Minimally Invasive, Robot-Assisted Heart Bypass Surgery

This patient handout is for you if you (1) have coronary artery disease or are about to undergo coronary angiography; (2) have stable angina or no angina; and (3) have not had a recent heart attack. It is NOT for pregnant women and NOT for people with congenital heart defects, heart valve disease, or cardiomyopathy unrelated to coronary artery disease.

If you have coronary artery disease or stable angina (chest pain), or if you are about to undergo coronary angiography (a procedure to x-ray your heart’s blood vessels after a dye is inserted into them), making decisions can be difficult. There is a lot of information to sort through, often in a short period. It’s important for you to know about your treatment choices and how they compare.

You have 3 main treatments for coronary artery disease to choose from:
(1) medical therapy (taking prescribed drugs)
(2) angioplasty, a procedure to eliminate narrowing of blood vessels by inserting and inflating a balloon-tipped catheter, usually including placement of stents (devices to support blood vessels)
(3) bypass surgery

All of these treatments provide similar benefits in preventing heart attacks and in helping you live longer. However, the treatments differ in how well they relieve angina symptoms and in their possible harms. The treatment decision often depends on how you feel about your angina symptoms and how much risk you are willing to take to try to relieve them.

Although you may think that your doctor should decide which treatment is right for you, your point of view and your preferences really matter. Once you understand your treatment choices, you and your doctor can discuss what’s important to you and make the decision together. You may then be more satisfied with not only the decision but also the results.
Here’s some background information on 2 conditions to try to avoid:

**Unstable angina**
Angina becomes unstable when it starts to happen more frequently than it used to, or at times when it did not happen before. For example, your doctor would say your angina has become unstable if you used to get it only when you exercised but then started getting it when at rest. Unstable angina is dangerous and can signal a heart attack.

**Heart attack**
A heart attack happens when the blood flow through a coronary artery is completely blocked. An artery can become completely blocked by (1) plaque (a deposit of fatty material) that gets so big that it cuts off blood flow or (2) a blood clot, which can form when plaque breaks open. In either case, such blockages prevent blood and oxygen from reaching part of the heart muscle. As a result, that part of the muscle can become damaged.

Scientists used to believe that most heart attacks happened when a large plaque completely blocked a coronary artery. But not all plaques are alike. In fact, it now appears that large plaques cause only about 15% of heart attacks.

Many heart attacks involve a different kind of plaque. In these cases, it’s not the size of the plaque that causes problems, but rather its tendency to break open or rupture. Even if the plaque is small, it can trigger a blood clot that blocks the artery and causes a heart attack.

Preventing heart attacks requires slowing the buildup of plaque and stabilizing the plaque that’s already in the arteries so that it’s less likely to rupture.

**Diagnosis**

Angiography (sometimes called cardiac catheterization) is a diagnostic test; the resulting x-ray is called an angiogram. During angiography, a thin tube called a catheter is threaded through an artery in your arm or leg into the coronary arteries. A dye that’s visible in x-rays is then injected through the catheter, allowing your doctor to see which coronary arteries have plaque in them and how much those arteries are narrowed by the plaque. This information helps determine how much heart muscle is at risk of damage if a heart attack occurs.

Doctors label plaques as large if they block 70% or more of the space inside the artery. If you have large plaques in 1 or more arteries, your doctor may suggest trying to fix the blockages right away with angioplasty.

Angioplasty is a treatment that involves the use of a catheter (like the one used in angiography, the diagnostic test). During angioplasty, a deflated balloon is inserted into the narrowed coronary arteries and inflated to compress the plaque. Tiny mesh tubes called stents are usually placed in the arteries to help prop them open. Stents are made of
metal; some, called drug-eluting stents, are coated with medications that help lower the chance that the treated area will narrow again.

Although angiography and angioplasty are 2 separate procedures, they are often done at the same time. Proceeding immediately to angioplasty may seem to make sense because the catheter from the angiography is already in place. But the downside is that it’s difficult for you to participate in making decisions during angiography; you may not have a chance to talk with your doctor about whether angioplasty and possibly stents are the best choice for your situation. In some cases, medications may be just as effective, with fewer risks. In other cases, bypass surgery may be better.

Therefore, before undergoing angiography, talk to your doctor. Discuss the what-ifs. When might you want to wait and talk about the results of the angiography before deciding on a treatment?

You can be undergoing angiography, a blockage can be found, and the decision to perform angioplasty could be made right then and there. Sometimes that’s the right decision, and sometimes it might be to your advantage to think about it before you proceed.

