** Drugs work to dilate the coronary arteries, enabling more oxygen to be delivered (via the blood) to the surrounding heart tissue.
- **Angioplasty:** Angioplasty is a procedure that uses a balloon on a catheter to expand the diameter of the vessel and squeeze the plaque against the wall of the vessel, thereby increasing the area for blood flow.

- **Stents:** A small device called a stent is placed in the artery after angioplasty to ensure that the artery remains open.
- **Surgical Intervention:** Coronary Artery Bypass Grafting (CABG) is the most common surgical treatment that creates alternate routes around coronary artery blockages for the blood flow to reach the heart muscle. Two techniques may be used: a conventional (stopped heart) or a beating heart approach. The remainder of this booklet will focus on surgical intervention.



Surgical Intervention

Coronary Artery Bypass Grafting (CABG) is a surgical procedure that restores blood flow to the portion of the heart beyond the blockage. This procedure reroutes the blood around the blockage, creating an alternative pathway for blood to reach the heart muscle that is not receiving sufficient blood flow.

Grafts are created by using portions of another artery or vein from the patient's body (the portions of artery or vein are referred to as "grafts") (see illustration). The grafts are connected to the diseased artery beyond the blockage to reestablish blood flow.

Your cardiologist and cardiac surgeon will review your coronary angiogram to determine the number of bypasses you will need.

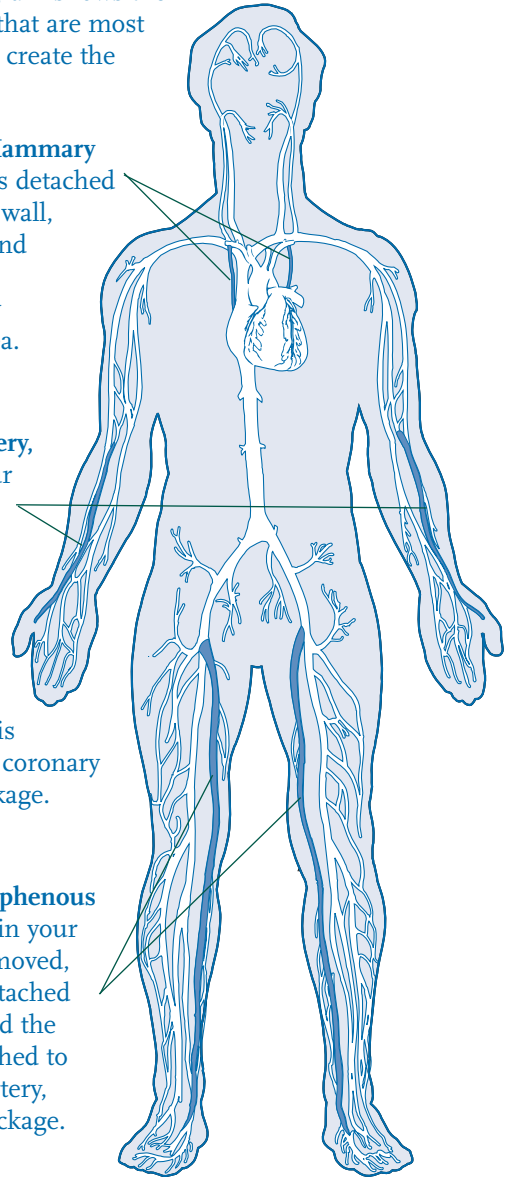
Coronary Bypass Graft Harvesting

The following diagram shows the arteries and veins that are most commonly used to create the bypass grafts.

A. The **Internal Mammary Artery**, which is detached from the chest wall, and the open end attached to the coronary below the blocked area.

