A Patient’s Guide to Heart Surgery

Knowing What to Expect
Cardiovascular Institute

Allegheny Health Network Cardiovascular Institute (CVI) is one of the premier cardiac programs in the country. We provide superior state-of-the-art care for patients with heart disease and access to the region’s most comprehensive, multidisciplinary team of specialists, and innovative therapies, including many available only through advanced clinical trials. Our team of heart specialists offers leading-edge treatments for heart failure, atrial fibrillation (a-fib), structural heart disease, vascular disease, thoracic disease, and many other cardiovascular conditions.

The physicians of the Allegheny Health Network CVI’s seven hospitals and 20 outpatient locations maintain a singular focus on each and every patient, ensuring that the care you receive is specific to your needs and the most effective approach to a full recovery.

Our true passion is to keep hearts beating healthier and longer.

To learn more, please visit us on the web at AHN.org/cardio.
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter to Patients</td>
<td>1</td>
</tr>
<tr>
<td><strong>Preparing for Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>Causes: Why do I have this?</td>
<td>4</td>
</tr>
<tr>
<td>Treatments: Do I really need CABG?</td>
<td>6</td>
</tr>
<tr>
<td>Types of surgery: What are the different types of surgery?</td>
<td>7</td>
</tr>
<tr>
<td>Options: What else can be done other than surgery?</td>
<td>11</td>
</tr>
<tr>
<td>Surgery: What goes on in the operating room?</td>
<td>14</td>
</tr>
<tr>
<td>Beating heart: Can CABG be done without stopping the heart?</td>
<td>15</td>
</tr>
<tr>
<td>Duration: How long will it take?</td>
<td>16</td>
</tr>
<tr>
<td>Incisions: Where will I be cut?</td>
<td>17</td>
</tr>
<tr>
<td>Risks: Will I die or be disabled?</td>
<td>20</td>
</tr>
<tr>
<td>Conduit vessels: Where can the surgeon find the spare parts?</td>
<td>22</td>
</tr>
<tr>
<td>Artificial valves: Which valve is right for me?</td>
<td>25</td>
</tr>
<tr>
<td>Breathing tube: Will the tube in my throat choke me?</td>
<td>27</td>
</tr>
<tr>
<td>Transfusion: Will I need a blood transfusion?</td>
<td>28</td>
</tr>
<tr>
<td>Transfusion: What are the risks of blood transfusions?</td>
<td>29</td>
</tr>
<tr>
<td>Pain: Will I be miserable after CABG?</td>
<td>30</td>
</tr>
<tr>
<td>Length of stay: How long will I be in the hospital?</td>
<td>31</td>
</tr>
<tr>
<td>Anticoagulation: What is a blood thinner and is it safe?</td>
<td>32</td>
</tr>
</tbody>
</table>
# Table of Contents (continued)

## Recovering at Home

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereditary: If my parent had it, will I get it?</td>
<td>34</td>
</tr>
<tr>
<td>Smoking: What is so bad about smoking?</td>
<td>35</td>
</tr>
<tr>
<td>Quit smoking: Can I get help to quit?</td>
<td>36</td>
</tr>
<tr>
<td>Cholesterol: Why is it bad?</td>
<td>37</td>
</tr>
<tr>
<td>Diet: Why should I make all these changes?</td>
<td>39</td>
</tr>
<tr>
<td>Blood sugar: How do I control my blood sugar?</td>
<td>41</td>
</tr>
<tr>
<td>Blood pressure: What is blood pressure?</td>
<td>42</td>
</tr>
<tr>
<td>Exercise: Why is exercise important?</td>
<td>43</td>
</tr>
<tr>
<td>Alcohol: Can I have a few drinks after surgery?</td>
<td>44</td>
</tr>
<tr>
<td>A Cure? Will I need another heart operation?</td>
<td>45</td>
</tr>
<tr>
<td>At home: What can I expect after going home?</td>
<td>46</td>
</tr>
<tr>
<td>Limitations: What will I be able to do?</td>
<td>47</td>
</tr>
<tr>
<td>Sexual activity: Is sex safe after heart surgery?</td>
<td>49</td>
</tr>
<tr>
<td>Recovery: When will I feel well?</td>
<td>50</td>
</tr>
<tr>
<td>Work: How soon can I go back to work?</td>
<td>51</td>
</tr>
</tbody>
</table>

## Appendices

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glossary of medical terms and abbreviations</td>
<td>52</td>
</tr>
<tr>
<td>Summary of common types of medicine</td>
<td>55</td>
</tr>
<tr>
<td>References</td>
<td>61</td>
</tr>
<tr>
<td>Coronary Vessels</td>
<td>62</td>
</tr>
</tbody>
</table>
About the Author

Dr. James Magovern earned his undergraduate degree from Harvard College and his medical degree from the University of Pittsburgh, graduating Alpha Omega Alpha (a distinguished national honor society for physicians and scientists). His postgraduate training included an internship in general surgery at Johns Hopkins Hospital, residencies in general surgery at both Johns Hopkins and the Pennsylvania State University College of Medicine, and a residency in cardiothoracic surgery, also at Penn State. In addition, he performed a post-doctoral research fellowship in cardiothoracic surgery at the Milton S. Hershey Medical Center. Dr. Magovern authored more than 200 articles, abstracts, and chapters in some of the surgical field’s most prestigious journals and textbooks. He was twice honored as a Health Care Hero Award Finalist by the Pittsburgh Business Times and held membership and/or positions in more than 20 professional societies.

A highly respected and gifted cardiac surgeon, researcher, and teacher, Dr. Magovern joined his father Dr. George Magovern, Sr., and brother, Dr. George Magovern, Jr., in practice at Allegheny General Hospital. He served as chief of cardiac surgery and surgical director of Allegheny General Hospital’s Gerald McGinnis Cardiovascular Institute until his passing in 2007 after a courageous battle with cancer.

Evidence of his commitment to his patients was the development of this educational booklet, written by Dr. Magovern to assist patients in preparing for open heart surgery.

James A. Magovern, MD
06/08/54 – 03/17/07

This booklet is dedicated and provided to our patients in memory of Dr. James Magovern
Heart surgery is a major life event for patients, and it also has consequences for family members, relatives, and friends. Patients are always apprehensive when faced with the prospect of a major operation. Through the years, I have spent many hours explaining heart surgery, answering questions, and providing reassurance to patients and families. In many ways, this is the most challenging aspect of being a doctor, because it requires knowledge, judgment, and the ability to interact with people under stressful circumstances.

From this experience, I have learned that most people have many of the same questions about what will happen to them with heart surgery. Also, patients and families appreciate having printed materials that they can review on their own at different times, since it is hard to understand and remember everything that is discussed with the doctor in one meeting.

This booklet presents an overview of heart surgery from the patient perspective. It contains the basic information patients need to know and reviews the most commonly
asked questions about heart surgery. It is intended to supplement interaction with your doctor and to help engage you as a partner in maintaining a healthy lifestyle. A glossary of common medical terms, information on common cardiac medications, and suggestions for additional reading are included at the end.

It is not necessary to read the entire booklet at one time, because each section stands alone and can be read without reference to the others. Certain questions are very important at one time, but other questions may become more important at a later time. Selective reading of this booklet on different occasions might be the best way to absorb the information.

George J. Magovern, MD
Preparing for Surgery
Why do I have this?

The coronary arteries are the blood vessels that supply the heart muscle with the nutrients it needs to beat. The inside wall of the coronary artery is lined with cells called endothelial cells. Coronary artery blockages are caused by things that injure the coronary endothelial cells. This results in the buildup of cholesterol in the coronary artery, which is called an atherosclerotic plaque. The coronary arteries are fairly small, measuring about 2-3 mm in diameter, and therefore it does not take that much atherosclerotic plaque to cause restriction of blood flow.

The factors that damage the inside lining of the coronary arteries are:

1. **Elevated Blood Cholesterol** — Cholesterol can cause the initial damage and then cause progression of the disease. This is why lowering cholesterol levels is important in prevention and treatment of coronary artery disease (CAD).

2. **Smoking** — Smoking is the most dangerous way to use tobacco, because many chemicals are breathed into the body in the smoke, and these are toxic to the heart, lungs, and blood vessels. However, all types of tobacco use are toxic and should be stopped.

3. **High Blood Pressure** — Elevated blood pressure causes damage to blood vessels because of the increased pressure exerted on the wall of the vessel.

4. **Diabetes** — Elevated levels of blood glucose (sugar) are toxic to cells, including the coronary endothelial cells, and lead to atherosclerotic plaque. If you have diabetes of any sort, including diet-controlled, oral-agent controlled, or insulin-dependent, the central issue is maintaining a normal blood glucose level. High levels of glucose are bad and always cause problems in the long term.
Other factors commonly associated with CAD work through these primary risk factors. For example, obesity is often associated with hypertension, elevated blood glucose, and high cholesterol levels, which is the reason why obese patients have a higher risk of CAD. On the other side, regular exercise helps prevent CAD, because it promotes weight loss, lowers blood pressure, and improves the cholesterol profile.

