

CORONARY ARTERY BYPASS GRAFT SURGERY.

The Coronary Arteries

The work of pumping blood requires lots of energy, so it is necessary for the heart to have its own source of blood to distribute oxygen and nutrients to the heart muscle.

Blood is pumped throughout the heart muscle through two main coronary arteries (left coronary artery and right coronary artery) that branch from the aorta and travel over the surface of the heart. The left and right coronary arteries have smaller branches that run off them that carry blood deep into the heart muscle.

Coronary Artery Disease

Due to the ageing process, and lifestyle issues, the walls of the coronary arteries often develop deposits of a fatty substance called plaque. This process of fatty deposits is known as coronary artery disease or atherosclerosis.

When enough plaque has been deposited, blood flow in a coronary artery is decreased, sometimes quite significantly. Low blood flow through one or more of these coronary arteries

can lead to recurrent chest pains, also known as angina.

A heart attack or myocardial infarction occurs when the blood flow in a coronary artery stops due to a clot forming over the plaque. This can result in permanent damage to the heart muscle.

Coronary Artery Bypass Grafts

When a coronary artery becomes too narrowed with fatty deposits, it can be treated surgically by using another blood vessel to deliver blood beyond the narrowing. This procedure is known as coronary artery bypass graft surgery or CABG.

CABG surgery is a very effective treatment for coronary artery disease that has been performed in millions of patients over the last 30 years. It has become a common procedure and is the most common heart surgery performed in Australia and New Zealand and many other Western countries.

The restoration of adequate blood flow to the heart by CABG can stop or ease angina, improving physical capabilities and for many prolong life.

With improved techniques in surgical methods and anaesthesia patients once deemed too old or too unwell to

withstand the rigors of surgery may now be helped.

Common Grafts

It is common to use between one and six grafts during CABG surgery, but more grafts may be necessary.

Grafts used are arteries or veins. The most common grafts used are:

- Internal thoracic also known as internal mammary arteries (IMA), taken from the chest wall
- Radial artery from the forearm
- Saphenous vein from the leg

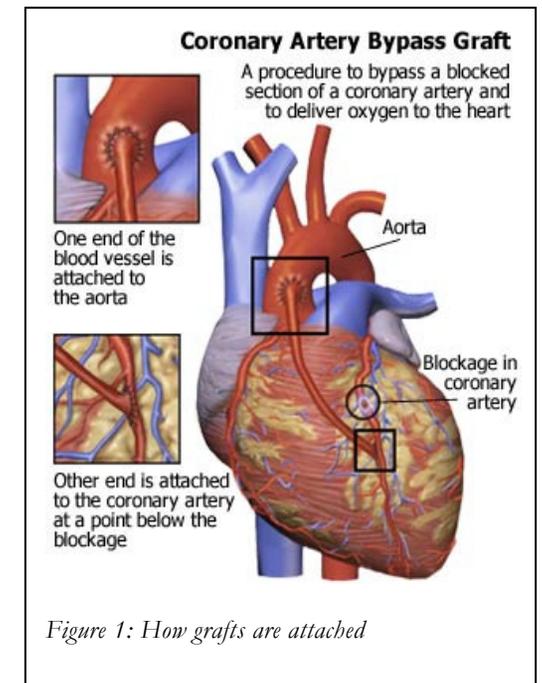


Figure 1: How grafts are attached

How the Heart Works

The heart is divided into four chambers. Valves located between the chambers allow the blood to flow through the heart in one direction only. The heart is about the size of a fist and is located in the centre of the chest behind the breastbone also known as the sternum.

It is the job of the heart to pump blood to itself, the lungs and throughout the rest of the body. The right ventricle pumps oxygen depleted to the lungs (venous) with the now oxygen enriched blood flowing back to the left side of the heart (arterial).

It is now the job of the left ventricle to pump the oxygen-rich blood through the aorta and then into all parts of the body. The first organ to take its share is the heart itself. Now the oxygen-depleted blood returns to the right side of the heart (right ventricle) and the whole process starts all over again. This routine happens with every heartbeat.

