Hodgkin Disease

What is cancer?

The body is made up of trillions of living cells. Normal body cells grow, divide to make new cells, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries.

Cancer begins when cells in a part of the body start to grow out of control. There are many kinds of cancer, but they all start because of out-of-control growth of abnormal cells.

Cancer cell growth is different from normal cell growth. Instead of dying, cancer cells continue to grow and form new, abnormal cells. Cancer cells can also invade (grow into) other tissues, something that normal cells cannot do. Growing out of control and invading other tissues are what makes a cell a cancer cell.

Cells become cancer cells because of damage to DNA. DNA is in every cell and directs all its actions. In a normal cell, when DNA gets damaged the cell either repairs the damage or the cell dies. In cancer cells, the damaged DNA is not repaired, but the cell doesn't die like it should. Instead, this cell goes on making new cells that the body does not need. These new cells will all have the same damaged DNA as the first cell does.

People can inherit damaged DNA, but most DNA damage is caused by mistakes that happen while the normal cell is reproducing or by something in our environment. Sometimes the cause of the DNA damage is something obvious, like cigarette smoking. But often no clear cause is found.

In most cases the cancer cells form a tumor. Some cancers, like leukemia, rarely form tumors. Instead, these cancer cells involve the blood and blood-forming organs and circulate through other tissues where they grow.

Cancer cells often travel to other parts of the body, where they begin to grow and form new tumors that replace normal tissue. This process is called metastasis. It happens when the cancer cells get into the bloodstream or lymph vessels of our body.

No matter where a cancer may spread, it is always named for the place where it started. For example, breast cancer that has spread to the liver is still called breast cancer, not liver cancer. Likewise, prostate cancer that has spread to the bone is still prostate cancer, not bone cancer.

Different types of cancer can behave very differently. For example, lung cancer and breast cancer are very different diseases. They grow at different rates and respond to different treatments. That is why people with cancer need treatment that is aimed at their particular kind of cancer.

Not all tumors are cancerous. Tumors that aren't cancer are called benign. Benign tumors can cause problems – they can grow very large and press on healthy organs and tissues. But they cannot grow into (invade) other tissues. Because they can't invade, they also can't spread to other parts of the body (metastasize). These tumors are almost never life threatening.

What is Hodgkin disease?

Hodgkin disease (Hodgkin lymphoma) is a type of lymphoma, a cancer that starts in white blood cells called *lymphocytes*. Lymphocytes are part of the body's immune system. There are 2 kinds of lymphomas:

- Hodgkin disease (named after Dr. Thomas Hodgkin, who first recognized it)
- Non-Hodgkin lymphoma

These 2 main types of lymphomas differ in how they behave, spread, and respond to treatment, so it is important to tell them apart. Doctors can usually tell the difference between them by looking at the cancer cells under a microscope or by using sensitive lab tests.

Both children and adults can develop Hodgkin disease. This document discusses treatment in both groups.

For information on non-Hodgkin lymphoma, see the American Cancer Society document, *Non-Hodgkin Lymphoma*.

The lymph system and lymphoid tissue

To understand what Hodgkin disease is, it helps to know about the body's lymph system.

The lymph system (also known as the *lymphatic system*) is part of the body's immune system, which helps fight infections and some other diseases. It also helps fluids move around within the body. The lymph system is composed mainly of:

- **Lymphoid tissue:** includes the lymph nodes and related organs (see below) that are part of the body's immune and blood-forming systems
- **Lymph:** a clear fluid that travels through the lymph system, carrying waste products and excess fluid from tissues, as well as lymphocytes and other immune system cells
- **Lymph vessels:** small tubes, similar to blood vessels, through which lymph travels to different parts of the lymph system

Lymphocytes

Lymphoid tissue is made up of cells called *lymphocytes*, a type of white blood cell that fights infection. There are 2 major types of lymphocytes: B lymphocytes (B cells) and T lymphocytes (T cells). Normal T cells and B cells have different jobs.

- **B lymphocytes:** B cells help protect the body from germs (bacteria and viruses). They do this by maturing into plasma cells, which make antibodies (immune proteins). These antibodies attach to the germs, marking them for destruction. Almost all cases of Hodgkin disease start in B lymphocytes.
- **T lymphocytes:** There are several types of T cells, and each has a special job. Some T cells can directly destroy certain kinds of bacteria or cells infected with viruses or fungi. Other types of T cells play a role in either boosting or slowing the activity of other immune system cells.

Organs that have lymphoid tissue

Because lymphoid tissue is in many parts of the body, Hodgkin disease can start almost anywhere. The major sites of lymphoid tissue are:

Lymph nodes: Lymph nodes are small, bean-sized collections of lymphocytes and other immune system cells found throughout the body, including inside the chest, abdomen, and pelvis. They can sometimes be felt under the skin in the neck, under the arms, and in the groin. Lymph nodes are connected to each other by a system of lymph vessels.

Lymph nodes get bigger when they fight an infection. Lymph nodes that grow in reaction to infection are called *reactive* nodes or *hyperplastic* nodes. These often hurt when they are touched. People with sore throats or colds might have enlarged neck lymph nodes. An enlarged lymph node is not always a sign of a serious problem, but it can be a sign of Hodgkin disease. See the section, "How is Hodgkin disease diagnosed?" for more information.

Spleen: The spleen is an organ under the lower part of the rib cage on the left side of the body. The spleen makes lymphocytes and other immune system cells to help fight infection. It also stores healthy blood cells and filters out damaged blood cells, bacteria, and cell waste.

Bone marrow: The bone marrow is the spongy tissue inside certain bones, which is where new white blood cells (including some lymphocytes), red blood cells, and platelets are made.

Thymus: The thymus is a small organ behind the upper part of the breastbone and in front of the heart. It is important in the development of T lymphocytes.

Digestive tract: The back of the throat (adenoids and tonsils), stomach, intestines, and many other organs also have lymphoid tissue.

Start and spread of Hodgkin disease

Because lymphoid tissue is in many parts of the body, Hodgkin disease can start almost anywhere. Most often it starts in lymph nodes in the upper part of the body. The most common sites are in the chest, in the neck, or under the arms.

Hodgkin disease most often spreads through the lymph vessels in a stepwise fashion from lymph node to lymph node. Rarely, and late in the disease, it can invade the bloodstream and spread to other sites in the body, including the liver, lungs, and/or bone marrow.

The Hodgkin disease cell

The cancer cells in most cases of Hodgkin disease are called *Reed-Sternberg cells*, after the 2 doctors who first described them. These cells are usually an abnormal type of B lymphocyte. Under a microscope, Reed-Sternberg cells are much larger than normal lymphocytes and also look different from the cells of non-Hodgkin lymphomas and other cancers.

In Hodgkin disease, the enlarged lymph nodes usually have a small number of Reed-Sternberg cells and a large number of surrounding normal immune cells. It is mainly these other immune cells that account for the enlarged lymph nodes.

Types of Hodgkin disease

Different types of Hodgkin disease are classified by how they look under the microscope. This is important because types of Hodgkin disease may grow and spread differently and may be treated differently. The 2 main types are:

- Classic Hodgkin disease (which has several subtypes)

- Nodular lymphocyte predominant Hodgkin disease

All types of Hodgkin disease are malignant (cancerous) because as they grow they may invade and destroy normal tissue and spread to other tissues. There is no benign (non-cancerous) form of Hodgkin disease.

Classic Hodgkin disease

Classic Hodgkin disease (HD) accounts for about 95% of all cases of Hodgkin disease in developed countries. It has 4 subtypes, all of which have classic-looking Reed-Sternberg cells.

Nodular sclerosis Hodgkin disease: This is the most common type of Hodgkin disease in developed countries, accounting for about 60% to 80% of cases. It occurs mainly in younger people, about equally in men and women. It tends to start in lymph nodes in the neck or chest. Under the microscope, the lymph nodes have fibrous bands that criss-cross the node and encircle abnormal nodules of lymph tissue.

Mixed cellularity Hodgkin disease: This is the second most common type (15% to 30%) and is seen mostly in older adults. It can start in any lymph node but most often occurs in the upper half of the body. Under the microscope, many different kinds of cells can be seen, including Reed-Sternberg cells and normal immune system cells.

Lymphocyte-rich Hodgkin disease: This subtype accounts for about 5% of Hodgkin disease cases. It usually occurs in the upper half of the body and is rarely found in more than a few lymph nodes. Under the microscope it looks very much like mixed cellularity Hodgkin disease, except that most of the cells are small lymphocytes.

Lymphocyte-depleted Hodgkin disease: This is the least common form of Hodgkin disease, making up less than 1% of cases. It is seen mainly in older people. The disease is more likely to be advanced when first found, in lymph nodes in the abdomen as well as in the spleen, liver, and bone marrow. When seen under a microscope, there are few normal lymphocytes or other immune system cells, and many Reed-Sternberg cells.

Nodular lymphocyte predominant Hodgkin disease

Nodular lymphocyte predominant Hodgkin disease (NLPHD) accounts for about 5% of Hodgkin disease. It can occur at any age, and is more common in men than in women. This type usually involves lymph nodes in the neck and under the arm. It contains large cells, often called *popcorn* cells (because they look like popcorn), which are variants of Reed-Sternberg cells. Under the microscope, there is a pattern of sheets of lymphocytes arranged in nodules.

What are the key statistics about Hodgkin disease?

The American Cancer Society's estimates for Hodgkin disease in the United States for 2014 are:

- About 9,190 new cases will occur (4,120 in females and 5,070 in males). These numbers have not changed much over the past few years.
- About 1,180 people (510 females, 670 males) will die of this cancer.

Hodgkin disease can occur in both children and adults. It is most common in early adulthood (ages 15 to 40, especially in a person's 20s), where it is mostly of the nodular sclerosis subtype, and in late adulthood (after age 55), where the mixed cellularity subtype is more common. Hodgkin disease is rare in children younger than 5 years of age. About 10% to 15% of cases are diagnosed in children and teenagers.

Because of advances in treatment, survival rates have improved in the past few decades. The 1-year relative survival rate for all patients diagnosed with Hodgkin disease is now about 92%; the 5-year and 10-year survival rates are about 85% and 80%, respectively.

Certain factors such as the stage (extent) of the disease and a person's age affect these rates. For more detailed survival rates based on the stage of disease, as well as a discussion of other factors that affect survival, see the section "Survival rates for Hodgkin disease by stage."

What are the risk factors for Hodgkin disease?

A risk factor is anything that affects your chance of getting a disease such as cancer. Different cancers have different risk factors. Some cancer risk factors, like smoking, can be changed. Others, like a person's age or family history, can't be changed.

But risk factors don't tell us everything. Having a risk factor, or even several, does not mean that you will definitely get the disease. And many people who get the disease may have few or no known risk factors. Even if a person with Hodgkin disease has one or more risk factors, it is often very hard to know how much these factors might have contributed to the lymphoma.

Scientists have found a few risk factors that may make a person more likely to develop Hodgkin disease, although it's not always clear why these factors increase risk.

Epstein-Barr virus infection/mononucleosis

People who have had infectious mononucleosis (sometimes called *mono* for short), an infection caused by the Epstein-Barr virus (EBV), have an increased risk of Hodgkin disease. The risk appears to be a few times higher than for people who have not had mono, although the overall risk is still very small.

The exact role of EBV in the development of Hodgkin disease is not clear. DNA from the virus is found in Reed-Sternberg cells in about half of patients with Hodgkin disease. But the other half has no evidence of EBV in their cancer cells. Many people are infected with EBV, but very few develop Hodgkin disease.

Age

Anyone can be diagnosed with Hodgkin disease, but it is most common in early adulthood (ages 15 to 40, especially in a person's 20s) and in late adulthood (after age 55).

Gender

Hodgkin disease occurs slightly more often in males than in females.

Geography

Hodgkin disease is most common in the United States, Canada, and northern Europe, and is least common in Asian countries.