Treatment Choices

Your treatment choices may differ depending on your age; your overall health; the number, location, and severity of the plaques in your coronary arteries; and any treatment you have already had. What’s more, the 3 main treatments for coronary artery disease (medical therapy; angioplasty, usually including stents; and bypass surgery) often overlap. Most people who undergo angioplasty or bypass surgery also take medications, and some may undergo additional procedures later.

The goals of all 3 treatments are the same:

- Relieve angina symptoms
- Prevent heart attacks
- Help you live longer

It’s important to consider the possible benefits and harms of each treatment when making your choice.

(1) Medical Therapy

Each of the medications used to treat coronary artery disease plays a different role in keeping you healthy. The medications can be divided into 2 general categories:

- Survival medications (those that reduce the risk of a heart attack and help you live longer), including statins; angiotensin-converting enzyme (ACE) inhibitors, or, if
you can’t tolerate ACE inhibitors, angiotensin-receptor blockers (ARBs); and anticlotting drugs (such as aspirin)

- Symptom medications (those that help you feel better), including nitrates (nitroglycerin) and calcium-channel blockers

Basically, for a year, I have had no angina pain at all. I can’t recall a single occasion of having the kind of pain that I was having prior to the diagnosis and prior to going on the medication.

~ patient who chose medical therapy

Benefits and Harms
Out of 100 people in the first year after starting medical therapy:

- 71 will have angina symptom relief, and 29 will not.
- 96 will not have a heart attack, and 4 will.
- 97 will still be alive, and 3 will not.
- 90 will not undergo angioplasty or bypass surgery, and 10 will.

If you choose medical therapy, it may well allow you to delay or avoid angioplasty or bypass surgery. More than half of people who take medications for coronary artery disease do not need either of those procedures up to 5 years later.

(2) Angioplasty and Stents

Doctors typically use angioplasty (with or without stents) only on arteries that are blocked by at least 70%. However, they will use angioplasty on the left main coronary artery if it is blocked by at least 50%.

Benefits and Harms
Out of 100 people in the first year after undergoing angioplasty:

- 80 will have angina symptom relief, and 20 will not.
- 94 will not have a heart attack, and 6 will.
- 97 will still be alive, and 3 will not.

During or shortly after angioplasty and stent placement, some serious problems can occur, though rarely, especially in older people:

Death
- Out of 100 people younger than 70, fewer than 1 will die, and more than 99 will not.
- Out of 100 people 70 and older, 2 to 3 will die, and 97 to 98 will not.
Heart attack
- Out of 100 people, 2 to 5 will have a heart attack, and 95 to 98 will not.

Stroke
- Out of 100 people, fewer than 1 will have a stroke, and more than 99 will not.

Other complications
More common, but less serious, complications of angioplasty and stents include the following:

- Infection
- Kidney problems from a reaction to the dye
- Damage to blood vessels at the site where the catheter was inserted
- Damage to a coronary artery that requires immediate bypass surgery

People treated by angioplasty teams that do at least 400 procedures a year have fewer complications than people treated by teams that do fewer procedures.

Most people who undergo angioplasty and stent placement will also take medications. Even when stents are used, the treated arteries can become narrowed or blocked again, or other arteries may become narrowed or blocked. If angina symptoms come back and are severe—even with medications—another angioplasty or bypass surgery may be needed.

- Out of 100 people in the first year after undergoing placement of traditional bare-metal stents, about 18 will undergo either another angioplasty or bypass surgery, and 82 will not.

- Out of 100 people in the first year after undergoing placement of drug-eluting stents, about 9 will undergo either another angioplasty or bypass surgery, and 91 will not.

Despite the advantage of drug-eluting stents in preventing narrowing of arteries, they do not appear to change the risk of a heart attack or death (as compared with traditional bare-metal stents). In fact, recent studies suggest they may be more likely to become blocked again after the first year. So doctors do not yet know how they’ll compare with traditional bare-metal stents over the long term, or which patients may benefit most from them. More research is being done.

(3) Bypass Surgery

Coronary artery bypass surgery is a major operation that takes healthy blood vessels from the leg or chest to reroute blood flow around portions of the coronary arteries that have large plaques. Traditionally, the operation involves a large incision in the front of the chest, through the sternum (the breastbone); a heart-lung machine is used to stop the heart and create the bypass grafts.
The introduction of surgical robotics has allowed selected candidates to avoid a full incision in the sternum and on the beating heart and to avoid use of a heart-lung machine. Known as less invasive or minimally invasive bypass surgery, it reduces some of the risks and shortens the recovery time associated with the traditional operation’s large chest incision.

