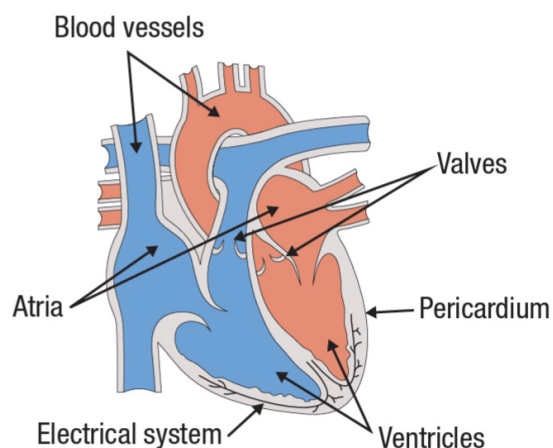


Keeping Your Heart Healthy

Most childhood cancer survivors do not develop heart problems; however, certain types of cancer treatment given during childhood can result in damage to the heart. Because heart problems may occur many years after cancer treatment, it is important for childhood cancer survivors to be aware of any treatments they may have received that can affect the heart. With this knowledge, steps can be taken to keep their heart healthy, including regular medical check-ups and tests to monitor heart function. And if a problem develops, it can be detected and treated early.

How does the heart work?

The heart is a muscular organ that is at the center of the body's circulatory system. The heart is responsible for pumping blood with oxygen and nutrients to body tissues. There are four chambers (two atria and two ventricles) within the heart that work together to pump blood. Valves direct the flow of blood through the heart chambers and into the blood vessels. The rhythm of heart contraction and rate of the heartbeat are coordinated by nerves that send electrical impulses to different parts of the heart. A thin membrane (pericardium) surrounds and protects the heart and anchors it within the chest.



What types of cancer treatments can cause heart problems?

Some types of chemotherapy and radiation involving the heart can cause problems.

Anthracycline chemotherapy

The anthracyclines are a type of chemotherapy used to treat many childhood cancers. This type of chemotherapy can sometimes affect the heart. Commonly used anthracyclines include:

- Doxorubicin (Adriamycin®)
- Daunorubicin/Daunomycin (Cerubidine®)
- Idarubicin (Idamycin®)
- Mitoxantrone (Novantrone®)
- Epirubicin

Radiation therapy

Heart problems may also result from radiation therapy to the heart or surrounding tissues. This includes radiation to the following areas:

- Chest
- Spine (chest or “thoracic” portion)
- Abdomen
- Total body irradiation (TBI)

What heart problems can occur after treatment for childhood cancer?

There are several types of heart problems that may result from cancer treatments:

- The muscle cells of the heart may be damaged so that the heart doesn't contract and relax normally (**left ventricular dysfunction, cardiomyopathy**).
- The electrical pathways that conduct impulses to control heart rhythm may be scarred or damaged, resulting in abnormally fast, slow, or irregular heartbeats (**arrhythmias**).
- The valves and blood vessels of the heart may be damaged, resulting in stiff or leaky valves (**valvular stenosis or insufficiency**).
- The protective covering of the heart may become inflamed (**pericarditis**) or scarred (**pericardial fibrosis**).
- The blood vessels of the heart may become scarred or blocked (**coronary artery disease**), preventing delivery of oxygen and nutrients to the heart and other tissues.

In severe cases, these problems may result in the death of heart tissue (heart attack or myocardial infarction), a dangerous heart rhythm (arrhythmia), or an inability of the heart to pump blood properly (congestive heart failure).

Which types of cancer treatment are associated with which heart problems?

- **Anthracyclines:** can cause problems with heart muscle function (left ventricular dysfunction, cardiomyopathy) and abnormal heart rhythms (arrhythmias).
- **Radiation therapy:** can cause scarring and stiffening of heart tissues which can result in an abnormal heart rhythm (arrhythmia) and/or problems with the heart muscle (cardiomyopathy), heart valves (valvular stenosis or insufficiency), blood vessels (coronary artery disease), or membrane surrounding the heart (pericarditis or pericardial fibrosis).

Are there other risk factors for heart problems?

Some other medical conditions may also increase the risk of heart problems from chemotherapy or radiation therapy. These include obesity, high blood pressure, high cholesterol or triglyceride levels in the blood, and diabetes. You may have a higher risk of having heart problems if these conditions run in your family. Heart disease is also more common in people who have gone through menopause, so survivors who go through an early menopause may be at higher risk. Many health behaviors can add to the risk of heart disease including smoking, having an inactive (sedentary) lifestyle, and eating a diet high in fat.

