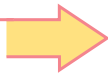


25 Healing the Heart



Your heart beats every minute of your life. If your heart stops beating, you only have about four minutes before severe brain damage and death occur. This makes it difficult for doctors to treat heart problems. Imagine trying to perform surgery on beating tissue when any cut forces blood out of the heart. How have doctors overcome this challenge? In this activity, you will learn about advances in heart surgery that have saved many lives.

CHALLENGE



What are some of the risks in developing new treatments for heart problems?

MATERIALS



For each student

- 1 Student Sheet 25.1. Heart Surgery Timeline
- 1 Student Sheet 25.2, "Three-Level Reading Guide: Healing the Heart"



Heart surgery

READING

Use Student Sheet 25.2, “Three-Level Reading Guide: Healing the Heart,” to guide you as you complete the following reading.



Dr. Daniel Hale Williams performed the first open-heart surgery in 1893, before x-rays, blood transfusions, and antibiotics. The patient lived for over 20 years after the operation.

Early Heart Surgery

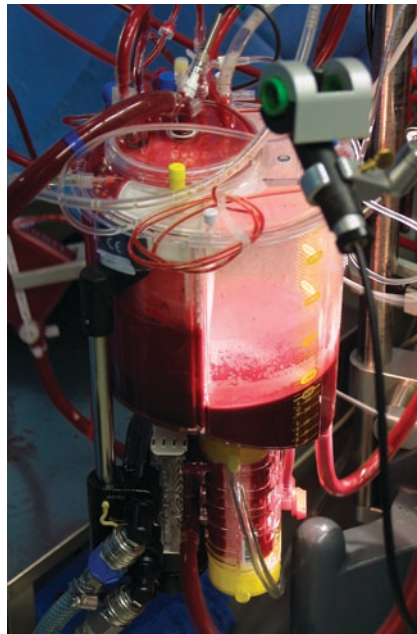
In 1893, a man arrived at a Chicago hospital with a knife wound in his chest. The chief doctor saw that the man was bleeding to death, and he made a risky decision: open the chest of the man, and repair the knife wound. In 1893, any operation on an internal organ ran a high risk of infection and death because sanitary procedures were poor, even in hospitals. Luckily for this patient, the doctor, Daniel Hale Williams, insisted on sanitary procedures. Probing inside the patient's chest, Dr. Williams found that the sac surrounding the heart had been cut. He sewed it up and became one of the first doctors to successfully operate on the heart. The patient was still alive 20 years later! Dr. Williams's sanitary procedures also set a new standard for surgeries.

Nearly 50 years later, most doctors considered surgery on the heart itself too dangerous to perform. But then, during the Second World War, a U.S. Army surgeon, Dr. Dwight Harken, created a technique to remove shrapnel from soldiers' hearts. He could make a small incision in the side of the heart and reach in with his fingers or a clamp to remove the shrapnel. When the war ended, doctors used similar methods to repair damaged heart valves. The discovery of antibiotics also improved patients' chances of surviving surgery.

Open Heart Surgery

To do more extensive heart repairs, doctors had to figure out how to stop the heart during surgery. The constant movement as the heart beat made it nearly impossible to operate on. Simply stopping the heart, however, was not the answer. The four minutes a patient can live without oxygen was not enough time to repair heart problems. Two things happened that allowed heart surgery to progress.

First, Dr. Wilfred Bigelow, a surgeon at the University of Minnesota, suggested cooling patients during heart surgery. He thought this might reduce the patients' need for oxygen. In 1952, surgeons at the University of Minnesota lowered a patient's body temperature to 81 degrees Fahrenheit (27 degrees Celsius). The surgeons were able to extend operating time to 10 minutes! That helped in some cases, but it was not enough time for more complex surgeries.



A heart-lung machine

The second breakthrough came in 1958, when a heart-lung machine was perfected. This machine delivered oxygen-rich blood to a patient's body while the heart was stopped. Doctors could perform longer operations on the stopped heart without risking brain damage or death. People with serious heart defects could now have their hearts repaired.

But what about people with heart disease whose hearts could not be repaired? If they were going to survive, they would need a heart transplant.

Artificial or Human Heart?

In the 1950s in Houston, Texas, Dr. Michael DeBakey and Dr. Denton Cooley developed new methods for operating on the heart. After working together for several years, however, they decided they could no longer get along with each other. In the early 1960s they went separate ways, although they both still worked in the same city.

During the early to mid-'60s Dr. DeBakey worked with heart failure patients. These patients' hearts were no longer strong enough to pump blood. Dr. DeBakey knew the left ventricle of the heart did the actual pumping of the blood to the body. He thought that he could help these patients if he could make their left ventricles pump blood. And so he invented a small pump that he could put in a person's left ventricle to help the heart pump blood. The device, with improvements, is still used today. His bigger dream, however, was to develop an artificial heart that could replace a diseased heart.