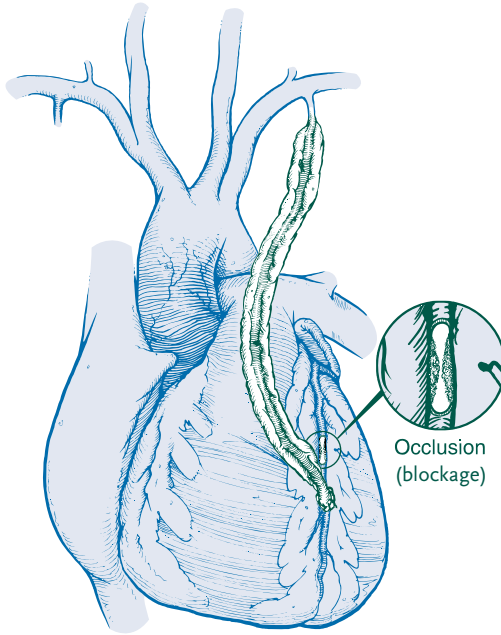
B. The **Radial Artery**, which is in your arm, may be removed, and one end sewn to the large artery leaving your heart (the aorta). The other end is attached to the coronary below the blockage.

C. The **Greater Saphenous Vein**, which is in your leg, may be removed, and one end attached to the aorta, and the other end attached to the coronary artery, beyond the blockage.

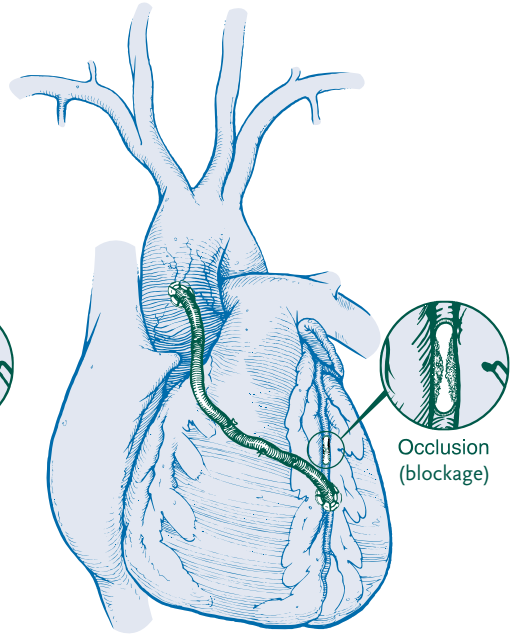


Coronary Artery Bypass Graft Harvesting

Two Types of Graft Bypasses



Internal Mammary Artery (IMA)
Graft Bypass



Radial Artery or Saphenous Vein
Graft Bypass



Conventional CABG

During conventional CABG surgery, the heart is stopped. In order to do this safely and effectively, the patient is placed on the heart-lung machine (which is also referred to as being placed “on-pump”). The heart-lung machine maintains circulation and does the work of the patient's heart and lungs, providing blood flow to the entire body.

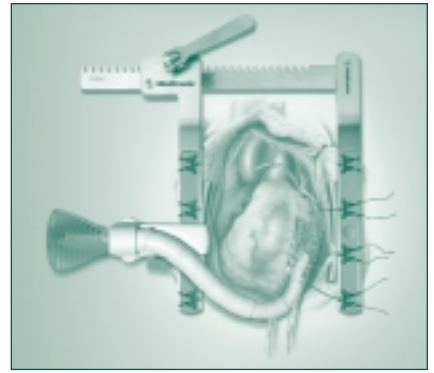
The heart-lung machine has allowed cardiac bypass surgery to be performed safely and effectively for many years, but the use of the heart-lung machine also has risks. The heart-lung machine can increase the risk for potential problems such as lung problems (pneumonia), fluid retention, stroke, abnormal heart rhythms, bleeding, and death. It may also potentially increase the length of hospitalization and prolong the recovery period.

In the past few years, technology has revolutionized how cardiac bypass surgery is performed. These advancements have allowed for a CABG procedure to be performed without the use of a heart-lung machine. The new procedure is called “Beating Heart CABG.”

Beating Heart CABG Surgery

Beating Heart Surgery allows the heart to continue beating while the surgery is performed. This procedure/surgery incorporates state-of-the-art technology of a heart-stabilizing device. The stabilizing device immobilizes a small section of the heart that needs the bypass graft while the rest of the heart muscle continues to beat and pump blood to the body.

The Medtronic Octopus® Stabilizer is used by thousands of surgeons worldwide to stabilize the heart while they perform the CABG surgery. The Octopus has small suction pods that gently grip the heart to steady it while the surgeon works.