Family history

Brothers and sisters of young people with this disease have a higher risk for Hodgkin disease. The risk is very high for an identical twin of a person with Hodgkin disease. But a family link is still uncommon, and is seen in only around 5% of all cases.

It's not clear why family history might increase risk. It might be because family members have similar childhood exposures to certain infections (such as Epstein-Barr virus), inherited gene changes that make them more susceptible, or some combination of these factors.

Socioeconomic status

The risk of Hodgkin disease is greater in people with a higher socioeconomic background. The reason for this is not clear. One theory is that children from more affluent families might be exposed to some type of infection (such as Epstein-Barr virus)

later in life than children from less affluent families, which might somehow increase their risk.

HIV infection

The risk of Hodgkin disease is increased in people infected with HIV, the virus that causes AIDS.

Do we know what causes Hodgkin disease?

The exact cause of Hodgkin disease is not known. However, scientists have found that the disease is linked with a few conditions, such as infection with the Epstein-Barr virus. Some researchers think that this may lead to DNA changes in B lymphocytes, leading to the development of the Reed-Sternberg cell and Hodgkin disease.

Normal human cells grow and function mainly based on the information contained in each cell's chromosomes. Each cell has 23 pairs of chromosomes, which are long molecules of DNA. DNA is the chemical that makes up our genes — the instructions for how our cells function. We look like our parents because they are the source of our DNA. But DNA affects more than how we look.

Some genes contain instructions for controlling when cells grow and divide into new cells. Certain genes that help cells grow and divide or help them live longer are called *oncogenes*. Others that slow down cell division or cause cells to die at the right time are called *tumor suppressor genes*. Cancers can be caused by DNA changes that turn on oncogenes or turn off tumor suppressor genes.

Scientists have found many gene changes in Reed-Sternberg cells that help the cells to grow and divide or prevent the cells from dying when they should. Reed-Sternberg cells also make substances called cytokines, which attract many other cells into the lymph node, enlarging it. In turn, these non-cancerous cells release substances that promote growth of the Reed-Sternberg cells.

Despite these advances, scientists do not yet know what sets off these processes. An abnormal reaction to the Epstein-Barr virus or to other infections may be the trigger in some cases. But more research is needed to understand what causes Hodgkin disease.

Can Hodgkin disease be prevented?

Few known risk factors for Hodgkin disease can be changed, so it is not possible to prevent most cases of the disease at this time.

Infection with HIV, the virus that causes AIDS, is known to increase risk, so one way to limit your risk is to avoid known risk factors for HIV, such as intravenous drug use or unprotected sex with many partners.

Another risk factor for Hodgkin disease is infection with the Epstein-Barr virus (the cause of infectious mononucleosis, or mono), but there is no known way to prevent this infection.

Can Hodgkin disease be found early?

At this time, there are no widely recommended screening tests for this cancer. (Screening is testing for cancer in people without any symptoms.) Still, in some cases Hodgkin disease can be found early.

The best way to find Hodgkin disease early is to pay attention to possible symptoms. The most common symptom is enlargement of one or more lymph nodes, causing a lump or bump under the skin which is usually not painful. This is most often on the side of the neck, in the armpit, or in the groin. More often this is caused by something like an infection, rather than Hodgkin disease, but it is important to have such lumps checked by your doctor.

Other symptoms can include fever that doesn't go away, drenching night sweats that often require changing bed sheets or night clothes, and unexplained weight loss. Severe and constant itching can be another symptom of Hodgkin disease. However, very early in the disease, many people with Hodgkin disease may not have any symptoms. For more on possible symptoms, see "How is Hodgkin disease diagnosed?"

Careful, regular medical checkups may be helpful for people with known risk factors for Hodgkin disease, such as a strong family history. These people do not commonly develop Hodgkin disease, but they and their doctors should know about possible symptoms and signs.

How is Hodgkin disease diagnosed?

Most people with Hodgkin disease see their doctor because they have felt a lump that hasn't gone away, they have some of the other symptoms listed below, or they just don't feel well and go in for a checkup.

If a person has signs or symptoms that suggest Hodgkin disease, exams and tests are done to find out for sure and, if so, to determine the exact type.

Signs and symptoms of Hodgkin disease

You or your child can have Hodgkin disease and feel perfectly well. However, there are some symptoms that this disease may cause.

Lump(s) under the skin

You may notice a lump in the neck, under the arm, or in the groin, which is an enlarged lymph node. Sometimes this may go away, only to come back. Although it doesn't usually hurt, the area may become painful after you drink alcohol. The lump may become more noticeable over time. There may even be several areas of enlarged lymph nodes.

But Hodgkin disease is not the most common cause of lymph node swelling. Most enlarged lymph nodes, especially in children, are caused by an infection. If this is the case, the node should return to its normal size a couple of weeks or months after the infection goes away.

Other cancers can also cause swollen lymph nodes. If you have an enlarged lymph node, especially if you haven't had a recent infection, it is best to see your doctor so that the cause can be found and treated without delay, if needed.

General (non-specific) symptoms

Some people with Hodgkin disease have what are known as *B symptoms*:

- Fever (which can come and go over several days or weeks)
- Drenching night sweats
- Weight loss without trying (at least 10% of body weight over 6 months)

These symptoms can help find Hodgkin disease, but they are also important in determining the stage and prognosis (outlook) if Hodgkin disease is found (see "How is Hodgkin disease staged?").

Other possible symptoms of Hodgkin disease include:

- Itching skin
- Tiredness
- Loss of appetite

Sometimes the only symptom may be being tired all the time.

Cough, trouble breathing, chest pain

If Hodgkin disease affects lymph nodes inside the chest, the swelling of these nodes may press on the windpipe (trachea) and make you cough or even have trouble breathing, especially when lying down. Some people may have pain behind the breast bone.

Having one or more of the symptoms above does not mean you have Hodgkin disease. In fact, many of these symptoms are more likely to be caused by other conditions, such as an infection. Still, if you or your child has any of these symptoms, it is very important to have them checked by a doctor so that the cause can be found and treated, if needed.

Medical history and physical exam

If the symptoms suggest you or your child might have Hodgkin disease, your doctor will want to get a thorough medical history, including information about symptoms, possible risk factors, family history, and other medical conditions.

Next, the doctor will do a physical exam, paying special attention to the lymph nodes and other areas of the body that may be involved, including the spleen and liver. Because infections are the most common cause of enlarged lymph nodes, especially in children, the doctor will look for an infection in the part of the body near any swollen lymph nodes.

The doctor also might order blood tests to look for signs of infection or other problems. If the doctor suspects that Hodgkin disease may be causing the symptoms, he or she will recommend a biopsy of the area.

Biopsies

Many of the symptoms of Hodgkin disease are actually more likely to be caused by non-cancerous problems or by other kinds of cancers. For example, enlarged lymph nodes are more often caused by infections than by Hodgkin disease. Because of this, doctors often wait a few weeks to see if they shrink on their own as the infection goes away. Antibiotics may also be prescribed to see if they cause the nodes to shrink.

If the nodes don’t shrink or continue to grow, either a small piece of a node or, more commonly, the entire node is removed to be looked at under the microscope and for other lab tests. This procedure, called a *biopsy*, is needed to be sure of the diagnosis. If it is Hodgkin disease, the biopsy can also tell what type it is.

Types of biopsies

There are different types of biopsy methods, and doctors choose one based on your situation.

Excisional or incisional biopsy: This is the preferred and most common type of biopsy for an enlarged lymph node. The doctor uses surgical tools to cut through the skin and remove the tumor or lymph node. If the doctor removes the entire lymph node, it is called an *excisional biopsy*. If a small part of a larger tumor or node is removed, it is called an *incisional biopsy*.

If the node is near the skin surface, this is a fairly simple operation that can sometimes be done with numbing medicine (local anesthesia). But if the node is inside the chest or abdomen, the patient is sedated or given general anesthesia (where he or she is in a deep sleep). This type of biopsy almost always provides enough of a tissue sample to make a diagnosis of the exact type of Hodgkin disease.

Fine needle aspiration (FNA) or core needle biopsy: In an FNA biopsy, the doctor uses a very thin, hollow needle attached to a syringe to withdraw (aspirate) a small amount of fluid and tiny bits of tissue from a lymph node or an organ in the body. For a core needle biopsy, the doctor uses a larger needle to remove a slightly larger piece of tissue.

If the enlarged node is near the surface of the body, the doctor can aim the needle while feeling the node. If a tumor is deep inside the body, the doctor can guide the needle using a computed tomography (CT) scan or ultrasound (see discussion of imaging tests in "How is Hodgkin disease staged?").

A needle biopsy does not require an incision, but in many cases it might not remove enough of a sample to diagnose Hodgkin disease (or to determine which type it is). Most doctors do not use needle biopsies (especially FNA biopsies) to diagnose Hodgkin disease. But if the doctor suspects that your lymph node swelling is caused by an infection or by the spread of cancer from another organ (such as the breast, lungs, or thyroid), a needle biopsy might be the first type of biopsy done. An excisional biopsy may still be needed to diagnose Hodgkin disease, even after a needle biopsy has been done.

After Hodgkin disease has been diagnosed, needle biopsies are sometimes used to check areas in other parts of the body that might be Hodgkin disease spreading or coming back after treatment.

Bone marrow aspiration and biopsy: These tests are not used to diagnose Hodgkin disease, but they may be done after the diagnosis is made to see if Hodgkin disease is in the bone marrow. They are described in more detail in the section, "How is Hodgkin disease staged?"

Lab tests of biopsy samples

All biopsy samples are looked at under a microscope by a pathologist (a doctor specially trained to recognize cancer cells), who looks at the size and shape of the cells and determines if any of them are Reed-Sternberg cells. The pathologist also looks at how the cells are arranged, which could point to the type of Hodgkin disease.

Because diagnosing Hodgkin disease can be tricky, it helps if the pathologist specializes in diseases of the blood. Sometimes the first biopsy does not give a definite answer and more biopsies are needed.

Immunohistochemistry: Looking at the samples under the microscope is often enough to diagnose Hodgkin disease (and what type it is), but sometimes further tests are needed. Special stains of the specimen can spot certain proteins, such as CD15 and CD30, on the surface of the Reed-Sternberg cells. These are typically found in classic Hodgkin disease. Tests for other proteins may point to nodular lymphocyte predominant Hodgkin disease, to non-Hodgkin lymphoma rather than Hodgkin disease, or to other diseases entirely.

How is Hodgkin disease staged?

Once Hodgkin disease is diagnosed, tests will be done to determine the stage (extent of spread) of the disease. The treatment and prognosis (outlook) for a person with Hodgkin disease depend to some extent on both the type and the stage of the disease.

Hodgkin disease generally starts in the lymph nodes. If it spreads, it is usually to another set of nearby lymph nodes. It may invade (grow into) nearby organs as well. Rarely, Hodgkin disease will start in an organ other than lymph nodes, such as a lung. The current staging system is based on these facts.

Staging is based on:

- Your medical history (if you have certain symptoms)
- The physical exam
- Biopsies
- Imaging tests, which typically include a chest x-ray, CT (computed tomography) scan of the chest/abdomen/pelvis, and PET (positron emission tomography) scan
- Blood tests
- Bone marrow aspiration and biopsy (sometimes but not always done)

The medical history/physical exam and biopsies are discussed in the section, “How is Hodgkin disease diagnosed?”

Imaging tests used to stage Hodgkin disease

Imaging tests use x-rays, sound waves, magnetic fields, or radioactive particles to make pictures of the inside of the body. Imaging tests may be done for a number of reasons, including:

- To look for possible causes of certain symptoms, such as enlarged lymph nodes in the chest
- To help determine the stage of the lymphoma
- To help determine if treatment is working
- To look for possible signs of cancer coming back after treatment

Chest x-ray

Hodgkin disease often enlarges lymph nodes in the chest, and they can usually be seen on a plain chest x-ray.