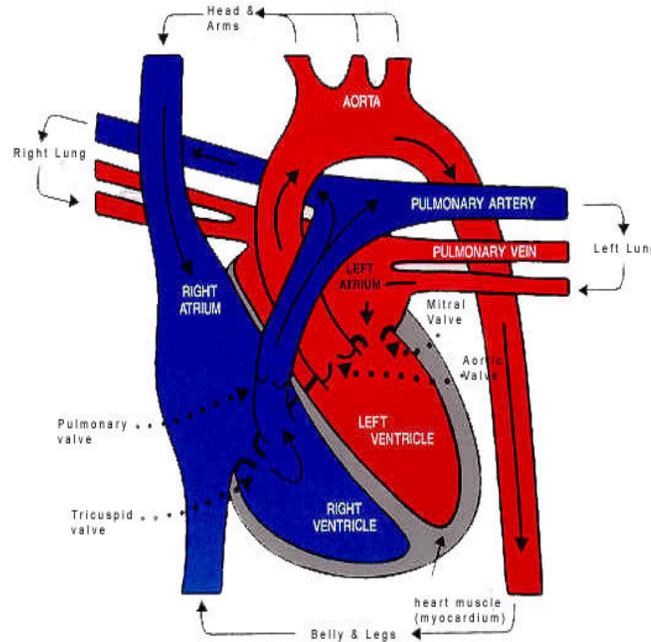


Figure 2: The four chambers of the heart and directions of blood flow

Diagnosing Heart Disease

Before your surgery is scheduled, your cardiologist will organize a full cardiac evaluation or “work-up”. Usually this would include an ECG (electrocardiogram), chest x-ray, cardiac catheterization, also known as a cardiac angiogram which will examine your heart internally.

A cardiac angiogram allows an x-ray examination of the heart using special dyes or contrasts that show up when they are exposed to x-ray.

During your angiogram a fine tube or catheter is inserted into a large artery,

usually the femoral artery which is located in your groin.

This tube is then passed along the vessel to the heart.

Images of the coronary arteries and pumping action of the heart (ventriculogram) and aorta (aortogram) are taken. At the same time various pressure measurements around the heart are obtained.

Your surgeon uses these images and measurements as a “map” that shows the coronary arteries and the location of any blockages or narrowings. This test may also discover narrowings that are very minor in minor or tiny arteries that do not require grafting.

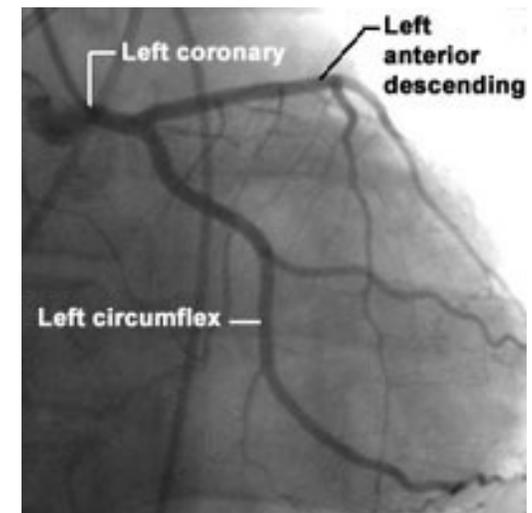


Figure 3: Cardiac catheterisation showing coronary vessels

Types of Bypass Grafts

The Internal Mammary Artery (IMA) is a blood vessel located on the inside of the chest cavity. It is an artery, not a vein it therefore carries oxygen-rich blood under the same blood pressure as that seen in the aorta or the coronary arteries themselves. There is one IMA on each side of the breastbone (sternum). This unique blood vessel runs along the inside edge of the sternum, sending off small branches to the bones, cartilage, and soft tissues of the chest wall. For unclear reasons, the IMA is remarkably resistant to cholesterol buildup. In studies of people who die beyond the age of 90, only 10% will show any atherosclerosis in the IMA vessels, while nearly all such individuals have atherosclerosis in the coronary arteries and other places. The reason for the mammary artery's resistance to atherosclerosis is not known at present.