Potential Advantages of Beating Heart Surgery

Beating Heart Surgery eliminates the need for the patient to be put on the heart-lung machine (pump). Recent clinical studies have suggested that the following are potential benefits to the patient:

- Shorter length of stay: Some patients are discharged from the hospital in 2-3 days versus the typical 7 to 10 days for conventional CABG surgery.
- Faster recovery: Patients are returning to their normal activities in 4 weeks rather than the typical 6 to 8 weeks with conventional surgery.
- Less damage to blood cells: The use of the heart-lung machine damages blood cells, which may affect the blood's ability to clot after surgery. Without the use of the heart-lung machine, the blood is not exposed to this potential damage.
- Shorter surgery time: The patient may spend about one hour less time in the operating room; and may be removed from the breathing machine (extubated) sooner.
- Better outcomes: Patients may have less risk of complications after surgery such as stroke, pneumonia or kidney problems.

The Surgical Experience

Out-Patient Pre-op Preparation

Today much of the preparation for cardiac surgery can be easily and successfully completed as an outpatient. If your heart surgery is urgent, you may need to remain in the hospital until the surgery is completed. Preparation for surgery involves many different activities:

- **Tests:** Tests may include chest X-ray, ECG, and blood work. This provides the surgical team with baseline information on the current state of your health.
- **Consent form:** You will need to sign a consent form granting the surgeon and his/her team permission to perform the surgery.
- **Shower with antibacterial soap:** You will be asked to shower the evening prior to surgery with a special antibacterial soap, which helps to decrease the amount of bacteria on your skin.
- **Patient education:** The nurse, physicians and other health team professionals will provide you with the necessary patient education information through verbal instruction, videos and written material. You and/or your family should feel comfortable to ask any questions that may come up.
- **Diet:** Usually, the evening before surgery, you should only have a light meal to eat, and then nothing to eat or drink after midnight. You may have sips of water with medications unless otherwise directed by your doctor.



- **Medications:** You will usually need to take a few medications starting the day before surgery to help prepare your body for the surgery.
- **Social Services:** Prior to the surgery, staff are available to meet with you and your family, if necessary, to identify any potential discharge needs.
- **Valuables:** You should leave your valuables and jewelry at home.

Same Day Admission –

Most of the preparation is done on an outpatient basis, so most patients are admitted to the hospital the morning of surgery. You will be required to come to the hospital a couple of hours prior to the scheduled time of the surgery. In the pre-op holding area, the nurse will take your blood pressure and heart rate and perform a basic assessment. The nurses are resources for any additional questions that you or your family may have. In the pre-op area, your chest will be shaved and pre-op sedation medication given. You will then be transferred to the operating room.

Intra-Operative

Once in the operating room, the anesthesiologist will give you additional medication to help you sleep. Once asleep, many things happen:

- **Intubation:** You will be intubated, which means that you will be placed on a breathing machine. The breathing machine helps you to breathe during the surgery and is different than the heart-lung machine.
- **Foley Catheter:** A foley catheter will be placed to drain urine from your bladder.

- **IV lines:** You will have several IV lines inserted. These IVs provide the doctors the necessary access to give you medications during the surgery.
- **Skin Preparation:** Your skin is scrubbed with a strong antibacterial solution to help prevent an infection. Once it is scrubbed thoroughly, you will be covered with sterile drapes.
- **Chest Opening:** During surgery, an incision is made down your chest, and your sternum (breastbone) is divided to allow access to your heart.

Artery and Vein Harvest During Bypass Surgery –

As mentioned earlier in this booklet (page 5), to create the grafts that will allow blood to flow past the blockage or blockages in your coronary arteries, the surgeon will need to use veins and/or arteries from your body. If a mammary artery (located in the chest) is used, surgeon detaches it from the chest wall and attaches the open end to the coronary artery past the blockage.