Computed tomography (CT) scan

The CT scan is an x-ray test that produces detailed cross-sectional images of the body. Unlike a regular x-ray, CT scans can show the detail in soft tissues (such as internal organs). This scan can help tell if any lymph nodes or organs in your body are enlarged. CT scans are useful for looking for Hodgkin disease in the chest, abdomen, pelvis, and neck.

Before the test, you may be asked to drink a contrast solution and/or get an intravenous (IV) injection of a contrast dye to better outline abnormal areas in the body. You might need an IV line through which the contrast dye is injected. The injection can cause some flushing (a feeling of warmth, especially in the face). Some people are allergic to the dye and get hives or a flushed feeling or, rarely, have more serious reactions like trouble breathing and low blood pressure. Be sure to tell the doctor if you or your child has any allergies or has ever had a reaction to any contrast material used for x-rays.

A CT scanner has been described as a large donut, with a narrow table in the middle opening. You will need to lie still on the table while the scan is being done. CT scans take longer than regular x-rays, and you might feel a bit confined by the ring while the pictures are being taken. Doctors may advise medicine for some children to help keep them calm or even asleep during the test.

Instead of taking one picture like an x-ray, a CT scanner takes many pictures as it rotates around your body. A computer combines these pictures into detailed images of the part of the body that is being studied.

In some cases, a CT can be used to guide a biopsy needle precisely into a suspicious area. For this procedure, called a *CT-guided needle biopsy*, you remain on the CT scanning table while a radiologist moves a biopsy needle through the skin and toward the location of the mass. CT scans are repeated until the needle is within the mass. A biopsy sample is then removed and looked at under a microscope.

Magnetic resonance imaging (MRI) scan

This test is rarely used in Hodgkin disease, but if your doctor is concerned about spread to the spinal cord or brain, MRI is very useful for looking at these areas.

Like CT scans, MRI scans provide detailed images of soft tissues in the body. But MRI scans use radio waves and strong magnets instead of x-rays. The energy from the radio waves is absorbed by the body and then released in a pattern formed by the type of body tissue and by certain diseases. A computer translates the pattern into a very detailed image of parts of the body. A contrast material called *gadolinium* is often injected into a vein before the scan to show details better. This contrast material usually does not cause allergic reactions.

MRI scans take longer than CT scans, often up to an hour. You may have to lie inside a narrow tube, which is confining and can be distressing to some people. Some children may need sedation. Newer, more open MRI machines might be another option. The MRI machine makes loud buzzing and clicking noises that you might find disturbing. Some places give you headphones or earplugs to help block this noise out.

Positron emission tomography (PET) scan

For a PET scan, a form of radioactive sugar (known as *fluorodeoxyglucose* or *FDG*) is injected into the blood. Because cancer cells in the body are growing quickly, they absorb large amounts of the radioactive sugar. After about an hour, you will be moved onto a table in the PET scanner. You lie on the table for about 30 minutes while a special camera creates a picture of areas of radioactivity in the body. The picture is not finely detailed like a CT or MRI scan, but it can provide helpful information about your whole body.

PET scans can help show if an enlarged lymph node contains Hodgkin disease or is benign. It can also help spot small areas that might be lymphoma, even if the area looks normal on a CT scan.

PET scans are often used to tell if Hodgkin disease is responding to treatment. Some doctors will repeat the PET scan after 2 or 3 courses of chemotherapy. If it is working, the lymph nodes will no longer take up the radioactive sugar. PET scans can also be used after treatment in helping decide whether an enlarged lymph node still contains cancer or is just scar tissue.

In looking at patients with Hodgkin disease, a machine that combines the PET scan with a CT scan is often used. This allows the doctor to compare areas of higher radioactivity on the PET scan with the more detailed appearance of that area on the CT. PET/CT scans often can help pinpoint the areas involved with lymphoma better than a CT alone.

Gallium scan

This test can find tumors that might be Hodgkin disease in lymph nodes and other organs. Gallium scans are not used as much now as in the past, because most doctors do a PET scan instead. This test can still sometimes be useful in finding areas of lymphoma that the PET scan might miss. It can also help distinguish infections from lymphomas when the diagnosis is not clear.

During this test, a small dose of radioactive gallium is injected into a vein. It is attracted to lymph tissue in the body. A few days later a special camera is used to detect the radioactivity, showing the location of the gallium.

Bone scan

This test is not usually done unless a person is having bone pain or has lab test results that suggest the Hodgkin disease may have reached the bones.

A different radioactive substance (technetium) is used for a bone scan. After it is injected into a vein, it travels to damaged areas of the bone. A special camera can then detect the radioactivity. Hodgkin disease sometimes causes bone damage, which may be picked up on a bone scan. But bone scans can’t show the difference between cancers and non-cancerous problems, which means further tests might be needed.

Other tests

Blood tests

Blood tests aren’t part of the formal staging system for Hodgkin disease, but they can help your doctor get a sense of how advanced the disease is and how well you might tolerate certain treatments.

Hodgkin disease cells do not appear in the blood, but a complete blood count can sometimes reveal signs of Hodgkin disease. Anemia (not having enough red blood cells) can be a sign of more advanced Hodgkin disease. A high white blood cell count is another possible sign, although it can also be caused by infection. Another test called an *erythrocyte sedimentation rate* (ESR) can help measure how much inflammation is in the body.

Blood tests may also be done to check liver and kidney function and to look for signs that that cancer might have reached the bones.

Your doctor may also suggest other blood tests to look for signs of certain infections:

- HIV test: if you have abnormal symptoms that might be related to HIV infection

- Hepatitis B virus test: if your doctor plans on using a drug called *rituximab* (Rituxan) in your treatment, which could cause problems if you have this infection

Bone marrow aspiration and biopsy

If Hodgkin disease has been diagnosed, these tests may be done sometimes to tell if it is in the bone marrow. The bone marrow aspiration and biopsy are usually done at the same time. The samples are taken from the back of the pelvic (hip) bone, although in some cases they may be taken from the sternum (breast bone) or other bones.

In bone marrow *aspiration*, you lie on a table (either on your side or on your belly). After cleaning the skin over the hip, the doctor numbs the area and the surface of the bone by injecting a local anesthetic, which may cause a brief stinging or burning sensation. A thin, hollow needle is then inserted into the bone and a syringe is used to suck out a small amount of liquid bone marrow. Even with the anesthetic, most patients still have some brief pain when the marrow is removed.

A bone marrow *biopsy* is usually done just after the aspiration. A small piece of bone and marrow is removed with a slightly larger needle that is twisted as it is pushed down into the bone. The biopsy may also cause some brief pain. Once the biopsy is done, pressure will be applied to the site to help stop any bleeding.

Most children having a bone marrow aspiration and biopsy either receive medicine to make them drowsy or have general anesthesia so they are asleep.

The samples are then sent to a lab, where they are viewed under a microscope to look for signs of Hodgkin disease.

Tests of heart and lung function

These tests are not used to help stage Hodgkin disease, but they may be done if certain chemotherapy drugs are going to be used that could affect the heart or the lungs.

- Your heart function may be checked with an echocardiogram (an ultrasound of the heart) or a MUGA scan.
- Your lung function may be checked with pulmonary function tests, in which you breathe into a tube connected to a machine.

Cotswold staging system

A staging system is a way for members of the cancer care team to sum up the extent of a cancer’s spread. The staging system for Hodgkin disease (HD) is known as the *Cotswold system*, which is a modification of the older Ann Arbor system. It has 4 stages, labeled I, II, III, and IV.

If Hodgkin disease affects an organ outside of the lymph system, the letter E is added to the stage (for example, stage IE or IIE). If it involves the spleen, the letter S may be added.

Stage I: Either of the following means that the disease is stage I:

- Hodgkin disease is found in only 1 lymph node area or lymphoid organ such as the thymus (I).
- The cancer is found only in 1 area of a single organ outside the lymph system (IE).

Stage II: Either of the following means that the disease is stage II:

- Hodgkin disease is found in 2 or more lymph node areas on the same side of (above or below) the diaphragm — the muscle beneath the lungs that separates the chest and abdomen (II).
- The cancer extends locally from one lymph node area into a nearby organ (IIE).

Stage III: Either of the following means that the disease is stage III:

- Hodgkin disease is found in lymph node areas on both sides of (above and below) the diaphragm (III).
- Hodgkin disease is in lymph nodes above and below the diaphragm, and has also spread to a nearby organ (IIIE), to the spleen (IIIS), or to both (IIIES).

Stage IV: Any of the following means that the disease is stage IV:

- Hodgkin disease has spread widely through 1 or more organs outside of the lymph system. Cancer cells may or may not be found in nearby lymph nodes.
- Hodgkin disease is found in organs in 2 distant parts of the body (and not in nearby lymph nodes).
- Hodgkin disease is in the liver, bone marrow, lungs (other than by growing there directly from another site), or cerebrospinal fluid (the liquid that surrounds the brain and spinal cord).

Other modifiers may also be used to describe the Hodgkin disease stage:

Bulky disease

This term is used to describe tumors in the chest that are at least ⅓ as wide as the chest, or tumors in other areas that are at least 10 centimeters (about 4 inches) across. It is usually labeled by adding the letter X to the stage. Bulky disease may require more intensive treatment.

A vs. B

Each stage may also be assigned a letter (A or B). B is added (stage IIIB, for example) if a person has any of the symptoms listed below:

- Loss of more than 10% of body weight over the previous 6 months (without dieting)
- Unexplained fever of at least 100.4°F (38°C)
- Drenching night sweats

If a person has any of these B symptoms, it usually means the disease is more advanced, and more intensive treatment is often recommended. If no B symptoms are present, the letter A is added to the stage.

Resistant or recurrent Hodgkin disease

These terms are not part of the formal staging system, but doctors or nurses may use them to describe what is going on with the lymphoma in some cases.

The terms *resistant* or *progressive* disease are used when the disease does not go away or progresses (grows) while you are still being treated.

Recurrent or *relapsed* disease means that Hodgkin disease initially responded well to treatment and went away, but it has now come back. If Hodgkin disease returns, it may do so in the area of the body where it first started or in another part of the body. This may occur shortly after treatment or years later.

Survival rates for Hodgkin disease by stage

Survival rates are often used by doctors as a standard way of discussing a person's prognosis (outlook). Some patients with Hodgkin disease may want to know the survival statistics for people in similar situations, while others may not find the numbers helpful, or may even not want to know them. If you do not want to read about Hodgkin disease survival statistics, skip to the next section.

The rates below are based on the stage of the cancer *when it is first diagnosed*. When looking at survival rates, it's important to understand that the stage of a cancer does not change over time, even if the cancer progresses. A cancer that comes back or spreads is still referred to by the stage it was given when it was first found and diagnosed, but more information is added to explain the current extent of the cancer. (And of course, the treatment plan is adjusted based on the change in cancer status.)

The 5-year survival rate is the percentage of patients who live *at least* 5 years after their cancer is diagnosed. Of course, many of these people live much longer than 5 years, and many are cured.

To get 5-year survival rates, doctors have to look at people who were treated at least 5 years ago. Improvements in treatment since then may result in a more favorable outlook for people now being diagnosed with these cancers.

The numbers below come from the National Cancer Institute's SEER database, looking at more than 8,000 people diagnosed with Hodgkin disease between 1988 and 2001.

Stage	5-year Survival Rate
I	About 90%
II	About 90%
III	About 80%
IV	About 65%

Survival rates are based on previous outcomes of large numbers of people who had the disease, but they cannot predict what will happen in your case. Many other factors could affect your outlook, such as your age and general health, how well the cancer responds to treatment, and other factors (see below). Your doctor can tell you how the numbers above may apply to you, as he or she is familiar with your situation. If you have any questions about the stage of your lymphoma or how it affects your treatment, do not hesitate to ask your doctor.