With either approach (traditional or minimally invasive), doctors typically perform bypass surgery only on arteries that are blocked by at least 70%. However, they will do bypass surgery on the left main coronary artery if it is blocked by at least 50%.

**Traditional Approach: Benefits and Harms**

Out of 100 people in the first year after undergoing traditional bypass surgery:

- 90 will have angina symptom relief, and 10 will not.
- 95 will not have a heart attack, and 5 will.
- 96 will still be alive, and 4 will not.

During or shortly after traditional bypass surgery, some serious problems can occur, though rarely, especially in older people:

**Death**

- Out of 100 people younger than 80, 1 to 2 will die, and 98 to 99 will not.
- Out of 100 people 80 and older, 5 to 9 will die, and 91 to 95 will not.

People with lung disease, kidney disease, or diabetes have a higher risk of death than people without those conditions.

People treated by bypass teams that do a lot of procedures each year have lower rates of death than people treated by teams that do fewer procedures.

**Heart attack**

- Out of 100 people, 6 will have a heart attack, and 94 will not.

**Stroke**

- Out of 100 people 55 and younger, fewer than 1 will have a stroke, and more than 99 will not.
- Out of 100 people 56 to 65, 2 will have a stroke, and 98 will not.
- Out of 100 people older than 75, 6 to 13 will have a stroke, and 87 to 94 will not.

**Cognitive problems**

People who have postoperative cognitive problems report having a hard time concentrating or doing tasks like reading a map. Such problems can make life difficult for people of any age, but are especially hard for those who are older or who have other health problems that limit their ability to function.
• Out of 100 people, in the first 6 months after surgery, 10 to 30 people will have some difficulty concentrating, and 70 to 90 will not. Such difficulties may persist even after 5 years.

**Depression**

• Out of 100 people, in the first 6 months after surgery, as many as 33 will be depressed, and 67 will not.

**Other complications**

Other possible harms of traditional bypass surgery include the following:

• Infection at the chest or leg incisions
• Numbness (which can last for some time) at the chest or leg incisions

**Minimally Invasive Approach: Benefits and Harms**

The criteria for selecting candidates for minimally invasive bypass surgery are determined, primarily, by the type of blood vessels that need to be bypassed in order to treat the heart. In addition, patients with unstable angina symptoms or with worrisome blood pressure readings are not likely to be good candidates. Patients with severe lung problems may not be able to tolerate minimally invasive surgery: the left lung must be deflated for a brief time during the procedure, so the oxygen levels need to be supported by just the right lung.

There is a 1% chance (1 in 100 cases) that the operation will need to be converted from a minimally invasive approach to a traditional approach. This determination is made while the patient is on the operating room table and is based, primarily, on safety concerns.

Because the minimally invasive approach is a recent development, its track record is not as established as that of traditional bypass surgery. Therefore, the outcomes are less certain. In the hands of experienced surgeons (those who have done more than 100 minimally invasive cases), the published literature suggests that short- and long-term outcomes after minimally invasive bypass surgery are similar (as compared with the traditional approach), but with a few notable differences:

**Stroke**

Plaque that becomes dislodged from the aorta during traditional bypass surgery is a major cause of postoperative stroke. With the minimally invasive approach, the use of robotics may reduce the risk of stroke by avoiding any manipulation of the aorta, using the “no touch” technique for creating bypass grafts.

With the minimally invasive approach, cognitive difficulties still seem to occur, and no evidence suggests that they are less severe.

**Need for another procedure**

Most people who undergo either type of bypass surgery will also take medications. After the traditional surgery, the bypass grafts (particularly the vein grafts from the legs) may
narrow or become blocked. If angina symptoms come back and are severe—even with medications—another bypass surgery or angioplasty may be needed.

- Out of 100 people in the first year after their initial bypass surgery, about 3 will undergo either another bypass or angioplasty, and 97 will not.

**Wound complications**
Avoiding an incision in the sternum can reduce the risk of problems with healing or with infection. This difference is most notable in patients with diabetes who have a prior history of wound healing difficulties.
Another potential advantage of the minimally invasive approach is the ability to take both of the internal mammary arteries from the chest wall, without creating a healing problem with the adjacent cut sternum. The use of those 2 vessels as bypass grafts improves long-term success (as compared with the use of only 1 mammary artery along with vein grafts). However, this advantage could be eliminated if the bypass grafts are not sewn as accurately as with the traditional approach.

**Hospitalization and recovery time**
For traditional bypass surgery that does not involve any complications during recovery, the typical hospitalization is 5 to 7 days, and the length of time to get back to normal activities or return to work is 2 to 3 months. For minimally invasive bypass surgery, those times are reduced by half: the typical hospitalization is 3 days, and the length of time to get back to normal activities or return to work is 1 month.