The IMA is also conveniently located near the most important coronary branch, the left anterior descending (LAD). The surgeon can transfer the lower end of the IMA down to the heart surface to use as a bypass graft to the coronary vessels. As compared to the veins from the lower extremity, the IMA is smaller and more delicate. However, studies have shown that the use of the left internal mammary artery (LIMA) is associated with improved long term results from coronary artery bypass surgery. In most places around the world, surgeons implant the LIMA into the LAD whenever possible. Sometimes the LIMA is too small to use. And in other cases, the

vessel is so delicate that just the steps taken to remove it from underneath the ribs will cause harm to the vessel wall, making the IMA useless. However, in about 90% of coronary bypass operations, this vessel is the best conduit available for surgical bypass to the major arteries of the heart.

Saphenous vein is located in the leg. It is often used for bypass grafting because it is long, straight and strong. Due to its long length it can be used for more than one graft. Blood flow in the leg following removal of the saphenous vein is usually not affected. Even though the walls of veins have thin walls, the walls of the saphenous vein are strong enough to withstand arterial pressures.

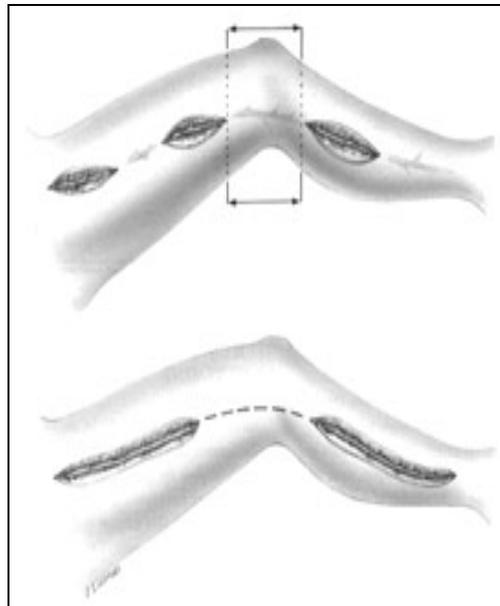
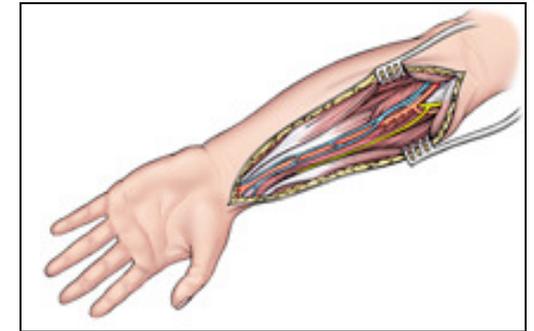


Figure 4: Saphenous vein harvesting

Radial Artery (RA) is located in the forearm and may be used as a bypass graft. Your surgeon will decide it is safe or useful to use this artery. The removal of this vessel does not usually affect blood flow to the hand as blood also flows through the ulnar artery.



Anaesthesia

CABG surgery is always performed under a general anaesthetic (GA) given to you by a specialist anaesthetist. You will meet your anaesthetist on the day of admission into hospital.

Today, modern anaesthetic drugs are safe with very few risks. However some people find they do have reactions to them which can be quite serious.

If you have ever had a previous reaction to an anaesthetic drug tell your surgeon or anaesthetist when you meet him. Your anaesthetist will explain to you more about the type of anaesthetic that is best for you and the risks and benefits.

The Surgical Procedure

The length of your breastbone or sternum will be cut and opened allowing your surgeon easier access to your heart. The soft tissues positioned in front of your heart are separated and the membrane that surrounds your heart (pericardium) is opened.

While this is happening vessels are being “harvested” and prepared for use as grafts. Before your surgeon can attach these grafts to your heart the beating of your heart is stopped, and a heart-lung machine takes over the role of circulating your blood to your head and brain and the rest of your body; this is known as “cardiopulmonary bypass”.