Other prognostic factors

Along with the stage of the Hodgkin disease, certain other factors can affect a person's prognosis (outlook). For example, some factors mean the disease is likely to be more serious and may prompt the doctor to give more intensive treatment:

- Having B symptoms or bulky disease
- Being older than 45
- Being male
- Having a high white blood cell count (above 15,000)
- Having a low red blood cell count (hemoglobin level below 10.5)
- Having a low blood lymphocyte count (below 600)
- Having a low blood albumin level (below 4)

- Having a high erythrocyte sedimentation rate, or ESR (over 30 in someone with B symptoms, or over 50 for someone without B symptoms)

How is Hodgkin disease treated?

This information represents the views of the doctors and nurses serving on the American Cancer Society's Cancer Information Database Editorial Board. These views are based on their interpretation of studies published in medical journals, as well as their own professional experience.

The treatment information in this document is not official policy of the Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor.

Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.

General treatment information

After Hodgkin disease is staged, the cancer care team will discuss treatment options with you. Treatment for Hodgkin disease is based largely on the stage of the disease. But other factors, including a person's age and general health, and the type and location of the disease, may also affect treatment options.

For almost all patients with Hodgkin disease, cure is the main goal. But treatment can have side effects that often don't show up for many years. Because of this, doctors try to choose a treatment plan with the lowest risk of potential side effects.

Several types of treatment can be used for Hodgkin disease:

- Chemotherapy
- Radiation therapy
- Monoclonal antibodies
- High-dose chemotherapy and stem cell transplant

The 2 main methods of treating Hodgkin disease are chemotherapy (the use of cancer-killing drugs) and radiation therapy (the use of high-energy rays or particles). Depending on the situation, one or both of these treatments might be used.

Monoclonal antibodies and high-dose chemotherapy with stem cell transplants may be used for certain patients, especially if other treatments haven't worked. Except for biopsy and staging, surgery is rarely used to treat Hodgkin disease.

Based on your treatment options, you may have different types of doctors on your treatment team. These doctors may include:

- A hematologist: a doctor who treats disorders of the blood, including lymphomas.
- A medical oncologist: a doctor who treats cancer with medicines.
- A radiation oncologist: a doctor who treats cancer with radiation therapy.

Many other specialists may be involved in your care as well, including nurse practitioners, nurses, nutrition specialists, social workers, and other health professionals.

It is important to discuss all of your treatment options as well as their possible side effects with your doctors to help make the decision that best fits your needs. In choosing a treatment plan, consider your health and the type and stage of the Hodgkin disease. Be sure that you understand all the risks and side effects of the various treatments before making a decision.

If time permits, it is often a good idea to seek a second opinion. Getting a second opinion can give you more information and help you feel confident about the treatment plan that you choose. Your doctor should be willing to help you find another cancer doctor who can give you a second opinion.

The next few sections describe the types of treatments used for Hodgkin disease. This is followed by a discussion of the typical treatment options based on the stage of the disease (and other prognostic factors when these are important). Finally, treatment of Hodgkin disease in special circumstances, such as in children or during pregnancy, is discussed.

Chemotherapy for Hodgkin disease

Chemotherapy (chemo) is the use of drugs to kill cancer cells. The drugs can be taken as pills or injected into a vein under the skin. Chemotherapy is systemic therapy, which means the drugs enter the bloodstream and travel throughout the body to reach and destroy cancer cells wherever they may be.

Doctors give chemo in cycles, in which a period of treatment is followed by a rest period to give the body time to recover. Each cycle generally lasts for several weeks. Most chemo treatments are given on an outpatient basis (in the doctor's office, clinic, or hospital outpatient department), but some may require a hospital stay.

The chemo regimens for Hodgkin disease combine several drugs because different drugs kill cancer cells in different ways. The combinations used to treat Hodgkin disease are often referred to by abbreviations that are easier to remember than the drugs' full names.

The most common regimen in the United States is a 4-drug combination called ABVD, which consists of:

- **A**driamycin® (doxorubicin)
- **B**leomycin
- **V**inblastine
- **D**acarbazine (DTIC)

Other common regimens include:

Stanford V

- Doxorubicin (Adriamycin)
- Mechlorethamine (nitrogen mustard)
- Vincristine
- Vinblastine
- Bleomycin
- Etoposide
- Prednisone

BEACOPP

- **B**leomycin
- **E**toposide (VP-16)
- **A**driamycin (doxorubicin)
- **C**yclophosphamide (Cytoxan®)
- **O**ncovin® (vincristine)
- **P**rocarbazine
- **P**rednisone

Radiation is given after chemo in the Stanford V regimen, and it is sometimes given after the ABVD or BEACOPP regimens as well.

Other chemotherapy combinations may also be used for Hodgkin disease. Most use the same drugs as listed above, but they may include different combinations and be given on different schedules.

Possible side effects

Chemo drugs attack cells that are dividing quickly, which is why they work against most types of lymphoma cells. But other cells in the body, such as those in the bone marrow, the lining of the mouth and intestines, and the hair follicles, also divide quickly. These cells are also likely to be affected by chemotherapy, which can lead to side effects.

The side effects depend on the type and dose of drugs given and the length of time they are taken. They can include:

- Hair loss
- Mouth sores
- Loss of appetite
- Nausea and vomiting
- Diarrhea
- Increased chance of infections (from having too few white blood cells)
- Easy bruising or bleeding (from having too few blood platelets)
- Fatigue (from having too few red blood cells)

These side effects are usually short-term and go away after treatment is finished. If serious side effects occur, the chemotherapy may have to be delayed or the doses reduced.

There are often ways to lessen these side effects. For example, drugs are usually given to help prevent nausea and vomiting.

Drugs known as growth factors, such as G-CSF (Neupogen®) or GM-CSF (Leukine®), are sometimes given to help the body make more white blood cells and thus reduce the chance of infection. Antibiotics may also be given at the earliest sign of an infection, such as a fever.

If your white blood cell counts are very low during treatment, you can help lower the risk of infection by carefully limiting your exposure to germs. During this time, your doctor may advise you to:

- Wash your hands often.
- Avoid fresh, uncooked fruits and vegetables and other foods that might carry germs.
- Avoid fresh flowers and plants because they may carry mold.
- Make sure other people wash their hands before they come in contact with you.

- Avoid large crowds and people who are sick (wearing a surgical mask offers some protection in these situations).

If your platelet counts are very low, you may be given drugs or platelet transfusions to help protect against bleeding. Fatigue caused by anemia (very low red blood cell counts) can be treated with drugs or with red blood cell transfusions.

Long-term side effects: Some chemo drugs can have long-term side effects that occur months or years after treatment has ended.

For example, doxorubicin can cause heart damage, so your doctor may order a test to check your heart function before and during treatment with this drug.

Bleomycin can cause lung damage, so some doctors order tests of lung function (called pulmonary function tests) before starting patients on this drug.

Some chemo drugs can increase the risk of getting a second type of cancer later in life (such as leukemia), especially in patients who have also received radiation therapy.

In children and young adults, some chemo drugs can also affect body growth and fertility (ability to have children) later on.

Long-term effects are discussed in more detail in the section, “What happens after treatment for Hodgkin disease?”

Before starting chemotherapy, ask your doctor to explain the possible side effects and your chances of having them.

Radiation therapy for Hodgkin disease

Radiation therapy uses high-energy rays (or particles) to destroy cancer cells.

To treat Hodgkin disease, a carefully focused beam of radiation is delivered from a machine outside the body. This is known as *external beam radiation*. Most often, radiation treatments are given 5 days a week for several weeks. Before the treatments start, the radiation team takes careful measurements to determine the dose needed and the correct angles for aiming the radiation beams. The treatment is much like getting an x-ray, but the radiation is more intense. Each treatment lasts only a few minutes, although the setup time – getting you or your child into place – usually takes longer. Radiation itself is painless, but some younger children may need to be sedated to make sure they don’t move during the treatment.

Radiation therapy is most useful when Hodgkin disease is only in one part of the body. For classic Hodgkin disease, radiation is often given after chemotherapy, especially when there is a large or bulky tumor mass (usually in the chest). The chemotherapy or radiation alone would probably not cure the disease, but both treatments together are usually

effective in getting rid of it. Radiation therapy may also be used by itself to treat some cases of nodular lymphocyte predominant Hodgkin disease.

Radiation therapy is often very good at killing Hodgkin disease cells. Decades ago, this was the best treatment available for Hodgkin disease, but over the years doctors realized it could lead to long-term side effects. As it became clear that chemotherapy was also effective, doctors began to use less radiation. Today, if radiation therapy is used, only the involved areas are treated with radiation to try to limit side effects.

Involved field radiation

This is the preferred form of radiation therapy when it is used to treat Hodgkin disease. Only the lymph node areas that contain Hodgkin disease are treated. Chemotherapy is typically given first, and then radiation is given to areas that were initially involved.

Extended field radiation

In the past, radiation was given to the major lymph node areas that contained Hodgkin disease, as well as the surrounding "normal" lymph node areas, just in case the Hodgkin disease had spread, even though the doctors could not actually detect it in these areas. This is called *extended field radiation*.

- If the Hodgkin disease was in the upper body, radiation was given to the *mantle field*, which included lymph node areas in the neck, chest, and under the arms. Sometimes this was extended to also include lymph nodes in the upper abdomen.
- *Inverted Y field* radiation therapy included the lymph nodes in the upper abdomen, the spleen, and the lymph nodes in the pelvis).
- When inverted Y field radiation was given together with mantle field radiation, the combination was called *total nodal irradiation*.

Because nearly all patients with Hodgkin disease are now treated with chemotherapy, extended field radiation is seldom used any more.

Total body irradiation

People who are getting a stem cell transplant may get radiation to the whole body along with high-dose chemotherapy, to try to kill lymphoma cells throughout the body. For more information on this procedure, see the section, "High-dose chemotherapy and stem cell transplant."

Possible side effects

The side effects of radiation therapy depend on where the radiation is aimed. Some people have skin changes similar to sunburn, which slowly fades away. Other possible short-term side effects include fatigue, dry mouth, nausea, or diarrhea. Radiation given to several areas, especially after chemotherapy, can lower blood cell counts.

Long-term side effects: Radiation therapy can also have long-term side effects. The most serious of these is the development of another cancer in the part of the body that was exposed to radiation.

Radiation to the chest or neck can damage the thyroid gland, which can affect its ability to make thyroid hormone. This can lead to fatigue and weight gain. Treatment with thyroid hormone pills can help with this. Radiation to the chest also increases the risk of heart disease (such as heart attacks) and lung problems, while radiation to the neck may increase the risk of stroke many years later.

In children, radiation that reaches the bones may slow their growth. Depending on where the radiation is given, this could result in deformities or a lack of growth to full height. Radiation to the lower part of the body in children and young adults might also affect fertility later in life.

To reduce the risk of side effects, doctors carefully calculate the exact dose of radiation needed and aim the radiation beam as accurately as they can. Shields may also be placed over nearby parts of the body to protect them from the radiation. In girls and young women, the ovaries may be moved out of the way with minor surgery before radiation is given to help preserve fertility.

For more information about long-term side effects, see the section, “What happens after treatment for Hodgkin disease?” If you or your child are getting radiation therapy, ask your doctor about the possible long-term side effects.

Monoclonal antibodies for Hodgkin disease

Antibodies are proteins made by your immune system to help fight infections. Man-made versions, called *monoclonal antibodies*, can be designed to attack a specific target, such as a substance on the surface of lymphocytes (the cells in which lymphomas start).

Some monoclonal antibodies are now being used to treat Hodgkin disease.

Brentuximab vedotin (Adcetris™): This drug is an anti-CD30 antibody attached to a chemotherapy drug. Hodgkin disease cells usually have the CD30 molecule on their surface. The antibody acts like a homing signal, bringing the chemo drug to the lymphoma cells, where it enters the cells and causes them to die when they try to divide into new cells.

This drug has been shown to help many people whose Hodgkin disease has come back after other treatments, including a stem cell transplant (see next section), as well as people who can't have a stem cell transplant. It is also being studied to see if it can be given with chemotherapy and if can be helpful earlier in the course of the disease.