Some patients do not have any obvious reason to explain why they have CAD. Many times these patients have a strong family history of CAD, which indicates they are more susceptible to CAD; however, this is not completely understood. In addition, several other factors may be important but have not yet been proven to cause CAD, including:

1. **Elevated Homocysteine Levels** — Homocysteine is an amino acid that is always present in the body but may injure endothelial cells if the levels are too high. High levels are mostly determined by genetic factors, but homocysteine levels will decline if folate and vitamin B supplements are given. Homocysteine-lowering therapy remains controversial.

2. **Infection** — There is some evidence that certain infectious organisms might cause or contribute to the progression of atherosclerosis. Cytomegalovirus, chlamydia, bacteria, and herpes viruses are several agents that have been evaluated. At this point the evidence is mixed, but important research is underway in this area that should yield some answers in the future.
Do I really need Coronary Artery Bypass Grafting (CABG)?

Coronary artery blockages are due to atherosclerotic plaque that builds up on the inside of the coronary artery. It is difficult to reverse this process once it is established but not impossible. Most of the medicines used to treat CAD do not have any effect on the atherosclerotic plaque. Rather, they reduce blood pressure, heart rate, and the strength of heart contraction, which allows the heart to do less work. Some medicines work by increasing the blood flow to the heart. Examples of this are nitroglycerin tablets and patches. The only medicines that act on the atherosclerotic plaque are ones that reduce cholesterol levels or triglyceride levels in the blood. The most commonly used drugs in this category are called statins, and examples of this are Lipitor and Zocor. These medicines can stabilize, and in some cases shrink, the blockage. Virtually all patients with CAD should take these medicines.

Lifestyle and dietary changes can reduce the blockage, but the changes required are drastic. Dean Ornish, MD, has published a program that is effective, but requires a major change in lifestyle, which includes exercise, weight loss, meditation, and a new diet. The diet is extremely low in fat (10 percent) and is not easily followed. Lesser degrees of lifestyle changes may slow the progression of the problem but will not eliminate the blockage.

Medicines, lifestyle, and dietary changes are most effective in the early stages of the problem. Once the patient is in the hospital with a heart attack or has severe blockage in all vessels, these conservative changes are not powerful enough. The decision to have CABG should be based on the severity of the blockage and the overall condition of the patient, and not because blockages are present. After surgery, these lifestyle and dietary changes are very effective and can help prevent future problems.
Heart surgery is used to treat several types of heart disease. Coronary artery bypass grafting (CABG), heart valve operations, and combined CABG/valve operations are the most common. Most of the information in this booklet refers to CABG, but it also applies in general to other heart operations. The following is an outline of common heart operations, including CABG, but concentrating on heart valve procedures.

Coronary Artery Bypass Surgery

This is the most common heart operation. Many people develop blockages (atherosclerosis) in the coronary arteries, which are the vessels that provide blood flow to the heart muscle. When the coronary arteries are blocked, chest pain, chest pressure, fatigue, shortness of breath, or a heart attack can occur. CABG provides more blood to the heart muscle by bypassing blood around the blockages. This operation is discussed in more detail in other parts of this booklet.

Heart Valve Surgery

The left ventricle pumps the blood to the body. To maintain forward blood flow, the heart has several one-way valves, which can be thought of as the inlet and the outlet valves. The inlet valve of the left ventricle is called the mitral valve. This valve opens to allow blood to enter the heart and closes to prevent blood from refluxing back into the lungs. The outlet valve of the left ventricle is called the aortic valve. This valve opens to allow blood to move from the heart to the body and closes to prevent the blood from falling back into the heart. In the course of one day, these valves open and close more than 100,000 times. This adds up to 40 million cycles per year or 2 billion cycles over 50 years. When considered in this way, it is not surprising that the valves can wear out or malfunction during a lifetime. The failure mode can be incomplete opening (stenosis), failure to close (regurgitation, also called insufficiency) or a mixture of both problems.
Aortic Valve Disease

1. Aortic Stenosis — This is when the aortic valve does not fully open. This is the most common heart valve disease in the United States. The majority of cases occur in older patients (older than 70 years). This occurs because of wear and tear on the valve over many years. Some patients develop aortic stenosis at a younger age (40 to 60 years), usually because they were born with a bicuspid valve (two leaflets, rather than three). These valves wear out faster than a normal valve, resulting in the need for surgery at a younger age.

2. Aortic Regurgitation — This problem occurs when the aortic valve does not close normally, which allows blood to fall back into the heart after each heartbeat. Some causes of aortic regurgitation are rheumatic fever and a bicuspid valve. This problem is less common than aortic stenosis but frequently requires surgery at a younger age than aortic stenosis. Infection on the valve (endocarditis) can also result in aortic regurgitation.

3. Surgery for Aortic Stenosis, Aortic Regurgitation, Mixed Aortic Stenosis/Aortic Regurgitation — Standard treatment for all forms of aortic valve diseases is valve replacement. Aortic valve repair is sometimes done for aortic regurgitation, but the long-term benefits are not proven. There are three categories of valves that can be used: 1) mechanical valves, 2) bioprosthetic “pig” valves, and 3) transplanted human valves. Choice of valve type is discussed in another section.
Mitral Valve Disease

1. Mitral Stenosis — This occurs when the mitral (inlet) valve becomes narrow and does not open fully. The only cause for this in an adult is previous rheumatic fever. In some cases the patient has a known history of rheumatic fever, but sometimes it was never diagnosed. Mitral stenosis used to be common in the United States, but now it is unusual.

2. Mitral Regurgitation — This occurs when the mitral (inlet) valve fails to close and large amounts of blood leak through the valve. There are many causes of this, which include the following.
   a) Ischemic — The valve leaks because of impaired heart function due to coronary artery blockages.
   b) Degenerative — In this disease, the mitral valve is more flimsy than usual and breaks down with time.
   c) Ruptured Chordae Tendonae — In this disease, a portion of the valve tears resulting in a localized leak.
   d) Annular Dilatation — This process occurs when the heart enlarges and stretches the valve open.
   e) Infection (Endocarditis) — The infection can damage the valve resulting in a leaking valve.

3. Surgery for Mitral Valve Disease — In the early stages of mitral stenosis, the narrow valve can be opened with a balloon in the catheterization laboratory or by repairing it in the operating room. In the later stages, when the valve becomes scarred, it is necessary to replace the valve, which requires an operation.

   The majority of valves with mitral regurgitation can be repaired with an operation. The details of the repair depend on the specific feature of the diseased valves. In patients with very complex pathology, the mitral valve is often replaced.
Some patients have significant coronary artery blockages and heart valve problems. In this situation, it is necessary to do coronary bypass and valve surgery during one operation. This is relatively common, but the risks are somewhat higher than for bypass surgery alone.

Many other heart operations are done, but they are infrequent compared to the procedures listed previously. These operations include repair of thoracic aneurysm, resection of left ventricular aneurysm, repair of the tricuspid valve, removal of heart tumors, and heart transplantation. Closure of a hole between the left and right atrium, called atrial septal defect, is the most common congenital heart problem that requires surgery. The technical details of these operations are different from each other, but the incisions used and the patient recovery are quite similar to the other operations discussed in this booklet.
There are only three ways to treat patients with blockages in the coronary arteries. The first option is medicine combined with lifestyle changes, including smoking cessation, dietary changes, and a regular exercise program. This approach is the best method for early stages of CAD. Not every blockage needs to be treated with angioplasty, stenting, or surgery. 

*Lifestyle changes should include:*

1. Regular exercise: such as walking, running, swimming or bicycling
2. Heart-healthy diet
3. Weight reduction (in most cases)
4. Elimination of smoking and all tobacco products

The preferred medical therapy includes: aspirin (1/day), a beta-blocker, and a cholesterol-lowering drug. Other commonly used medications include nitroglycerin (tablets, patches, spray) and calcium channel blockers. For this approach to work, the patient must be fully committed to making lifestyle changes that continue for a lifetime.

The second method for treating this disease is with a catheter (plastic tube) that directly attacks the blockage. Considered together, these procedures are called interventional cardiology techniques. Following is a list of several specific procedures and what they do.

1. **Angioplasty** (also called PTCA) — In this procedure, a small balloon is inflated inside the coronary artery, which stretches the vessel and compresses the blockage.
2. **Stenting** — In this technique, the blockage is usually first dilated with a balloon (angioplasty). Then a wire cylinder (stent) is placed inside the vessel and across the blockage. This stent stretches and maintains the vessel in an open position.

3. **Drug-eluting Stent** — Many stents now have medication attached to them, which act locally on the blood vessel at the site of the stent. These drug-eluting stents have been very effective in preventing recurrence of the blockage (re-stenosis).