Now that the heart is still, your surgeon is able to connect all the grafts into their new positions using very tiny stitches (sutures). One end of the graft is attached to your aorta and the other end attached to the coronary artery just past the blockage or narrowing. The blocked section is not removed. If an internal mammary artery is used, it usually remains attached at its origin, with the cut end now joined to the coronary artery past the blockage.

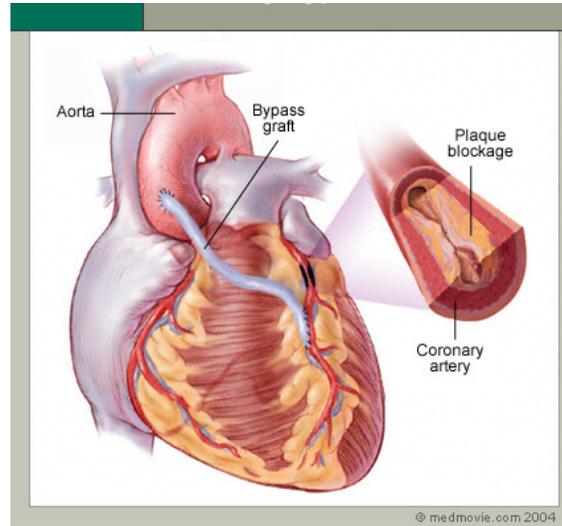


Figure 5: Attachment of the graft from aorta to past the blockage

Once the grafts are connected, the surgeon restarts the heart and disconnects the heart-lung machine, now allowing blood to be pumped through the heart and lungs once again.

The surgeon checks that the new grafts are working properly with good blood flow and that there is no other bleeding from tissues. Drain tubes are placed within the chest to remove blood and fluids which can collect during and after the surgery.

The breastbone in most cases is closed with strong stainless steel wire (which will be left in place) and the chest wall and skin is closed with either sutures or clips.

CABG surgery takes anywhere from 3 to 5 hours to complete.

OPCAB Surgery: For some patients, cardiopulmonary bypass (the heart-lung machine) is not used. In this instance the surgeon performs the surgery while the heart remains beating. This procedure is called “off-pump coronary artery bypass” or OPCAB. The decision to use this procedure will be made by your doctor.

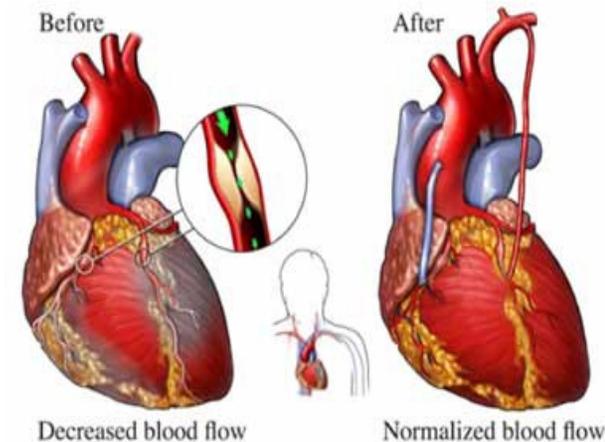


Figure 6: Following surgery there is increased blood flow to the heart

Should I Go Ahead?

Only after discussion with your cardiologist or your surgeon should the decision to have CABG surgery be made. The decision to go ahead is yours and should not be rushed or coerced by others. Only once you are satisfied with the information you have received and you believe you have enough information should you make your decision.



Figure 7: Discuss your options

Remember your surgeon cannot guarantee that the surgery will meet your expectations or that your proposed surgery carries no risks.

Queensland Heart and Lung Surgery encourage you to seek the opinions of other surgeons if you feel uncertain about the advice you have received.

Have realistic expectations!

Everyone is different, your outcome may not be the same as that of your neighbour or your relative. Not everyone will have the same result.

Before Your Surgery

Before your surgery, your surgeon will need to know your medical history.