Brentuximab is given as an infusion into a vein (IV) every 3 weeks. Common side effects include nerve damage (neuropathy), low blood counts, fatigue, fever, nausea and vomiting, infections, diarrhea, and cough. Rarely, more severe side effects occur during infusions, such as trouble breathing and low blood pressure.

Rituximab (Rituxan®): This antibody attaches to a substance called CD20 found on some types of lymphoma cells, which seems to cause the lymphoma cell to die. Rituximab may be used to treat nodular lymphocyte predominant Hodgkin disease (NLPHD), often with chemotherapy and/or radiation therapy.

Rituximab is given as an IV infusion in the doctor's office or clinic. When it is used by itself to treat lymphoma, it is usually given once a week for 4 weeks, which may then be repeated several months later. When it is combined with chemotherapy, it is most often given on the first day of each chemo cycle.

Common side effects are usually mild but may include chills, fever, nausea, rashes, fatigue, and headaches. Rarely, more severe side effects occur during infusions, such as trouble breathing and low blood pressure. Even if these symptoms occur during the first rituximab infusion, it is very unusual for them to recur with later doses. Rituximab can cause dormant (inactive) hepatitis B infections to become active again, sometimes leading to severe liver problems or even death. Your doctor may check your blood for signs of hepatitis before starting this drug. This drug may also increase the risk of certain infections for several months after the drug is stopped.

High-dose chemotherapy and stem cell transplant for Hodgkin disease

Stem cell transplants (SCTs) are sometimes used for Hodgkin disease that is hard to treat, such as those that don't go away completely after chemotherapy and/or radiation, or those that come back after treatment.

The doses of chemotherapy drugs normally are limited by the side effects these drugs cause. Higher doses can't be used, even if they might kill more cancer cells, because they would severely damage the bone marrow, where new blood cells are made.

A stem cell transplant lets doctors use higher doses of chemotherapy (sometimes along with radiation therapy). After getting high-dose treatment, the patient receives a transplant of blood-forming stem cells to restore the bone marrow.

Blood-forming stem cells used for a transplant come either from the blood (for a peripheral blood stem cell transplant, or PBSCT) or from the bone marrow (for a bone

marrow transplant, or BMT). Peripheral blood stem cells are obtained from a procedure similar to a blood donation, while bone marrow donation is usually done in an operating room with the marrow donor under general anesthesia (in a deep sleep). Bone marrow transplants were more common in the past, but they have largely been replaced by PBSCTs.

Types of transplants

There are 2 main types of stem cell transplants. They differ with regard to the source of the blood-forming stem cells.

Autologous stem cell transplant

In this type of transplant, a patient's own blood stem cells are removed from his or her bone marrow or peripheral blood. They are collected several times in the weeks before treatment. The cells are frozen and stored while the person gets treatment (high-dose chemotherapy and/or radiation) and then are given back to the patient by infusion into the patient's blood. This is the more common type of transplant for Hodgkin disease.

Allogeneic stem cell transplant

In this type of transplant, the blood stem cells come from someone else. The donor's tissue type (also known as the HLA type) needs to match the patient's tissue type as closely as possible to help prevent the risk of major problems with the transplant.

Usually the donor is a brother or sister if they have the same tissue type as the patient. If there are no siblings who are a good match, the cells may come from an HLA-matched, unrelated donor — a stranger who has volunteered to donate their cells.

Sometimes umbilical cord blood stem cells are used. These cells come from blood drained from the umbilical cord and placenta after a baby is born, which is rich in blood stem cells. These are more often a source of blood stem cells for transplants in children.

Regardless of the source, the stem cells are then frozen and stored until they are needed for the transplant.

Allogeneic transplants may be more likely to rid the body of lymphoma cells, but they are also more likely to cause serious complications that could be life-threatening. In treating Hodgkin disease, an allogeneic transplant is generally used only if an autologous transplant has already been tried without success.

Non-myeloablative transplant: This special type of allogeneic transplant may be an option for some patients who couldn't tolerate a regular allogeneic transplant because it would be too toxic. This type of transplant uses less chemo and radiation, so it is also known as a *mini-transplant* or *reduced-intensity transplant*.

The lower doses of chemotherapy and radiation do not completely destroy the cells in the bone marrow. After treatment, the patient gets the allogeneic (donor) stem cells. These cells establish a new immune system in the body, which sees the lymphoma cells as foreign and attacks them (called the *graft-versus-lymphoma effect*).

Even though it uses small doses of certain chemotherapy drugs and low doses of total body radiation, this type of transplant can still sometimes work and have less serious side effects. In fact, some patients can receive a non-myeloablative transplant as an outpatient.

Doctors aren't yet sure exactly how effective these types of transplants are for patients with Hodgkin disease, but studies are now being done to find out.

The transplant procedure

The patient may be admitted to the stem cell transplant unit of the hospital or receive treatment as an outpatient depending on a number of factors.

If they are going to be treated in the hospital, the person is usually admitted to the hospital the day before the high-dose chemo is to begin. He or she will usually stay in the hospital until the stem cells have started to make new blood cells again, which often takes several weeks.

If the transplant is done as an outpatient procedure, patients and families must be able to spot complications requiring their doctor's attention. Unless they live close to the transplant center, they will be asked to stay in a nearby hotel.

Treatment starts with high-dose chemo and may include high-dose whole body radiation. The chemo and radiation treatments are meant to destroy any remaining cancer cells. They also kill the normal cells of the bone marrow and the immune system. Once treatment is complete, the new stem cells (autologous or allogeneic) are given through a vein, just like a blood transfusion. The stem cells then migrate to the bone marrow.

In an allogeneic SCT, the person getting the transplant may be given drugs to keep the new immune system from attacking the body. This is known as *graft-versus-host disease* or GVHD. For the next several weeks the patient is likely to have very low blood cell counts, so they are given as much supportive therapy as needed. This may include antibiotics, red blood cell or platelet transfusions, other medicines, and help with nutrition.

Usually within a couple of weeks after the stem cells have been infused, they begin making new white blood cells. This is later followed by the new platelet production and new red blood cell production. Because of the high risk of serious infections right after treatment, patients remain protected in isolation (where exposure to germs is kept to a minimum) until a measure of their white blood cells, the absolute neutrophil count (ANC), rises above 500. They can usually leave the hospital when their ANC nears 1,000.

Patients then typically make regular visits to the outpatient transplant clinic for about 6 months, after which their care is continued by their regular doctors. At this point, they may only come back to the clinic for their regular exams or if they have symptoms that should be checked by their doctor.

Practical points

A stem cell transplant is a complex treatment that can cause life-threatening side effects. If the doctors think a patient may benefit from a transplant, it should be done at a hospital where the staff has experience with the procedure and with managing the recovery phase. Some stem cell transplant programs may not have experience in certain types of transplants, especially transplants from unrelated donors.

SCTs often require a long hospital stay and can be very expensive (costing well over $100,000). Because some insurance companies may view it as an experimental treatment, they may not pay for it. Even if the transplant is covered by your insurance, your co-pays or other costs could easily amount to tens of thousands of dollars. Find out what your insurer will cover before deciding on a transplant so you will have an idea of what you might have to pay.

Possible side effects

Early or short-term effects: The early complications and side effects are basically the same as those caused by any other type of high-dose chemotherapy (see the "Chemotherapy" section of this document), and can be severe. They are caused by damage to the bone marrow and other quickly growing tissues of the body and can include:

- Low blood cell counts (with fatigue and increased risks of infection and bleeding)
- Nausea and vomiting
- Diarrhea
- Loss of appetite
- Mouth sores
- Hair loss

One of the most common and serious short-term effects is the increased risk for infection. Antibiotics are often given to try to prevent this from happening. Other side effects, like low red blood cell and platelet counts, may require blood product transfusions or other treatments.

Long-term side effects: Some complications and side effects can last for a long time or occur many years after the transplant. These can include:

- Graft-versus-host disease, which occurs only in allogeneic transplants (see next paragraph)
- Menstrual changes, early menopause, and loss of fertility in female patients (caused by damage to the ovaries)
- Loss of fertility in male patients
- Damage to the thyroid gland, causing problems with metabolism
- Cataracts (damage to the lens of the eye that can affect vision)
- Damage to the lungs, causing shortness of breath
- Bone damage called aseptic necrosis (if damage is severe, the patient may need to have part of the affected bone and the joint replaced)
- Development of leukemia or another cancer years later

Graft-versus-host disease (GVHD): This is one of the most serious complications of allogeneic (donor) stem cell transplants. It occurs because the immune system of the patient is replaced by the donor's immune system. The donor immune system then may "see" the patient's own body tissues as foreign and may react against them.

Symptoms can include severe skin rashes, itching, mouth sores (which can affect eating), nausea, and severe diarrhea. Liver damage may cause yellowing of the skin and eyes (jaundice). The lungs may also be damaged. The patient may also tire easily and have muscle aches.

GVHD is either acute or chronic, based on how soon after the transplant it begins. Sometimes GVHD can become disabling, and if it is severe enough, it can be life-threatening. Usually, immune-suppressing drugs can be used to help control GVHD, although they can have their own side effects.

On the positive side, the graft-versus-host disease also leads to graft-versus-lymphoma activity. Lymphoma cells remaining after the chemotherapy and radiation therapy are often killed by donor immune cells since the lymphoma cells are seen as foreign by the donor's immune system as well. Mild graft-versus-host disease can be a good thing.

For more information, see the American Cancer Society document, Stem Cell Transplant *(Peripheral Blood, Bone Marrow, and Cord Blood Transplants)*.

Clinical trials for Hodgkin disease

You may have had to make a lot of decisions since you've been told you have cancer. One of the most important decisions you will make is choosing which treatment is best

for you. You may have heard about clinical trials being done for your type of cancer. Or maybe someone on your health care team has mentioned a clinical trial to you.

Clinical trials are carefully controlled research studies that are done with patients who volunteer for them. They are done to get a closer look at promising new treatments or procedures.

If you would like to take part in a clinical trial, you should start by asking your doctor if your clinic or hospital conducts clinical trials. You can also call our clinical trials matching service for a list of clinical trials that meet your medical needs. You can reach this service at 1-800-303-5691 or on our Web site at www.cancer.org/clinicaltrials. You can also get a list of current clinical trials by calling the National Cancer Institute's Cancer Information Service toll-free at 1-800-4-CANCER (1-800-422-6237) or by visiting the NCI clinical trials Web site at www.cancer.gov/clinicaltrials.

There are requirements you must meet to take part in any clinical trial. If you do qualify for a clinical trial, it is up to you whether or not to enter (enroll in) it.

Clinical trials are one way to get state-of-the art cancer treatment. In some cases they may be the only way to get access to newer treatments. They are also the only way for doctors to learn better methods to treat cancer. Still, they are not right for everyone.

You can get a lot more information on clinical trials in our document called *Clinical Trials: What You Need to Know*. You can read it on our Web site or call our toll-free number (1-800-227-2345) and have it sent to you.

Complementary and alternative therapies for Hodgkin disease

When you have cancer you are likely to hear about ways to treat your cancer or relieve symptoms that your doctor hasn't mentioned. Everyone from friends and family to Internet groups and Web sites may offer ideas for what might help you. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

What exactly are complementary and alternative therapies?

Not everyone uses these terms the same way, and they are used to refer to many different methods, so it can be confusing. We use *complementary* to refer to treatments that are used *along with* your regular medical care. *Alternative* treatments are used *instead of* a doctor's medical treatment.

Complementary methods: Most complementary treatment methods are not offered as cures for cancer. Mainly, they are used to help you feel better. Some methods that are used along with regular treatment are meditation to reduce stress, acupuncture to help

relieve pain, or peppermint tea to relieve nausea. Some complementary methods are known to help, while others have not been tested. Some have been proven not be helpful, and a few have even been found harmful.