These procedures are performed by a cardiologist in the cardiac catheterization laboratory by means of a plastic catheter inserted in the groin or the arm. The major advantages to the patient are the ease of the procedure, the speed of the recovery, and the excellent short-term results. The only disadvantage is a significant chance that the blockage will return within several months, which is called re-stenosis. The incidence of re-stenosis varies between 10 percent and 50 percent, depending on the circumstances, but averages about 20 to 25 percent with regular stents. With the use of drug-eluting stents, the risk of re-stenosis is less than 10 percent. In general terms, re-stenosis is caused by scar tissue that develops as a result of the interventional procedure. This process is different from the one that caused the blockage in the first place and is difficult to predict.

The third option is bypass surgery. This is generally called CABG, which stands for Coronary Artery Bypass Grafting. In most circumstances, this is done through an incision down the front of the chest, which divides the breastbone (sternum). During this operation blood vessels are taken from one part of the body
and used to divert blood around the blockage. The blockage is not removed but bypassed. The saphenous vein (from the leg), the internal mammary artery (from the inside of the chest) and the radial artery (from the arm) are the most common conduits used for bypass. The major disadvantage of CABG is the invasive nature of the operation, which usually results in hospitalization for four to seven days and a gradual recovery to full health during the next several months. The major advantage of CABG is that the results are durable for many years.

The decision about which method to use for a specific patient requires careful judgment by your doctor. In general, PTCA/stenting is done when there are three or fewer blockages and the atherosclerotic plaque is not calcified or irregular. If the left main coronary has a significant blockage, if multiple vessels are 100 percent blocked, or if three or more vessels are involved, then CABG is frequently necessary. Medical therapy is preferred when the symptoms are mild, the heart function is normal, and the number of vessels involved is small.
What goes on in the operating room?

After you are asleep, the skin is cleaned with a disinfectant solution and sterile surgical drapes are placed. The incision is made down the middle of the breastbone. The breastbone is divided with a powersaw and spread with a retractor. The protective sac around the heart (pericardium) is opened to expose the heart. Plastic tubes (cannulae) are inserted to drain the blood to the heart-lung machine and then return it back to the body. This is called cardiopulmonary bypass, because a machine temporarily assumes the function of the heart (cardio) and lungs (pulmonary). Heparin, which is a blood thinner, is given before starting cardiopulmonary bypass to prevent blood clotting in the machine. The heart is then stopped by infusing a solution (cardioplegia) that stops and preserves the heart. This allows the surgeon to complete the operation with the heart empty and motionless.

After the repair is complete, the heart is started by re-establishing its blood supply. The heart always starts again, but frequently it is necessary to give the heart an electric shock (defibrillation) to obtain a regular contraction rhythm. Once the heart regains full function, the cardiopulmonary bypass is gradually discontinued and the Heparin is reversed. Large plastic tubes help drain blood and fluid from around the heart and lungs. The sternum is closed using stainless steel wires and the remainder of the tissues are closed with sutures. The anesthesia used for heart surgery keeps the patient asleep for several hours after surgery.
Can CABG be done without stopping the heart?

In a traditional CABG operation, the heart is stopped while suturing the bypasses, but it is necessary to circulate blood to the rest of the body while the heart is stopped. Surgeons accomplish this with cardiopulmonary bypass, which is performed with a heart-lung machine, called on-pump CABG. The heart-lung machine provides effective support for the patient but can be associated with certain problems that occur from the interaction of the blood with the machine. This contributes to the need for blood transfusions, which may result in problems and injury to other organs.

Some CABG operations can be completed without the heart-lung machine, called off-pump CABG. This involves the same incision as traditional CABG but uses equipment to move and stabilize the heart while the bypasses are sutured. The initial results with this operation are excellent, but the long-term comparisons of this procedure to traditional CABG are not yet available. Depending on the individual patient’s risk factors, on- or off-pump surgery may be considered. The choice of procedure should be discussed with your surgeon.
How long will it take?

The average surgical time for a triple-bypass procedure is about three hours. The time is shorter if fewer vessels are bypassed and longer if more vessels are bypassed. This is the time that the surgeon spends, but there is time spent preparing for surgery and for transport from the operating room to the intensive care unit (ICU) after surgery. From the family’s viewpoint, surgery takes five to six hours, starting when the patient leaves the room and ending when the visitors are allowed into the ICU. Second-time heart operations generally take an hour or two longer. Other cardiac operations — such as aortic valve replacement or mitral valve surgery — also require approximately three hours. Valve surgery combined with coronary bypass surgery usually adds another hour to the surgical time. Very complex cardiac operations can take five to six hours, but procedures longer than this are unusual.
The most common surgical incision for heart surgery is the midline sternotomy. It is made on the front of the chest and extends down the middle for about 8 inches. The breastbone is divided with a saw and then spread apart 4 inches, which allows space for the surgeon to perform the operation. After completing the heart operation, the breastbone is pulled together and held tight with stainless steel wires. The soft tissue (muscle, fat, and skin) are closed with sutures. In most circumstances you do not see any sutures, because they are all buried under the skin and dissolve over several months.

The midline sternotomy provides the surgeon with excellent visibility and full access to all parts of the heart, which improves the safety and reliability of the surgery. However, this incision takes two to three months to heal, because the divided sternum is a broken bone. The pain from the incision is no worse than from other surgical incisions, but it takes longer to fully recover than patients expect. After the first five days, the incision is not painful at rest, but it does hurt when you cough, sneeze, or exert yourself. By six weeks after surgery, the incision is about 80 percent healed, but it is not fully healed for three months.
Leg — Most patients have a leg incision to allow removal of the saphenous vein, which is used for a bypass. This can be one long incision that extends the entire length of the leg or a series of smaller incisions that leave areas of skin intact. Removal of the vein can also be done with several 1/2-inch incisions and a scope, but this is not performed by all surgeons. There are many other veins in the leg, and the saphenous vein can be removed safely. The incidence of problems with leg incisions is higher than with chest incisions, but 90 percent of the time the leg heals without problems. Most patients have some swelling of the ankle and foot after removal of the vein that lasts six to 12 weeks. Other problems include persistent pain, collection of clear fluid under the skin (seroma), severe bruising, and infection. Leg-incision problems can be very uncomfortable and inconvenient, but they are not usually life-threatening.
Arm — In some circumstances, the surgeon removes the radial artery from the lower arm to use for a bypass. This is usually done through one long incision measuring about 10 inches in length. There are two arteries in the lower arm — the radial artery and the ulnar artery — that connect with each other in the hand. The radial artery can be removed in most patients without compromising hand blood flow. The incision generally heals very well, but some patients have numbness at the bottom of the thumb for several months after removal of the artery.
Will I die or be disabled?

There are two types of risk that are important: 1) the risk of death from the operation, and 2) the risk of complications occurring after surgery. Both types of risk are related to the condition of the patient before surgery and the type of surgery that is planned.

The most common type of heart surgery is coronary artery bypass grafting (CABG). The risk of dying after CABG is approximately 2 percent if all patients are considered together. However, this includes many different types of patients, some of whom are at low risk and some of whom are at high risk for the operation. Most patients fall into a low- or medium-risk group, where the risk of dying is less than 2 percent. The factors that define low risk are strong heart function, younger age, and lack of other serious medical problems (see Table 1). Conversely, some patients have very high risk for surgery, which can be 20 to 30 percent. The factors that define this group are emergency operation, weak heart function, older age and multiple associated medical problems. Determining the risk of death for each patient can be easily calculated, and your doctor should be able to give you a specific number or percentage for this risk.

Table 1

<table>
<thead>
<tr>
<th>Low Risk (&lt;2%)</th>
<th>Medium Risk (2 to 10%)</th>
<th>High Risk (&gt;10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger age (under 60)</td>
<td>1 to 2 elements of high risk</td>
<td>Older age (over 70)</td>
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<tr>
<td>Good heart function</td>
<td>Poor heart function</td>
<td>Poor heart function</td>
</tr>
<tr>
<td>Otherwise healthy</td>
<td>Other medical problems:</td>
<td>Other medical problems:</td>
</tr>
<tr>
<td></td>
<td>• diabetes</td>
<td>• diabetes</td>
</tr>
<tr>
<td></td>
<td>• renal insufficiency</td>
<td>• renal insufficiency</td>
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<tr>
<td></td>
<td>• chronic lung disease</td>
<td>• chronic lung disease</td>
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<tr>
<td></td>
<td>• peripheral vascular disease</td>
<td>• peripheral vascular disease</td>
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<td></td>
<td>• cerebrovascular disease</td>
<td>• cerebrovascular disease</td>
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<tr>
<td></td>
<td>• previous operation</td>
<td>• previous operation</td>
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<tr>
<td>Elective operation</td>
<td>Emergency operation</td>
<td>Emergency operation</td>
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</tbody>
</table>
The other risk is that of complications. Only a few patients die after CABG, but many more have complications, which can be minor or major. The risk of complications is influenced by the same factors that influence the risk of death. In other words, low-risk patients have a low risk of complications as well as a low risk of death, and high-risk patients have a high risk of complications as well as a high risk of death. The major complication that occurs after heart surgery and the overall incidence of these complications are listed in Table 2.