Tell your surgeon if you have ever had:

- An allergy or bad reaction to any antibiotics, anaesthetics, other drugs, surgical tapes or dressings
- Prolonged bleeding or excessive bruising when injured
- Previous problems with blood clots
- Recent or long-term illnesses
- Psychological or psychiatric illness
- Poor healing or bad scar formation after previous surgery or injury

Make sure you give your surgeon a complete list of all medications and vitamins or herbal remedies you are taking or have recently taken. Include also medicines such as insulin, Warfarin and the contraceptive pill.

Medicines that increase the risk of bleeding include:

- Aspirin and medicines containing Aspirin such as cold preparations or cough mixtures
- Low molecular weight Heparins such as Clexane and Fragmin

- Anti-inflammatory medications (such as those to treat arthritis)
- Anti-platelet medications other than Aspirin, such as Plavix, Persantin, Asasantin, Iscover and Ticlid
- Large doses of Vitamin E

Often the above medications are withheld for a time before surgery – your doctor will advise you. Please feel free to ask your doctor any questions about your medications.

Smoking: Smoking is the leading risk factor for coronary artery disease and ceasing this habit is an important part of the management of heart disease. Smoking will also increase the risks of your surgery and anaesthetic and should be stopped as early as possible before your operation. Smokers who do not stop this habit permanently cannot expect a good long-term result from their surgery.



Your Recovery

Following your surgery, you will be moved into the Intensive Care Unit and will stay there for approximately 2 days.

When you wake up you may find you feel cold, thirsty and possibly confused. All of these sensations are normal effects and will soon pass. You may be aware of a breathing tube in your mouth and throat, this will be removed once you awaken properly and begin breathing on your own.

You will be cared for by specially trained nurses, one for each patient so you will always have someone close by. Your pain is always kept under control through medication. Your nurse will give you a sponge bath and assist in your personal care. You will be assisted to sit in a chair the day after surgery for a short time.

Physiotherapy will begin with a simple breathing programme including deep breathing exercises and coughing as well as arm and leg exercises. This programme reduces the risk of pneumonia and improves circulation whilst not disturbing the breastbone area. Drain tubes in the chest are removed once no longer required. A catheter that has been placed in your bladder is to drain urine. This is for your comfort and to allow doctors and nurses to monitor your kidney output. The catheter is usually removed by the 2nd day following your surgery.

It is normal to not have a bowel motion for a couple of days following surgery, but it is important that you do have one within 4 – 5 days following your operation.

Eating prunes and drinking pear juice can assist in this process. You should mention to your doctor or nurse if you are having trouble.

Wound Care: Following your surgery you will have a chest wound where your surgeon opened your breastbone. You may also have wounds to your legs and arms where the grafts were harvested. Dressings will be removed 2 – 3 days following your operation. Make sure you do not have the water too hot in your shower, and pat dry the wounds afterwards. Use a soft soap only but no talcum powder or creams or lotions.

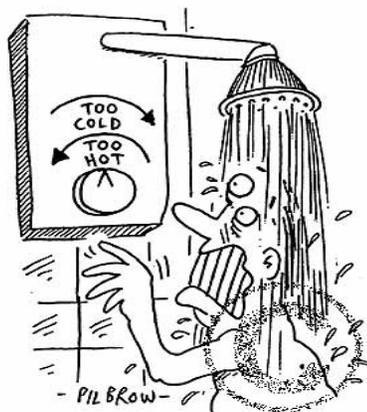


Figure 8: Make sure your shower is not too hot!

Once your doctor is happy you can move around without assistance, you will be discharged from hospital.

When you're home: It is important to gradually resume activities to help your recovery. Your doctor will recommend an exercise programme suitable to help you regain your strength.



Figure 9: Don't over exert yourself

It is important to remember not to lift heavy weights such as small children, baskets of wet laundry or drive until approved by your doctor (usually around 6 weeks).

After surgery many patients report a variety of problems or symptoms that usually resolve themselves over time. These include tiredness, blurred vision, nausea, poor appetite, poor concentration, memory loss, constipation and sleep disturbances.