Alternative treatments: Alternative treatments may be offered as cancer cures. These treatments have not been proven safe and effective in clinical trials. Some of these methods may pose danger, or have life-threatening side effects. But the biggest danger in most cases is that you may lose the chance to be helped by standard medical treatment. Delays or interruptions in your medical treatments may give the cancer more time to grow and make it less likely that treatment will help.

Finding out more

It is easy to see why people with cancer think about alternative methods. You want to do all you can to fight the cancer, and the idea of a treatment with few or no side effects sounds great. Sometimes medical treatments like chemotherapy can be hard to take, or they may no longer be working. But the truth is that most of these alternative methods have not been tested and proven to work in treating cancer.

As you consider your options, here are 3 important steps you can take:

- Look for “red flags” that suggest fraud. Does the method promise to cure all or most cancers? Are you told not to have regular medical treatments? Is the treatment a “secret” that requires you to visit certain providers or travel to another country?
- Talk to your doctor or nurse about any method you are thinking about using.
- Contact us at 1-800-227-2345 to learn more about complementary and alternative methods in general and to find out about the specific methods you are looking at.

The choice is yours

Decisions about how to treat or manage your cancer are always yours to make. If you want to use a non-standard treatment, learn all you can about the method and talk to your doctor about it. With good information and the support of your health care team, you may be able to safely use the methods that can help you while avoiding those that could be harmful.

Treating classic Hodgkin disease, by stage

This section sums up the treatment options for Hodgkin disease (HD) in adults, based on the stage of cancer. Treatment of the disease in children is slightly different from the treatment used for adults. Some of the differences in treating adults and children are discussed in the section, “Hodgkin disease in children.” If a teen has achieved full growth, the treatment is usually the same as that for an adult.

Treatment options depend on many factors, including:

- The kind of Hodgkin disease you have
- The extent of the Hodgkin disease in your body
- Whether or not the disease is bulky (large)
- Whether the Hodgkin disease is causing certain symptoms
- Results of blood and other lab tests
- Your general health
- Your age
- Your medical history

Based on these factors, your treatment may be a little different from the general outline given below.

Stages IA and IIA, favorable

This group includes HD that is only on one side of the diaphragm (above or below) and that doesn't have any unfavorable factors. For example:

- It is not bulky
- It is not in several different lymph node areas
- It doesn't cause any of the B symptoms
- It doesn't cause an elevated erythrocyte sedimentation rate (ESR)

Treatment for most patients is chemotherapy (usually 2 to 4 cycles of the ABVD regimen or 8 weeks of the Stanford V regimen), followed by involved field radiation to the initial site of the disease. Another option is chemotherapy alone (usually for 4 or 6 cycles) in selected patients.

Doctors often order a PET/CT scan after a few courses of chemo to see how well the treatment is working and to determine how much more treatment (if any) is needed.

If a person can't tolerate chemotherapy because of other health issues, radiation therapy alone may be an option.

For those who don't respond to treatment, chemotherapy using different drugs or high-dose chemotherapy (and possibly radiation) followed by a stem cell transplant may be recommended. Treatment with the monoclonal antibody brentuximab vedotin (Adcetris) may be another option.

Stages I and II, unfavorable

This group includes HD that is only on one side of the diaphragm (above or below), but that is bulky, is in several different areas, is causing any of the B symptoms, and/or is causing an elevated erythrocyte sedimentation rate (ESR).

Treatment is generally more intense than that for favorable disease. It typically starts with chemotherapy (usually ABVD for 4 to 6 cycles or other regimens such as Stanford V for 12 weeks).

PET/CT scans are often done after several cycles of chemo to determine how much more treatment you need. This is often followed by more chemo. Involved-field radiation therapy is typically given to the sites of the tumor at this point, especially if it was bulky.

For those who don't respond to treatment, chemotherapy using different drugs or high-dose chemotherapy (and possibly radiation) followed by a stem cell transplant may be recommended. Treatment with the monoclonal antibody brentuximab vedotin may be another option.

Stages III and IV

This includes HD that is both above and below the diaphragm and/or has spread widely through one or more organs outside the lymph system.

Doctors generally treat these stages with chemotherapy at full doses. Although ABVD (for at least 6 cycles) can be used, some doctors favor more intense treatment with the Stanford V regimen for 12 weeks, or even the BEACOPP regimen if there are several unfavorable prognostic factors.

PET/CT scans might be used during or after chemotherapy to assess how much more treatment you need. Depending on the results of the scans, more chemotherapy may be given. Radiation therapy may be given after chemotherapy, especially if there were any large tumor areas.

For those who don't respond to treatment, chemotherapy using different drugs or high-dose chemotherapy (and possibly radiation) followed by a stem cell transplant may be recommended. Treatment with the monoclonal antibody brentuximab vedotin may be another option.

Resistant Hodgkin disease

Treatment for HD should remove all traces of the cancer. Once initial treatment is complete, the doctor will do tests such as PET and CT scans to look for any signs of HD. If the HD is still there, most experts think that more of the same treatment is unlikely to cure it.

Sometimes, radiation therapy to an area of disease that remains after chemotherapy might be curative. Using a different combination of chemotherapy drugs may be another option. If radiation alone was the initial treatment, using chemotherapy (with or without more radiation) might also be curative.

If HD is still there after a combination of these treatments, most doctors would recommend high-dose chemotherapy (and possibly radiation) followed by an autologous stem cell transplant, if it can be done. If cancer still remains after this, an allogeneic stem cell transplant may be an option.

Another option, either instead of or after a stem cell transplant, may be treatment with the monoclonal antibody brentuximab vedotin (Adcetris).

Recurrent or relapsed Hodgkin disease

Treatment in this situation depends on where the disease comes back, on how long it has been since your initial treatment, and on what your initial treatment was. If the initial treatment was radiation therapy alone, chemotherapy is usually given for recurrent disease.

If chemotherapy without radiation therapy was used first, and the cancer comes back only in the lymph nodes, the patient could receive radiation therapy to the lymph nodes with or without more chemotherapy. Chemotherapy with different drugs may be another option.

Radiation usually cannot be repeated in the same area. If, for example, HD in the chest was treated with radiation and it comes back in the chest, it could not be treated with more radiation to the chest. This holds true no matter how long ago the radiation was first given.

If the disease returns after several years, then using the same or different chemotherapy drugs (possibly along with radiation) might still cure it. On the other hand, patients whose cancer recurs soon after treatment may need more intensive treatment. For example, if the HD has returned within a few months of the original treatment, high-dose chemotherapy (and possibly radiation) followed by an autologous stem cell transplant may be recommended. These are decisions that you and your cancer care team need to make.

If the cancer still remains after an autologous transplant, an allogeneic stem cell transplant may be an option. Another option, either instead of or after a stem cell transplant, may be treatment with the monoclonal antibody brentuximab vedotin (Adcetris).

Treating nodular lymphocyte predominant Hodgkin disease (NLPHD)

Because this rare type of Hodgkin disease (HD) tends to grow more slowly than classic HD, it is sometimes treated slightly differently.

In people with early stage NLPHD without any B symptoms, radiation therapy alone is often all that is needed.

If the disease is more advanced or if a person has B symptoms, chemotherapy, with or without radiation therapy, is likely to be recommended. Many doctors use the ABVD chemo regimen, although some doctors prefer others. Another option is to give the monoclonal antibody rituximab (Rituxan), with or without chemotherapy (and sometimes radiation).

An option for some people who are not having major symptoms might be to have the disease watched closely at first, and then start treatment only when symptoms appear.

Treating Hodgkin disease in children

Treatment of Hodgkin disease in children is slightly different from the treatment used for adults. Children's bodies tend to tolerate chemotherapy better in the short term than adults do. But some side effects are more likely to occur in children. And because some of these side effects could be long-term, children who survive their cancer need careful attention for the rest of their lives.

Since the 1960s, most children and teens with cancer have been treated at special centers designed for them. Being treated in these centers offers them the advantage of having a team of specialists who are experienced with the differences between adult and childhood cancers, as well as the unique needs of children with cancer. This team usually includes pediatric oncologists, surgeons, radiation oncologists, pathologists, pediatric oncology nurses, and nurse practitioners.

Childhood cancer centers also have psychologists, social workers, child life specialists, nutritionists, rehabilitation and physical therapists, and educators who can support and educate the entire family.

Most children with cancer in the United States are treated at a center that is a member of the Children's Oncology Group (COG). All of these centers are associated with a university or children's hospital. As we have learned more about treating childhood cancer, it has become even more important that treatment be given by experts in this area.

In these centers, doctors treating children with Hodgkin disease often use treatment plans that are part of clinical trials. The purpose of these studies is to find the most effective treatment that causes the fewest side effects.

Differences from treatment in adults

As in adults, the major goal of treatment is to cure the child without causing long-term problems. If the child is sexually mature and muscles and bones are fully developed, treatment is usually the same as that given to adults. But if the child has not reached his or her full body size, chemotherapy will likely be favored over radiation therapy. Radiation could affect bone and muscle growth and prevent children from reaching their normal size.

When treating children, doctors often combine chemotherapy with low doses of radiation. The chemotherapy often includes combinations of many drugs rather than just the usual adult ABVD regimen, especially for cancers that are unfavorable or are more advanced. This approach has had excellent success rates, even for children with more advanced disease.

Stages IA and IIA, favorable: Treatment generally starts with chemotherapy alone, used at the lowest dose that is likely to result in a cure. If the disease doesn't go away completely, radiation therapy or more chemotherapy might be added.

If radiation therapy is used, the dose and field are kept as small as possible. If radiation is used below the diaphragm in girls and young women, the ovaries should be protected. Damage to the ovaries might prevent them from ever being able to become pregnant.

Stages I and II, unfavorable: Treatment is likely to consist of more intense chemotherapy combined with radiation therapy, although the dose and field of radiation are kept as small as possible.

Stages III and IV: Treatment includes more intense chemotherapy, either alone or combined with low-dose radiation therapy to areas with bulky disease (areas that contain a lot of Hodgkin disease).

Hodgkin disease in pregnancy

If a woman is pregnant and diagnosed with Hodgkin disease, there are often several treatment approaches that can be successful. The woman and her doctors must take into account the extent of the cancer, how quickly it is growing, how far along the pregnancy is, and the woman's own personal preferences.

If the cancer is diagnosed during the second half of the pregnancy and is not causing problems, a woman can often wait until the baby is born and then begin treatment. This is the approach that is safest for the baby.

If the Hodgkin disease requires treatment during the pregnancy, chemotherapy using either one or a combination of drugs may be given, based on the circumstances. If possible, this is delayed until later in the pregnancy (typically after the first trimester, when the baby's organs are fully formed).

Radiation is not often given because of concerns about the possible long-term effects on the unborn baby. But a few studies suggest that as long as very careful precautions are taken to aim the radiation precisely, limit the doses, and shield the baby, pregnant women with Hodgkin disease in lymph nodes in the neck, underarm area, or inside the chest can receive this treatment with little or no apparent risk to the baby.

The need to avoid radiation also limits which imaging tests can be used to help determine the extent of the lymphoma or to see if treatment is working. CT scans, PET scans, and x-rays all use radiation, so they are avoided if at all possible. MRI scans and ultrasound can often be used instead.

More treatment information

For more details on treatment options – including some that may not be addressed in this document – the National Comprehensive Cancer Network (NCCN) and the National Cancer Institute (NCI) are good sources of information.

The NCCN, made up of experts from many of the nation's leading cancer centers, develops cancer treatment guidelines for doctors to use when treating patients. These are available on the NCCN Web site (www.nccn.org).

The NCI provides treatment guidelines via its telephone information center (1-800-4-CANCER) and its Web site (www.cancer.gov). Detailed guidelines intended for use by cancer care professionals are also available on this site.

What should you ask your doctor about Hodgkin disease?