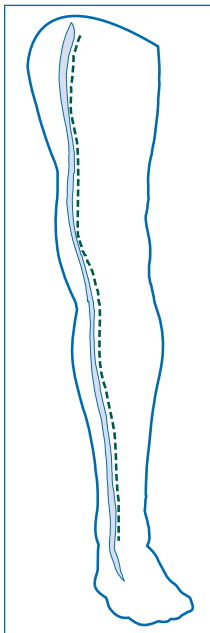
Vein Removal Techniques –

If a vein from your leg is needed, traditionally, the vein is removed through a long incision that may stretch from ankle to groin (Fig. 1). Using special instruments, an alternative and less invasive vein removal technique can be performed using smaller incisions (Fig. 2).

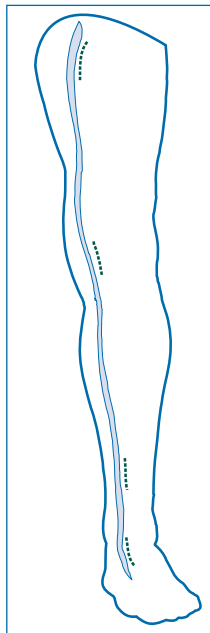
Through these smaller openings, your surgical team will use instrumentation to view the saphenous vein and remove the needed portions with minimal trauma to the leg.

In most cases, the small-incision approach can be used successfully. However, every surgical patient is unique, and your surgical team will recommend the best procedure for you.

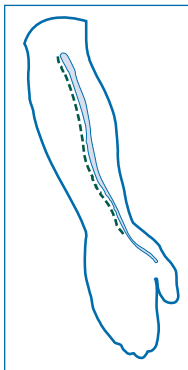
The removal of the radial artery is done through an incision in your arm (extending from your wrist to elbow). (Fig. 3)



*Fig. 1
Traditional Incision
for Vein Removal*



*Fig. 2
Alternative Incisions
for Vein Removal*



*Fig. 3
Incision for Radial
Artery Removal*

Coronary Grafting –

Once the grafts are removed, the surgeon attaches them to the aorta (major blood vessel carrying oxygen rich blood out of the heart), and to the coronary artery past the blockage. To attach the grafts while the heart is beating, the surgeon will use a stabilization device, like the Octopus®3, to keep a small section of the heart still.

End of Surgery –

At the end of the surgery, chest tubes are placed in order to drain any excess drainage of fluid out of the chest. The chest is then closed.

Many beating heart patients are able to be successfully extubated (removed from the breathing machine) in the operating room. If not extubated in the OR, beating heart patients are usually able to be extubated within a short time of arriving in the intensive care unit (ICU).

Recovery

After surgery, you will be monitored closely in the ICU. Once you have been stabilized and are alert, you will be transferred to a step down unit where you will stay until discharge. Beating heart patients are commonly transferred out of ICU as early as the same day as surgery.

Post-op Recovery –

- **Tests:** It is common to have daily blood draws as your body recovers from the surgery.
- **Chest X-rays:** Chest X-rays are also commonly done following cardiac surgery.

- **Monitoring:** Your heart rhythm will be continuously monitored, and 12 lead ECGs may also be done immediately following cardiac surgery. Your vital signs and physical assessment will be completed often to note any subtle changes in your condition.
- **Chest tubes:** The nurses and doctors will monitor the amount of drainage from tubes placed in your chest during the surgery. Chest tubes are usually removed one day after the surgery.
- **Foley catheter:** The Foley catheter which was placed prior to the surgery is removed once you are able to move about and can get up to the bathroom.
- **Activity:** Activity progression is key to successful recovery from CABG surgery. Once you are extubated, the nurses will begin an aggressive activity protocol, which requires you to sit on the side of the bed, to stand and to walk. These activities can all occur within a few hours after surgery. Cardiac Rehabilitation staff will be involved with your activity in the step-down unit.
- **Cardiac Rehab:** Cardiac Rehab is an intricate part of successful recovery following cardiac surgery. You will be seen by Cardiac Rehab as an inpatient for activity progression and some basic patient education. Cardiac Rehab involves progression of activity within limits that you can tolerate.
- **Pain management:** Although you may experience pain following cardiac surgery, it can be controlled with pain medications. It is important for recovery that your pain is kept under control. It is your responsibility as a patient to notify your nurse and physician if you are experiencing pain or if the pain medications are not helping.