Who is at risk for developing heart problems?

The risk of developing a heart problem after childhood cancer treatment is related to several factors:

- The total dose of anthracycline chemotherapy
- The total dose of chest radiation
- The amount of the heart tissue included in the radiation treatment field
- Treatment with other medications that affect heart function
- The presence of other conditions that affect heart function

Most childhood cancer survivors who were treated with anthracyclines or chest radiation have no heart damage at all. Some survivors have very mild changes in heart size or function that have not gotten worse over time. Only a small number of survivors have developed severe heart problems leading to heart failure or dangerous heart rhythms. Overall, the risk of developing heart problems after childhood cancer therapy is highest in survivors treated with higher doses of anthracyclines or chest radiation, especially those who received both treatments at a young age.

Because we do not understand why some survivors develop heart problems after treatment for childhood cancer and others do not (even when they have gotten the same treatment), it is important for each childhood cancer survivor treated with anthracyclines or chest radiation to continue to have regular medical check-ups so that if a problem with the heart develops, it can be detected and treated early.

What are the symptoms of heart problems?

- No symptoms may be noted with mild to moderate heart problems. Identification of problems may only be detected by cardiac tests such as ECHO, EKG, or MUGA.
- Shortness of breath
- Dizziness
- Lightheadedness, fainting or near-fainting
- Severe fatigue preventing exercise or normal play
- Chest pain that feels like a heavy pressure or fullness and travels to the arm, chin, or face
- Sweating, nausea, or shortness of breath with chest pain
- Sharp piercing pain in the center or the left side of the chest (often worsens with taking a deep breath)
- Very swollen feet or ankles (so swollen that if a finger is pressed firmly on the area for a few seconds it leaves an indentation)
- Cough and wheezing that doesn't go away
- Periods of feeling your heart racing while at rest or skipping beats
- Abdominal symptoms (nausea or emesis)

How does exercise affect the heart?

Aerobic exercise (brisk walking, running) is generally safe and healthy for the heart. However, some types of intensive exercise are particularly stressful to the heart.

Survivors treated with high doses of anthracyclines (250 mg/m² or higher), or chest radiation therapy (30 Gy or 3000 cGy/rads or higher), or with a combination of anthracyclines (any dose) and chest radiation (≥ 15 Gy) should check with their healthcare provider before beginning any intensive exercise program. Those who plan to engage in strenuous or varsity team sports may benefit from evaluation by a heart specialist (cardiologist).

What other conditions or activities can make heart problems worsen?

A heart exposed to anthracyclines and/or chest radiation may not adapt well to situations that increase the workload of the heart. This includes:

- Pregnancy
- Use of stimulant medications or drugs (amphetamines, cocaine, diet pills, ephedra, mahuang, or performance enhancing drugs)

Illicit drugs should always be avoided. If you are at risk of heart problems from childhood cancer therapy and planning to use stimulant medications or become pregnant, it is important to discuss this with your healthcare provider. It may be recommended that you undergo heart testing such as an echocardiogram before becoming pregnant or taking certain types of medications that may cause excess stress to the heart.

Are there any other special precautions?

Survivors with prosthetic heart valves and those with currently active chronic graft-versus-host disease (cGVHD) following hematopoietic cell transplant (HCT) may need to take an antibiotic prior to dental work or other invasive medical procedures (such as those involving the respiratory, gastrointestinal, or urinary tracts) to prevent an infection called endocarditis. If you have a prosthetic heart valve or if you have active cGVHD, ask your doctor, heart specialist, and/or dentist if you should take antibiotics to prevent endocarditis before dental or other medical procedures.

What monitoring is required for potential heart problems?

Anyone treated with anthracycline chemotherapy or chest radiation for childhood cancer should have a yearly check-up with special attention to any symptoms relating to the heart. In addition, an electrocardiogram (ECG, EKG) should be done at the time the survivor enters long-term follow-up (usually about 2 years from completion of therapy). An echocardiogram or comparable imaging is also recommended at the first long-term follow-up visit, then according to the following schedule (or as recommended by your healthcare provider):

Cardiac Imaging Schedule Recommendations

Anthracycline Dose*	Radiation Dose**	Recommended Frequency of ECHO
None to <100 mg/m ²	None to < 15 Gy	No screening
None to <100 mg/m ²	15 to < 30 Gy	Every 5 years
≥ 100 to < 250 mg/m ²	None to < 15 Gy	
≥ 100 to < 250 mg/m ²	≥15 Gy	Every 2 years
None to Any	≥30 Gy	
≥ 250 mg/m ²	None to Any	

*Based on doxorubicin isotoxic equivalent dose

**Based on radiation dose with potential impact to heart (radiation to chest, abdomen, spine [thoracic, whole], total body [TBI])

Survivors who received radiation at a dose of 30 Gy (3000 cGy) or higher to the heart or surrounding tissues or radiation at a dose of 15 Gy (1500 cGy) or higher plus anthracycline chemotherapy may be advised to undergo evaluation by a cardiologist for stress testing 5 to 10 years following radiation, with repeat testing as recommended by the cardiologist.