As you cope with Hodgkin disease and the process of treatment, you need to have honest, open discussions with the cancer care team. You should feel free to ask any question you have no matter how minor it might seem. Among the questions you might want to ask are:

- What type of Hodgkin disease is it?
- What is the stage? What does the staging mean?
- Will I (we) need to have other tests before we can decide on treatment?
- Are there other doctors I (we) need to see?
- How much experience do you have treating Hodgkin disease?
- What are the treatment choices? Which do you recommend? Why?

- Does one type of treatment reduce the risk of recurrence more than another?
- What short-term side effects can be expected from treatment? What can be done about these side effects?
- What are the possible long-term side effects?
- Will the treatment affect my (my child's) ability to have children? Can we do anything about this?
- What should I do to be ready (or get my child ready) for treatment?
- How long will treatment last? What will it involve? Where will it be done?
- How will treatment affect my (child's) daily activities?
- What are the chances that the cancer will recur? How will we know if the cancer has recurred? What should I look out for?
- What would we do if the treatment doesn't work or if the cancer recurs?
- What type of follow-up is needed after treatment?
- Should we get a second opinion? Can you suggest someone?

You will no doubt have other questions. For instance, you might want more information about recovery times so that you can plan work or school schedules. Or you might want to ask about clinical trials.

Be sure to write your questions down so that you remember to ask them during visits with your cancer care team. Also keep in mind that doctors are not the only ones who can provide you with information. Other health care professionals, such as nurses and social workers, may have the answers.

What happens after treatment for Hodgkin disease?

For many people with Hodgkin disease, treatment may remove or destroy the cancer. Completing treatment can be both stressful and exciting. You may be relieved to finish treatment, but find it hard not to worry about the lymphoma growing or coming back. (When cancer comes back after treatment, it is called *recurrence*.) This is a very common concern in people who have had cancer.

It may take a while before your fears lessen. But it might help to know that many cancer survivors have learned to live with this uncertainty and are leading full lives. Our

document, *Living With Uncertainty: The Fear of Cancer Recurrence*, gives more detailed information on this.

For some people, the lymphoma may never go away completely. These people may get regular treatments with chemotherapy, radiation therapy, or other therapies to help keep the lymphoma in check for as long as possible. Learning to live with lymphoma as more of a chronic disease can be difficult and very stressful. It has its own type of uncertainty.

Follow-up care

If you (or your child) have completed treatment, your doctors will still want to watch you closely. It is very important to keep all follow-up appointments. You or your child will need follow-up care for many years after treatment for Hodgkin disease.

During these visits, the doctor will ask about symptoms, do physical exams, and may order blood tests or imaging tests such as CT scans or chest x-rays. Doctor visits are usually recommended every few months for the first several years after treatment. Gradually, the length of time between visits can be increased, but even after 5 years they should be done at least yearly.

Follow-up is needed to check for cancer recurrence or spread, as well as possible side effects of certain treatments. This is the time for you to ask your health care team any questions you need answered and to discuss any concerns you might have.

If Hodgkin disease does come back at some point, further treatment will depend on what treatments you've had before, how long it's been since treatment, and your health. For more information, see "Recurrent or relapsed Hodgkin disease" in the "Treatment options by stage" section. For more general information on dealing with a recurrence, you may also want to see our document, *When Your Cancer Comes Back: Cancer Recurrence*. You can get it by calling 1-800-227-2345.

Watching for long-term side effects

Each type of treatment for Hodgkin disease has side effects that could last for months or longer. Some side effects, like loss of fertility, may be permanent. Because so many people now live for a long time after their treatment, watching for these serious side effects is very important.

Second cancers: One of the most serious side effects of Hodgkin disease treatment is developing a second cancer later on. For example, acute myelogenous leukemia (AML) can develop in a small portion of patients after receiving certain types of treatment. This usually occurs in the first few years after treatment and is seen more often in older people.

This might be less likely with current chemo drug combinations like ABVD than with some combinations used more often in the past, such as the MOPP regimen, but there is still a small risk.

Radiation may also add to this risk. Although radiation alone does not increase the risk for leukemia much, it can raise the risk of other forms of cancer in the part of the body that received the radiation.

Women who receive chest radiation before they are 30 years old have a much higher risk of breast cancer. They should be especially careful about following American Cancer Society recommendations for early detection of breast cancer and should talk to their doctor about starting screening at an early age.

Both men and women receiving chest radiation have a higher chance of developing lung cancer, mesothelioma (a cancer of the lining of the lungs), and thyroid cancer. The risk of lung cancer is much higher in smokers, so not smoking is especially important among survivors of Hodgkin disease. Follow-up physical exams, blood tests for thyroid problems, and spiral CT scans or x-rays of the chest as suggested by your doctor may be helpful.

Cancers of muscle or bone, called *sarcomas*, can also develop in areas that get radiation. Likewise, digestive tract cancers such as colon cancer are also more likely.

Another type of cancer, non-Hodgkin lymphoma, develops in a small number of patients with Hodgkin disease. It is thought that this risk is due mostly to the disease itself and not the treatment.

Fertility issues: A possible long-term effect of chemotherapy and radiation therapy, especially in younger patients, is reduced or lost fertility. For example, some chemotherapy drugs might affect a male's ability to make sperm, which might be temporary or permanent. If the patient is old enough and is going to get drugs that can affect fertility, sperm banking should be considered before chemotherapy is started.

Likewise, women may stop ovulating and menstruating with chemotherapy. This may or may not return to normal. Radiation to the lower abdomen can cause infertility unless the ovaries are surgically moved outside the radiation field beforehand. Moving the ovaries does not affect cure rates because Hodgkin disease almost never spreads to the ovaries.

Infections: For unknown reasons, the immune system of people with Hodgkin disease does not work properly. Treatments such as radiation, chemotherapy, and surgery to remove the spleen (splenectomy) can add to this problem. Splenectomy was once common but is now rare for people with Hodgkin disease. Patients who have their spleen removed should be immunized against certain bacteria.

All people who have had Hodgkin disease should keep up with their flu shots. Keeping up with vaccinations and careful, prompt treatment of infections are very important.

Thyroid problems: Radiation therapy to the chest or neck to treat Hodgkin disease might affect the thyroid gland, causing it to make less thyroid hormone. People with this condition, known as *hypothyroidism*, may need to take thyroid medicine. People who got radiation to the neck or upper chest should have their thyroid function checked with blood tests at least yearly.

Heart disease and strokes: People who have had radiation to the chest have a higher risk of heart disease and heart attacks. This has become less of a problem with more modern radiation techniques, but it is important to not smoke and maintain a healthy diet to help avoid this problem. Some chemotherapy drugs such as doxorubicin (Adriamycin) and mitoxantrone can also cause heart damage. Your doctor may advise you to have tests to check your heart function several years after your treatment.

Radiation to the neck increases the chance of stroke because it can damage the blood vessels in the neck that supply the brain. Smoking and high blood pressure also increase the risk of stroke. Once again it is important to avoid smoking. It is also important to have regular check-ups with your doctor and have any high blood pressure treated.

Lung damage: The chemotherapy drug bleomycin can damage the lungs, as can radiation therapy to the chest. This can lead to problems such as shortness of breath, which might not show up until years after treatment. Smoking can also seriously damage the lungs, so it is important that people who have had these treatments do not smoke.

Special concerns in childhood Hodgkin disease survivors

Just as the treatment of childhood Hodgkin disease requires a very specialized approach, so does follow-up and monitoring for late effects of treatment. Careful follow-up after treatment is very important.

Along with physical side effects (including those listed above), survivors of childhood cancer may have emotional or psychological issues that need to be addressed. They also may have some problems with normal functioning and school work. These can often be addressed with support and encouragement. Doctors and other members of the health care team can also often recommend special support programs and services to help children after cancer treatment.

To help increase awareness of late effects and improve follow-up care of childhood cancer survivors throughout their lives, the Children’s Oncology Group (COG) has developed long-term follow-up guidelines for survivors of childhood cancers. These guidelines can help you know what to watch for, what types of health screening should be done, and how late effects may be treated.

It is very important to discuss possible long-term complications with your child’s health care team, and to make sure there is a plan in place to watch for these problems and treat them, if needed. To learn more, ask your child’s doctors about the COG survivor guidelines. You can also download them for free on the COG Web site:

www.survivorshipguidelines.org. The guidelines are written for health care professionals. Patient versions of some of the guidelines available (as "Health Links") on the site as well, but we urge you to review them with a doctor.

For more about some of the possible long-term effects of treatment, see our document called *Children Diagnosed With Cancer: Late Effects of Cancer Treatment*.

Seeing a new doctor

At some point after treatment, you (or your child) may be seeing a new doctor who does not know anything about your (child's) medical history. It is important that you be able to give the new doctor the details of the diagnosis and treatment. Gathering these details soon after treatment may be easier than trying to get them at some point in the future. Make sure you have this information handy:

- A copy of your pathology report(s) from any biopsies or surgeries
- Copies of imaging tests (CT or MRI scans, etc.), which can usually be stored on a CD, DVD, etc.
- If you had surgery, a copy of your operative report(s)
- If you stayed in the hospital, a copy of the discharge summary that doctors prepare when patients are sent home
- If you had chemotherapy or monoclonal antibodies, a list of the drugs, drug doses, and when you took them
- If you had radiation therapy, a summary of the type and dose of radiation and when and where it was given

It is also important to keep health insurance. Tests and doctor visits cost a lot, and even though no one wants to think of their cancer coming back, this could happen.

Lifestyle changes after having Hodgkin disease

You can't change the fact that you have had cancer. What you can change is how you live the rest of your life – making choices to help you stay healthy and feel as well as you can. This can be a time to look at your life in new ways. Maybe you are thinking about how to improve your health over the long term. Some people even start during cancer treatment.

Making healthier choices

For many people, a diagnosis of cancer helps them focus on their health in ways they may not have thought much about in the past. Are there things you could do that might make you healthier? Maybe you could try to eat better or get more exercise. Maybe you

could cut down on the alcohol, or give up tobacco. Even things like keeping your stress level under control may help. Now is a good time to think about making changes that can have positive effects for the rest of your life. You will feel better and you will also be healthier.

You can start by working on those things that worry you most. Get help with those that are harder for you. For instance, if you are thinking about quitting smoking and need help, call the American Cancer Society at 1-800-227-2345 for information and support.

Eating better

Eating right can be hard for anyone, but it can get even tougher during and after cancer treatment. Treatment may change your sense of taste. Nausea can be a problem. You may not feel like eating and lose weight when you don't want to. Or you may have gained weight that you can't seem to lose. All of these things can be very frustrating.

If treatment caused weight changes or eating or taste problems, do the best you can and keep in mind that these problems usually get better over time. You may find it helps to eat small portions every 2 to 3 hours until you feel better. You may also want to ask your cancer team about seeing a dietitian, an expert in nutrition who can give you ideas on how to deal with these treatment side effects.

One of the best things you can do after cancer treatment is put healthy eating habits into place. You may be surprised at the long-term benefits of some simple changes, like increasing the variety of healthy foods you eat. Getting to and staying at a healthy weight, eating a healthy diet, and limiting your alcohol intake may lower your risk for a number of types of cancer, as well as having many other health benefits.

Rest, fatigue, and exercise

Extreme tiredness, called *fatigue*, is very common in people treated for cancer. This is not a normal tiredness, but a bone-weary exhaustion that often doesn't get better with rest. For some people, fatigue lasts a long time after treatment, and can make it hard for them to exercise and do other things they want to do. But exercise can help reduce fatigue. Studies have shown that patients who follow an exercise program tailored to their personal needs feel better physically and emotionally and can cope better, too.

If you were sick and not very active during treatment, it is normal for your fitness, endurance, and muscle strength to decline. Any plan for physical activity should fit your own situation. An older person who has never exercised will not be able to take on the same amount of exercise as a 20-year-old who plays tennis twice a week. If you haven't exercised in a few years, you will have to start slowly – maybe just by taking short walks.