Dr. Michael DeBakey holding artificial heart grafts

On the other side of the world in 1967, a South African surgeon, Dr. Christiaan Barnard, performed the first human heart transplant. He removed a diseased heart from a patient and replaced it with a heart from a young woman who had died in a car accident. The patient lived 18 days. Shortly after that, a heart transplant was performed in the United States, but that patient lived only six hours. However, Dr. Barnard's next heart-transplant patient lived for 18 months. While the survival time of these patients seems short today, it was a major advance at the time. Transplant surgeons were only allowed to take patients who had no hope for survival. In many cases these people were days away from death. They had to consent to the risky, experimental surgery. Today, more than 2,000 successful heart transplants are performed each year.

About this time, Dr. DeBakey received a grant to develop an artificial heart. He and his team built an experimental model in his laboratory, but tests on animals were not successful. He knew it would be a long time before he could fulfill his dream and use the artificial heart to help a human patient.

In 1969, his former partner, Dr. Cooley, transplanted an artificial heart into a man. The man survived for three days until a donor heart became available. Dr. Cooley claimed he and another doctor from Dr. DeBakey's team had invented the artificial heart. Dr. DeBakey claimed that Dr. Cooley took the heart from his lab. Although an investigation was conducted, no one knows what really happened. This dispute led to a 40-year feud between Dr. DeBakey and Dr. Cooley.

The first permanent artificial heart, designed by Dr. Robert Jarvik in Utah, was implanted in a man in 1982. The Jarvik heart was connected to a control unit the size of a shopping cart. Although it was considered a "permanent" heart, a person receiving it could not do much of anything. Other downsides were that many people with artificial hearts developed blood clots, strokes, or other serious problems.

The Problem of Rejection

The body's immune system fights bacteria and other foreign objects. This keeps people healthy. However, if the immune system recognizes a transplanted organ as a foreign object, it attacks the organ. Drugs were developed

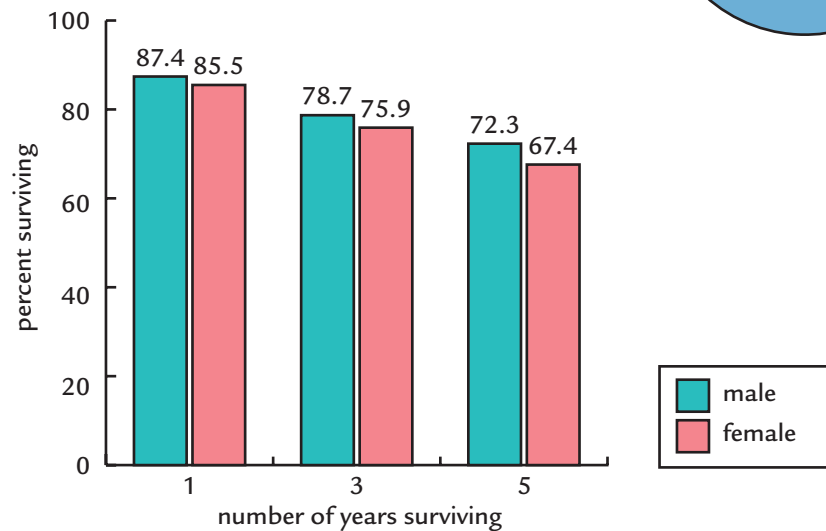
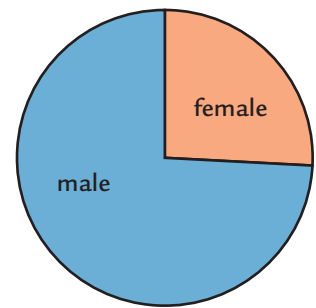
Activity 25 • Healing the Heart

to decrease the immune response, so a person's body was less likely to reject the new organ. Unfortunately, these drugs also lowered patients' ability to fight off bacteria and other organisms. In 1983, a new drug was approved for transplant patients. It was more effective than previous drugs and had fewer side effects. This increased the survival rate of organ transplant patients. Today, doctors carefully match blood type and tissue type between organ donor and organ recipient. This further improves a patient's chances of living for a long time.



Transplant Recipients by Age	
Under 18	14%
18–34	11
35–49	20
50–64	44
Over 64	11

Transplants Today

The major problem for people who need a heart transplant today is that there are not enough donors. In the United States, about 4,000 people need a heart transplant each year. Yet only about 2,200 hearts become available. About 15% of people who are waiting for a transplant die before they can get a donor heart. Artificial hearts can keep people alive for a short time until a donor heart is found. However, the risks of infection or blood clots from artificial hearts are still high.




ANALYSIS

1. What is the age range of most transplant patients?
2. What is a heart transplant patient's chance of survival after:
 - one year?
 - three years?
 - five years?
3. Compare the percentages of male and female transplant patients. Why do you think there is a difference? Explain.
-  4. Why did the early heart transplant patients agree to a transplant when it was so risky?
-  5. What are the challenges that had to be overcome to develop new surgeries for heart problems?
6. **Reflection:** A person can sign up to be an organ donor when he or she receives a driver's license. Would you be willing to sign up to be an organ donor? Explain.



EXTENSION

-  Go to the *Issues and Life Science* page of the SEPUP website to link to sites with more information on the history of heart surgery.