<table>
<thead>
<tr>
<th>Infrequent Problems</th>
<th>Frequent Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg wound problems 5%</td>
<td>Incisional pain 100%</td>
</tr>
<tr>
<td>Lung problems 5%</td>
<td>Fatigue 100%</td>
</tr>
<tr>
<td>after surgery 5%</td>
<td>Sleep disturbance 75%</td>
</tr>
<tr>
<td>Severe bleeding &lt; 5%</td>
<td>Blood transfusion 50%</td>
</tr>
<tr>
<td>after surgery &lt; 5%</td>
<td>Nausea 50%</td>
</tr>
<tr>
<td>Stroke 1-2%</td>
<td>Mental depression 25%</td>
</tr>
<tr>
<td>Myocardial infarction &lt; 5%</td>
<td></td>
</tr>
<tr>
<td>Sternal wound infection/problem 1-4%</td>
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</tbody>
</table>
In a CABG operation, blood vessels are removed from somewhere in the body and used to bypass blood around a blocked coronary artery. These vessels are referred to as conduits, which can be veins or arteries. Veins normally return blood to the heart, whereas arteries normally deliver blood to the body. Veins are designed to carry blood at low pressure and are thin-walled. Arteries are designed to carry blood at high pressure, and they have a stronger and thicker structure. There are only a few vessels in the body that can be removed from their normal spot and used as a conduit without causing a problem in the area from which they were taken.

Located just under the skin’s surface, this vein runs from the ankle to the groin. It was the first vessel to be used on a widespread basis for CABG and is still the most commonly used.

Advantages of using the saphenous vein are:

- It is easily found and not difficult to remove.
- Long lengths can be obtained, which allows the surgeon to do many bypasses.
- There are no serious consequences from removing the vein from the leg except some incisional pain and leg swelling, both of which will resolve with time.

Potential problems with using the saphenous vein are:

- Sometimes it has already been removed because of varicose veins.
- On rare occasions, it is too small, too large or of poor quality, which means it cannot be used.
- The long-term results show that after many years a significant number of saphenous vein bypasses become clogged with atherosclerosis. At the 10-year mark after surgery, approximately 50 percent of vein bypasses are closed.
Located on the inside of the chest cavity, about a 1/2 inch from the breastbone, this artery runs from the collarbone toward the abdomen and normally supplies blood to the breastbone, ribs, chest muscles, and breast. The IMA can be pulled away from the ribs and used as a conduit, because other blood vessels in the area can maintain a satisfactory blood supply to the breastbone. Most often the IMA remains attached at its origin from the subclavian artery, but the remainder of the vessel is mobilized. The cut end of the vessel is then sutured to the coronary artery to complete the bypass.

*Advantages of using the IMA are:*

- It is very resistant to atherosclerosis and almost never becomes blocked, even when the patient has blockages in many other vessels.
- It is about the same size as a coronary artery and makes a good size match.
- Bypasses made with the IMA stay open at a much higher rate in the long term than bypasses made with the saphenous veins.

*Disadvantages of using the IMA are:*

- It is more difficult to harvest and suture the IMA than the saphenous vein.
- The IMA is only about 6 to 8 inches in length and generally can only be used to do one bypass.
- There are two IMA vessels (right and left) but problems with breastbone healing occur at a slightly higher rate if both are harvested, especially if the patient is diabetic, obese, or in poor general condition. Therefore, the use of both IMA vessels is not routinely done except in younger patients.
- Patients may experience chest wall or breast numbness.
Located in the forearm, this artery can be easily felt at the wrist when checking the pulse. This vessel can be removed in most patients without causing a problem, because there is another artery (the ulnar artery) in the forearm that compensates for the missing artery.

Advantages of using the radial artery are:

- It is fairly easy to remove.
- It is an acceptable conduit if the IMA and the SVG are not suitable.

Disadvantages of using the radial artery are:

- Most patients experience some hand/thumb numbness, which is usually minor and temporary but on occasion can be persistent.
- There is a very small risk (one in 1,000) of hand/finger complications resulting in permanent disability if there is a problem with the ulnar artery.
- The vessel is approximately 8 to 10 inches in length and can be used for only one bypass.
- The radial artery is prone to spasm (constriction).
Which valve is right for me?

There are two general types of artificial heart valves: 1) bioprosthetic (tissue) valves, commonly referred to by patients as pig valves, and 2) mechanical valves, commonly called metal valves by patients. Bioprosthetic valves are made from animal tissues draped over an artificial frame.

The original bioprosthetic valves were made from pig heart valves, and these valves are still used. However, the most commonly used bioprosthetic valve is actually made from cow tissues. All animal tissues are sterilized and processed, so there is no risk of infection or rejection from the valve. The advantage of bioprosthetic valves is that they do not require long-term anticoagulation (blood thinners). The disadvantage is that they wear out over approximately 10 to 15 years, which means that the patient might require another heart operation in the future to replace the valve.

Mechanical valves are made entirely from synthetic materials. Patients often refer to them as metal valves, but most modern heart valves are made from a very hard material known as pyrolite carbon. These valves are very durable and do not wear out. However, they require the use of a blood thinner (warfarin). The degree of blood thinning must be kept within a certain range. If it is too little, then clots can occur on the valve. If it is too much, then bleeding can occur. Warfarin is a serious medicine and requires careful management and frequent blood testing to help prevent problems.
Both types of valves work very well, and patient survival is the same with mechanical and bioprosthetic valves. The overall complication rates are also equal, but the specific complications are different. Mechanical valve patients face risks from bleeding and blood clots, and bioprosthetic valve patients face the risks of valve failure and reoperation. The choice of valve type should be discussed with the surgeon before surgery. In the United States, bioprosthetic valve use has increased in recent years. There are a few general guidelines to keep in mind.

1. Warfarin causes birth defects and cannot be safely taken during pregnancy. Therefore, women of child-bearing age usually choose bioprosthetic valves.

2. Patients at high risk for physical injury (race car drivers, policemen, etc.) should not take warfarin and usually choose tissue valves.

3. Patients younger than 60 to 65 may elect mechanical valves because of the reoperation rate with tissue valves.

4. Most patients older than 70 to 75 receive tissue valves, because reoperation for worn out tissue valves is unusual in this age group.
Heart surgery is always performed with general anesthesia, which means the patient is completely unconscious during the operation. This prevents pain, but it also means that the patient does not breathe spontaneously. Therefore, a breathing tube is placed into the trachea (windpipe) after the patient is asleep. The tube is connected to a machine (ventilator) that pushes air in and out of the lungs during and after the surgery.

After heart surgery, patients wake up gradually over a period of several hours. During this time they are only partially aware of the breathing tube. Once they are awake, the tube is removed. It is very uncommon for patients to be significantly bothered by the tube. A few patients require a longer period of time with the breathing tube due to postoperative complications. Some of these patients are uncomfortable with the breathing tube, but this is not common.
**Will I need a blood transfusion?**

Every effort is made to avoid blood transfusion during and after heart operations, but some patients will require blood transfusions. No one knows for sure who will require blood, but good predictions for individual patients can be made. There are three categories we assess to help determine whether a patient will need a blood transfusion:

1. **Emergency operation**, when the patient needs to be operated on immediately because of a heart attack, cardiac arrest, or an unstable situation.

2. **Small blood volume**: Some patients have less blood than others and therefore more often require a transfusion. This group includes females, older patients (older than 70 years), small patients (less than 120 pounds), and patients with anemia.

3. **Medical problems** in addition to heart disease, which include peripheral vascular disease, insulin-dependent diabetes, renal insufficiency, and poor nutrition.

Individually, each category increases the risk of needing a blood transfusion. They also work in an additive fashion. In other words, having more than one category further increases the patient’s chances of requiring a blood transfusion. For example, if the patient undergoing emergency heart surgery is a female older than age 74, she will very likely receive a blood transfusion; this is in comparison to a younger male undergoing an elective operation, who most likely will not.
What are the risks of blood transfusions?

There are small risks related to blood transfusions, and every effort is made to avoid blood transfusions during and after heart operations. The risks are related mostly to transmission of viral diseases, such as hepatitis and AIDS viruses. However, the risks of disease transmission are very low, and the blood supply is safe. Fifteen years ago the risks of blood transfusion were higher because the tests for detecting these diseases were not as good.

<table>
<thead>
<tr>
<th>Virus</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>1 in 1,000,000</td>
</tr>
<tr>
<td>HBV (Hepatitis B)</td>
<td>1 in 130,000</td>
</tr>
<tr>
<td>HCV (Hepatitis C)</td>
<td>1 in 500,000</td>
</tr>
</tbody>
</table>

The above table identifies the risks of contracting a disease from a single blood transfusion. For example, the chance of getting AIDS from a blood transfusion is one in 1,000,000. In other words, if 1 million patients receive a blood transfusion, then one patient will contract AIDS. The average risk of dying from heart surgery is two chances in 100 (2 percent). The logical conclusion is that patients undergoing heart surgery have far greater risks from the surgery than from the risks of blood transfusions.