Talk with your health care team before starting anything. Get their opinion about your exercise plans. Then, try to find an exercise buddy so you're not doing it alone. Having

family or friends involved when starting a new exercise program can give you that extra boost of support to keep you going when the push just isn't there.

If you are very tired, you will need to balance activity with rest. It is OK to rest when you need to. Sometimes it's really hard for people to allow themselves to rest when they are used to working all day or taking care of a household, but this is not the time to push yourself too hard. Listen to your body and rest when you need to. (For more information on dealing with fatigue, please see *Fatigue in People With Cancer* and *Anemia in People With Cancer*.)

Keep in mind exercise can improve your physical and emotional health.

- It improves your cardiovascular (heart and circulation) fitness.
- Along with a good diet, it will help you get to and stay at a healthy weight.
- It makes your muscles stronger.
- It reduces fatigue and helps you have more energy.
- It can help lower anxiety and depression.
- It can make you feel happier.
- It helps you feel better about yourself.

And long term, we know that getting regular physical activity plays a role in helping to lower the risk of some cancers, as well as having other health benefits.

Can I lower my risk of Hodgkin disease progressing or coming back?

Most people want to know if there are specific lifestyle changes they can make to reduce their risk of cancer progressing or coming back. Unfortunately, for most cancers there is little solid evidence to guide people. This doesn't mean that nothing will help — it's just that for the most part this is an area that hasn't been well studied. Most studies have looked at lifestyle changes as ways of preventing cancer in the first place, not slowing it down or preventing it from coming back.

At this time, not enough is known about Hodgkin disease to say for sure if there are things you can do that will be helpful. Adopting healthy behaviors such as not smoking, eating well, and maintaining a healthy weight may help, but no one knows for sure. However, we do know that these types of changes can have positive effects on your health that can extend beyond your risk of Hodgkin disease or other cancers.

How might Hodgkin disease affect your emotional health?

During and after treatment, you may find yourself overcome with many different emotions. This happens to a lot of people.

You may find yourself thinking about death and dying. Or maybe you're more aware of the effect the cancer has on your family, friends, and career. You may take a new look at your relationships with those around you. Unexpected issues may also cause concern. For instance, you may see your health care team less often after treatment and have more time on your hands. These changes can make some people anxious.

Almost everyone who is going through or has been through cancer can benefit from getting some type of support. You need people you can turn to for strength and comfort. Support can come in many forms: family, friends, cancer support groups, church or spiritual groups, online support communities, or one-on-one counselors. What's best for you depends on your situation and personality. Some people feel safe in peer-support groups or education groups. Others would rather talk in an informal setting, such as church. Others may feel more at ease talking one-on-one with a trusted friend or counselor. Whatever your source of strength or comfort, make sure you have a place to go with your concerns.

The cancer journey can feel very lonely. It is not necessary or good for you to try to deal with everything on your own. And your friends and family may feel shut out if you do not include them. Let them in, and let in anyone else who you feel may help. If you aren't sure who can help, call your American Cancer Society at 1-800-227-2345 and we can put you in touch with a group or resource that may work for you.

If treatment for Hodgkin disease is no longer working

If Hodgkin disease keeps growing or comes back after one kind of treatment, it is often possible to try other treatment plans that might still cure it, or at least shrink the tumors enough to help you live longer and feel better.

But when a person has tried many different treatments and the lymphoma is no longer getting better, even newer treatments may no longer be effective. If this happens, it's important to weigh the possible limited benefits of trying a new treatment against the possible downsides, including treatment side effects. Everyone has their own way of looking at this.

This is likely to be the hardest part of your battle with cancer — when you have been through many treatments and nothing's working anymore. Your doctor might offer you new options, but at some point you may need to consider that treatment is not likely to improve your health or change your outcome or survival.

If you want to continue to get treatment for as long as you can, you need to think about the odds of treatment having any benefit and how this compares to the possible risks and

side effects. Your doctor can give you an estimate how likely it is the cancer will respond to treatment you are considering. For instance, the doctor may say that more treatment might have about a 1 in 100 chance of working. Some people are still tempted to try this. But it is important to think about and understand your reasons for choosing this plan.

No matter what you decide to do, it is important that you feel as good as you can. Make sure you are asking for and getting treatment for any symptoms you might have, such as nausea or pain. This type of treatment is called *palliative care*.

Palliative care helps relieve symptoms, but is not expected to cure the disease. It can be given along with cancer treatment, or can even be cancer treatment. The difference is its purpose — the main goal of palliative care is to improve the quality of your life, or help you feel as good as you can for as long as you can. Sometimes this means using drugs to help with symptoms like pain or nausea. Sometimes, though, the treatments used to control your symptoms are the same as those used to treat cancer. For instance, radiation might be used to help relieve pain caused by a large tumor. Or chemo might be used to help shrink a tumor and keep it from blocking the bowels. But this is not the same as treatment to try to cure the cancer.

At some point, you may benefit from hospice care. This is special care that treats the person rather than the disease; it focuses on quality rather than length of life. Most of the time, it is given at home. Your cancer may be causing problems that need to be managed, and hospice focuses on your comfort. You should know that while getting hospice care often means the end of treatments such as chemo and radiation, it doesn’t mean you can’t have treatment for the problems caused by your cancer or other health conditions. In hospice the focus of your care is on living life as fully as possible and feeling as well as you can at this difficult time. You can learn more about hospice in our document called *Hospice Care.*

Staying hopeful is important, too. Your hope for a cure may not be as bright, but there is still hope for good times with family and friends — times that are filled with happiness and meaning. Pausing at this time in your cancer treatment gives you a chance to refocus on the most important things in your life. Now is the time to do some things you’ve always wanted to do and to stop doing the things you no longer want to do. Though the cancer may be beyond your control, there are still choices you can make.

What’s new in Hodgkin disease research and treatment?

Important research into Hodgkin disease is being done right now in many university hospitals, medical centers, and other institutions around the world. Scientists are getting closer to finding out what causes the disease and how to improve treatment.

Imaging tests

In recent years, PET scans and combined PET/CT scans have been found to be very helpful in determining the extent of Hodgkin disease in the body and in assessing how well treatment is working. PET scans are now commonly used early in the course of treatment to help doctors decide how much treatment needs to be given.

Tailoring treatment

In general, cure rates for Hodgkin disease are high, but long-term side effects of treatment are an important issue. A very active area of research is directed at learning which patients can be treated with gentler therapy and which patients need stronger treatment.

A related area of research is finding less-toxic treatments that do not have serious long-term side effects, yet still cure as many patients as possible. New chemotherapy combinations of as many as 10 different drugs are being studied. The reasoning behind this approach is that even though more drugs are needed, by using less of each drug, fewer side effects may occur. Another approach is using drugs that better target Hodgkin disease cells, as opposed to chemotherapy drugs. Some of these are described below.

The same is true for radiation therapy. Doctors are looking to see which patients might do just as well with lower doses of radiation, or even no radiation. Doctors are also studying whether newer forms of radiation therapy, such as intensity-modulated radiation therapy (IMRT) and proton therapy, might be useful in Hodgkin disease. These approaches focus radiation more precisely on tumors, which limits the doses reaching nearby normal tissues.

Chemotherapy

New chemotherapy drugs and drug combinations are being studied in patients with Hodgkin disease. Some drugs, such as vinorelbine, idarubicin, bendamustine, and gemcitabine, which are already used to treat other cancers, have shown promise against Hodgkin disease that has relapsed after other chemotherapy treatments. Studies are in progress to see if these drugs could be more effective than the ones now in use.

Targeted therapy

Newer drugs that work differently from typical chemotherapy drugs are now being studied as well. These are known as *targeted therapy* drugs.

For example, a class of drugs known as *mTOR inhibitors* has shown some promise in early clinical studies against relapsed Hodgkin disease. Drugs called *histone deacetylase (HDAC) inhibitors*, such as panobinostat, have also shown some early promise.

Other drugs being studied include lenalidomide (Revlimid®) and bortezomib (Velcade®). These drugs are more often used to treat multiple myeloma and some non-Hodgkin lymphomas, but they may prove to be useful in Hodgkin disease as well.

Some newer targeted drugs, such as PLX3397, affect tumor cells other than the lymphoma cells themselves. These other cells actually make up much of the Hodgkin disease tumors and are thought to help the lymphoma cells grow. Research on these types of drugs is still early.

Monoclonal antibodies

Antibodies are proteins normally made by the immune system to help fight infections. Each antibody attacks only a specific target (usually a protein on the surface of an unwanted cell). Monoclonal antibodies are man-made versions of these immune system proteins. Some can kill cancer cells by themselves. Others have radioactive molecules or cell poisons attached to them, which help kill the cancer cells. An advantage of these drugs is that they seem to target lymphoma cells while having fewer side effects than chemotherapy drugs. They may be used alone or combined with chemotherapy.

Some monoclonal antibodies, such as brentuximab vedotin (Adcetris™) and rituximab (Rituxan®), are already being used to treat Hodgkin disease (see "Monoclonal antibodies for Hodgkin disease"), while others are now being studied.

Hodgkin disease cells have the CD30 molecule on their surface, which is the target of brentuximab vedotin and several other monoclonal antibodies, including XmAb2513.

The cells in the nodular lymphocyte predominant type of Hodgkin disease often have the CD20 antigen, which is the target of rituximab. Studies are now being done to see if rituximab can help treat classic forms of Hodgkin disease as well.

Tositumomab (Bexxar®) is an anti-CD20 antibody that is attached to a radioactive molecule. When injected into the blood, the antibody brings the radiation directly to the lymphoma cells. This drug is used to treat some types of non-Hodgkin lymphoma, but studies are in progress to see if it might also help treat Hodgkin disease.

Additional resources for Hodgkin disease

More information from your American Cancer Society

Here is more information you might find helpful. You also can order free copies of our documents from our toll-free number, 1-800-227-2345, or read them on our Web site, www.cancer.org.

After Diagnosis: A Guide for Patients and Families (also available in Spanish)

Caring for the Patient With Cancer at Home (also available in Spanish)

Clinical Trials: What You Need to Know

Living With Uncertainty: The Fear of Cancer Recurrence

Pain Control: A Guide for People With Cancer and Their Families (also available in Spanish)

Stem Cell Transplant (Peripheral Blood, Bone Marrow, and Cord Blood Transplants)

Understanding Chemotherapy: A Guide for Patients and Families (also available in Spanish)

Understanding Radiation Therapy: A Guide for Patients and Families (also available in Spanish)

When Cancer Comes Back: Cancer Recurrence

Your American Cancer Society also has books that you might find helpful. Call us at 1-800-227-2345 or visit our bookstore online at cancer.org/bookstore to find out about costs or to place an order.

National organizations and Web sites*

In addition to the American Cancer Society, other sources of patient information and support include:

Hodgkin disease

Leukemia & Lymphoma Society
Toll-free number: 1-800-955-4572 or 1-914-949-5213
Web site: www.lls.org

Lymphoma Research Foundation
Toll-free number: 1-800-500-9976
Web site: www.lymphoma.org

National Cancer Institute
Toll-free number: 1-800-4-CANCER (1-800-422-6237) or TTY: 1-800-332-8615
Web site: www.cancer.gov

National Coalition for Cancer Survivorship
Toll-free number: 1-888-650-9127
1-877-NCCS-YES (622-7937) for some publications and Cancer Survivor Toolbox® orders
Web site: www.canceradvocacy.org

Bone marrow and peripheral blood stem cell transplants

Be the Match (formerly National Marrow Donor Program)
Toll-free number: 1-800-MARROW-2 (1-800-627-7692)
Web site: www.bethematch.org

National Bone Marrow Transplant Link (nbmtLINK)
Toll-free number: 1-800-LINK-BMT (1-800-546-5268)
Web site: www.nbmtlink.org

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

The American Cancer Society is happy to address almost any cancer-related topic. If you have any more questions, please call us at 1-800-227-2345 at any time, 24 hours a day.

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