Pain Relief: There have been many changes in pain relief options in recent years. These are best discussed with your anaesthetist. After the first few days, medications such as paracetamol and codeine are usually sufficient to control pain.

Possible Complications of Surgery

As with any invasive medical procedure, CABG has associated risks despite the highest medical and surgical standards. Your surgeon will make every attempt to minimize risks and complications but they can still occur and may have permanent effects.

It is not usual for a surgeon to outline every possible or rare complication of an operation.

It is however important to be given enough information to fully assess the benefits and risks of surgery for yourself. Most patients undergoing surgery will not have a complication, but if you are concerned about the possibilities, you should discuss this with your surgeon.

General Risks

Wound Infection: All surgery, major or minor has a risk of wound infection. This can occur days or weeks following the operation. Infections of the wound are usually treated quite effectively with antibiotics.

Blood Clots: Blood clots can develop in a deep vein, most usually in the leg or thigh (deep vein thrombosis or DVT). This is a life-threatening condition and requires urgent treatment.

Scarring: Generally speaking, most incisions heal well but some people find they develop raised or widened scars. Infections of the wound or movement of the wound area increase the incidence of scarring.

Specific Risks

Death (Mortality): Overall, the mortality rate in Australia and New Zealand is about one or two patients for every 100 CABG procedures performed. However the risk of not having the surgery may be higher for the patient. Risk of death increases with age, other serious illnesses, previous heart damage, urgency of the operation and recurrent surgery.

Stroke: The incidence of stroke (cerebrovascular accident) increases significantly with age and disease of the aorta, but it is an uncommon complication. The effects of stroke can be temporary and disappear over a few days or may be permanent and include:

-  Loss of feeling and sensation in a part of the body
-  Paralysis of one side of the body or limb (complete or partial)
-  Speech and/or swallowing difficulties
-  Visual disturbances

Patients suffering stroke following surgery will require some form of rehabilitation as either an in-patient or out-patient.

Infection of Breastbone: Infections of the breastbone require in-patient treatment with prolonged administration of antibiotics and possible further surgery.

Non-healing (non-union) of the Breastbone: Rarely, the incision of the breastbone does not heal or knit normally. This is most likely to happen following prolonged coughing after surgery. Sometimes the wires holding the breastbone together pull out. This may require further surgery to repair the breastbone. This complication can also be caused by infection of the bone.

Bleeding: This is the most common complication. About 5% of patients (5 in 100) need further surgery to control bleeding. Usually this complication resolves with no further ill-effects.

Irregular Heart Rhythm

(Arrhythmia): The most common irregular heart rhythm following surgery is atrial fibrillation (AF). This affects up to 1 in 3 patients in the first week following surgery. It is usually treated with medication. Uncommonly, a serious irregular rhythm can occur that requires electrical shock to correct. If you experience an irregular rhythm once you are home, contact your cardiologist. If these palpitations do not subside after a few minutes or cause dizziness or feeling unwell call an ambulance.

Graft Failure: Sometimes a graft does not successfully bypass a narrowed or blocked vessel. The new graft may become blocked with clot and lead to a heart attack following surgery.

Heart Attack (Myocardial

Infarction): Even if the graft has not failed, occasionally a heart attack can occur causing damage to the heart muscle.

Mood Swings: It is not uncommon for some patients to feel anxious and lacking in confidence about their heart and health in general. As the patient heals and convalesces this usually improves.

Arm Sensations: Some patients report temporary sensations of numbness and tingling at the back of the thumb near the wrist. Hand function is not affected.

Leg Sensations: If Saphenous vein has been harvested some swelling and aching of the leg may occur. It may be necessary to wear special stockings to help reduce this swelling. Small nerves near

the vein may also be injured causing decreased sensation or some skin numbness in the affected leg. Some patients also report they have more discomfort from the leg wound than from the chest wound.

Cognitive Function: It is common for patients to have some impairment of short-term memory, difficulty with concentration, reading and/or perhaps visual blurring. As these symptoms are most likely to occur in the first few weeks it is important that you do not drive for at least 6 weeks following your surgery. It can be possible for 6 to 9 months to pass before all of these symptoms disappear.