At Allegheny General Hospital, we also have a Bloodless Medicine and Surgery Center to assist in blood conservation and with those patients who for personal or religious reasons do not want to receive blood transfusions.
Will I be miserable after CABG?

All major operations, including heart surgery, result in incisional pain after surgery. This can be controlled quite well and is not a major problem for most patients. In fact, patients are usually surprised that the surgery was not as painful as they expected.

This is partly because the anesthesia for heart surgery is very powerful and patients are not fully awake until several hours after surgery. In addition, the medicines used for cardiac anesthesia usually include a large dose of narcotics (morphine-like drugs) that provide some pain relief for several hours after surgery.

There is pain in the incision after surgery and during this time, patients receive pain pills or shots, depending on how uncomfortable they are. Most patients receive pills and do not need shots. After this time, the incision does not hurt much unless the patient coughs, sneezes, or puts stress on the incision by lifting or pulling. The incision will continue to be uncomfortable, but not severely painful, for at least six weeks after surgery, but the pain will gradually lessen.

Most patients also experience itching of the incision starting about two weeks after surgery, and many patients notice numbness or tingling on the chest to the left or right of the incision. These sensations are expected and are not cause for concern.

Occasionally, some patients find that touching of the skin with clothing causes discomfort or pain. This will disappear over time and is not a cause for alarm. The incision will usually not be 100 percent healed and pain-free for at least three months after surgery.
How long will I be in the hospital?

The patient’s length of hospital stay after surgery has decreased in recent years. The anticipated hospitalization for otherwise vigorous patients who do not have complications is five days but can be as short as three days or as long as 10 days.

The first 12 to 24 hours after surgery are spent in an intensive care unit. After that, patients move to a regular hospital bed if there are no issues, or to an intermediate unit if minor problems develop. Patients must walk, climb stairs, and care for themselves without assistance before discharge can occur.

If patients are elderly, frail, or in poor condition before surgery, the hospitalization will most likely be longer. Patients who suffer major complications after surgery, such as pneumonia, stroke, or wound infection can remain in the hospital for a long time.
What is a blood thinner and is it safe?

The medical term anticoagulation refers to the use of drugs to reduce blood clotting. Patients usually call these drugs “blood thinners.” There are two types of anticoagulants:

1. **Heparin**, which comes in several forms but must be given by injection.
2. **Warfarin** (common trade name – Coumadin), which comes as a pill and is taken orally.

These two drugs work in completely different ways to achieve roughly the same result, which is to inhibit (slow down) the formation of blood clots. Heparin is used for short-term anticoagulation, usually while a patient is in the hospital, because it acts quickly and can be reversed. It must be given by intravenous or subcutaneous injection and is therefore not practical for long-term use outside of a hospital.

Warfarin is taken orally as a pill. It takes several days to have an effect and several days to wear off. It can be reversed in emergency situations, but this is not necessary very often.

The major complication of anticoagulation is the risk of internal bleeding, such as in the stomach or brain. This is rare if the level of anticoagulation is right, but it can occur if it is too high. The risk of having too little anticoagulation is that the blood may clot. The dose of Heparin is monitored closely in the hospital by the doctors and nurses. Warfarin is a medicine that patients take for long periods of time, and it must be followed closely. The effects of warfarin are hard to predict, so frequent blood testing is necessary to check the level of anticoagulation. Initially, the blood is checked several times per week. After the level has stabilized, it can be checked weekly, then biweekly, then monthly. Many medicines interact with warfarin.
Frequently Asked Questions –

Heart Health and Recovery
If my parent had it, will I get it?

The answer to this question is complex, because there are both genetic and environmental (or acquired) causes for atherosclerosis. At the one extreme, there are individuals from families with extremely high cholesterol levels, all of whom develop atherosclerosis at a young age. This is called familial hypercholesterolemia and is an inherited disease. However, this is an uncommon problem and the vast majority of people with CAD do not suffer from this disease.

In most cases, the disease has many causes and is more acquired than genetic. These factors include:

1. **Smoking**, which of course is entirely under the control of the individual;
2. **High-fat, high-cholesterol diet**, which is chosen by the individual;
3. **Diabetes**, which is caused or made worse by obesity and inactivity; and
4. **Hypertension**, which is often related to obesity.

It is also true that there are genetic factors that make some people more likely to get CAD when exposed to these factors than others. Therefore, if you have a strong family history of CAD, especially at an early age, this should be considered an additional risk factor, but one that can be influenced by lifestyle, diet, and medical interventions.
What is so bad about smoking?

Smoking cessation is the single most important lifestyle change that can be made to improve cardiovascular health. The negative consequences of smoking are many. Most patients know that smoking causes lung cancer, but fewer patients realize that coronary artery disease and heart attack are the most common health problems caused by smoking. Other diseases caused or made worse by smoking are:

- **Emphysema**, in which the lungs degenerate, resulting in chronic shortness of breath.
- **Peripheral vascular disease**, in which atherosclerotic blockages occur in the leg blood vessels, resulting in pain with walking. In some patients, the reduced leg blood flow results in amputation of the legs.
- **Cerebrovascular disease**, in which atherosclerotic blockages occur in the blood vessels to the brain. This is the most common cause for stroke.
- **Erectile dysfunction**, when a man is unable to achieve a penile erection. Smoking causes this by damaging the small blood vessels necessary for erection.
- **Cancer of the oral cavity**, in which the risk of cancer in many tissues — including the mouth, tongue, larynx, esophagus and lung — is increased.

The mechanisms by which smoking causes diseases are complex. In general terms, tobacco smoke contains many chemicals and substances that the patient breathes into the body. Nicotine is one of these, but there are many others. These chemicals are toxic to various tissues of the body. All forms of tobacco are toxic and should be stopped. This includes cigarettes, cigars, pipes, chewing tobacco, and snuff.
Can I get help to quit?

It is not easy to quit smoking. In essence, people who smoke are addicted to cigarettes in the same way that others are addicted to drugs or alcohol. Various methods have been developed to help smokers quit. The addicting chemical in tobacco is nicotine. Several nicotine-containing formulations — such as nicotine patches, sprays, and gum — are available as substitutes for cigarettes. The idea is that the patient can quit smoking by switching to another source for nicotine. This source is then gradually discontinued at which point the patient is free of cigarettes and nicotine. This is an attractive concept, however, the success rates with this approach have been only slightly better than just quitting. Recently, a pill was approved to help smokers quit. The pill has an effect on the brain, which reduces the craving for cigarettes. Used in combination with a nicotine substitute, this approach results in a higher success rate than any other method.

After heart surgery, a patient has an opportunity and huge motivation to quit. Smoking is not permitted in the hospital, which gives patients a one-week head start. While the patient is in the hospital, all cigarettes, lighters, matches, and other items associated with smoking should be discarded. Smoking by family members, guests, and friends also needs to be forbidden in the home. With the support and encouragement of family members, friends, and the family doctor, most patients — after a major event such as heart surgery — can remain tobacco-free without the need for patches or pills.
Why is cholesterol bad?

Cholesterol is a fat-like substance produced by your body in the liver. It is classified as a lipid and is essential to your body’s function. Cholesterol is a necessary part of cell membranes, which are the envelopes surrounding each cell. In addition, cholesterol plays an important role in your body’s production of vitamin D, bile, and some hormones. Without cholesterol, the body would not be able to perform these basic operations.

There are two sources for the cholesterol that is in your body. The liver makes cholesterol, and cholesterol is absorbed from food that you eat. The liver is the storehouse for cholesterol. To move from the liver to the cells, cholesterol travels through the blood stream in a carrier. These carriers are called lipoproteins, because they contain a mixture of fats and proteins.

The lipoprotein that carries cholesterol from the liver to the body cells is called low-density lipoprotein (LDL), which is sometimes called “bad cholesterol” because it causes atherosclerosis. These lipoproteins are only “bad” when the levels are high and damage occurs to the inside lining of the blood vessels, resulting in atherosclerotic plaque. When the plaque builds up and the passage for the blood becomes restricted, this condition is known as atherosclerosis, which is a leading cause of coronary artery disease.