Survivors who received radiation to the heart or surrounding tissues should also have periodic blood tests to check for other cardiac risk factors (lipid profile and fasting glucose or hemoglobin A1C).

Additional evaluation by a cardiologist is recommended for survivors who are pregnant or planning pregnancy and received any of the following therapy:

- Anthracycline chemotherapy at a dose of 250 mg/m² or more
- Radiation at a dose of 30 Gy (3000 cGy) or higher to the heart or surrounding tissues
- Radiation to the heart (15 Gy) or higher in combination with anthracycline chemotherapy (at any dose)

Heart monitoring may be necessary due to the extra strain on the heart during the later stages of pregnancy and during labor and delivery. Suggested monitoring includes an echocardiogram before and periodically during pregnancy, especially during the third trimester, and cardiac monitoring during labor and delivery.

How are the heart tests done?

An **electrocardiogram (ECG, EKG)** is a test used to evaluate heart rate and rhythm. Electrodes (small sticky patches) are placed on the chest, arms, and legs. Wires are attached to the electrodes and the electrical impulses of the heart are then recorded.

An **echocardiogram** (ECHO; heart ultrasound) is used to test the muscle function of the heart and how well the heart pumps. The person lies on a table and has conductive jelly applied to the chest. Then a transducer (device that emits the ultrasound waves) is placed on the chest to obtain different views of the heart. Slight pressure is applied on the transducer and can sometimes cause discomfort. The test results are displayed on a monitor for the doctor to study later. Many measurements are done during this test to help find out if the heart muscle is pumping blood well. The ultrasound test also looks at the valves of the heart to see that they open and close normally. Electrodes are usually placed on the chest to monitor the heart's electrical impulses during the test.

Cardiac magnetic resonance imaging (**MRI**) uses a large magnet, radio waves, and a computer to create detailed images of the heart. Radiation is not used during the MRI. The person lies on the scanning table, which slides into the circular opening of the MRI machine. Jewelry, eyeglasses, hearing aids, or other objects that may interfere with the MRI must be removed prior to the test. If contrast is needed, it will be injected into a vein. The scanner can be noisy, so you will be given earplugs to wear or music to listen to during the test to help block out the noise. Because of the strong magnet, people who have metal devices (such as a pacemaker, implanted infusion pump, or iron-based metal implant) cannot have MRIs.

A **cardiac stress test** measures heart function during periods when the heart is working hard. During this test, the heart and blood pressure are usually monitored while the person walks on a treadmill.

What happens if a problem with the heart is detected?

Your healthcare provider will advise you about the follow-up care you need. Sometimes, a referral to a cardiologist is needed for additional evaluation and/or treatment with medications.

What can be done to prevent heart problems?

With increasing age, the risk of certain types of heart disease (such as heart attacks and hardening of the arteries) also increases. Lifestyle factors that may increase the risk of heart problems include smoking, being overweight, eating a high fat diet, and not exercising. Medical conditions that increase the risk include diabetes, high blood pressure, and high blood cholesterol. You can reduce your risk of heart problems by:

- Avoid smoking and excessive alcohol intake.
- Maintaining a healthy body weight.
- Limiting the fat in your diet to no more than 30% of calories.
- Exercising regularly for at least 30 minutes on most days of the week.

Medical conditions that increase the risk of heart problems include obesity, high blood pressure, high cholesterol or triglyceride levels in the blood, and diabetes. If you have any of these conditions it is important to take medications or adjust your lifestyle as recommended by your healthcare provider.

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Additional health information for childhood cancer survivors is available at
www.survivorshipguidelines.org

Note: Throughout this *Health Links* series, the term “childhood cancer” is used to designate pediatric cancers that may occur during childhood, adolescence, or young adulthood. Health Links are designed to provide health information for survivors of pediatric cancer, regardless of whether the cancer occurred during childhood, adolescence, or young adulthood.

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