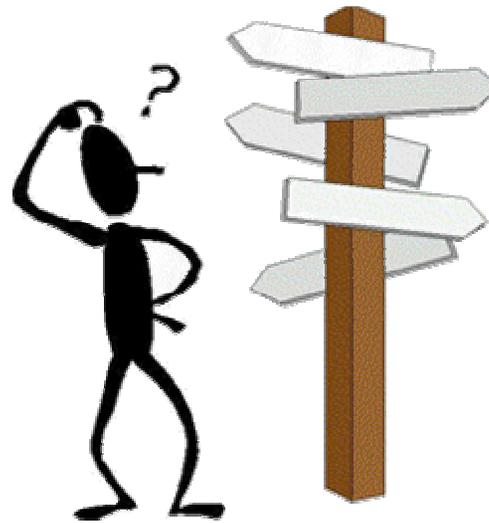


Figure 10: Confusion is common after surgery

Chest Wall Pain: Persistent pain from healing breastbone and ribs.

Other Risks:

- ✚ Temporary or permanent kidney failure
- ✚ Respiratory failure requiring tracheotomy
- ✚ Blood infection
- ✚ Permanent pacemaker due to chronic changes in heart rhythm
- ✚ Accumulation of fluid around heart and lung cavities requiring drainage
- ✚ Accumulation of air in chest cavity (pneumothorax) requiring temporary drainage

Graft Occlusion – after several years, one or more grafts may again become blocked or occluded. Coronary artery disease may progress further into grafts or into ungrafted vessels with perhaps another operation being necessary.

Remember to.....

- While the breastbone is healing avoid lifting, or pushing and pulling activities using your arms
- Showers are permitted, but baths or spas should be avoided for 4 – 6 weeks or until your incisions are healed. Avoid very hot water which may make you dizzy and gently wash (don't rub) your incisions with soap. Do not use creams or lotions until incisions are healed.
- Avoid driving your car for 6 weeks after surgery. Your reaction time will be delayed due to weakness, fatigue and/or medication. You may risk injury to the sternum. When riding in a car for long periods stop every 1 -2 hours to stretch your legs.
- Do not cross your legs when lying in bed or sitting. If you have swelling of feet or legs put them on a stool or chair while sitting.
- Avoid isometrics – straining to move your bowels, pushing or pulling heavy objects or working with your arms overhead all increase blood pressure putting added strain on a healing heart.
- Pace yourself to minimize fatigue. If you feel tired – STOP. Don't push yourself to finish a task.
- A rest period should be taken at least once a day for a few weeks -

two if possible morning and afternoon. Napping is not necessary but resting is. Be sure to dress in your daily street clothes. This will help in your sense of recovery and that you are well on your way!

- Stair climbing is safe but avoid pulling yourself up by the handrail and go slowly.
- Use your stockings as directed by your doctor to decrease swelling in the legs and aid in the healing process.
- It is important to distinguish between incisional pain and chest pain (angina) you may have experienced prior to surgery. Contact your doctor if you are experiencing chest pain.
- If your chest or limb incisions do not appear to be healing contact your doctor.
- Check your weight every morning for one week following discharge. Notify your doctor if you notice a sudden weight gain.
- Try to avoid becoming upset, your heart works harder then. Try to avoid situations, people or topics of conversation that make you tense or angry.
- Remember your diet, medications and exercise regime are prescribed specifically for you. Do not expect your friend or neighbour

who has a heart condition to have the same prescriptions.

- Keep a record of your medications and medical history when you are traveling.

Reasons to Call the Surgeon's Office

If you experience any of the following symptoms, report them to our office, or if after hours contact the hospital where your surgery was performed.

- Fever (more than 38°C) or chills
- Bleeding from the surgical area
- Excessive oozing, redness, swelling or tenderness at your incision site
- Increased fatigue or shortness of breath
- Abnormal pain or other symptoms that are not relieved by your medications