Another form of cholesterol is known as high-density lipoproteins (HDL), also called “good cholesterol.” The HDL transports cholesterol from the body back to the liver, which reduces the accumulation of cholesterol in the blood vessels. A high HDL level helps protect against atherosclerosis.
Knowing your total cholesterol level is important, but it is more beneficial to determine your HDL and LDL levels independently. In addition, it is also helpful to compare your total cholesterol and HDL levels, by dividing total cholesterol by the HDL. The ratio of total cholesterol/HDL is a good predictor of your risk of coronary artery disease. Another ratio that may be a helpful predictor of your risk of CAD requires your LDL level to be divided by your HDL. The following table contains some basic guidelines that indicate when a cholesterol reading may suggest a higher risk for coronary artery disease:

<table>
<thead>
<tr>
<th></th>
<th>Low Risk</th>
<th>Borderline</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol</td>
<td>&lt; 200</td>
<td>200-240</td>
<td>&gt; 240</td>
</tr>
<tr>
<td>HDL</td>
<td>&gt; 40</td>
<td>30-40</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>LDL</td>
<td>&lt; 130</td>
<td>130-150</td>
<td>&gt; 150</td>
</tr>
<tr>
<td>Total cholesterol/HDL</td>
<td>&lt; 3.5</td>
<td>3.5-4.0</td>
<td>&gt; 4.0</td>
</tr>
</tbody>
</table>

If you have coronary artery disease, then the cholesterol needs to be lowered more aggressively than if you are well. In this circumstance, the target for total cholesterol should be 150 and the LDL should be less than 100. Nearly all patients who have had CABG should be on a cholesterol-lowering medicine.
Many people in the United States are overnourished. That is, they eat too much food and too much fat. This diet results in obesity, high blood cholesterol levels, hypertension, and diabetes, all of which contribute to coronary heart disease. If you have had a heart attack, angioplasty, or CABG, it is essential for you to modify your diet to help prevent further problems. Many people have a hard time accepting that the food they enjoy can cause health problems, but there is no question that it does. In countries where low-fat and low-calorie diets are common, coronary heart disease is rare. When people from these countries change to a high-calorie, high-fat diet, they develop heart disease at a rate similar to that in the United States.

Patients frequently share stories of their parents and grandparents who ate very high-fat diets and lived to an old age. This might be true for some people, but the health statistics show a different story. The number of deaths from heart attacks was much higher 50 years ago than it is today. The improvement is due mostly to dietary changes that have occurred in the population during this period. There has been progress, but we must continue to do better.

There are two main reasons why fatty foods should be reduced in your diet. The first is that fatty foods are very high in calories in comparison to low-fat foods. The amount of food we consume can be measured in grams, which is a measurement of weight. Fat has 9 calories/gram, whereas protein and carbohydrates have only 4 calories/gram. In other words, if you eat 100 grams of fat, you consume 900 calories. If you eat the same amount of carbohydrates or protein, you consume only 400 calories. Therefore, if you reduce the amount of fat in your diet, you can lose weight without reducing the total quantity of food you consume.
The second reason why fat intake should be reduced is that most fats elevate the cholesterol levels in the bloodstream, which is a major cause of coronary heart disease. This is especially true of saturated animal fat, which is contained in meat, milk, cream, butter, and cheese. Unsaturated or monosaturated fats are not as harmful. Many foods contain partially hydrogenated fats, which means the fats were unsaturated to start with but were partially saturated (hydrogenated) to improve the consistency or taste. Margarine is an example of this. These are intermediate in their degree of harm and should be avoided if possible. Olive oil and canola oil are vegetable fats that actually reduce your cholesterol level. Therefore, they are good substitutes for other oils or fats in the diet. Palm oil and coconut oil on the other hand raise blood cholesterol levels and should be eliminated from the diet.

A number of dietary programs have been shown to reduce cardiovascular events, such as heart attack, stroke, and death. In general, all of these diets involve a large reduction of dietary fat intake, especially saturated animal fat, which is found in fatty meats, dairy products, snack foods, pastries, and cookies. Instead of fat, patients should increase their intake of fruits, fish, vegetables, and whole grains. The American Heart Association and the National Institutes of Health provide specific dietary plans; sources for these are listed in the appendix. In addition, a Mediterranean diet has also been shown to be effective in improving cardiovascular health. This type of diet features grilled lean meats, vegetables, and whole grains and makes liberal use of olive oil, which has been shown to lower blood cholesterol levels. Some patients prefer this type of diet to the strict low-fat diet, but both approaches are effective. The key issue is to reduce the intake of saturated fat and increase the intake of fruits, vegetables, and grains.
Undergoing surgery and staying in the hospital places stress on the body which sometimes causes your blood sugar to be high. This may occur in patients who have diabetes and those that do not have diabetes. After heart surgery, high blood sugar can lead to complications. Surgical standards prove that good blood sugar control helps to minimize infections.

Upon your arrival to the hospital, the nursing staff will be taking your blood sugar via a blood test. If your blood sugar is high, the physicians or nursing staff will start an IV and give you insulin in an IV bag. Insulin will help to bring your high blood sugar into normal range. The IV with insulin is called an insulin drip and will be monitored closely by doctors and nurses. You may have the insulin drop for a day or two after surgery.

The physicians who will be watching your blood sugar are known as endocrinologists. They will come in the day after surgery to determine the best way to manage your blood sugar. If your blood sugars are normal, the physicians may decide to stop the insulin drip and place you on other medications that control blood sugar.

Once you are ready to eat, your first meal will be a sugar free clear liquid diet. After this, you will be started on a “low or moderate carbohydrate” diet which will help to keep your blood sugars in normal range. Please inform your family that you will be on a special diet while in the hospital and not to bring in outside foods at this time.

After you are discharged home, you may or may not need to continue to take medications for your blood sugar. The endocrinologists at Allegheny General Hospital will help determine the best plan for your recovery.
What is blood pressure and why is it important?

Your blood pressure measures the force exerted on the arterial wall by the blood. Blood pressure levels are recorded with two numbers, for example 120/80. The top number is the systolic pressure, which is the force exerted on the artery when the heart is contracting. The bottom number is the diastolic pressure, which is the force exerted on the artery when the heart is resting. The current definition of high blood pressure is a systolic pressure of 140 mmHg or higher; a diastolic pressure of 90 mmHg or higher; or both. High blood pressure causes damage to the blood vessels, which can result in heart attack or stroke, and increases the workload of the heart, which can result in heart failure. The optimal blood pressure is usually 120/80 or less.
Maintaining a regular exercise program is an essential component of a heart-healthy lifestyle. The benefits of exercise are numerous, with the major health advantages identified below:

- Exercise helps patients lose weight by burning more calories.
- Exercise can lower blood pressure by causing weight loss and by improving cardiovascular fitness.
- Exercise lowers blood sugar, which is important for diabetic patients.
- Regular exercise raises HDL and lowers LDL levels in the blood, which helps to prevent atherosclerosis.
- An exercise program makes patients feel better, sleep more soundly, and improve energy levels.

The major questions about exercise are how much and what type is necessary to obtain the desired benefits. The cardiovascular health benefits of exercise occur at a lower level than that necessary to achieve a training effect for athletic competition. Recent evidence shows that approximately 30 minutes per day of aerobic activity six times per week is sufficient. The type of exercise does not matter as long as it involves steady light to moderate exertion. Walking, swimming, bicycling, treadmill walking, and stationary cycling are all effective forms of exercise. More rigorous exercise, such as running, is also effective but not required to improve your health and may result in minor injuries.

It is not necessary to exercise to the point of discomfort to obtain the desired benefits, unless the individual plans to enter competitive endurance sports, which is not the usual case after heart surgery. The easiest and most effective lifestyle change that can be made after heart surgery is implementing an exercise program that the patient can maintain for a lifetime.
Can I have a few drinks after surgery?

The effects of alcohol on the heart have been studied in great detail. Recent data clearly shows that small amounts of alcohol are beneficial to the heart for patients with atherosclerosis. Alcohol raises HDL levels (“good cholesterol”), and alcoholic beverages also contain other substances that may be partially protective. The incidence of stroke, heart attack, and death from cardiac causes is slightly lower in light drinkers than in non-drinkers.

The key feature of this relationship is in the definition of light alcohol consumption. In all of the studies, this is defined as one to two drinks per day, consisting of either beer, wine, or a mixed drink. Of the three options, it appears that wine, especially red wine, is the best for the heart. For those people who do not drink alcohol, purple grape juice also has a beneficial effect. To benefit, the patient should have one to two drinks per day. High alcohol consumption — defined as greater than two to three drinks per day or intermittent binge drinking — is harmful to the heart by a direct toxic effect on the heart muscle. Heavy drinking also raises the blood pressure, injures the liver, and increases the incidence of cancer.
Coronary bypass surgery and other procedures such as angioplasty and stenting are repairs of existing blockage, but they do not prevent new blockages from occurring. Therefore, it is essential to modify the factors that caused the problem, which is discussed in detail earlier in this booklet. Only a small percentage (10 to 20 percent) of patients who have CABG require another operation. Most patients make major lifestyle changes after CABG, which help them stay healthy and avoid future operations.

Several practical factors exist that influence the need for repeat procedures or operations, including:

- The age at which the first operation was done. The younger the patient’s age at the first operation, the more likely it is that additional procedures will be needed.
- The degree to which the risk factors are reduced. If you quit smoking, change your diet, lose weight, exercise, and reduce your cholesterol level, then your odds for more problems are reduced.
- The use of arterial grafts at the first operation, especially the internal mammary artery. The internal mammary arteries are very resistant to atherosclerosis. If one or both of these are used, the need for re-intervention is decreased.
What can I expect after going home?

• **Lack of appetite:** Eat small, frequent meals. Eat foods you like and drink supplemental shakes. Avoid taking pills on an empty stomach.