**Pain**
With the use of surgical robotics, pain in the ribs is a problem postoperatively. Typically, it is at its worst for the first 1 to 2 days and then rapidly declines to low levels by the third day after surgery. This pain can cause patients to not take deep breaths and can prolong the requirement for oxygen support.

**Treatment Comparisons at a Glance**

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**Symptom relief**
On average, bypass surgery provides the highest chance of symptom relief at 1, 3, and 5 years postoperatively. Medical therapy provides the lowest chance of symptom relief, and angioplasty is somewhere in between.

**Heart attack prevention**
On average, the number of people who do not have a heart attack is basically the same after all 3 treatments.

Remember that angioplasty and bypass surgery are used to treat only large plaques, so they do not prevent heart attacks caused by small plaques. There is also some risk of a heart attack as a result of both of the procedures themselves.
Survival
Soon after treatment, the survival rate is slightly lower after bypass surgery than after either medical therapy or angioplasty. But after the first year, on average, all 3 treatments are equally successful at prolonging life.

However, certain types of patients (such as those with diabetes or congestive heart failure) do better after bypass surgery.

Studies that look specifically at people with severe coronary artery disease have found that, over the long term, bypass surgery helps them live longer, assuming they accept the short-term risks of surgery. Such patients have a higher risk of a heart attack and death than those with milder forms of the disease. (People with severe disease include those who have large plaques in the left main coronary artery; large plaques in all 3 of the important coronary arteries (the right coronary artery, the left anterior descending artery, and the circumflex coronary artery); heart failure; or diabetes.)

Need for another procedure
People who undergo bypass surgery are less likely to need another procedure than those who choose medical therapy or angioplasty.

But undergoing angioplasty or bypass surgery does not mean that another procedure will not be needed. People on medical therapy are more likely to need a procedure at some point than those who have already undergone one. However, more than half of those on medical therapy do not need a procedure within 5 years after starting medications.

So, What’s Best for You?

Although having coronary artery disease can be uncomfortable, painful, and frightening, treatment can relieve your symptoms, prevent heart attacks, and help you live longer.

For many people with coronary artery disease, all 3 treatments—medical therapy, angioplasty and stents, and bypass surgery—provide similar benefits in preventing heart attacks and lengthening life. After the first year, patients with more severe disease may have a better survival rate with bypass surgery or angioplasty than with medical therapy. The treatments differ most in 2 areas: angina symptom relief and possible harms, as summarized below:

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<td>Lower chance of angina symptom relief</td>
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<td>Fewest possible harms</td>
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<td>More possible harms</td>
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Bypass surgery

Highest chance of angina symptom relief
Most possible harms

In addition to the medical factors that affect your treatment decision, consider how you feel about the possible benefits and harms of each treatment:

- Can you live with your angina symptoms? Or are they keeping you from doing the things you want or need to do?

- Would you prefer to put off invasive procedures for as long as possible? Or would you rather undergo angioplasty or bypass surgery sooner, rather than later, in order to have a better chance of angina symptom relief? (Either way, you will probably need to take medications and make lifestyle changes.)

- How would you feel if you had to undergo several angioplasties or a second bypass surgery?

- If you are considering bypass surgery, is there something you are looking forward to in the next 6 months or so, such as a vacation, graduation, birth, anniversary, or other special event? If so, would you rather postpone bypass surgery until after the event?

There are no right or wrong answers—only your answers. Tell your doctor what you think about each of the treatment choices. Let your doctor know how you feel about your symptoms, the different treatments, and their benefits and harms. Together, you can make the treatment choice that is right for you.

You need to take into account many factors that are individual to you: whether you want to take medications; how old you are; how active you want to be; what other diseases you have. Nobody knows you better than you do.
Doing Your Part

All coronary artery disease treatments work better if you have a healthy lifestyle. Some people think that it is too late for lifestyle changes to make a difference, but in fact, people with coronary artery disease have the most to gain from making lifestyle changes.

You can do a number of things to reduce your risk of having a heart attack or of dying from your coronary artery disease:

- Take prescribed medications
- Quit smoking (if you smoke)
- Get regular physical activity
- Eat a heart-healthy diet

If you have already undergone angioplasty or bypass surgery, or if you have already had a heart attack, cardiac rehabilitation (rehab for short) is a good place to start. Your cardiac rehab staff, along with your doctor, can help you incorporate heart-healthy habits into your everyday routine. You can then work with your family and friends to get the support you need to stay healthy.