- **Respiratory:** It is important for you to do deep breathing/coughing exercises every hour while you are awake. This helps to open up or re-expand your lungs. Your nurse will help you learn to do these exercises properly.
- **Medications:** Depending on your medical history, your medications may vary. However, you will need to take your regularly scheduled medications, with the addition of antibiotics and pain medications.

Patient Education –

Following cardiac surgery, your nurse, doctor and cardiac rehab staff are available to answer any questions that you or your family may have. They will also ensure that you and your family understand what you need to know to be safe at home. Education includes:

- Incision care
- Diet for strength/energy and wound healing
- Medications
- Activity expectations, limitations and exercises
- Pulse checking
- Smoking cessation (if appropriate)
- Follow-up appointments
- Discharge instructions

Discharge –

Discharge following cardiac surgery can occur as soon as you are medically stable. This may occur as soon as the second day after surgery, particularly if you are a beating heart patient. It may take at least 4 weeks before you feel “back to normal.” You will be referred

to an Outpatient Cardiac Rehabilitation Program for monitored exercise, blood pressure surveillance, and continued education. You will begin the program about one week after discharge. The following are “normal” feelings following cardiac surgery:

- “Aches and pains” as you heal
- Fatigue with exertion
- Irritability
- Difficulty in sleeping
- Loss of appetite
- Constipation (from pain medication)
- Slight swelling at the vessel harvest site

General discharge instructions may follow the plan below. These discharge instructions are specific to the All Saints Healthcare System, Inc. program, and you should always refer to your physician’s instructions.

Incision Care –

- Watch your incisions for signs of infection: redness, drainage (pus), and increased tenderness.
- Shower daily. You should not swim or take a tub bath for 2 weeks.
- You will have steri-strip bandages over your incision. These will fall off in 10 to 14 days.
- It is a good idea to wear sunblock if exposing the incision to direct sunlight.

Activity Restrictions –

- You should not lift, push or pull anything heavier than 10-15 pounds for 6 weeks.
- You should not drive for 1 month.



Medications –

You may be on new medications, or your physician may have discontinued some of your previous medications. Your doctor and nurses will thoroughly review these with you prior to discharge. Never stop taking a medication or start a new medication without consulting with your doctor. Always continue to take your medications as directed by your doctor.

When to Call Your Doctor –

- Chest pain similar to your angina
- Shortness of breath
- Dizziness
- Palpitations
- Fever greater than 101.0 degrees F
- Redness around incisions
- Drainage (pus) from the incisions

Recovering At Home

Physician Follow-Up

Follow-up may vary from hospital to hospital, but in general, you should see the nurse in the clinic about one week post discharge, and follow up with your surgeon about one month after discharge. Usual follow up is at 4 months and one year following the surgery.

Following discharge, you will attend outpatient Cardiac Rehab sessions for about 4-6 weeks, depending on your specific needs. These sessions not only consist of monitored exercise sessions, but also patient education classes that focus on risk factor modification.

Risk factor modification is extremely important in the prevention of the continued development of coronary artery disease. Classes include: diet, exercise,

smoking cessation (if appropriate), and blood pressure control. A plan, with specific goals set collaboratively between you and your cardiac rehab staff, will be designed for you. Specific outcomes for your to return to work are also considered. Strength training classes are available to help you regain the strength and endurance to return to work or participate in other previously enjoyed recreational activities. Once the goals are obtained, you can “graduate” from the Cardiac Rehab program, but you will be encouraged to continue in a regular exercise routine.

Conclusion

Today, technology, doctors and other healthcare professionals are working together to provide you with the best care possible. The beating heart approach to coronary artery bypass surgery allows the possibility of superior benefits to you including a quicker recovery time and decreased complications. It can be a highly stressful time, but you can be assured your team of doctors, nurses, respiratory therapists, cardiac rehab staff and other health care professionals are here to help your surgery be successful and return you to an active and healthy life for years to come.



The information contained in this booklet should not be considered a replacement for a consultation with a medical professional.

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