• **Fatigue and sleeplessness at night:** No napping during the day. If awake at night, get out of bed and keep busy. Stay awake in the daytime. The sleep cycle will eventually regulate itself without the need for sleeping pills.

• **Pain:** Everyone should take some sort of pain medication, whether it is over-the-counter pills or prescription medication. This will reduce pain and allow you to increase your activity. You will not become addicted. The soreness will take a few months to totally resolve, and it is normal to have some muscular spasms. The application of moist heat coupled with pain medication will maximize your comfort.

• **Swelling of the leg:** Swelling of the leg where the vein was removed is normal. The leg swelling will be better in the morning and will worsen through the day due to gravity. During the day you should elevate the leg for several hours, so the leg is higher than your armpit.

• **Feeling depressed:** It is common to feel depressed after surgery. This will eventually resolve. Set small short-term goals and a regular daily schedule including meals, exercise, and activities. Gradually increase the time and frequency of these to recondition your body to tolerate the activity you had prior to surgery. This will improve your outlook on your convalescence.

• **Incisional care:** Wash your incision with soap and water and keep it clean and dry. Do not apply lotions, powder, ointments, or creams in the first six weeks after surgery. Call your surgeon if you experience any redness or drainage from your incisions to receive directions on how to care for them.
Recovery from any major operation such as heart surgery is gradual. In the first week after discharge from the hospital, the major tasks involve resuming the activities of daily living, such as showering, using the toilet, and getting around inside the house. Climbing stairs is permitted but should be considered a major effort that may require some supervision. Approximately two weeks after surgery, patients feel strong enough to start walking outside or riding in the car (as a passenger). Thereafter, recovery is usually steady, so by four weeks after surgery most patients have recovered about 75 percent of their strength. Complete recovery to full activity generally requires at least three months. The skin incisions are usually fully healed by six weeks, but the breastbone will not be at full strength for about three months after surgery. The following is a list of common activities and a schedule of when they can safely be undertaken.

Patients should not drive the car for four to six weeks after surgery. This allows time for the sternal bone to strengthen and ensures that the patient will be mentally alert and physically stable.

Most programs start at roughly six weeks after surgery, but this can safely be started sooner (four weeks) in some cases.

Light activities such as preparing meals and cleaning dishes can be undertaken at two to four weeks after surgery. Activities that require more effort — such as cleaning and vacuuming — should wait until six to eight weeks after surgery. Heavy work such as moving furniture or heavy lifting should not be done before three months.

What will I be able to do?

**Driving**

Patients should not drive the car for four to six weeks after surgery. This allows time for the sternal bone to strengthen and ensures that the patient will be mentally alert and physically stable.

**Cardiac Rehabilitation**

Most programs start at roughly six weeks after surgery, but this can safely be started sooner (four weeks) in some cases.

**Household Chores**

Light activities such as preparing meals and cleaning dishes can be undertaken at two to four weeks after surgery. Activities that require more effort — such as cleaning and vacuuming — should wait until six to eight weeks after surgery. Heavy work such as moving furniture or heavy lifting should not be done before three months.
Outdoor Activities

Vigorous activities such as shoveling snow, cutting grass, trimming trees, and operating a rototiller should wait at least three months. Lighter activities such as planting, weeding, and light raking can be started at six weeks.

Sports and Recreation

Golf — At six weeks you can begin working on the short game (putting, chipping, pitching, sand play), but you will not be comfortable with the full swing for three months.

Bowling — Three months.

Hunting — Three months.

Fishing — Six weeks for light fishing, preferably with a companion.

In the long term, there will be no limitations to activity for most patients. The only real limitation is the motivation and dedication of the patient to resume full activity.
Is sex safe after heart surgery?

Most patients and their partners are apprehensive about sexual activity after heart surgery. The major concerns are that a heart problem will occur or that the incision will be damaged during sex. Neither of these issues should prevent a couple from resuming normal relations. The heart recovers quickly after surgery and is usually stronger and more stable several weeks after surgery than it was before. Until the incision is fully healed certain situations will be uncomfortable, but the patient will be comfortable lying on his or her back. The physical demands of sexual activity are not much more than climbing a flight of stairs, which means that sexual activity can be resumed two to three weeks after returning home. Many patients will not feel confident enough for four to six weeks.

Another issue for men with cardiovascular disease is erectile dysfunction. This is not uncommon, especially if the patient has diabetes, peripheral vascular disease, or is a smoker. Some cardiac medicines, especially beta-blockers such as Lopressor or Tenormin can also cause this problem, but these medicines should not be stopped without discussing the issue with a doctor.

The use of Viagra after heart surgery is safe, but a prescription for Viagra should be obtained from a doctor who knows the patient’s medical condition. Viagra should not be used before six weeks after surgery. In addition, patients using Nitroglycerin (pills, patches, spray) should not take Viagra, because the combination of these two medications can cause a dangerous drop in blood pressure.
When will I feel well?

The initial stay in the hospital after heart surgery is approximately five days. Some patients are discharged to home sooner than this (three to four days), and many patients stay for longer (six to seven days). If problems occur during or after surgery, the duration of hospitalization can be longer.

Your recovery starts as soon as the operation is completed. You will be asleep when you arrive in the cardiac surgery ICU, however, you will start to wake up within several hours. As soon as you are fully awake, the breathing tube will be removed, which is usually between six and 12 hours after the operation. In most cases you will be transferred to a regular room the next day. You will be sitting in a chair on the first day after surgery and walking to the bathroom on the second day. By the third day, you should be able to walk in the hospital hallway. Before you go home, you will be walking without assistance and be able to climb steps slowly.

The first week at home can be a little discouraging. You will be tired, have trouble sleeping, and have some pain from the incision. Your care is now managed by you and your family rather than the hospital staff. If arrangements were made before you left the hospital, a nurse will come to your home to check on your progress. The nurse can answer many questions and will call a doctor if there are problems.

Most patients are feeling much better by two weeks after surgery and make rapid progress after that. By four weeks after surgery, you will feel about 75 percent normal, but you will not be 100 percent recovered for at least three months.
How soon can I go back to work?

Most patients do not return to work until three months after surgery. This is especially true if your job involves physical labor, such as lifting, climbing, or driving. If your job involves mostly desk work, you can sometimes return to work in six weeks, but most people prefer to wait two to three months. If you must return to work to avoid losing your job or because you have no income while you are off, this can be done in most cases after six weeks. Those lucky individuals who can work half days, light duty, or part-time can return sooner than those who must resume their job full-time as soon as they return. Do not underestimate how tired you will feel after surgery. Heart surgery is a major life event, and you should not resume the problems and stresses that come with a job until you are fully recovered.
Appendices

Glossary of Medical Terms and Abbreviations

Summary of Common Types of Medicine

References

Coronary Vessels
Glossary of medical terms and abbreviations

Hospital Locations
ICU: Intensive Care Unit
SICU: Surgical Intensive Care Unit
MICU: Medical Intensive Care Unit
CCU: Coronary Care Unit
Cath Lab: Cardiac Catheterization Laboratory
Intermediate Unit: Also called the stepdown unit. This unit is more intensive than a regular hospital floor, but less than the ICU.

Medical Terms

Myocardial Infarction (MI): Heart damage caused by closure of a coronary artery; also called a heart attack.

Angina: Heart pain caused by inadequate blood to the heart muscle. This is usually caused by a blocked coronary artery.

Transient Ischemic Attack (TIA): A mini-stroke that resolves within 24 hours.

Cerebrovascular Accident (CVA): Stroke, which can be from an atherosclerotic blockage or from bleeding in the brain.

Chronic Obstructive Pulmonary Disease (COPD): Chronic lung disease, usually caused by smoking.

Coronary Artery Disease (CAD): A disease in which the coronary arteries become clogged with atherosclerotic plaque, composed of cholesterol.

LV Function: The capacity or strength of the left ventricle (LV) to contract.

Ejection Fraction (EF): This is a measure of LV function, which is reported as the fraction of blood ejected (or pumped) from the heart with each beat. Normal EF is 60 percent; less than 30 percent is a very weak heart.

Congestive Heart Failure (CHF): A condition resulting from a weak heart in which a patient retains fluid.

Blood Pressure (BP): The pressure inside the arteries. The pressure is the result of blood pumped by the heart and constriction of the blood vessels.

Systolic Blood Pressure: The blood pressure in the arteries while the heart is contracting. This is the top number when BP is recorded as two numbers.

Diastolic Blood Pressure: The pressure in the arteries during the time between heart beats, when the heart is relaxing. This is the bottom number when BP is recorded as two numbers.
**Heart Rhythm**

**Rhythm:** The pattern of the heart rate, such as regular, irregular or fast/slow.

**Tachycardia:** A fast heart rhythm, usually greater than 100 beats per minute.

**Bradycardia:** A slow heart rhythm, usually less than 60 beats per minute.

**Arrhythmia:** An abnormal heart rhythm.

**Atrial Fibrillation (AF):** An irregular rhythm caused by an irregular atrial rhythm. Frequently this rhythm is also fast, but it can be slow. In most circumstances this is not a dangerous situation.

**Ventricular Fibrillation (VF):** A heart rhythm caused by irregular and ineffective ventricular contractions. This causes death unless promptly treated.

**Ventricular Tachycardia (VT):** A fast heart rhythm caused by abnormal ventricular beats. This is a dangerous rhythm that needs to be treated promptly to avoid death or syncope (passing out).

**Heart Operations and Procedures**

**Coronary Artery Bypass Grafting (CABG):** An operation in which substitute blood vessels are used to divert blood around a blocked coronary artery.

**Aortic Valve Replacement (AVR):** Replacement of the aortic valve, which is the outlet valve of the left ventricle.

**Mitral Valve Replacement or Repair (MVR):** Replacement or repair of the mitral valve, which is the inlet valve of the left ventricle.

**Repair of Thoracic Aortic Aneurysm:** Replacement of an enlarged or damaged aorta, which is the large blood vessel into which the heart pumps the blood.

**Percutaneous Transluminal Coronary Angioplasty (PTCA):** A catheterization procedure in which a balloon catheter is expanded inside a coronary artery to open a blocked vessel.

**Stenting:** A catheterization procedure in which a wire cylinder is placed inside a vessel to keep it open.

**Atherectomy:** A catheterization procedure in which the blockage is removed.
Summary of common types of medicine

**Diuretics (water pill)**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lasix</td>
<td>Furosemide</td>
</tr>
<tr>
<td>Bumex</td>
<td>Bumetanide</td>
</tr>
</tbody>
</table>

**Mechanism**
- Promotes loss (elimination) of sodium in the urine. Potassium and magnesium are also lost.

**Effects**
- Lowers blood pressure
- Prevents fluid retention

**Uses**
- Treatment of hypertension
- Treatment and/or prevention of fluid retention

**Side Effects**
- Dehydration
- Loss of sodium, potassium and magnesium in the urine

**Beta Blockers**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inderal</td>
<td>Propanolol</td>
</tr>
<tr>
<td>Lopressor</td>
<td>Metoprolol</td>
</tr>
<tr>
<td>Tenormin</td>
<td>Atenolol</td>
</tr>
</tbody>
</table>

**Mechanism**
- Blocks receptors on the heart and blood vessel cells, which lowers blood pressure and reduces the energy used by the heart during contraction.

**Effects**
- Slows heart rate
- Reduces blood pressure

**Uses**
- Treatment of hypertension
- Treatment of angina (heart pain) from coronary artery blockage

**Side Effects**
- Light headedness from slow heart rate and lower blood pressure
- Fatigue
**Calcium Blockers**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardizem</td>
<td>Diltiazem</td>
</tr>
<tr>
<td>Procardia</td>
<td>Nifedipine</td>
</tr>
<tr>
<td>Calan</td>
<td>Verapamil</td>
</tr>
<tr>
<td>Norvasc</td>
<td>Amlodipine</td>
</tr>
</tbody>
</table>

**Mechanism**
- This class of medicines acts by blocking calcium channels in heart and blood vessel cells, which lowers blood pressure and reduces the energy used by the heart during contraction.

**Effects**
- Lowers blood pressure
- Slows heart rate

**Uses**
- Treatment of hypertension
- Treatment of angina (heart pain) due to blockage in the coronary arteries

**Side Effects**
- Very few; generally well-tolerated by most patients

**Inotropes (heart stimulants)**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
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</thead>
<tbody>
<tr>
<td>Dobutrex</td>
<td>Dobutamine</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Dopamine</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>Epinephrine</td>
</tr>
</tbody>
</table>

**Mechanism**
- Stimulates adrenergic receptors on the heart and blood vessels.

**Effects**
- Strengthens cardiac contractions, which increases the amount of blood pumped by the heart (cardiac output)

**Uses**
- Stimulates a weak or sluggish heart after surgery or after a heart attack

**Side Effects**
- Fast heart rate (tachycardia)
- Extra heartbeats (arrhythmia)
**Antiplatelet Drugs**

**Trade Name** | **Generic Name**
---|---
Aspirin | Acetylsalicylic acid
Plavix | Clopidogrel

**Mechanism**
- Inhibit platelet aggregation and degranulation.

**Effects**
- Serves as a mild blood thinner to prevent blood clots forming on atherosclerotic plaques.

**Uses**
- Prevents heart attacks and strokes; adjunct in stent implantation

**Side Effects**
- Stomach irritation (aspirin)
- Bleeding

**Anticoagulant**

**Trade Name** | **Generic Name**
---|---
Heparin | Heparin
Warfarin | Coumadin

**Mechanism**
- Interferes with the blood clotting system.

**Effects**
- Prevents blood clotting
- Acts as stronger blood thinner than aspirin

**Uses**
- Prevents blood clotting during heart surgery or heart cath (Heparin)
- Prevents blood clots from forming in the heart or on heart valves (Coumadin)

**Side Effects**
- Major or minor bleeding
ACE Inhibitor

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capoten</td>
<td>Captopril</td>
</tr>
<tr>
<td>Vasotec</td>
<td>Enalapril</td>
</tr>
</tbody>
</table>

Mechanism
- Inhibits angiotensin-converting enzyme.

Effects
- Lowers blood pressure
- Reduces deterioration of heart function in heart failure and after myocardial infarction

Uses
- Treatment of hypertension
- Treatment of congestive heart failure

Side Effects
- Cough
- Kidney damage

Nitroglycerin (NTG)

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTG tablets</td>
<td>Nitrostat</td>
</tr>
<tr>
<td>NTG patches</td>
<td>Transderm-Nitro</td>
</tr>
<tr>
<td>NTG spray</td>
<td>Nitrolingual spray</td>
</tr>
</tbody>
</table>

Mechanism
- Relaxes blood vessels.

Effects
- Increases blood flow, but can lower blood pressure

Uses
- Treatment or prevention of angina (heart pain), by increasing blood flow to the heart muscle

Side Effects
- Headache
Statins

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipitor</td>
<td>Atorvastatin</td>
</tr>
<tr>
<td>Zocor</td>
<td>Simvastatin</td>
</tr>
<tr>
<td>Pravachol</td>
<td>Pravastatin</td>
</tr>
</tbody>
</table>

**Mechanism**
- Interferes with the synthesis of cholesterol in the liver.

**Effects**
- Lowers total and LDL cholesterol
- Stabilizes atherosclerotic plaques

**Uses**
- Treatment of patients with high cholesterol

**Side Effects**
- Muscle aches (common)
- Severe muscle damage (very rare)
- Liver injury (rare)

Digitalis Glycosides (Digoxin, Digitoxin)

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
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<tbody>
<tr>
<td>Digoxin</td>
<td>Digoxin</td>
</tr>
<tr>
<td>Lanoxin</td>
<td>Digoxin</td>
</tr>
<tr>
<td>Digitoxin</td>
<td>Digitalis</td>
</tr>
</tbody>
</table>

**Mechanism**
- Increases the force of cardiac contraction and slows the heart rate.

**Uses**
- Treatment of congestive heart failure
- Control the heart rate in atrial fibrillation

**Side Effects**
- Minimal side effects when the blood level of digoxin is right, but many side effects if the blood level gets too high
- Extra premature heartbeats (PVCs)
- Very slow heart rate
- Visual changes, nausea, dizziness
**Antiarrhythmics**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cordarone</td>
<td>Amiodarone</td>
</tr>
<tr>
<td>Quinaglute</td>
<td>Quinadine</td>
</tr>
<tr>
<td>Procan</td>
<td>Procainamide</td>
</tr>
</tbody>
</table>

**Mechanism**
- Alters ion channel transport of electrolytes in heart cell membranes.

**Uses**
- Prevention and treatment of atrial fibrillation
- Treatment of ventricular arrhythmias

**Side Effects**
- Lung and thyroid problems (amiodarone)
- Complex arrhythmias (quinadine, procainamide)
- Low platelet count (quinadine)
- Lupus-like syndrome (procainamide)

**Viagra**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viagra</td>
<td>Sildenafil</td>
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</tbody>
</table>

**Mechanism**
- Relaxes blood vessels and increases blood flow to the penis.

**Uses**
- Helps achieve a penile erection

**Side Effects**
- Headache
- Flushing
- Dyspepsia (sour stomach)
- Nasal congestion
- Visual changes
References

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*American Heart Association Quick & Easy Cookbook: More Than 200 Healthful Recipes You Can Make in Minutes*
The American Heart Association

*The Healthy Heart Walking Book: The American Heart Association Walking Program*
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*State of the Heart The Practical Guide to Your Heart and Heart Surgery*
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http://www.myheartwatch.org

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http://www.nhlbi.nih.gov/health

*The National Coalition of Women with Heart Disease (WomenHeart)*
womenheart.org

*Centers for Disease Control*
http://www.CDC.gov/NCCDPHP/CVD

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*Harvard Heart Letter*
http://www.berkeleywellness.com
Coronary vessels

Human Heart
Questions for your doctor